X-Series Signal Analyzers

Spectrum Analyzer Mode

M9410A M9411A M9415A
N9000B N9010B N9020B N9021B N9030B N9032B N9038B
N9040B N9041B N9042B N9048B

KEYSIGHT

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X-Series Signal Analyzers
Spectrum Analyzer Mode User's & Programmer's Reference

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1 Documentation Roadmap

This section describes the Keysight products covered by this document, and provides links to related documentation.

– "Products Covered by this Document" on page 81

– "Additional Documentation" on page 82

1.1 Products Covered by this Document

For the full list of instrument models covered by this documentation, see the title page: "Spectrum Analyzer ModeUser's & Programmer's Reference" on page 1.

1.2 Additional Documentation

If your instrument or computer has an internet connection, then you can access the latest editions of all relevant X-Series documentation via the links below.

This document is available in 3 formats:

- **Embedded Help**, in the instrument
- **Online Help**, at Keysight's web site

  For information on this Mode, browse to:

  http://rfmw.em.keysight.com/wireless/helpfiles/SAMode/FlexUI.htm
- **Users & Programmers Reference**, in downloadable PDF format

  For information on this Mode, download from:

  http://literature.cdn.keysight.com/litweb/pdf/N9060-90041.pdf

The following documents are available online at keysight.com:

X-Series Messages Guide

The following documents are in downloadable PDF format:

Getting Started Guides, Instrument Messages & Security

- N90x0B Getting Started & Troubleshooting Guide
- N9041B Getting Started & Troubleshooting Guide
- X-Series Status Register System Diagram
- Security Features & Statement of Volatility

Specifications Guides

- N9000B CXA Specifications Guide
- N9010B EXA Specifications Guide
- N9020B MXA Specifications Guide
- N9030B PXA Specifications Guide
- N9040B UXA Specifications Guide

- N9041B UXA Specifications Guide

Measurement Guides

- Spectrum Analyzer Mode Measurement Guide
- Real-Time Spectrum Analyzer Measurement Guide
- Noise Figure Measurement Guide
- Analog Demod Measurement Application Measurement Guide
- Phase Noise Measurement Application Measurement Guide
- EMI Measurement Application Measurement Guide
- M9484C VXG Signal Generator and X-Series Signal Analyzers Measurement Guide

Service Guides

- N9010B EXA Service Guide
- N9020B MXA Service Guide
- N9030B PXA Service Guide
- N9040B UXA Service Guide

2 User Interface

Here are the basic elements of the Multitouch User Interface. For more information, tap a topic.

Included in this section are also topics for several front panel keys not described in other topics. Tap one of these topics for more information.

"Cancel key" on page 130

"Onscreen Keyboard key" on page 131

"Touch On/Off Key" on page 132

"Tab key" on page 133

2.1 Screen Tabs

In the X-Series Multitouch User Interface (or Multitouch UI), you can run many different Measurement Applications, or “Modes”. Examples are Spectrum Analyzer Mode, LTE-A FDD Mode, IQ Analyzer Mode, and Real Time Spectrum Analyzer Mode. Each Mode has its own set of controls, windows and SCPI commands.

Each Mode runs within a “Screen”. The Multitouch UI supports multiple “Screens” (see "Multiscreen" on page 174 for more information). Each screen displays one Measurement in one Mode. The set of configured screens is shown across the top of the display as a set of Screen Tabs, with a + tab at the right for adding new Screens:

You can see up to six tabs at a time on the UXA, and 4 at a time on the CXA, EXA, MXA and PXA. If there are more Screens configured than this, arrows appear to the left and right of the Screen Tabs; pressing the arrows scrolls the Screen Tabs to the left or right. A scroll bar also appears at the bottom of the Screen Tabs, indicating that you can scroll the tabs by dragging them with your finger; you can also scroll them by dragging the scroll bar.

Pressing a Screen Tab selects that screen for operation. Pressing the blue (selected) Screen Tab is the same as pressing the Mode/Meas front panel key.

Both actions open the "Mode/Meas/View Dialog" on page 86. In addition, if you have a PC keyboard plugged in, the sequence CTL-SHIFT-M will open up this dialog.

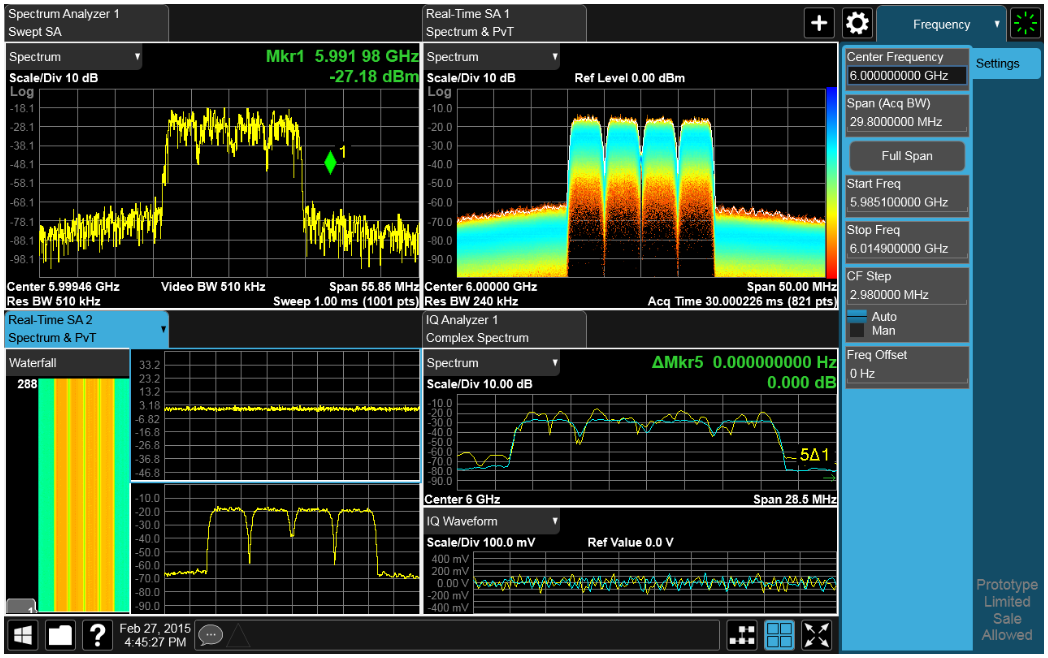
The + tab at the right of the Screen Tabs bar adds a new Screen by cloning the current screen. The new Screen has the identical setup and settings as the current Screen. You can then change the Mode, Measurement and/or settings of the new Screen.

You can define up to 16 screens at once.

Example Multiscreen View

The example below shows a four-screen display in Multiscreen view.

The Screen called “Real-Time SA 2” is selected, as indicated by its blue tab. Touching any other screen or tab selects the screen for that tab and brings it to the foreground.



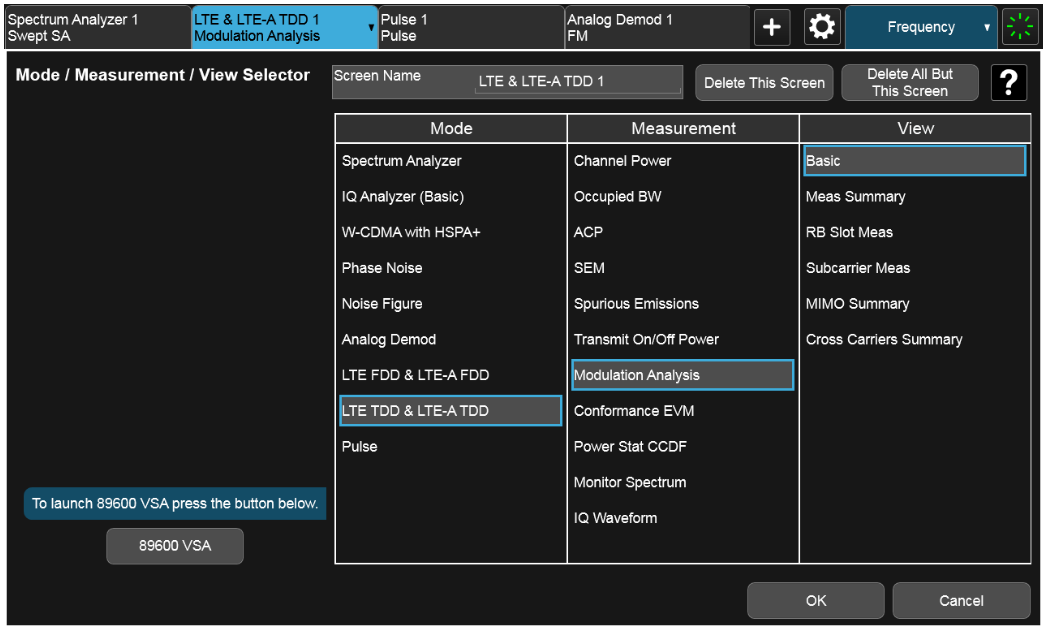
The following topics provide more information:

- "Mode/Meas/View Dialog" on page 86
- "Add Screen" on page 103
- "Multiscreen" on page 174

2.1.1 Mode/Meas/View Dialog

The Mode/Meas/View dialog opens when you press the selected (blue) Screen tab (see "Screen Tabs" on page 85) or the **Mode/Meas** front panel key.

This dialog displays lists of available Modes, Measurements and Views, as well as the "Sequencer" on page 97 control for configuring Screens.



2.1.1.1 Mode

The first column in the Mode/Meas/View dialog allows you to select the desired Mode from those currently licensed in your instrument.

Modes, also known as “measurement applications”, are collections of measurement capabilities packaged together to provide you with an instrument personality specific to your measurement needs. Each Mode is ordered separately by Model Number and must be licensed in order for it to be available in the instrument.

You select the Mode you want to run using the Mode/Meas/View dialog. Once a Mode is selected, only the commands that are valid for that mode can be executed

For more information on Modes, preloading Modes, and memory requirements for Modes, see "More Information" on page 90

The `:INSTrument[:SELect]` command is used to remotely select a Mode by sending the instrument a parameter which represents the name of the desired Mode. The Mode Names may be found in the table under "Index to Modes" on page 89.

The `:INSTrument:NSELect` command is used to remotely select a Mode by sending the Mode Number of the desired Mode. See "Instrument Number Select" on page 88. The Mode Numbers may be found in the table under "Index to Modes" on page 89.

The `:INSTrument:CONFigure` command causes a Mode and Measurement switch at the same time. This generally results in faster overall switching than sending the

:INSTrument:SELect and CONFigure commands separately. See "Mode and Measurement Select" on page 88.

Remote Command	:INSTrument[:SELect] <mode_id> where <mode_id> is one of the values listed in "Index to Modes" on page 89 below :INSTrument[:SELect]?
Example	:INST SA
Notes	A list of the valid mode choices is returned by the :INST:CAT? query
Preset	The default Mode is set to SA on **Restore System Defaults->All**, unless noted below: For N8973B, N8974B, N8975B, or N8976B: NFIG
State Saved	Saved in instrument state
Annunciation	Application Title is in the Screen Tab

Instrument Number Select

Remote Command	:INSTrument:NSELect <integer> :INSTrument:NSELect?
Example	:INST:NSEL 1
Notes	The Mode Numbers may be found in the table under "Index to Modes" on page 89 SA mode is number 1 The command is sequential: that is, continued parsing of commands cannot proceed until the instrument select is complete and the resultant SCPI trees are available
Preset	The default Mode is set to 1 by **Restore System Defaults->All**, unless noted in the table above
State Saved	Saved in instrument state

Mode and Measurement Select

Remote Command	:INSTrument:CONFigure:<mode_id>:<meas> where <mode_id> is a valid parameter for the :INST:SEL command and <meas> is a valid parameter for the :CONF command in the Mode specified by <mode>
Example	:INST:CONF:SA:SAN selects the Spectrum Analyzer mode and the Swept SA measurement :INST:CONF:WCDMA:RHO selects the WCDMA mode and the Mod Accuracy measurement
Notes	The available parameters for <mode_id> are dependent upon installed and licensed applications resident in the instrument. The available parameters for <meas> are dependent on the <mode_id> parameter and the valid measurements available for that mode, which can depend on model numbers and installed options In general this command will execute more quickly than sending the equivalent separate :INST:SEL

and :CONF commands

Index to Modes

The Mode Number in the table below is the parameter for use with the :INSTrument:NSELect command. The Mode Parameter is the parameter for use with the :INSTrument[:SELect] command. Your actual choices will depend upon which applications are installed in your instrument.

Mode	Mode Number	Mode Parameter <mode_id>
5G NR	109	NR5G
89601 VSA	101	VSA89601
Analog Demod	234	ADEMOD
Avionics	232	AVIONIC
Bluetooth	228	BTooth
Channel Quality / Group Delay	161	CQM
EMI Receiver	141	EMI
GSM/EDGE/EDGE Evo	13	EDGEGSM
I/Q Analyzer (Basic)	8	BASIC
LTE FDD & LTE-A FDD	107	LTEAFDD
LTE TDD & LTE-A TDD	108	LTEATDD
Measuring Receiver	233	MRECEIVE
MSR	106	MSR
Noise Figure	219	NFIGure
Phase Noise	14	PNOISE
Power Amplifier	81	PA
Pulse	151	PULSEX
Radio Test	300	RTS
Real Time Spectrum Analyzer	2	RTSA
Remote Language Compatibility	266	RLC
SCPI Language Compatibility	270	SCPILC
Sequence Analyzer	123	SEQAN
Short Range Comms	218	SRCOMMS
Spectrum Analyzer	1	SA
Vector Modulation Analyzer	200	VMA
WCDMA with HSPA+	9	WCDMA
WLAN	217	WLAN

More Information

The Mode name appears on the Screen Tab, followed by a number identifying which instance of the Mode appears on that screen. Each Screen contains one Mode. For example, in the image below, there is one Real-Time Spectrum Analyzer screen, and two Spectrum Analyzer screens. The current Screen contains **Real-Time SA 1**.

It is possible to specify the order in which the Modes appear in the Mode menu, using the **Configure Applications** utility on the Desktop. Using the same utility, it is also possible to specify a subset of the available applications to load into memory at startup time, which can decrease the startup time of the instrument and the amount of memory consumed.

Each application (Mode) that runs in an X-Series instrument consumes virtual memory. The various applications consume varying amounts of virtual memory, and as more applications run, the memory consumption increases. Keysight characterizes each Mode and assigns a memory usage quantity based on a conservative estimate. The **Configure Applications** utility shows an estimate for how much memory each Mode will consume.

You can still run a Mode even if it is not preloaded into memory – during runtime, the first time an application that is not loaded into memory is selected (either by pressing that application's **Mode** key or by sending that application's `:INST:SEL` command), the Application will be loaded, but this takes a few seconds. The instrument will pause while loading the application while displaying a message box that says "Loading application, please wait..." Preloading the application eliminates this wait time *but* consumes additional memory.

2.1.1.2 Application Mode Remote Commands

This section contains a number of remote commands that are provided for programming convenience and remote compatibility.

Application Mode Catalog Query (Remote Command Only)

Returns a string containing a comma-separated list of names of all the installed and licensed measurement modes (applications). These names can only be used with `:INSTrument[:SELect]`.

Remote Command	`:INSTrument:CATalog?`

Example	`:INST:CAT?`
Notes	Query returns a quoted string of the installed and licensed modes separated with a comma. Example: `"SA,PNOISE,WCDMA"`
Backwards Compatibility Notes	VSA (E4406A): `:INSTrument:CATalog?` returned a list of installed `INSTrument:SELECT` items as a comma separated list of string values, for example: `"BASIC","GSM","EDGEGSM","CDMA","SERVICE"` X-Series uses the ESA/PSA compatible query of a string contain comma separated values: `"SA,PNOISE,NFIG,BASIC"`

Current Application Model (Remote Command Only)

Returns a string that is the Model Number of the currently selected application (mode). This information is also displayed in the **Show System** screen.

Remote Command	`:SYSTem:APPLication[:CURRent][:NAME]?`
Example	`:SYST:APPL?`
Notes	Query returns a quoted string that is the Model Number of the currently selected application (Mode). Example: "N9060A" String length between 6 to 9 characters.
Preset	Not affected by Preset
State Saved	Not saved in state, the value will be the selected application when a Save is done.

Current Application Revision (Remote Command Only)

Returns a string that is the Revision of the currently selected application (mode). This information is also displayed in the Show System screen

Remote Command	`:SYSTem:APPLication[:CURRent]:REVision?`
Example	`:SYST:APPL:REV?`
Notes	Query returns a quoted string that is the Revision of the currently selected application (Mode). Example: "1.0.0.0" String length is a maximum of 23 characters. (each numeral can be an integer + 3 decimal points) The format is Major.Minor.Build.Compile, where Major must correspond to the Integer portion of the Version in the license file for the application.
Preset	Not affected by a Preset
State Saved	Not saved in state, the value will be the selected application when a Save is done.

Current Application Options (Remote Command Only)

Returns a string that is the Options list of the currently selected application (Mode). This information is also displayed in the Show System screen

Remote Command	`:SYSTem:APPLication[:CURRent]:OPTion?`
Example	`:SYST:APPL:OPT?`
Notes	Query returns a quoted string that is the Option list of the currently selected application (Mode). The format is the name as the *OPT? or SYSTem:OPTion command: a comma separated list of option identifiers. Example: "1FP,2FP" String length is a maximum of 255 characters.
Preset	Not affected by a Preset
State Saved	Not saved in state per se, the value will be the selected application when a Save is invoked.

Application Catalog Number of Entries (Remote Command Only)

Returns the number of installed and licensed applications (Modes).

Remote Command	`:SYSTem:APPLication:CATalog[:NAME]:COUNt?`
Example	`:SYST:APPL:CAT:COUN?`
Preset	Not affected by Preset
State Saved	Not saved in instrument state.

Application Catalog Model Numbers (Remote Command Only)

Returns a list of Model Numbers for the installed and licensed applications (Modes).

Remote Command	`:SYSTem:APPLication:CATalog[:NAME]?`
Example	`:SYST:APPL:CAT?`
Notes	Returned value is a quoted string of a comma separated list of Model Numbers. Example, if SAMS and Phase Noise are installed and licensed: "N9060A,N9068A" String length varies based on licenses. Licenses are between 6 and 9 characters. So the string length will be between COUNt * 7 – 1 and COUNt * 10 – 1. (7 & 10 = Model Number length + 1 for comma. -1 = no comma for the 1st entry.)
Preset	Not affected by a Preset
State Saved	Not saved in instrument state.

Application Catalog Revision (Remote Command Only)

Returns the Revision of the provided Model Number.

Remote Command	`:SYSTem:APPLication:CATalog:REVision? <model>`
Example	`:SYST:APPL:CAT:REV? 'N9060A'`
Notes	Returned value is a quoted string of revision for the provided Model Number. The revision will be a null-string ("") if the provided Model Number is not installed, licensed, and loaded. Example, if SAMS is installed and licensed: "1.0.0.0" String length is a maximum of 23 characters. (each numeral can be an integer + 3 decimal points)
Preset	Not affected by a Preset.
State Saved	Not saved in instrument state.

Application Catalog Options (Remote Command Only)

Returns a list of Options for the provided Model Number

Remote Command	`:SYSTem:APPLication:CATalog:OPTion? <model>`
Example	`:SYST:APPL:CAT:OPT? 'N9060A'`
Notes	Returned value is a quoted string of a comma separated list of Options, in the same format as *OPT? or :SYSTem:OPTion?. If the provided Model Number is not installed and licensed a null-string ("") will be returned. Example, if SAMS is installed and licensed: "2FP" String length is a maximum of 255 characters.
Preset	Not affected by a Preset
State Saved	Not saved in instrument state.

ESA SA compatibility command (Remote Command only)

Provided for backwards compatibility with ESA. When this command is received, the analyzer aliases it to the appropriate Mode.

Remote Command	`:INSTrument[:SELect] 'SA' | 'PNOISE' | 'EDGE' | 'GSM' | 'BASIC'`
Example	`:INST 'SA'`
Notes	The query is not a quoted string. It is an enumeration as indicated in the Instrument Select table above

GSM Mode compatibility command (Remote Command only)

Provided for backwards compatibility. When this command is received, the analyzer aliases it to the following:

`:INST:SEL EDGEGSM`

Remote Command	`:INSTrument[:SELect] GSM`
Example	`:INST GSM`

SA compatibility command for EMC (Remote Command only)

Provided for ESU compatibility. When this command is received, the analyzer aliases it to the following:

`:INST:SEL SCPILC`

This results in the analyzer being placed in SCPI Language Compatibility Mode, in order to emulate the ESU Spectrum Analyzer Mode.

Remote Command	`:INSTrument[:SELect] SANalyzer`
Example	`:INST SAN`

Receiver compatibility command for EMC (Remote Command only)

Provided for ESU compatibility. When this command is received, the instrument aliases it to the following:

`:INST:SEL EMI`

`:CONF FSC`

This results in the instrument being placed in the EMI Receiver Mode, running the Frequency Scan measurement, in order to emulate the ESU Receiver Mode.

Remote Command	`:INSTrument[:SELect] RECeiver`
Example	`:INST REC`

APD compatibility command for EMC(Remote Command only)

Provided for ESU compatibility. When this command is received, the analyzer aliases it to the following:

`:INST:SEL EMI`

`:CONF APD`

This results in the analyzer being placed in the EMI Receiver Mode, running the APD measurement, in order to emulate the ESU APD Mode.

Remote Command	`:INSTrument[:SELect] APDistribution`
Example	`:INST APD`

IF Mode compatibility command for EMC (Remote Command only)

Provided for ESU compatibility. When this command is received, the analyzer aliases it to the following:

`:INST:SEL EMI`

`:CONF MON`

This results in the analyzer being placed in the EMI Receiver Mode, running the Monitor Spectrum measurement, in order to emulate the ESU IF Mode.

Remote Command	`:INSTrument[:SELect] IFANalyzer`
Example	`:INST IFAN`

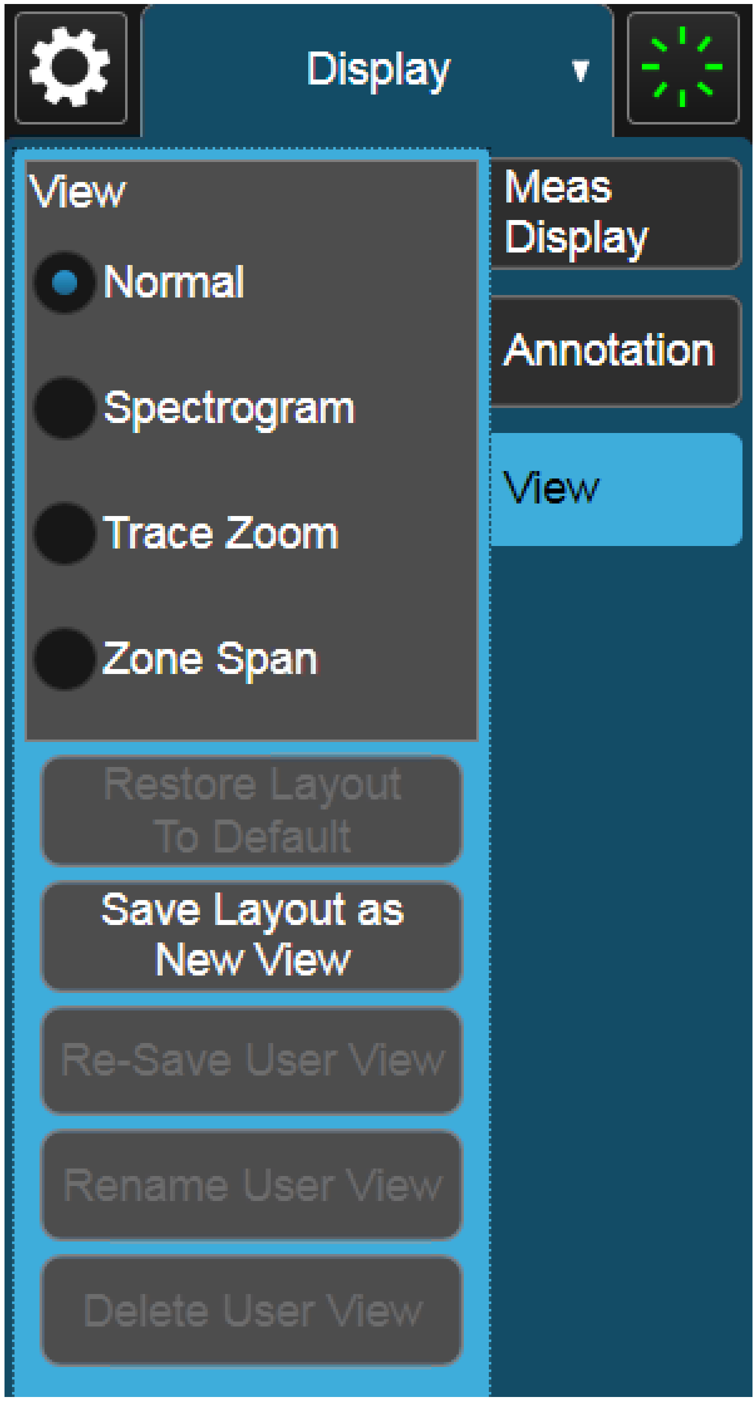
2.1.1.3 Measurement

The Measurement column of the Mode/Meas/View dialog shows all the Measurements available for the Mode which is selected in the first column. Select a Measurement in the second column and the View column will show all the Views available for that measurement. Once you have the Mode, Measurement and View selected, press OK to change the current Screen to that Mode, Measurement and View.

2.1.1.4 View

A View is a collection of Result Windows. The View column of the "Mode/Meas/View Dialog" on page 86 shows all the Views available for the Measurement which is selected in the second column. Once you have the Mode, Measurement and View selected, press OK to change the current Screen to that Mode, Measurement and View.

The View may also be set by using the View tab on the Display menu. The View tab is the last tab on the Display menu for every measurement. The Views are the same as those listed in the "Mode/Meas/View Dialog" on page 86.


Display
View
Normal
Spectrogram
Trace Zoom
Zone Span
Restore Layout To Default
Save Layout as New View
Re-Save User View
Rename User View
Delete User View
Meas Display
Annotation
View

2.1.1.5 Sequencer

Allows multiple Screens to update sequentially while in "Multiscreen" on page 174 display mode. Each Screen updates in sequence, and when all have updated, the sequence will start again.

To start the Sequencer, you must have more than one Screen defined, and you must have Multiscreen selected (see "Screen Tabs" on page 85).

If you want each Screen to use a different input, you must turn off **All Screens Use Same Input** under **Input/Output**, **Input**.

CAUTION Differences in hardware settings between the Screens may cause switches and/or attenuators to cycle as you go from one Screen to another. This could potentially reduce the life of these components. To avoid this, make sure **Attenuation**, **µW Path Control** and other switch settings are the same in each Screen.

NOTE When the Sequencer is running, the destination of remote commands is unpredictable, so you should stop the Sequencer before sending any measurement-related commands. Once the Sequencer has stopped, select a specific Screen using `:INSTrument:SCReen:SELect`, before sending any further commands. See "Select Screen" on page 176

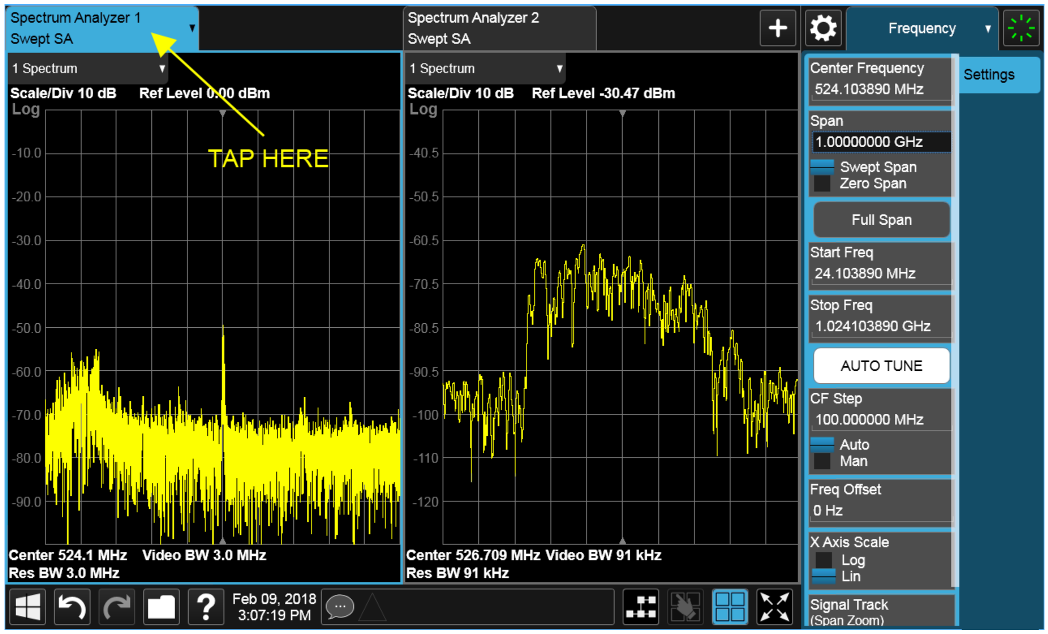
NOTE When the Sequencer is running, Auto alignment is temporarily disabled. A pending auto alignment might be executed when the sequencer is stopped.

See "More Information" on page 97

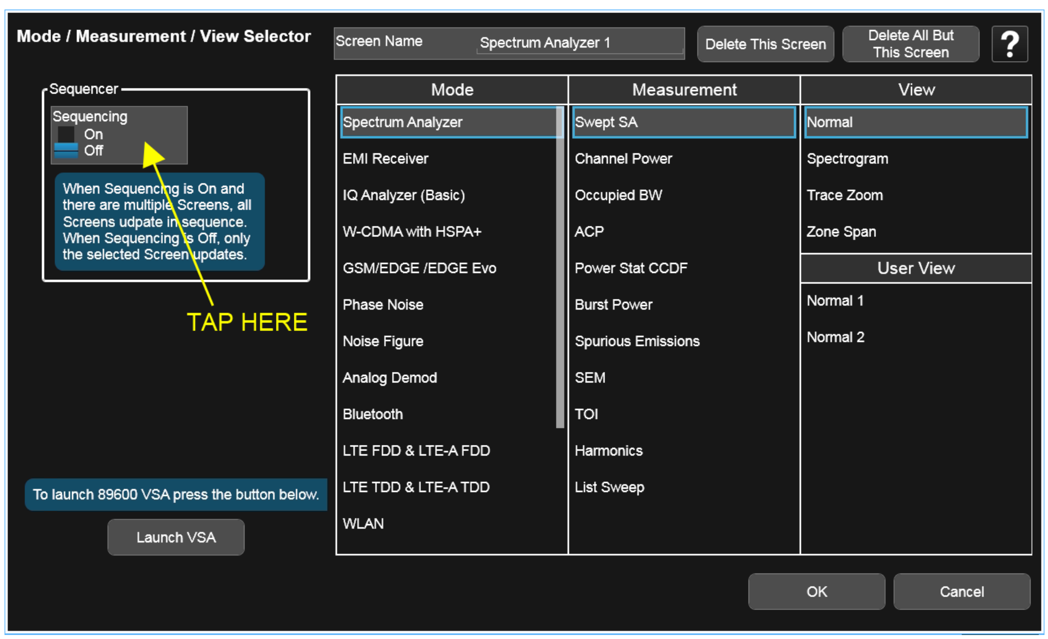
Remote Command	`:SYSTem:SEQuencer ON | OFF | 1 | 0` `:SYSTem:SEQuencer?`
Example	`:SYST:SEQ ON`
Notes	If the display is disabled (via `:DISP:ENAB OFF`) then the error message "-221, Settings conflict; Screen SCPI cannot be used when Display is disabled" is generated
Dependencies	To start the Sequencer, you must have more than one Screen defined and you must have Multiscreen selected
Preset	`OFF`

More Information

To start the Sequencer, tap the current (blue) Screen tab to go into the Mode/Meas/View Dialog:

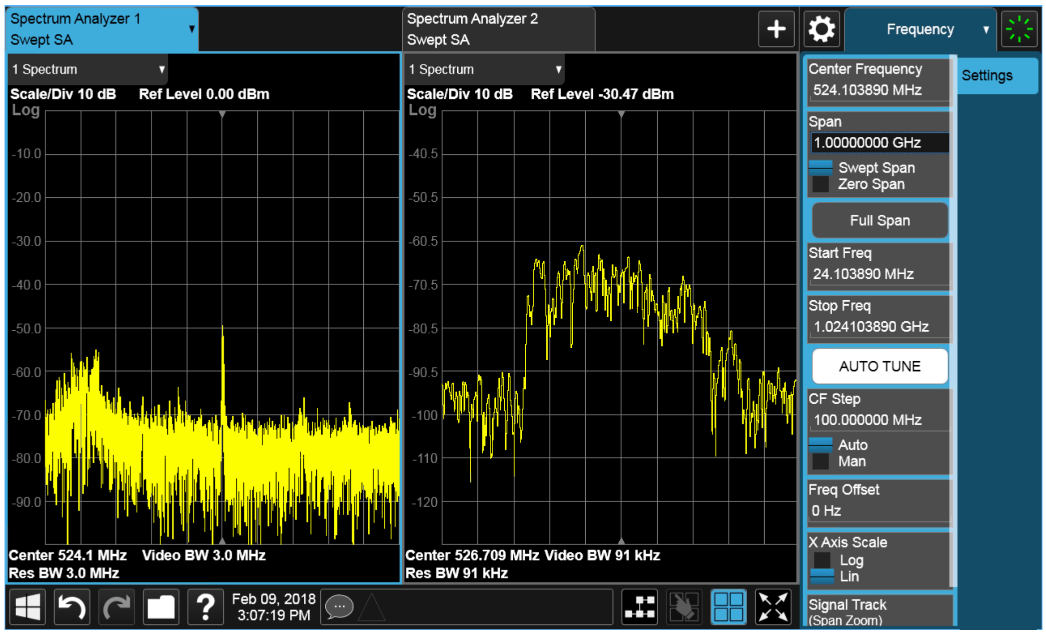


In the Sequencer block in the upper left hand corner, tap the Sequencing switch to turn it On:

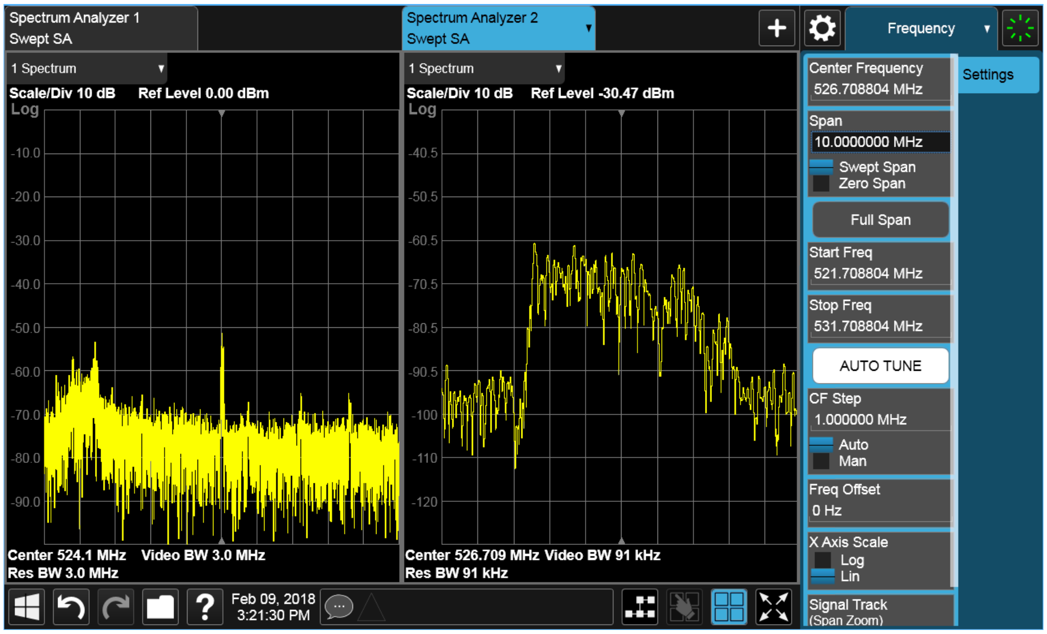


The instrument will immediately exit the Mode/Meas/View Dialog and begin making measurements in each of the screens, one after the other. When a measurement is being made in a particular Screen, that Screen's tab will be blue.

Measurement being made in Screen 1:



Measurement being made in Screen 2:



Touching any key or control on the display will cause the Sequencer to stop, so that you can make desired changes. When this happens, the message “Sequencer stopped” is displayed.

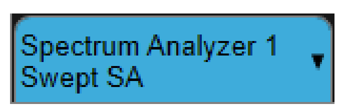
When the Sequencer is running, the screens update in the order in which they were created.

Each Screen takes one measurement then passes control to the next Screen. Each Screen updates as though it were in Single Sweep or Single Measurement mode. Thus, if Averaging is on, a Screen may take multiple sweeps before moving on to the next Screen.

2.1.1.6 Screen Name

By default, the screen name is the Mode (Application) name followed by a number indicating the instance of the application.

You may change the name displayed on the Screen Tab of any screen. The control to do this appears in the "Mode/Meas/View Dialog" on page 86:



When you touch this control an onscreen keyboard appears, allowing you to change the name. Whatever you change it to appears on the Tab, even if you subsequently change the screen to a different Mode.

To reset the name, delete the screen name entirely.

Each Screen Name must be unique; you cannot give the same name to more than one screen.

Remote Command	`:INSTrument:SCReen:REName <alphanumeric>`
Example	`:INST:SCR:REN “Baseband”`
Notes	The currently active screen is renamed. If the `<alphanumeric>` specifying the new name is already present in the list of screen names, the error message “-224, Illegal parameter value; New name <name> already exists” appears If the display is disabled (via `:DISP:ENAB OFF`) then the error message “-221, Settings conflict; Screen SCPI cannot be used when Display is disabled” appears

2.1.1.7 Delete This Screen

Pressing this button deletes the current Screen (the one with the blue tab). Deleting a screen removes it from view and selects the next lower screen in the list of screens. If only one screen is configured, it cannot be deleted.

If you press the **Delete This Screen** button, a prompt appears:

“This function will delete the current screen and its settings. This action cannot be undone. Do you want to proceed?”

Pressing **OK** or Enter deletes the screen, pressing **Cancel** or **ESC** does not.

Remote Command	`:INSTrument:SCReen:DELete`
Example	`:INST:SCR:DEL`
Notes	The currently active screen is deleted If the screen you are attempting to delete is the only configured screen, the error message “-221, Settings conflict; Last screen cannot be deleted” is displayed If the display is disabled (via `:DISP:ENAB OFF`) then the error message “-221, Settings conflict; Screen SCPI cannot be used when Display is disabled” is generated

2.1.1.8 Delete All But This Screen

Pressing this control deletes all the Screens except the current Screen (the one with the blue tab).

If you press the **Delete All But This Screen** button, a prompt appears:

"This function will delete all defined screens and their settings, except for the current screen. This action cannot be undone. Do you want to proceed?"

Pressing **OK** or Enter deletes the screen, pressing **Cancel** or ESC does not.

Remote Command	`:INSTrument:SCReen:DELete:ALL`
Example	`:INST:SCR:DEL:ALL`
Notes	You can reset the instrument to the power-on configuration by invoking `:INST:SCR:DEL:ALL` followed by `:SYSTem:DEFault ALL` If the display is disabled (via `:DISP:ENAB OFF`) then the error message "-221, Settings conflict; Screen SCPI cannot be used when Display is disabled" appears

2.1.1.9 89600 VSA

Pressing this button launches the 89600 VSA software. The 89600 VSA software is powerful, PC-based software, offering the industry's most sophisticated general purpose and standards specific signal evaluation and troubleshooting tools for R&D engineers. Even for proprietary and non-standard signals in SATCOM or MILCOM applications, you can make signal quality measurements with customized IQ constellation.

The 89600 VSA software offers the following features:

- Over 35 general-purpose analog and digital demodulators ranging from 2FSK to 4096QAM
- Flexible and custom IQ and OFDM signal analysis for single carrier
- Standards specific modulation analysis including:
  - Cellular: GSM/EDGE, cdma2000, W-CDMA, TD-SCDMA, LTE(FDD/TDD),
  - LTE-Advanced and more
  - Wireless networking: 802.11a/b/g, 802.11n, 802.ac, 802.16 WiMAX (fixed/mobile), WiSUN (MR-FSK PHY)
  - RFID
  - Digital satellite video and other satellite signals, radar, LMDS
- Up to 400K bin FFT, for the highest resolution spectrum analysis
- A full suite of time domain analysis tools, including signal capture and playback, time gating, and CCDF measurements
- 20 simultaneous trace displays and the industry's most complete set of marker

functions

– Easy-to-use Microsoft Windows graphical user interface

For more information see the Keysight 89600 Series VSA web site at www.keysight.com/find/89600vsa

To learn more about how to use the 89600 VSA in the instrument, start the 89600 VSA software, then open the 89600 VSA Help and navigate to the topic "About Keysight X-Series Signal Analyzer with 89600 VSA Software".

Example	`:INST:SEL VSA89601` `:INST:NSEL 101`

2.1.2 Add Screen

On X-Series analyzers you can configure up to 16 different Screens at one time. Each Screen contains one Mode, each Mode contains one Measurement, and each Measurement contains a number of Windows.

You can add screens by pressing the “+” icon in the "Screen Tabs" on page 85 panel. The icon is shown below:

Every time you add a Screen, the instrument “clones” or “copies” the current Screen into the new Screen. If desired, you can then use the "Mode/Meas/View Dialog" on page 86 to change the Mode, Measurement and/or View of the new Screen, or simply operate a second copy of your previous Screen, thus preserving the settings of your previous Screen.

When you have defined the maximum number of Screens (16), the “+” icon disappears.

For more information about operating the instrument with multiple screens configured, see "Multiscreen" on page 174.

Remote Command	`:INSTrument:SCReen:CREate`
Example	`:INST:SCR:CRE`
Notes	The maximum number of screens is 16. If an attempt to add a screen occurs when the maximum have been defined, the error message “-221, Settings conflict; Screen limit reached” appears When you create a new screen the Screen Name is the current Mode name followed by a number indicating the instance of the Mode.

If the display is disabled (via `:DISP:ENAB OFF`) then the error message “-221, Settings conflict; Screen SCPI cannot be used when Display is disabled” appears

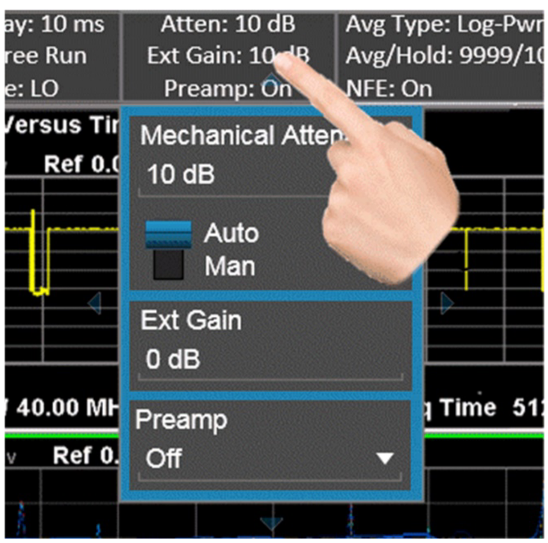
2.2 Meas Bar

The Meas Bar is used to display annotation for the current measurement. There are three primary uses for the Meas Bar:

1. To show annotation for the most important parameters in the measurement so you can see them at a glance
2. To show the annotation that you will most want to have recorded in a screen dump
3. To give you quick access to settings.

The Meas Bar is made up of a number of annotation panels, each of which, when pressed, opens up a dialog below it which contains controls for those settings.

For example, here is what the display looks like when you touch one of the regions of the Meas Bar:



Touching anywhere off the hotspot panel or pressing any hardkey except **Save** or **Quick Save** closes the hotspot panel.

In a hotspot panel, the control in black with the blue border is the active function. Each panel may have its own default active function.

Settings that are colored amber are those that you need to be particularly aware of; for example, if Alignments are off, this is shown in amber, so you will know that you may not be meeting spec. Similarly, if DC coupling is on, this is shown amber, to alert you to be careful what voltage you put on the input.

You can turn the Meas Bar on and off with a switch on the Annotation tab of the Display menu.

System Control Panel

The leftmost panel holds the GPIB/Remote annunciators, the Single/Continuous symbol/control, the LXI indicator and the PASS/FAIL indicator. Tapping this panel drops down controls for Single/Continuous, Pause/Resume and restart.

GPIB/Remote annunciators

The GPIB/Remote annunciators are shown as the letters `KRLTS`. Each letter is shown if the state is true and is not shown if the state is false, as follows:

K	Keylock indicator	This is shown when the instrument is in the Keylock state (turned on and off by the `SYST:KLOCk` command)
R	Remote annunciator	Shown when the instrument is in the remote state, as when being controlled via the IEEE-488 bus (GPIB) or TCP/IP connections
L	GPIB Listen annunciator	Shown when addressed to listen via GPIB orTCP/IP
T	GPIB Talk annunciator	Shown when addressed to talk via GPIB or TCP/IP
S	GPIB SRQ annunciator	Shown when the instrument is asserting SRQ on GPIB. This annunciator is an amber color

Single/Continuous symbol/control

This annunciator shows as an arrow on an oval line when in Continuous, or an arrow on a straight line when in Single.

LXI indicator

This indicator displays in green when LAN is connected, in white when LAN is not connected, and in red when LAN is connected but has a connection problem.

PASS/FAIL indicator

This annunciator displays when Limits are turned on. It is green if all Limits are passing, and a red FAIL if any limit is not passing.

The following command queries the status of the current measurement limit testing. It returns a 0 if the measured results pass when compared with the current limits. It returns a 1 if the measured results fail any limit tests.

Remote Command	`:CALCulate:CLIMits:FAIL?`
Example	`:CALC:CLIM:FAIL?` queries the current measurement to see if it fails the defined limits Returns a 0 or 1: 0 it passes, 1 it fails

Trace Detector Settings Panel

In the Swept SA and some other measurements, there is a special panel summarizing the settings for the traces in the measurement:

There is one column for each trace. The rows are as follows:

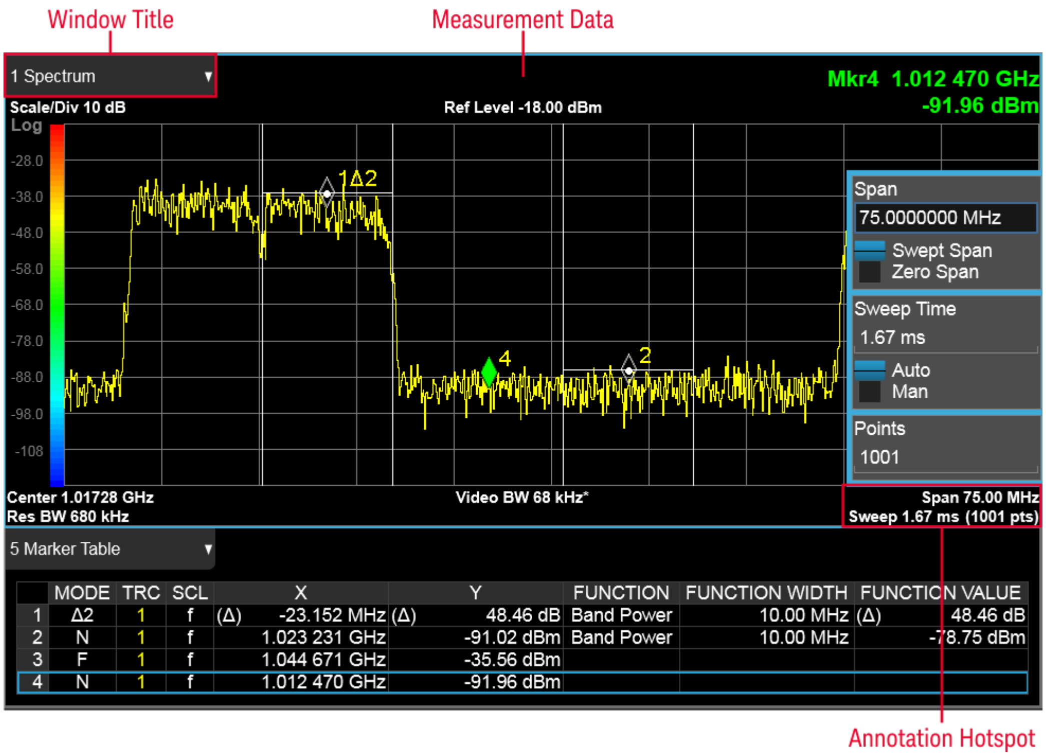
- The top row shows the Trace Number, in the trace color.
- The second row shows the Trace Type for each trace (W=Clear/Write, A=Trace Average, M=Max Hold, m=Min Hold); this letter is in white if the trace is Active, in gray if the trace is inactive; there is a bar through the letter if the trace is not being displayed
- The third row shows the detector for each trace (N=Normal, S=Sample, A=Average, P=peak, p=negative peak, Q=Quasi Peak, E=EMI Average, R=RMS Average, f=math function)

In the example above, trace 1 is active, visible, and in Average using the Sample detector, the other traces are inactive, blanked and in Clear/Write using the Normal detector.

Tapping this panel drops down controls for the Traces.

2.3 Measurement Display

The Measurement Display contains one or more data windows displaying the result of the current measurement. These may be graphical or textual windows.



Each window in the Measurement display contains a "Window Title" on page 109, "Measurement Data" on page 113, and graphical windows also may contain "Annotation Hotspot" on page 116.

The selected window in the Measurement Display is indicated by a blue border. Window-dependent controls in the menu panel always refer to the selected window.

2.3.1 Window Title

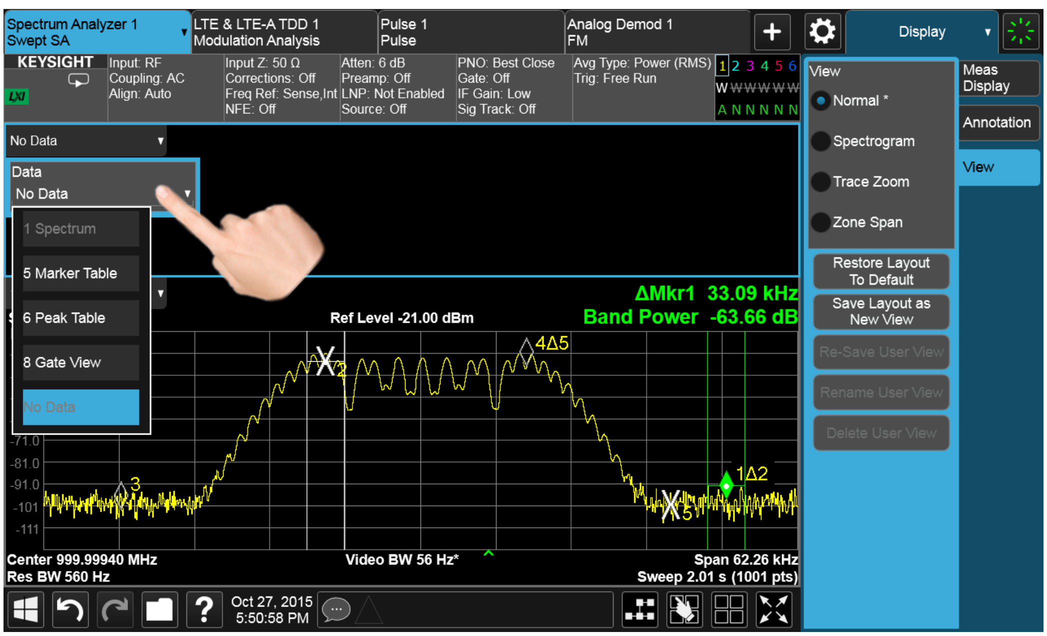
The Window Title appears in the upper left hand corner of the window, and includes a title describing the measurement data currently being displayed in the window. The title may also contain additional information about the data in the window, for example in the LTE measurement supplication, the component carrier being displayed in the window will be indicated (e.g., “CC0”).

Measurements that support User Views (see "View Editor" on page 153) also display the Window Number in the Window Title, to enable window addressing from SCPI. The number is the number that will be used in the SCPI command to address that window, for example, in the WCDMA Mod Accuracy measurement, Code Domain Power is assigned window number 6, so you address it with the following SCPI command:

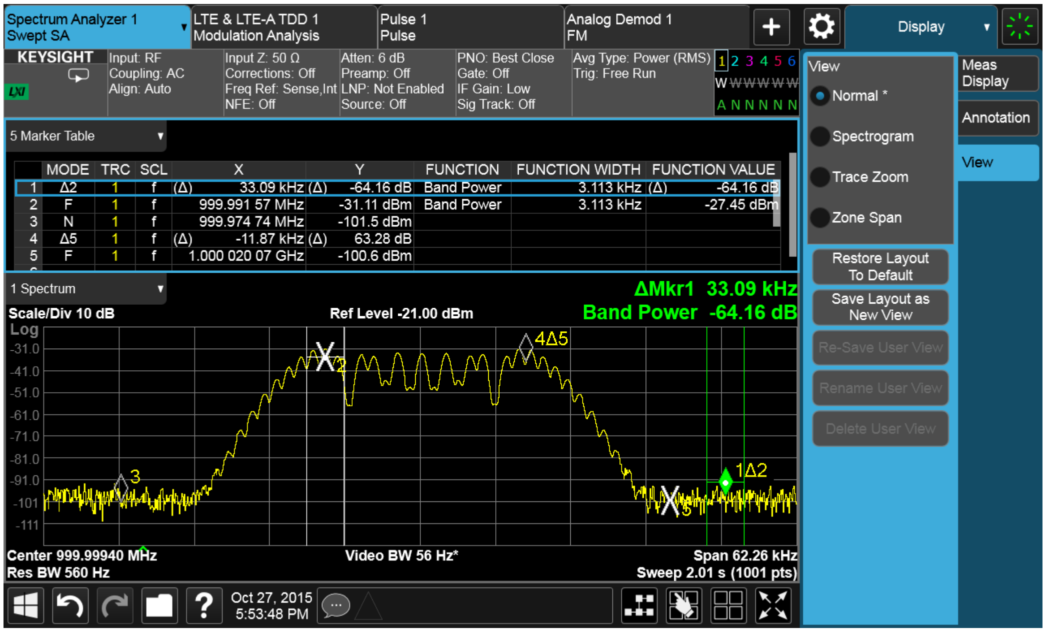
```
:DISP:RHO:WIND6:TRAC:Y:RLEV 0.0
```

Note the arrow pointing down on the right side of the Window Title. This indicates that touching the Window Title will display a dropdown, which enables you to select the Measurement Data to be displayed in the window.

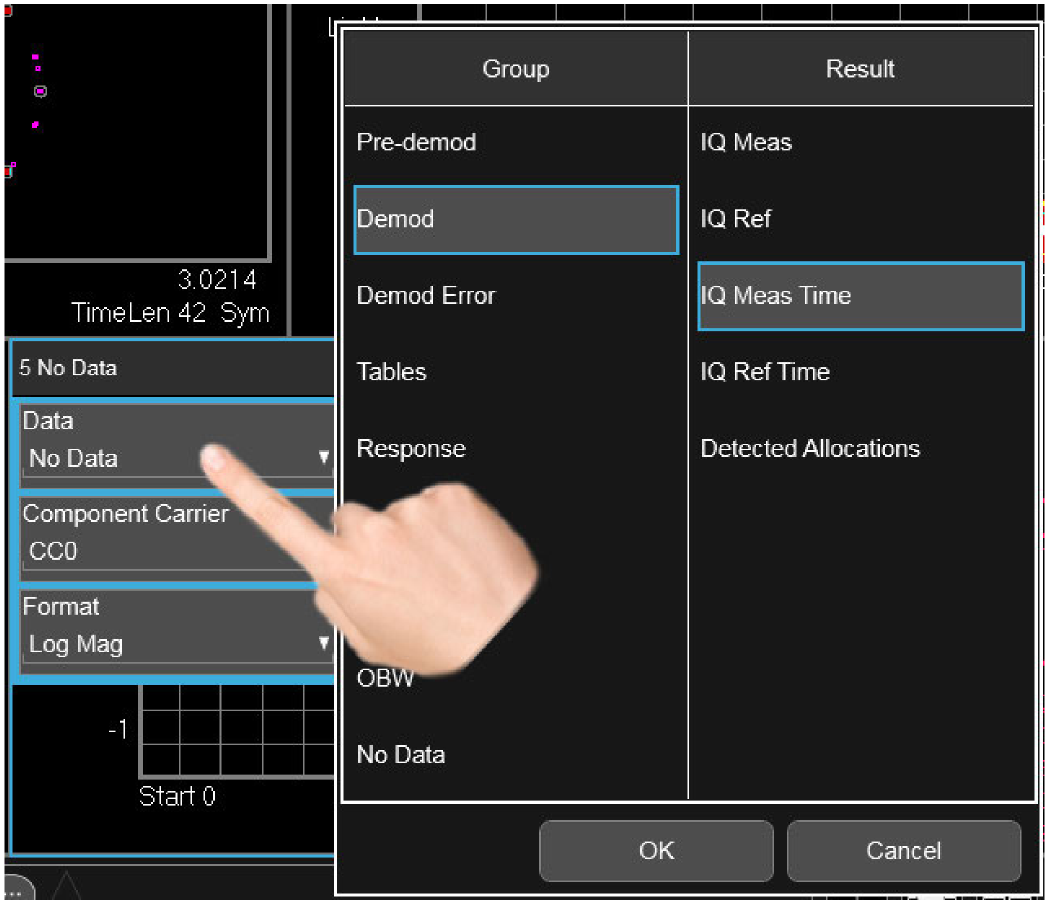
For example, if we wish to assign the results of the upper window in the display below to the Marker Table, we would touch the window title and then the “Data” control that is revealed, as shown:



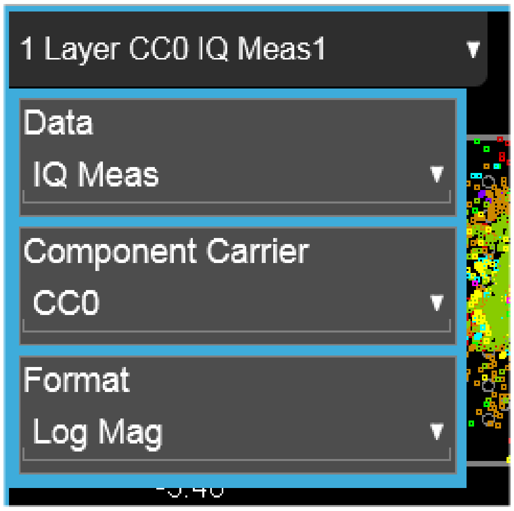
And then select Marker Table, yielding the result below:



Note also that the Window Data dropdown can be a cascaded list, if the number of available results requires categorization to hold them all:



Note also that the Window Data dropdown sometimes includes controls for further configuring the window, for example, in LTE choosing the desired Component Carrier and Data format.



Touching a window's title dropdown also selects the window.

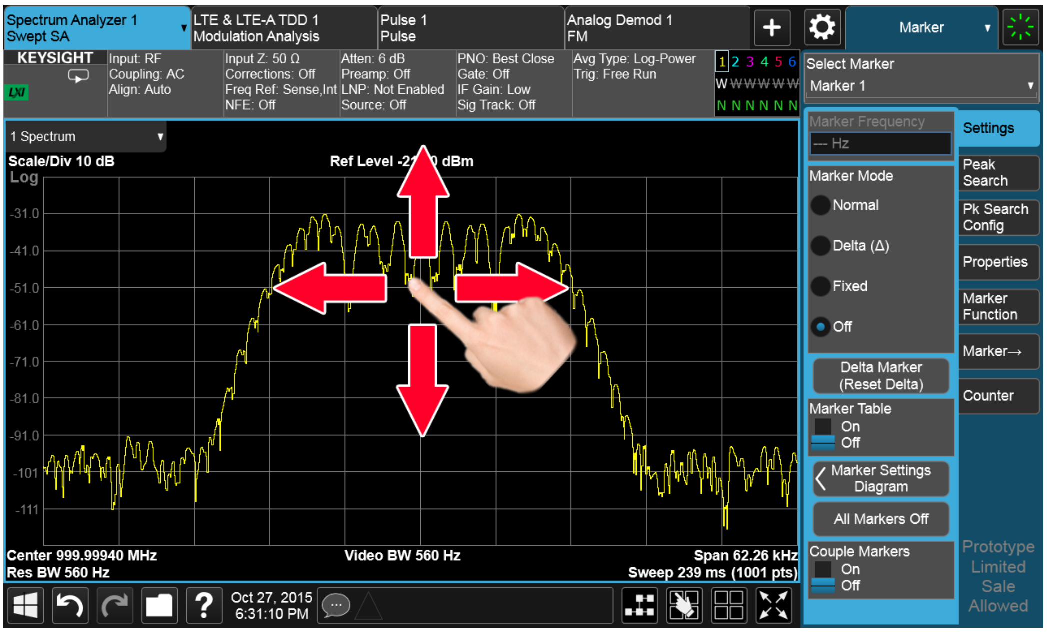
2.3.2 Measurement Data

The Measurement Data region shows graphical or textual data for the Data selected in the Window Title Data control. Below you can see examples of both graphical and textual windows in a four-window display.

There are many gestures which you can use to interact with a measurement display window. They are detailed below.

Swipe

There are several swipe actions, as listed below. One of the most important actions is swiping a spectrum window to the left or right, or up or down, to adjust the frequency and level of the spectrum, as shown below.



Swipe actions are summarized in the table below. Not all of these may be available, depending on the measurement.

Object	Action
Spectrum Trace Left/Right	Drag trace (change Center Frequency)
Spectrum Trace up/down	Drag trace (change Ref Level)
Marker Left/Right	Drag marker along trace
Fixed Marker Left/Right/Up/Down	Drag marker in space
Scrollable area	Scroll vertically or horizontally. Scrollable areas include the Menu Panel (if overfull), tables and lists. A scrollable area is indicated by a vertical or horizontal translucent white bar which can also be dragged by a mouse When scrolling a table: – Row headers remain in place when the table is scrolled horizontally, and scroll with the table when the table is scrolled vertically – Column headers remain in place when the table is scrolled vertically, and scroll with the table when the table is scrolled horizontally

Object	Action
Toggle control	Toggle in that direction

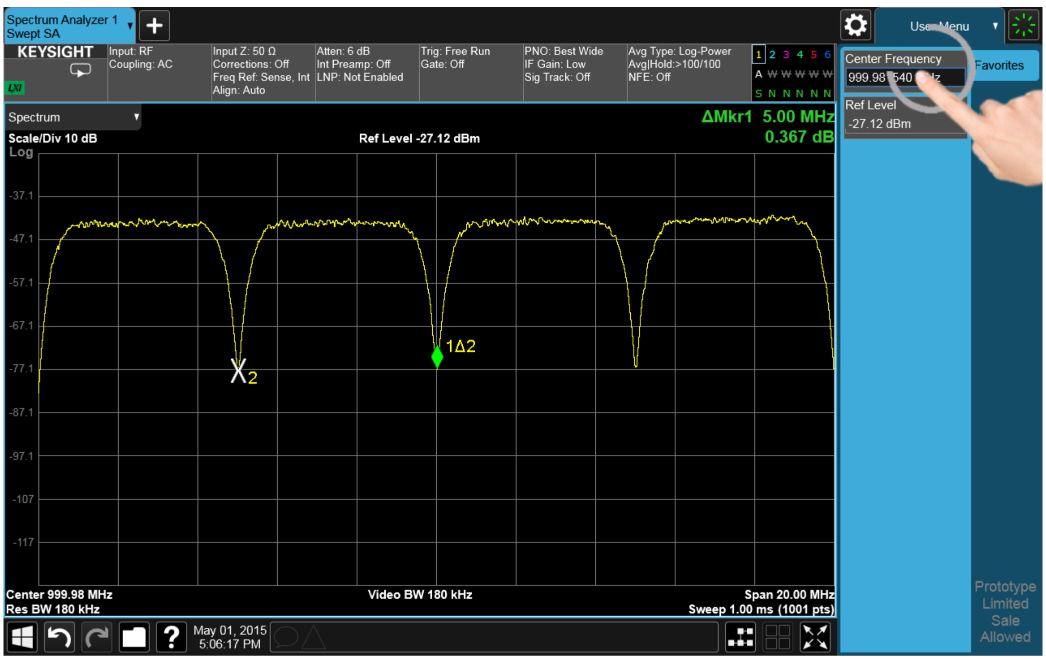
Pinch

You can also pinch in or out either horizontally or vertically to zoom in the x-axis or y-axis dimension. For example, a pinch horizontally lets you adjust the Span of the Spectrum window. Also, pinching on the wings of a Band Power or other Band Function allows you to widen or narrow that Band Function.

Pinching may sometimes be easier if you use the index finger of each hand, rather than pinching with one hand.

Touch-and-Hold

You can also touch-and-hold the display, that is, touch it and hold your finger on the display. A circle is drawn, and when the drawing completes, a right-click gesture is performed that depends on the screen feature touched, as listed in the table below.



Right Click on a Trace	Peak Search, Trace Type (Clear/Write, Trace Average, Max Hold, Min Hold), Trace View/Blank (Active, View, Blank, Background). Not all of these may be available, depending on the measurement
Right Click on a Marker	Marker Mode (Normal. Delta, Fixed, Off), Peak Search, Next Peak, Next Pk Right, Next Pk Left). Not all of these may be available, depending on the measurement

Right Click on the Background	Lets you select Help
Right Click on a Menu Panel control	Lets you add or remove that control from the User Menu or get Help on that control

Tap

Tapping an object causes the actions defined in the table below:

Object	Action
Marker	Select
Marker (repeated taps on stacked)	Cycle through stacked markers
Trace	Select. In addition if Marker is the active function, move the selected marker to the point where you tapped
Trace (repeated taps on stacked)	Cycle through stacked traces
Window	Select if unselected
Screen	Select if unselected

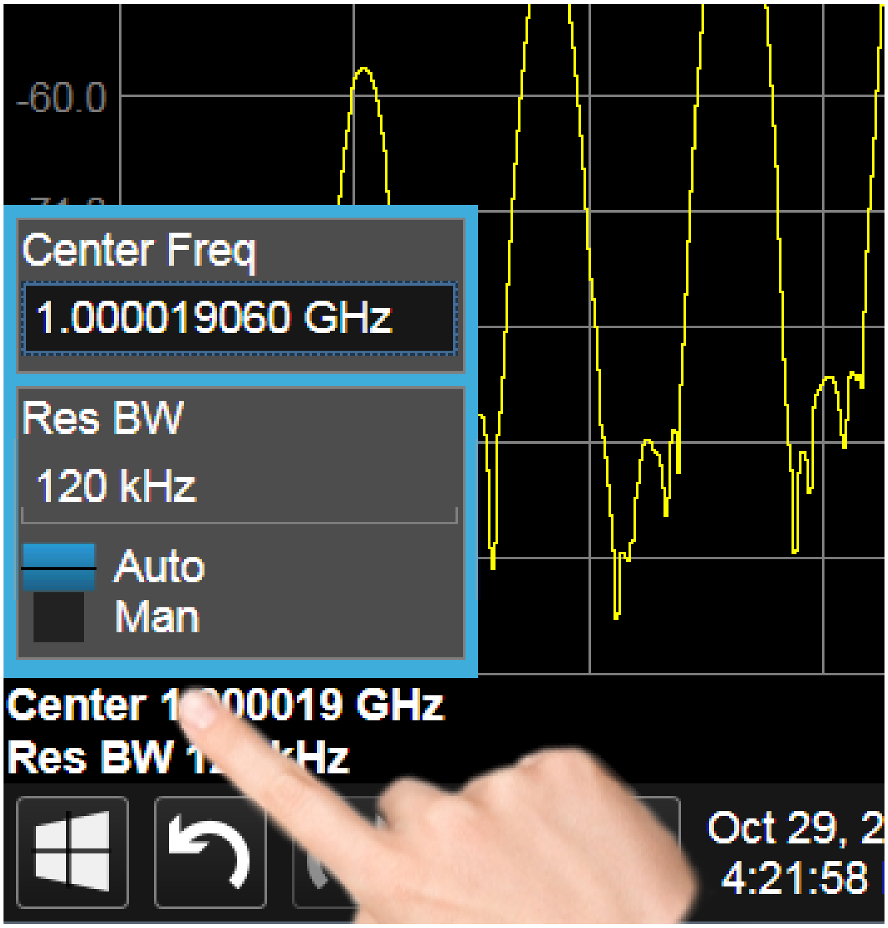
Double Tap

Double-tapping an object causes the actions defined in the table below:

Object	Action
Window	Zoom/Unzoom

2.3.3 Annotation Hotspot

You can tap on a graticule annotation to modify one of the fields in that annotation. For example if you tap on the region with Center Freq and Res BW in it, a menu panel pops up with just those settings on it.



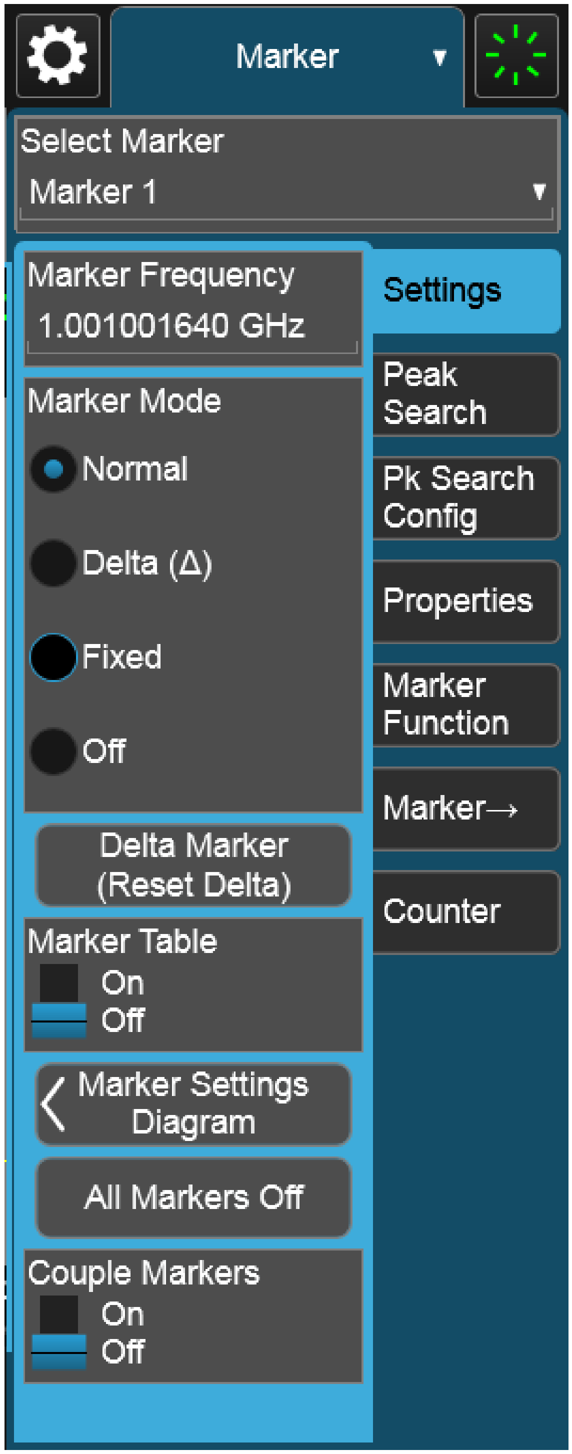
Touching anywhere off the hotspot panel or pressing any hardkey except **Save** or **Quick Save** closes the hotspot panel.

Annotation which is not currently able to be adjusted is not grayed out on the display, but the control in the hotspot that drops down or pops up is grayed out.

In a hotspot panel, the control in black with the blue border is the active function. Each panel may have its own default active function

2.4 Menu Panel

The menu panel is the main focus of the X-Series Multitouch user interface. The controls include active functions, dropdowns, action buttons, radio buttons and toggles.

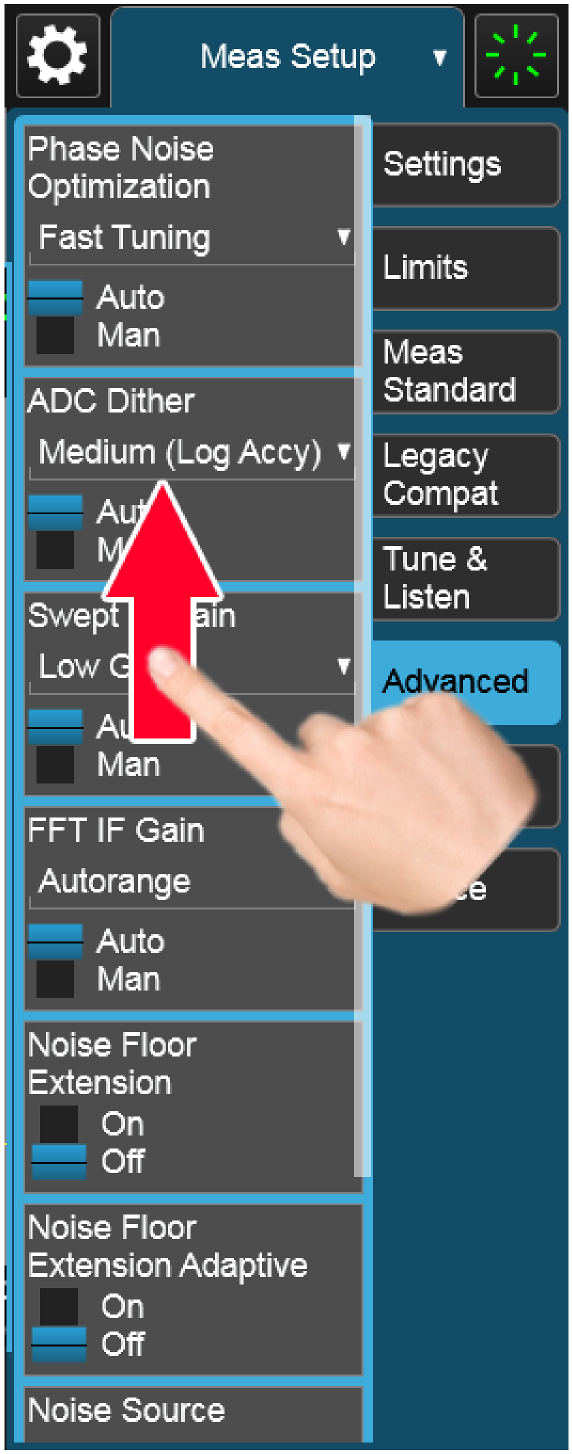

Marker
Select Marker
Marker 1
Marker Frequency
1.001001640 GHz
Settings
Peak Search
Pk Search Config
Properties
Marker Function
Marker→
Counter
Marker Mode
Normal
Delta (Δ)
Fixed
Off
Delta Marker (Reset Delta)
Marker Table
On
Off
Marker Settings Diagram
All Markers Off
Couple Markers
On
Off

The menu panel normally appears on the right side of the display and consists of a rectangular panel with multiple “sub-panels” lying on top of each other, each sub-panel being accessed by a tab on the right.

You press a front panel key (or “hardkey”) to access a particular menu. On the front panel there are twelve “measurement hardkeys” (the ones in the shaded region in the figures below) – these are the hardkeys that open up menus in the menu panel.

With a menu open, tap a tab to access the controls on its sub-panel. Whenever you press the front panel key associated with a menu, the default (top) tab is selected.

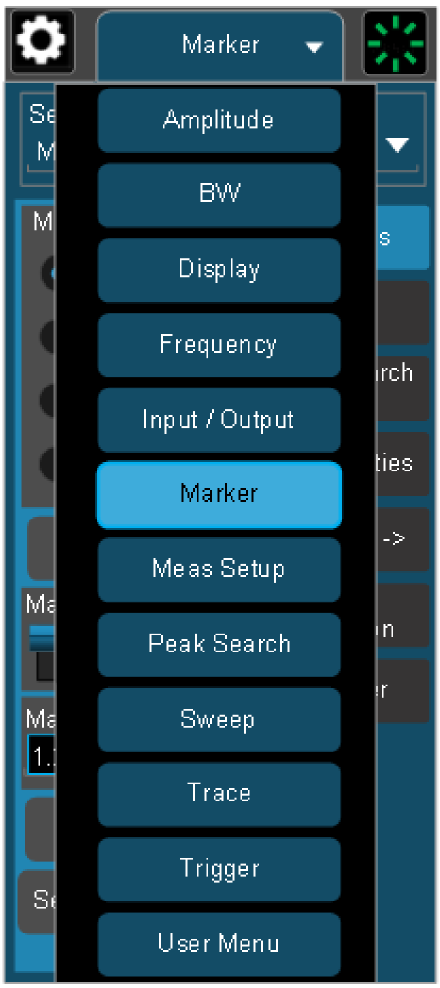
If the number of controls on a panel exceeds the height of the panel, scrolling is enabled, which is indicated by a white bar on the left that fades away after a few seconds. You swipe up or down with your finger to scroll the panel, or you can grab the white bar with a mouse.


Meas Setup
Phase Noise Optimization
Fast Tuning
Auto
Man
ADC Dither
Medium (Log Accy)
Swept
Low G
Man
FFT IF Gain
Autorange
Auto
Man
Noise Floor Extension
On
Off
Noise Floor Extension Adaptive
On
Off
Noise Source
Settings
Limits
Meas Standard
Legacy Compat
Tune & Listen
Advanced

If you move to a different menu panel or sub-panel and then come back to a previous panel, the previous panel is always reset to be scrolled all the way back to the top.

Accessing Menus Without Using Front-Panel Keys

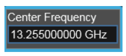
You can access the menu panels without using the front panel keys, as you would need to do if you were operating the instrument using Remote Desktop. Touch or click on the menu title, as shown below. A dropdown containing the twelve measurement hardkeys appears. Selecting a hardkey from the dropdown displays the corresponding menu, and the dropdown disappears.



Entering Numeric Values

Many controls on the menu panel allow you to enter numeric values. These are called “active functions.” An active function control displays a number and a suffix, for example 13.255 GHz, as in the example below:

An active function is “active” if the numeric value is surrounded by a black background with a blue border, as below. In this state, it is ready to receive numeric input from the number pad on the front panel, the knob, or the step keys.



When an active function is in the active state, you can start typing or pressing the number keys on the front panel, which causes the Numeric Entry Panel to appear, as shown below. The Numeric Entry Panel displays the typed value, and the terminators to complete the entry.

Here we see a UXA with an active function control in the active state. Although no Numeric Entry Panel is displayed, you can just touch the “2” key:

This causes the Numeric Entry Panel to pop up to receive the numbers you are typing:

Type in as many digits as required, then touch one of the unit terminator buttons in the Numeric Entry Panel to complete the entry. In this case, 2 GHz was the desired entry, so you just touch the “GHz” terminator:

The Numeric Entry Panel disappears and, in the example, the active function value becomes 2 GHz.

It is important to note that you can always pop up the Numeric Entry Panel by touching an active function control while it is active; for example, if you were to touch it in the figure above, the Numeric Entry Panel would pop up right next to the control:


UXA
Frequency
Settings
Center Frequency
Span
Swept Span
Zero Span
Full Span
Start Freq
-80.000000 MHz
Stop Freq
4.080000000 GHz
Auto Tune
CF Step
416.000000 MHz
Auto
Man
Freq Offset
0 Hz
Signal Track
(Span Zoom)
On
Off
Span 4.160 GHz
Sweep 6.93 ms (1001 pts)


UXA
Center Frequency
2.000000000 GHz
GHz
MHz
kHz
Hz
Frequency
Settings
Center Frequency
2.000000000 GHz
Span
4.16000000 GHz
Swept Span
Zero Span
Full Span
Start Freq
-80.000000 MHz
Stop Freq
4.080000000 GHz
Auto Tune
CF Step
416.000000 MHz
Auto
Man
Freq Offset
0 Hz
Signal Track
(Span Zoom)
On
Off
Span 4.160 GHz
Sweep 6.93 ms (1001 pts)

You can display the Numeric Entry Panel by touching any active function control while it is active, but you don't have to pop up the Numeric Entry Panel first, you can just start typing and it will pop up on its own, thus saving you a keystroke.

You can also adjust a value without displaying the Numeric Entry panel by turning the knob or using the step keys while an active function is active. If you turn the knob or use the step keys while the Numeric Entry Panel is displayed, it disappears, allowing you to see the entire screen while you are making the adjustment.

You can also drag the Numeric Entry Panel to another part of the display if it is covering something that you wish to see while it is on the screen.

2.4.1 Right-Click Menu

If you click with the right mouse button on any of the menus in measurements, a popup menu appears, which includes:

The items in this menu are:

- "Add to User Menu" on page 128
- "Help on this setting" on page 128
- "Show SCPI Command" on page 128
- "Add to SCPI Recorder" on page 129
- "Start/Stop SCPI Recorder" on page 129
- "Show SCPI Recorder" on page 129

2.4.1.1 Add to User Menu

For details, see "User Menu" on page 129.

2.4.1.2 Help on this setting

For details, see "Help" on page 142.

2.4.1.3 Show SCPI Command

Enabled/visible when the currently-active feature has an associated SCPI command or query. Displays a popup dialog that shows the active GUI selection's SCPI command.

To close the popup dialog, click **OK**

2.4.1.4 Add to SCPI Recorder

Adds SCPI to the recorder from User Interface features that have equivalent SCPI.

This is the manual mode for adding SCPI to the recorder when you do not wish to add SCPI continuously. This control is enabled only when the current active feature has an associated SCPI command or query.

Irrespective of the continuous recording state, clicking this control adds the active entry into the recorder, including the active value if it is a setting.

2.4.1.5 Start/Stop SCPI Recorder

Starts or stops continuous recording mode. After starting the recording, any changes to settings will be recorded.

After continuous recording is enabled, the button label changes to **Stop SCPI Recorder**, which is displayed while recording is in progress. Clicking **Stop SCPI Recorder** halts recording and switches the control label back to **Start SCPI Recorder**.

2.4.1.6 Show SCPI Recorder

This shortcut opens the dialog "SCPI Recorder" on page 2172.

2.4.2 User Menu

Lets you create your own menu, to include controls that you frequently use. You can have one **User Menu** for each measurement, and all User Menus survive a power cycle.

You add a control to the User Menu for the current measurement by right-clicking on the control, then selecting "Add to User Menu" on page 128. You can also remove the control from the User Menu using the same right-click menu item.

User Menu appears at the bottom of the menu drop-down panel.

2.5 Cancel key

Local

This front-panel key has the same functions as the Windows **Esc** (Escape) key. It does the following:

- Cancels dialogs
- Cancels active functions (unless there is an entry in progress, in which case it cancels that, and reverts to the previous value)
- Resets input overloads
- Aborts print operations
- Cancels certain other operations (such as alignments)
- Returns you to Local Control (if in Remote)
- If the backlight is off, turns on the backlight, and does nothing else

Most of this functionality is the same as earlier X-Series models and similar to ESA and PSA operation.

When the instrument is in Remote, any hardkey that is pressed on the front panel displays this message:

`Analyzer is in Remote. Press ESC to return to Local`

The exception is the **Cancel (ESC)** key, which takes the instrument out of Remote.

When the instrument is also in the LLO (local lockout state), the **Local** key is locked out as well. When this is the case, and the **Local** key is pressed, this message is displayed:

`Local key is locked out by remote computer. Cancel Local Lockout on computer or release remote control`

When you see this message, you should disconnect the remote computer, or use it to take the instrument out of the Local Lockout state.

2.6 Onscreen Keyboard key

This key turns the onscreen alpha keyboard (OSK) on and off.

There are two onscreen keyboards:

- The Multitouch OSK, which pops up automatically if, while using the analyzer application, a text field becomes the active function
- The Windows OSK, which you must open manually when a text field must be entered while interacting with Windows or other apps

2.7 Touch On/Off Key

This front-panel key turns the display touch functionality on and off. If off, you can turn it back on using the front panel **Touch On/Off** key. When the touch functionality is off, you can still use a mouse as a pointer.

When toggled, a dialog box appears midscreen that confirms “Touchscreen On” or “Touchscreen Off”.

This function remains in effect until it is turned off or until the app shuts down. The app always starts up with Touch enabled.

2.8 Tab key

This key has the same function as the **Tab** key on a PC keyboard.

You can use this key to display the Windows Taskbar, as follows.

– Alt-Tab to the Desktop

– Touch the desktop

– Touch **TAB**

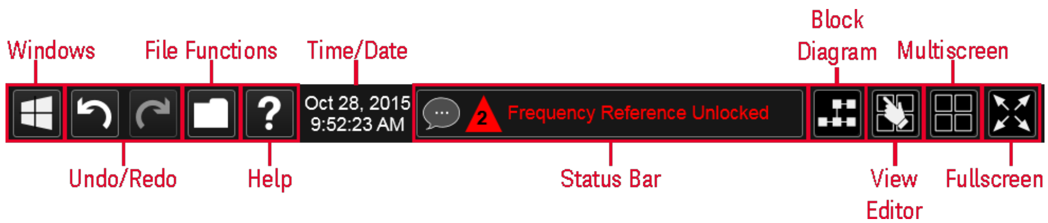
– The Taskbar appears

2.9 Local Button

Appears in the Menu Panel when the instrument is in remote, and can be brought back to local via the **Local (ESC)** Key. See also "Cancel key" on page 130.

2.10 Control Bar

The Control Bar contains controls and readouts that let you control instrument functions independent of the current measurement.



2.11 Windows

Pressing the Windows icon on the "Control Bar" on page 135 has the same effect as pressing the Windows icon on the Windows taskbar. It displays the Windows taskbar and Start Menu, which allows you to launch Windows programs and access features such as the Control Panel.

2.12 Undo/Redo

The Undo button in the "Control Bar" on page 135,

and the Undo front panel key,

are used to undo the most recently executed function.

If you Undo a function, and then decide you should not have done so, you can use the **Redo** button in the "Control Bar" on page 135 to put it back the way it was. The Redo function may also be executed by pressing **Ctrl+Undo** (holding the **Ctrl** key down while pressing the **Undo** font panel key).

Undo allows you to restore a setting, which you had previously set, back to its value before you changed it. When you press the Undo button or front panel key, the last setting you changed is "undone", that is, its previous setting is restored. You are notified of this fact with an advisory pop up message; for example, if the Center Frequency had been 300 MHz, and you changed it to 1 GHz and then pressed **Undo**, the message would show:

```
UNDO: Center Freq 1 GHz -> 300 MHz
```

The instrument can store 5 levels of action for Undo.

To truly understand Undo and Redo, it helps to think of two "stacks", an Undo stack and a Redo stack,

UNDO stack	REDO stack

Whenever you perform an action, it is placed on the Undo stack. So for example, if you set the Center Frequency to 1 GHz, then set the RBW to 1 MHz, then set the Detector to Peak, each of these actions gets "pushed" onto the Undo stack:

UNDO stack	REDO stack
Det = Peak	
RBW = 1MHz	
CF = 1 GHz	

When you press **Undo**, the top item on the Undo stack is removed, the action represented by that item is undone, and the item is placed on the Redo stack. So pressing **Undo** once in the above case would undo the setting of the peak detector, and the stacks would look like this:

UNDO stack	REDO stack
RBW = 1MHz	Det = Peak
CF = 1 GHz	

Now pressing **Undo** again would undo the RBW = 1 MHz action, and the stacks would look like this:

UNDO stack	REDO stack
CF = 1 GHz	RBW = 1MHz
	Det = Peak

Now pressing Redo would Redo the RBW = 1 MHz action, and the stacks would again look like this:

UNDO stack	REDO stack
RBW = 1MHz	Det = Peak
CF = 1 GHz	

Also, whenever you set a value, the Redo stack is cleared; you can't redo an action once you have interrupted the original flow of actions. Think of the Undo stack as the past, and the Redo stack as the future; if you have items in both stacks it means you have gone back to a time in the past; if you then *do* something you have changed the future, so the old future (the Redo stack) gets cleared.

For example, in the example above, if you now were to change another setting, such as VBW = 1 kHz, the Redo stack gets cleared, and the stacks would look like this:

UNDO stack	REDO stack
VBW = 1 kHz	
RBW = 1MHz	
CF = 1 GHz	

Undo can undo changes you make with the knob or step keys, however all contiguous events that affect the same parameter are aggregated into one event for the sake of Undo. For example, if CF is the active function and is 1 GHz, and you turn the knob back and forth, then enter a value, then use the step keys, when you press **Undo**, the instrument returns to CF = 1 GHz.

Actions that Cannot be Undone

There are some actions that cannot be undone, because these clear the Undo/Redo stack:

- Restore Mode Defaults clears the stack for that Mode in that Screen
- Sending SCPI commands clears the stack for that Mode in that Screen
- Loading a state file (including User Preset) clears the stack for that Mode in that Screen
- Deleting a Screen clears all the stacks in that screen
- Changing Views

Undo/Redo works within the context of a Mode. Each Mode in each Screen keeps its own record. Settings in the Control Panel or System Settings menus are not undoable.

There are several actions that may change many parameters. Among these are Auto Tune, and Adjust Atten for Min Clipping. After executing such a function, Undo sets all parameters back to their value before the function was selected. Auto Tune appears to be a single action, even though the instrument executes it in several steps.

Redo reverses the effect of the last Undo action, assuming that no other settings have been changed since the last Undo. Changing a setting after an Undo clears memory of all settings after that Undo, that is, it clears the Redo stack, as explained above.

When you press the **Redo** icon or **Ctl** and the **Undo** hardkey, you are notified with an advisory popup message; for example, if the Center Frequency had been 300 MHz, and you changed it to 1 GHz and then pressed **Undo**, the message would say:

```
UNDO: Center Freq 1 GHz -> 300 MHz
```

If you then press **Redo**, the message will say:

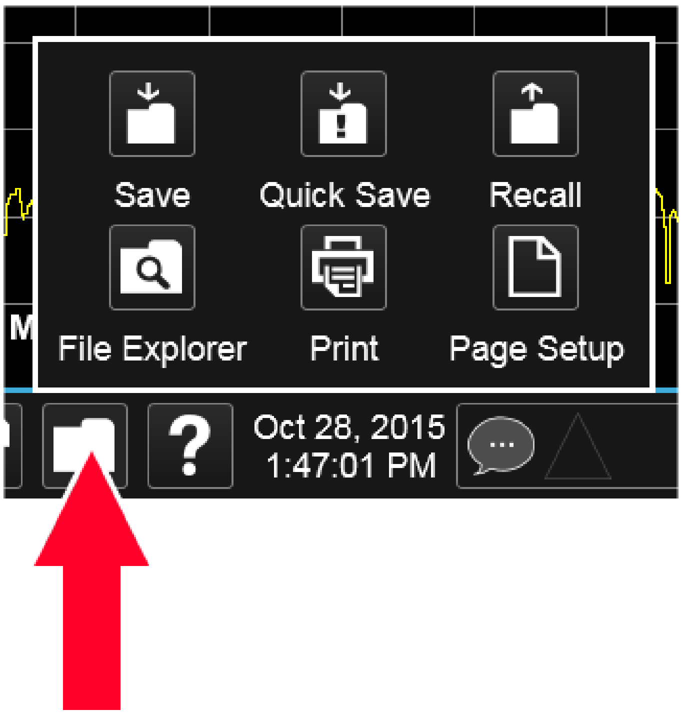
```
REDO: Center Freq 300 MHz -> 1 GHz
```

Neither **Undo** nor **Redo** perform any navigation, and have no effect on which menu panel is displayed nor which function is active.

2.13 File Functions

The File Functions popup contains controls for executing Save, Recall, File and Print operations. You display the File Functions popup by tapping the File Functions icon in the "Control Bar" on page 135.

For more information on a control, tap an icon in the image below.



Tapping this folder icon displays the File Functions popup

2.13.1 File Explorer

Pressing the File Explorer button in the "File Functions" on page 141 dialog opens the Windows File Explorer, which allows you to perform operating system file functions such as Move, Copy and Delete.

File Explorer also allows you to map network drives to drive letters on your PC or intranet, in order to more easily save screen images, states and other data, and load them back into the instrument.

2.14 Help

Pressing the **Help** button in the "Control Bar" on page 135, the **Help** front panel key, or the **F1** key if you have a PC keyboard connected, opens the context-sensitive help system. The **Help** button appears in the "Control Bar" on page 135 and in the banner of full-screen dialogs

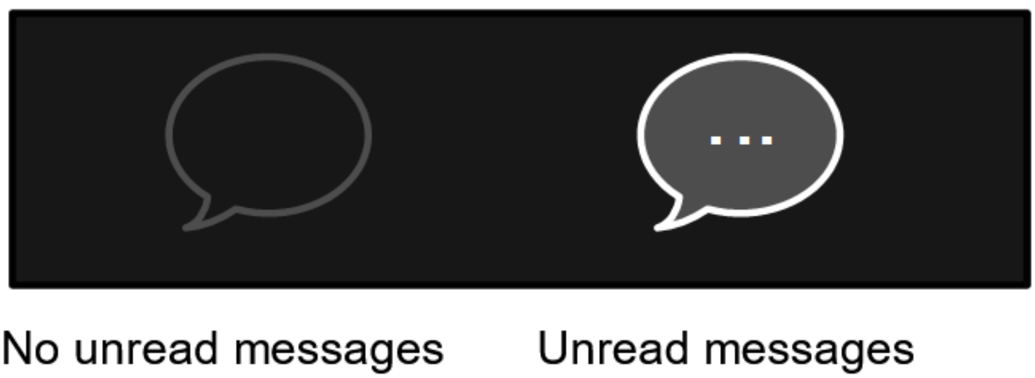
You can also use the Help window's Contents pane to navigate to Help for any function in the instrument

You can also touch-and-hold a specific control to display a "right-click" menu, in which one of the choices is **Help on this setting**

2.15 Status Bar

The Status Panel (or Status Bar) appears at the bottom of the display and contains three fields:

The Message Balloon appears on the left side of the Status Panel and lets you know when there is an unread message in the queue.



The Message Balloon has a gray outline and no fill if there are no unread messages; it has a gray fill and a white outline and displays a white ellipsis in the middle if there are unread messages.

The Condition Indicator appears to the right of the Message Balloon and shows the current number of open conditions. Below are some examples of what the Condition Indicator can look like:

The triangle is unfilled if no there are no open conditions, filled with yellow if all open conditions are warnings, and filled with red if at least one open condition is an error. The number displayed is the total number of open conditions.

Touching the Condition Indicator opens up the Show Status dialog (see below) with the Current Conditions tab selected. Touching anywhere else on the Status Bar opens up the Show Status dialog with the History tab selected.

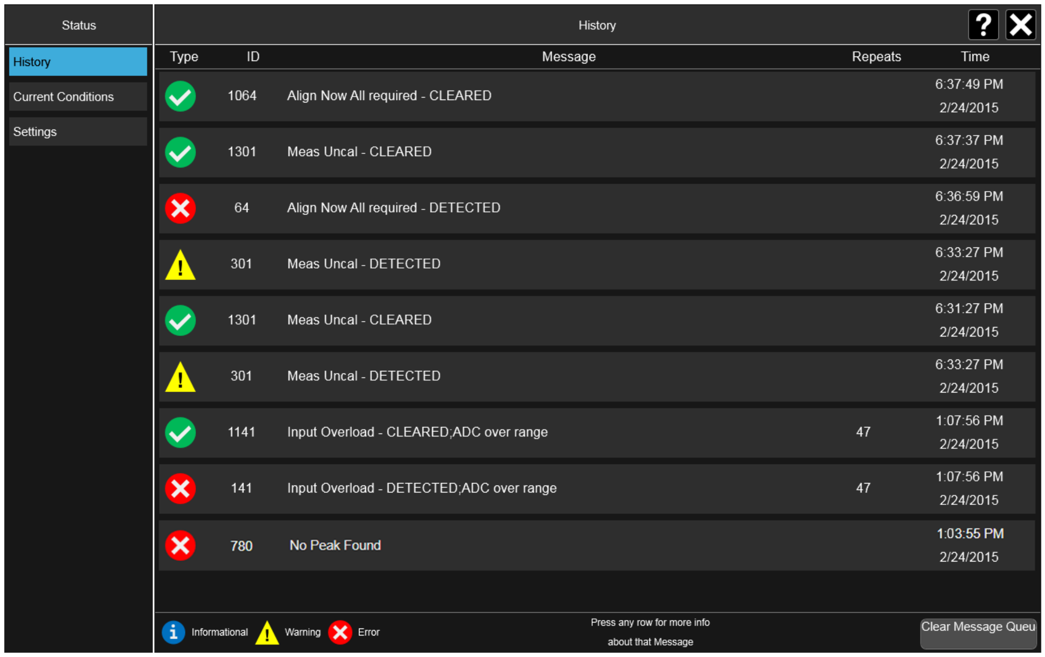
The Condition Message appears to the right of the Condition Indicator. In the example below, the cCondition Message is “Align All, Now required”:

Warning condition messages display in yellow, error condition messages display in red.

If there is more than 1 open condition, the Condition Message cycles through the display of all of the open conditions, one at a time. Each message is displayed for 2 seconds, then the next for 2 seconds, and so on.

Show Status Dialog

The Show Status dialog appears if you tap anywhere in the Status Bar. Touching the Condition Indicator (the triangle in the Status Bar) opens up the Show Status dialog with the Current Conditions tab selected. Touching anywhere else on the Status Bar opens up the Show Status dialog with the History tab selected.



If the display fills up, scrolling is enabled just as in other X-Series Multi-touch UI displays.

The Status dialog automatically refreshes as new messages and conditions occur.

At the bottom of the screen is a Clear Message Queue button. This button clears all errors in all error queues.

Note the following:

– Clear Message Queue does not affect the current status conditions

– Mode Preset does not clear the message queue

– Restore System Defaults (Super Preset) will clear all message queues

– *CLS only clears the queue if it is sent remotely and *RST does not affect any error queue

– Switching Modes does not affect any error queues

See "More Information" on page 146

Remote Command	`:SYSTem:ERRor[:NEXT]?`
Example	`:SYST:ERR?`
Notes	The return string has the format:

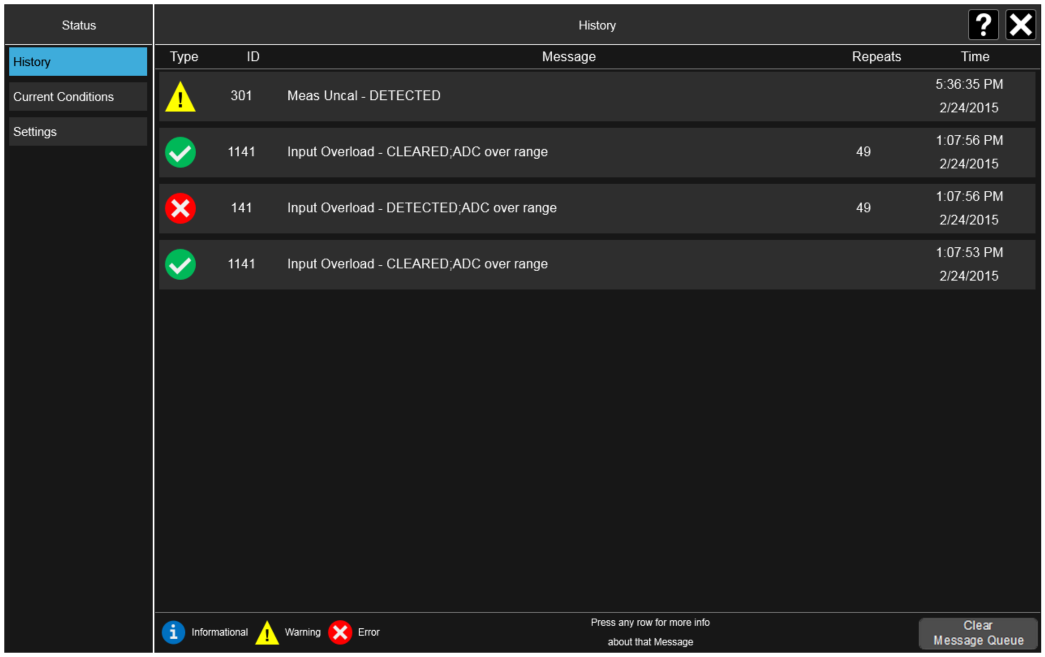
	`<Error Number>,<Error>` Where `<Error Number>` and `<Error>` are those shown on the Show Errors screen
Backwards Compatibility Notes	In some legacy analyzers, the Repeat field shows the number of times the message has repeated since the last time the error queue was cleared. In the X-Series, the Repeat field shows the number of times the error has repeated since the last intervening error. So the count may very well be different than in the past even for identical signal conditions Unlike previous analyzers, in the X-Series all errors are reported through the Message or Status lines and are logged to the event queue. They never appear as text in the graticule area (as they sometimes do in previous analyzers) and they are never displayed in the settings panel at the top of the screen (as they sometimes do, by changing color, in previous analyzers) As a consequence of the above, the user can only see one status condition (the most recently generated) without looking at the queue. In the past, at least in the Spectrum Analyzer, multiple status conditions might display on the right side of the graticule In general, there is no backwards compatibility specified or guaranteed between the error numbers in the X-Series and those of earlier products. Error, event, and status processing code in customers' software will probably need to be rewritten to work with X-Series In the legacy analyzers, some conditions report as errors and others simply turn on status bits. Conditions that report as errors often report over and over as long as the condition exists. In the X-series, all conditions report as start and stop events. Consequently, software that repeatedly queries for a condition error until it stops reporting will have to be rewritten for the X-series

More Information

The Status Dialog has two screens, selectable by the tabs on the right: **History** and **Current Conditions**:

History

History brings up a screen displaying the front panel message queue in chronological order, with the newest event at the top. Remember that the front panel queue contains all of the events generated by front panel actions as well as error events from all of the SCPI queues. A typical History display appears below:



The fields on the History display are:

Type	Displays the icon identifying the event or condition as an error or warning
ID	Displays the error number
Message	Displays the message text
Repeat (RPT)	This field shows the number of consecutive instances of the event, uninterrupted by other events. In other words, if an event occurs 5 times with no other intervening event, the value of repeat will be 5 If the value of Repeat is 1 the field does not display. If the value of Repeat is >1, the time and date shown are those of the most recent occurrence. If the value of repeat reaches 999,999 it stops there. The Repeat field can run into some pretty large numbers when apps (like the GSM app) report things like “GSM sync burst not found” as events rather than conditions, which is actually fairly common Note that the repeat count is unavailable over SCPI
Time	Shows the most recent time (including the date) at which the event occurred. Time is displayed to the second

To understand the History dialog, and to properly program the instrument’s messaging system, remember that there are two types of occurrences, events and conditions:

- An event is an occurrence of zero duration. Events generate messages which are displayed in the center of the display for a period of time and then fade away. These may be of an advisory nature or may represent errors, for example “No peak found”

- A condition is an occurrence of finite duration, that is, it has a start and an end. Conditions are states of the analyzer characterized by some combination of settings or some kind of failure that the user needs to be told about while it is happening, but then can stop being told once it goes away; for example “Input overload; ADC over range”

The error queue contains error events as well as the DETECTED and CLEARED events for condition errors, as seen in the figure above.

DETECTED events have numbers less than 1000 and CLEARED events have the same number plus 1000. For example,

301, Meas Uncal – DETECTED

and later

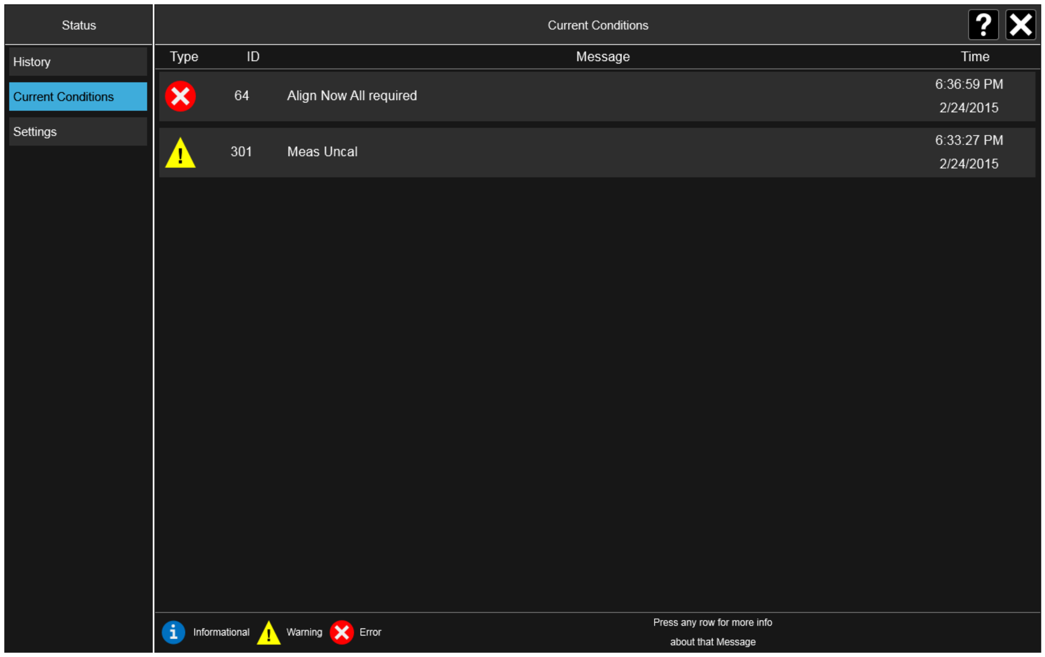
1301, Meas Uncal – CLEARED

To detect a condition error over SCPI, you should read the error queue and note any DETECTED error which is not followed eventually by an associated CLEARED error. This means the condition is still in effect. It is not sufficient to simply read the error queue until you get “No Errors” back. You may still have the condition error; the condition may still be in effect, and if that is the case, all you have done by clearing the error queue is to remove the first event (the DETECTED event) from the queue. For a condition error, you have to read the error queue until you see the CLEARED event for that condition. THEN you know that the condition is gone.

Current Conditions

The **Current Conditions** display shows all of the open conditions in the instrument. An open condition is a condition error or warning for which a start (detected) event has occurred but for which no corresponding stop (cleared) event has occurred.

An example of the Current Conditions screen appears below:



The fields on the Current Conditions display are:

Type	Displays the icon identifying the event or condition as an error or warning or informational
ID	Displays the error number
Message	Displays the message text
Time	Shows the most recent time (including the date) at which the event occurred. Time is displayed to the second

Touching a condition message expands the display of that message. Touching again collapses it. The description is the same as the one that appears on the message dialog. An example of this is shown in the History section, below.

When there are no open conditions, the display is as shown below:


Show Status
Current Conditions
History
Current Conditions
Settings
Type
ID
Message
Time
No Conditions Present
Informational
Warning
Error
Press any row for more info about that message

2.16 Block Diagram

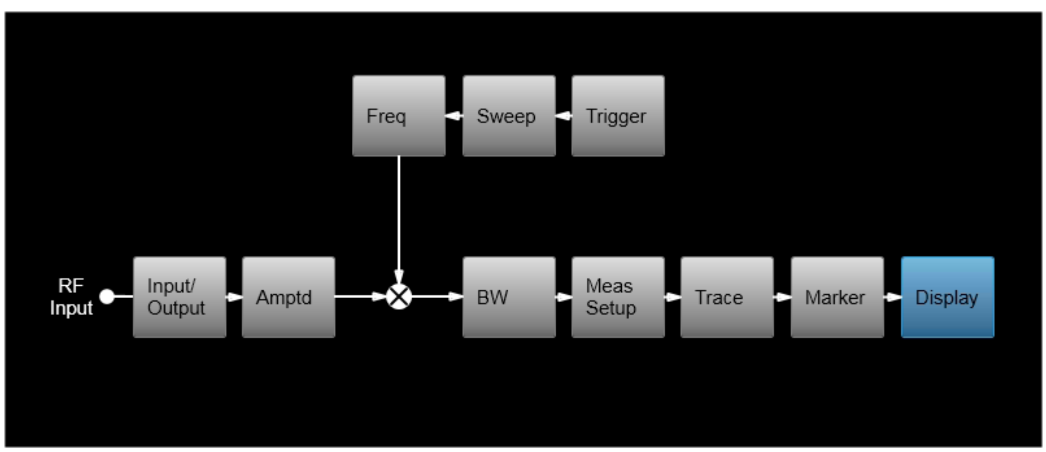
When you press the Block Diagram button in the "Control Bar" on page 135, the display changes to a stylized pictorial representation of the current internal hardware setup and signal processing path. When you touch one of the blocks on the Block Diagram, the corresponding menu panel opens.

When you press the Block Diagram button, the display changes to a stylized pictorial representation of the current internal hardware setup and signal processing path. When you touch one of the blocks on the Block Diagram, the corresponding menu panel opens.

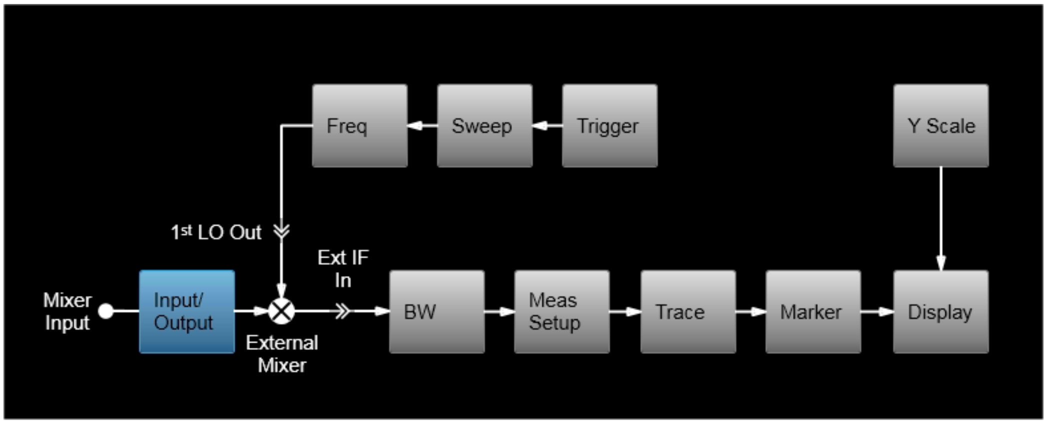
While in the Block Diagram display, the button is blue colored, as:

To exit the Block Diagram display, tap the button again.

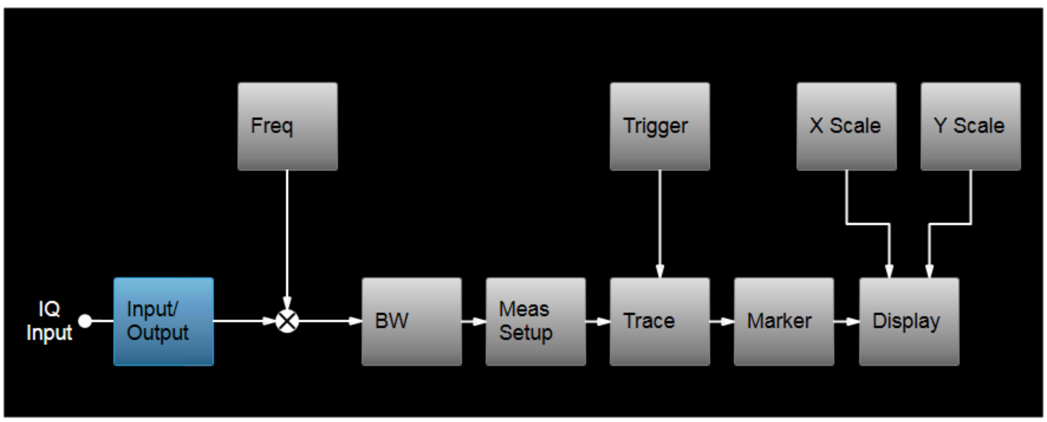
The Block Diagram display is not meant to be a completely accurate representation, but one which can show differences as you change the hardware setup. For example, here is the basic RF Block Diagram:



And here is the Block Diagram when External Mixing is selected:



And here is the Block Diagram when the I/Q inputs are selected:

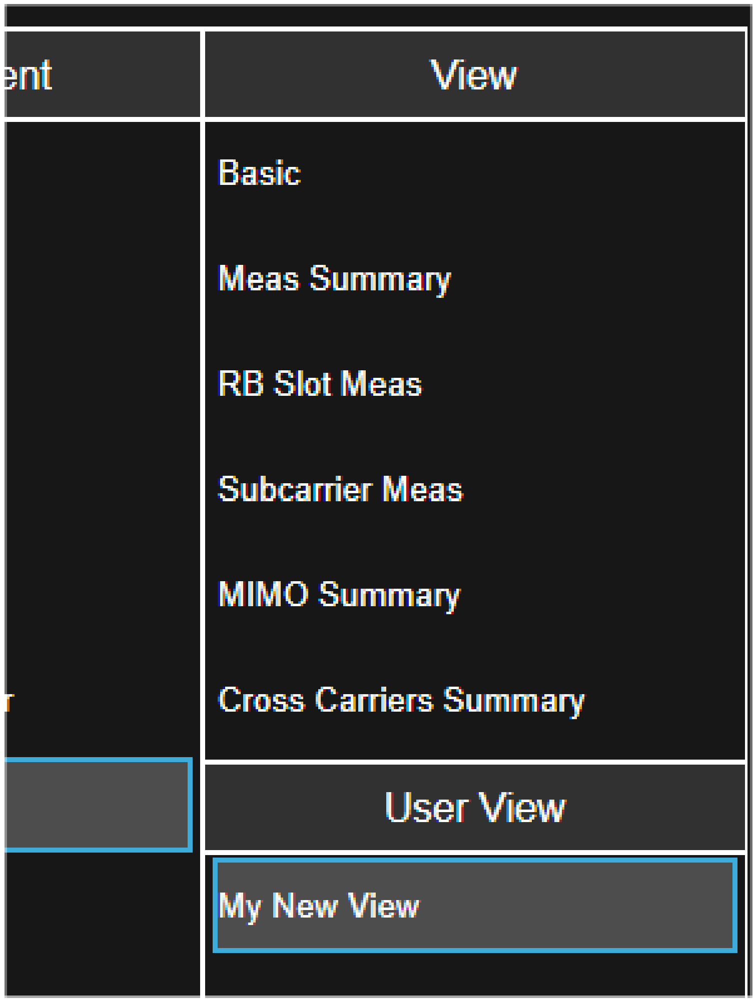


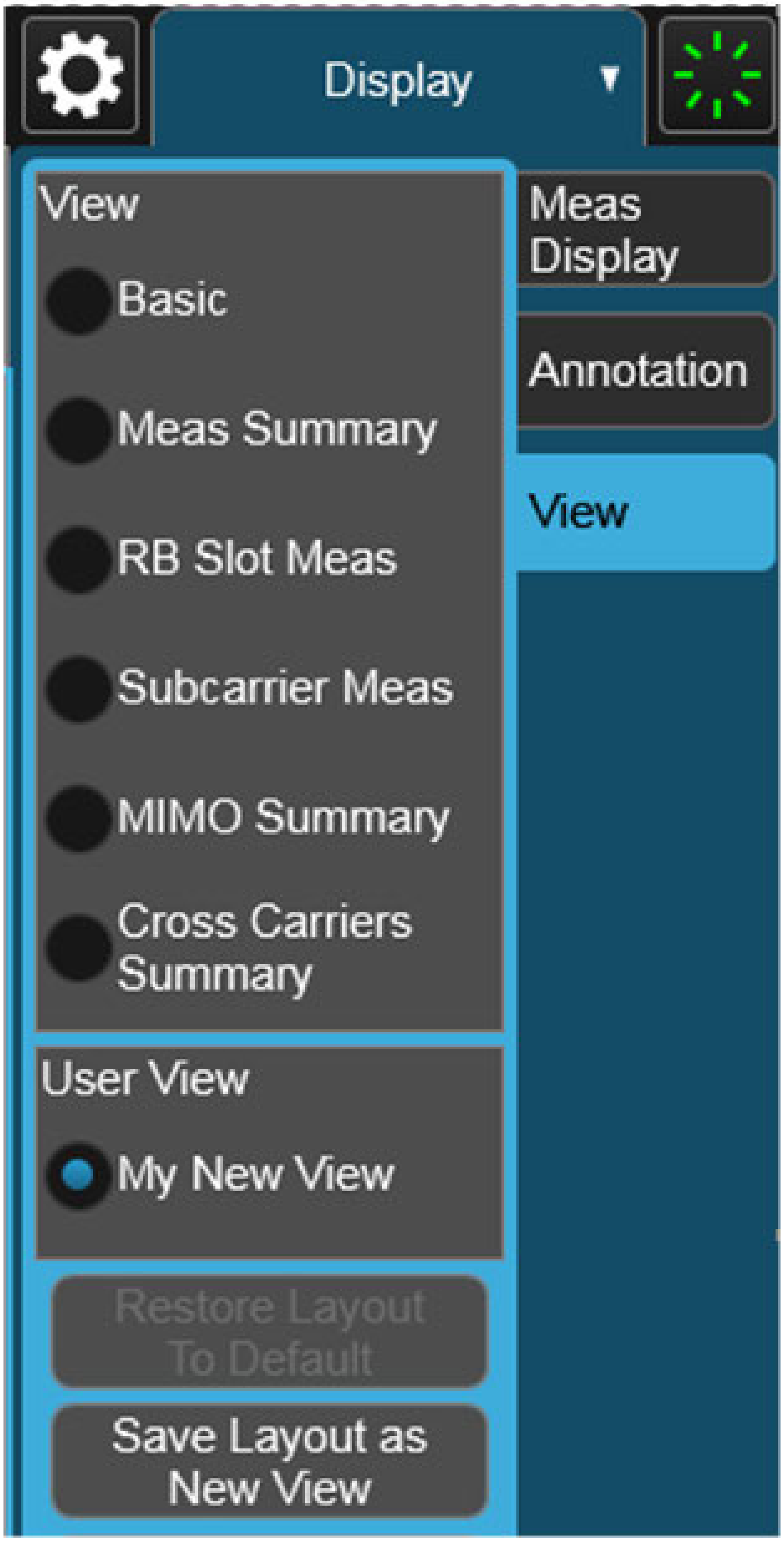
2.17 View Editor

This section describes the use of the View Editor, which allows you to:

- Add windows to and delete windows from the current measurement
- Resize and rearrange windows
- Create User Views

User Views are custom Views that you create by adding, deleting, rearranging, resizing, or changing the contents of the windows in an existing View, and then saving the edited View as a new View. The instrument lists the current User Views for a measurement after the Predefined Views, in the Mode/Meas dialog and on the View menu panel under Display:


View
Basic
Meas Summary
RB Slot Meas
Subcarrier Meas
MIMO Summary
Cross Carriers Summary
User View
My New View

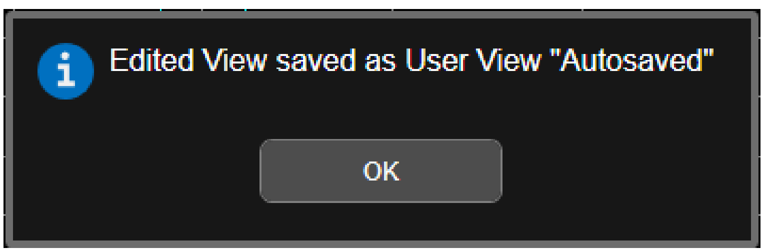

Display
View
Basic
Meas Summary
RB Slot Meas
Subcarrier Meas
MIMO Summary
Cross Carriers Summary
User View
My New View
Restore Layout To Default
Save Layout as New View
Meas Display
Annotation
View

You can save an edited View using the **Save Layout as New View** control in the View menu (see "To Save a User View" on page 166).

On occasion, the instrument may automatically save an edited View for you. If you have edited a View, so that the * is displaying next to the View name, you must save that View as a User View before you save State or switch measurements. If you forget that you have made changes to a View, then to keep from losing your edited View when you switch measurements, the instrument will save it for you. If you have an edited View that has not been saved and you try to do any of the following:

- Enter the “Save” menu
- Switch Measurements
- Switch Modes
- Switch Screens

the edited view will be saved for you with the name “Autosaved”. When this happens, you will receive the following message:



If an Autosaved User View already exists, the User View called “Autosaved” will be overwritten with the currently edited view. If you have multiple edited views, the selected edited view will be Autosaved. If there is not an edited view selected the last selected edited view will be Autosaved.

To Open the View Editor

Pressing the View Editor button (shown above) in the "Control Bar" on page 135, at the bottom right of the screen, opens the View Editor.

While in the View Editor, the icon is blue colored, as:

Pressing the View Editor button again exits the View Editor.

To Close the View Editor

Tap the View Editor button again.

The user chooses the desired View through the use of the Mode/Meas/View dialog (see "Mode/Meas/View Dialog" on page 86) or the View menu (a tab under the **Display** key). The View menu allows the user to browse the views in the current measurement. The View menu contains a list of Predefined Views for you to use. If you wish to modify a Predefined View or create your own, new View, you use the View Editor.

User Views & Predefined Views

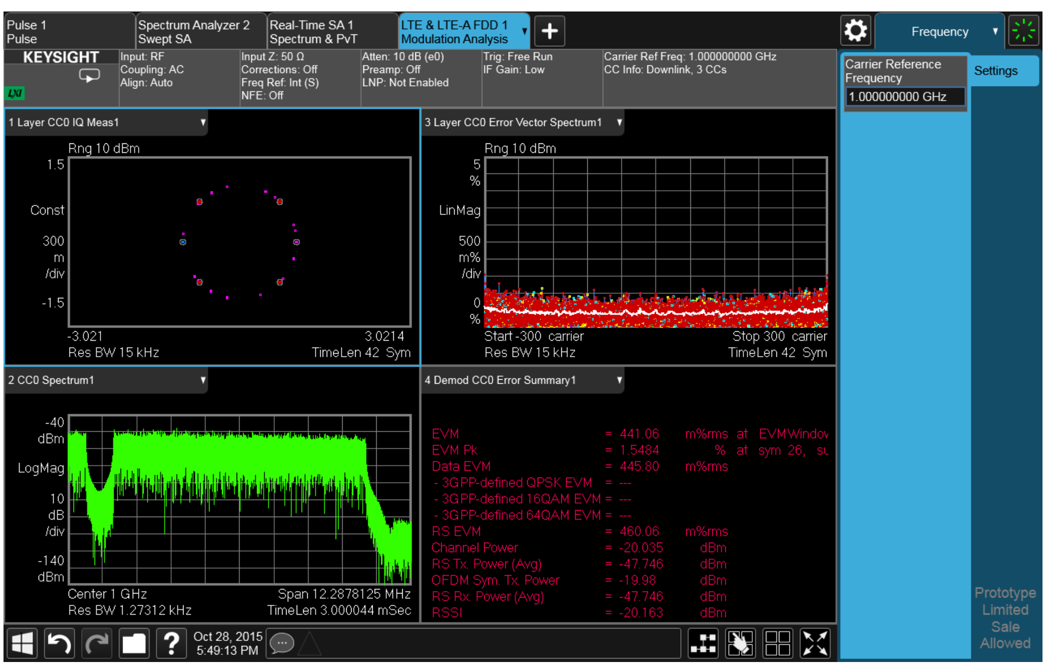
A User View is any View that is not in the list of predefined Views for the current measurement. For example, the Swept SA measurement has four predefined Views: Normal, Spectrogram, Zone Span, and Trace Zoom.

User Views allow you to add, delete, change and rearrange the windows of a predefined View, creating a new custom view.

2.17.1 To Create a User View

Whenever you add or delete a window to/from a predefined View, or change what is being displayed in a Predefined View's window, the Predefined View is marked with an asterisk (*), to show that it has been modified.

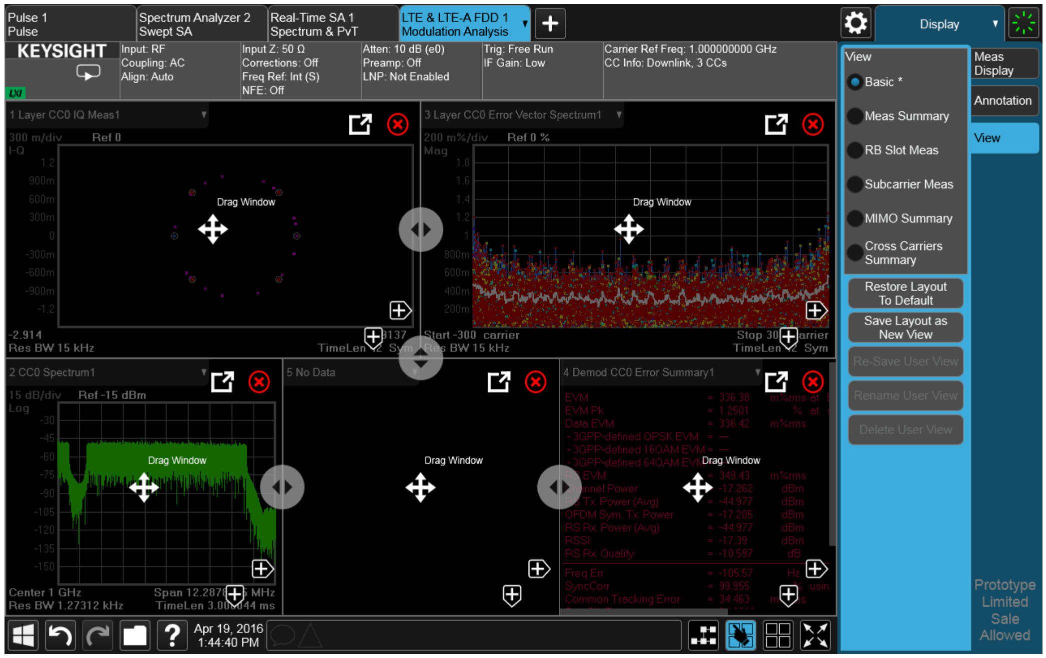
For example, to edit the View shown below, you press the Edit View icon.



When you do this, you get the View Editor screen, which appears as below. The menu panel switches to the View menu. Here we see that we are in the Predefined View called “Basic”.

Each window has two arrows containing + signs. Pressing either of the “+” symbols adds a new window on that side. For example, let’s say you press the + symbol on the right of the lower left window:

You would then see this:



A fifth window has been added, and is automatically assigned the number 5. (The window number, which is displayed in the Window Title region, is used when sending SCPI commands to that window).

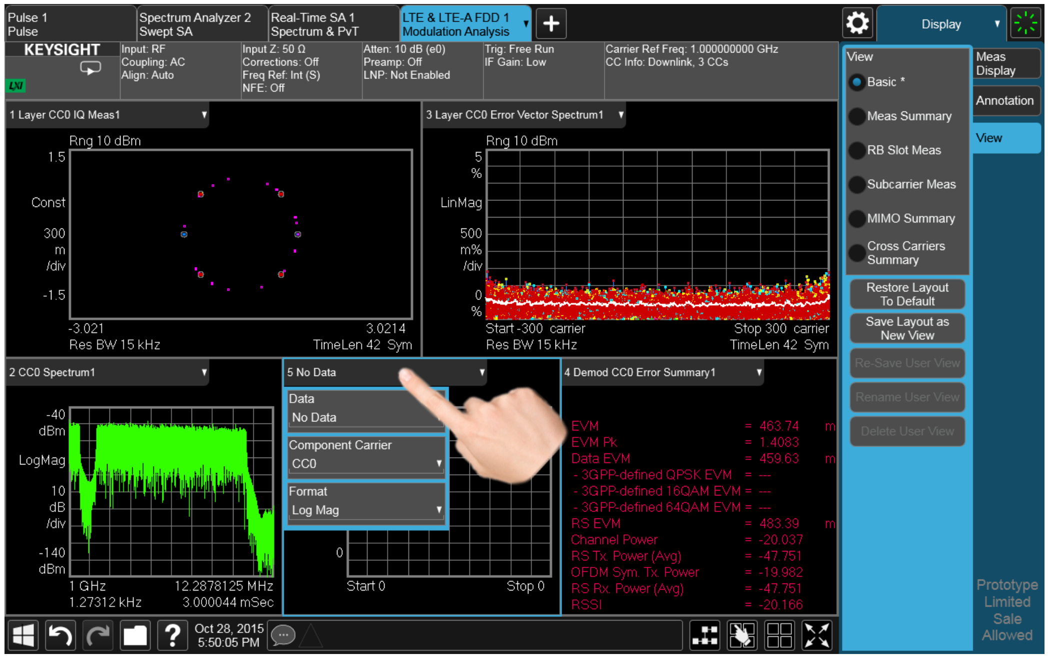
Note the * that now appears next to Basic in the View menu, indicating that you are now in the **modified** Basic View. You see the * if you add, delete or rearrange windows, but simply resizing windows does not display the *. The * means you are in a modified View, which must be saved as a User View before you leave the measurement (if you don't save it, the instrument will save it for you).

Note also that the Restore Layout to Default control is no longer grayed out. If you press this control it restores the Basic View to its default state. Restore Layout to Default becomes available when you add, delete or rearrange windows **and** when you resize them; otherwise it is grayed out.

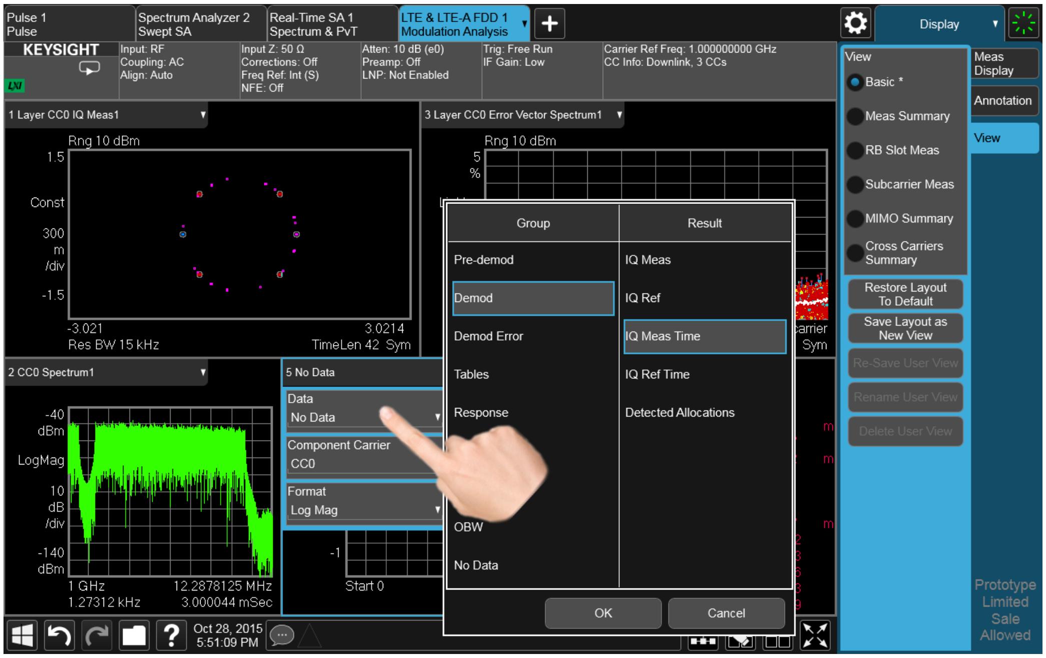
You can add more windows with the "+" arrow symbols. Note that the "+" arrow symbols only appear if the current measurement has more windows available to display. If you are already displaying all the measurement's windows, the "+" symbols disappear.

You can exit the View Editor by again tapping the Edit View icon.

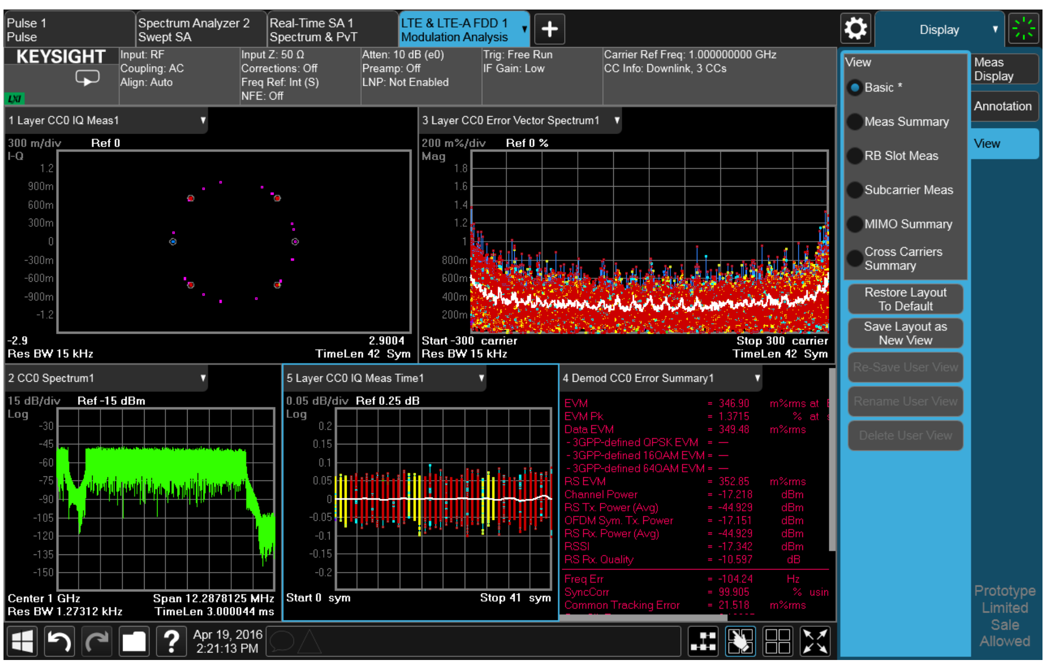
You can specify which result you want to see in the new window by tapping its title region.



A panel drops down, containing a Data control for specifying window results. Some measurements, such as LTE-A in this example, also provide controls on this dropdown for specifying other window parameters, such as the Component Carrier and Data Format, Tap the Data control and you will see a list of available results for the window. In some cases, as in LTE-A, this will be a cascading list, due to the number of results available:



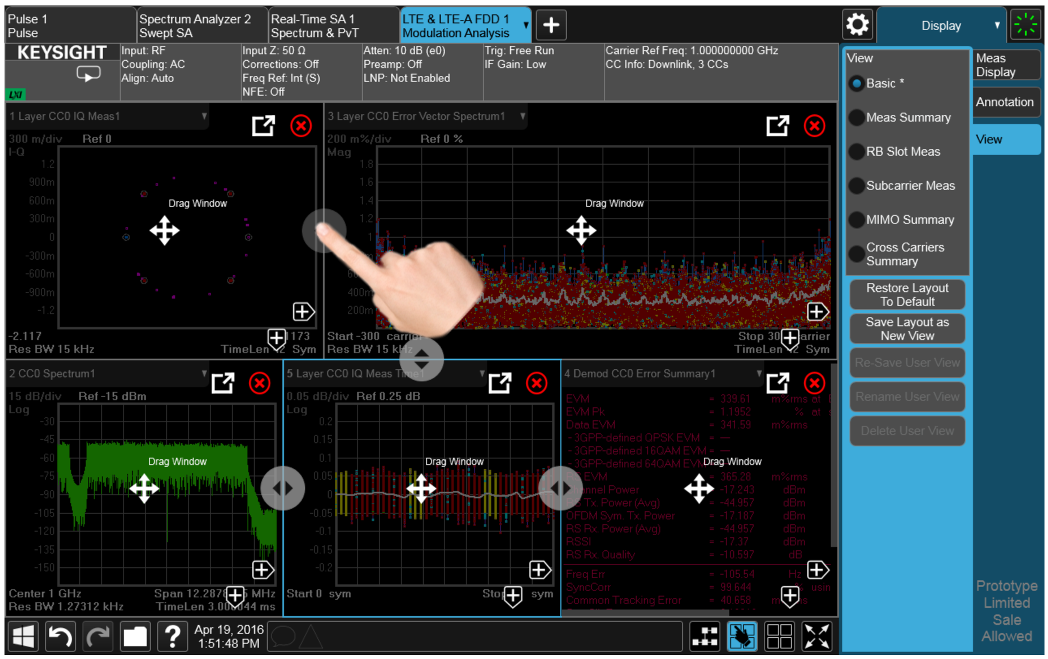
Choose the result you want and tap OK. Here we have chosen IQ Meas Time from the Demod group:



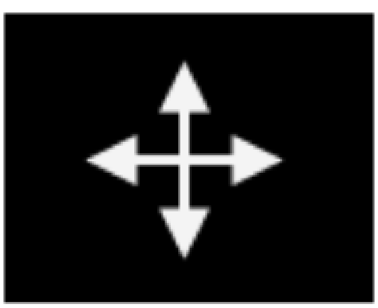
Your new, edited User View is now ready to use.

2.17.2 To Resize or Rearrange Windows in a View

Sometimes you may wish to resize a window. To do this go back into the View Editor and note the large, translucent white circles along the edges of the draggable borders. These are the “resize handles”. You can resize the windows by dragging these handles. Note that in their quiescent state they are slightly translucent; when you touch one it turns solid white, indicating that it is draggable. If you touch and drag one of them it moves the axis to which it is attached.

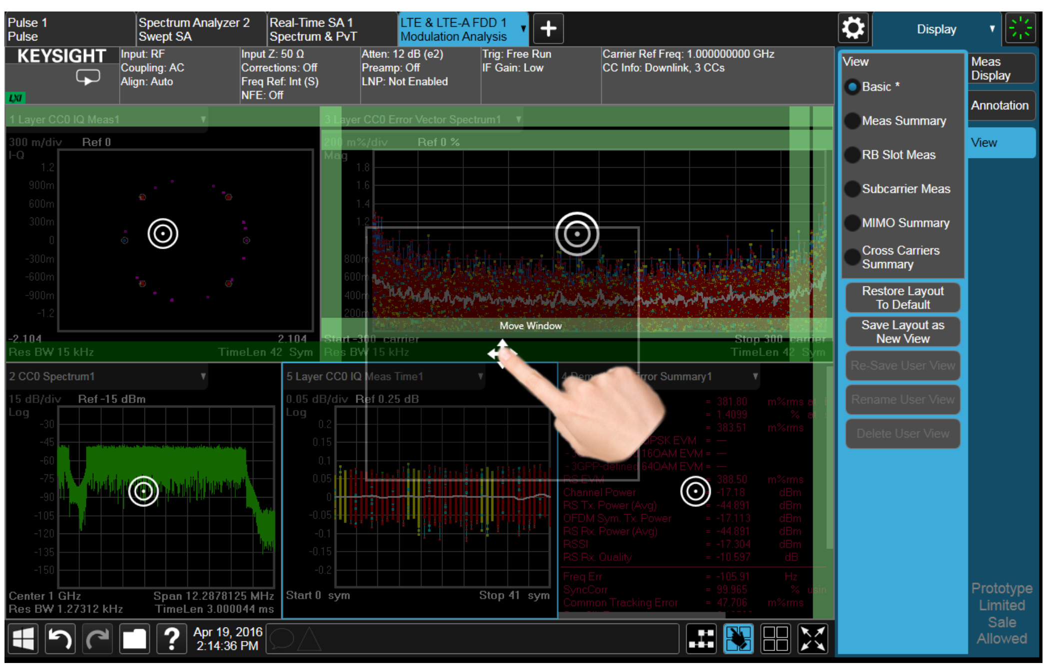


Another feature that comes with the View Editor is the ability to move windows around. You do this by dragging the four-arrow objects in the center of the window; the whole window goes along. Actually you can touch and drag anywhere in the window (except on one of the arrows or the delete circle) and it will drag, but the four-arrow objects give you an indication and a convenient finger target.

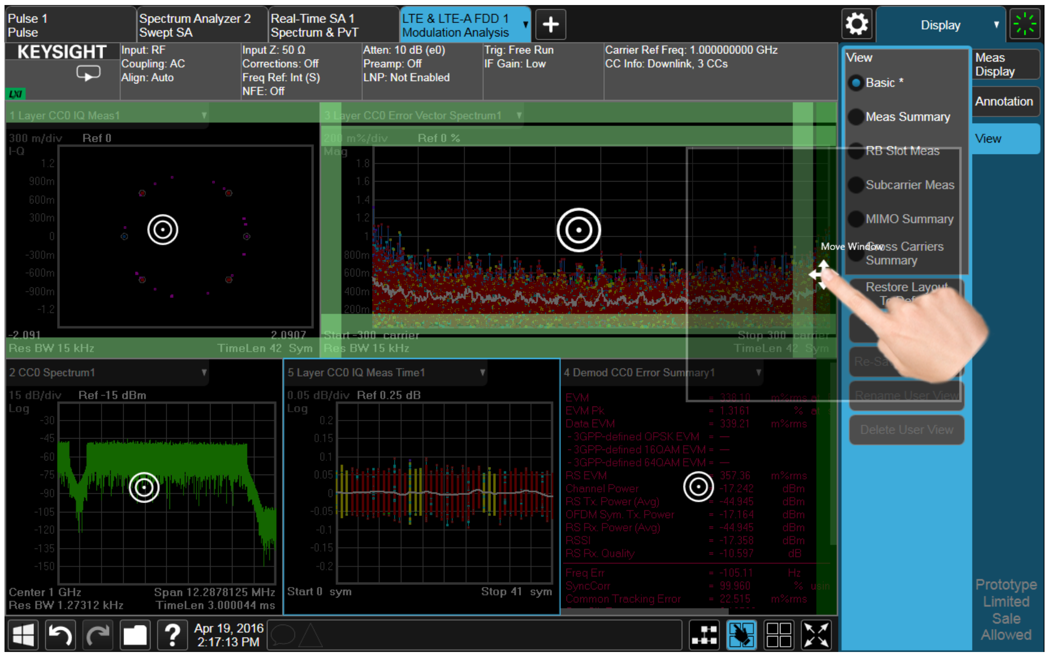


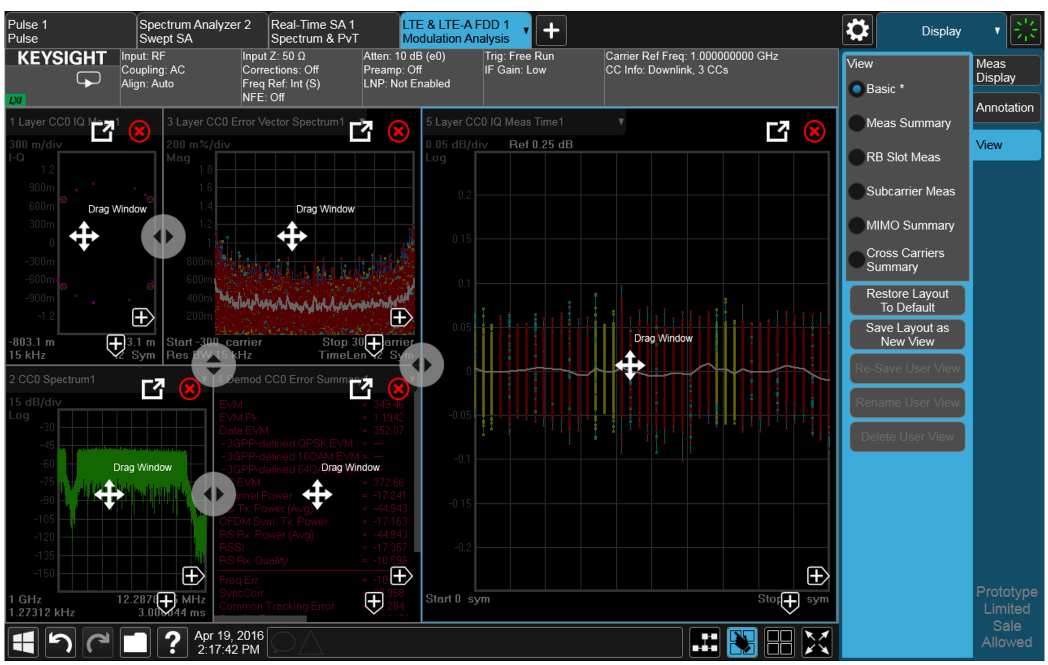
The outline of the window appears as it is being dragged. When you start to drag a window, target symbols appear in the other windows:

If you drop a window on one of the targets, it swaps positions with the target window. If you drag a window's center into another window, green stripes appear on the edges to show you where the window will go when you release it:



When you hover over one of the stripes it gets dimmer, to show the position the window being dragged will take on. If you release a window over an inner stripe, the window you are dragging and the window over which you were hovering resize to share the space the target window originally occupied. If you release a window over an outer stripe, as shown below, the window you are dragging takes on a new position outside the array of other windows:



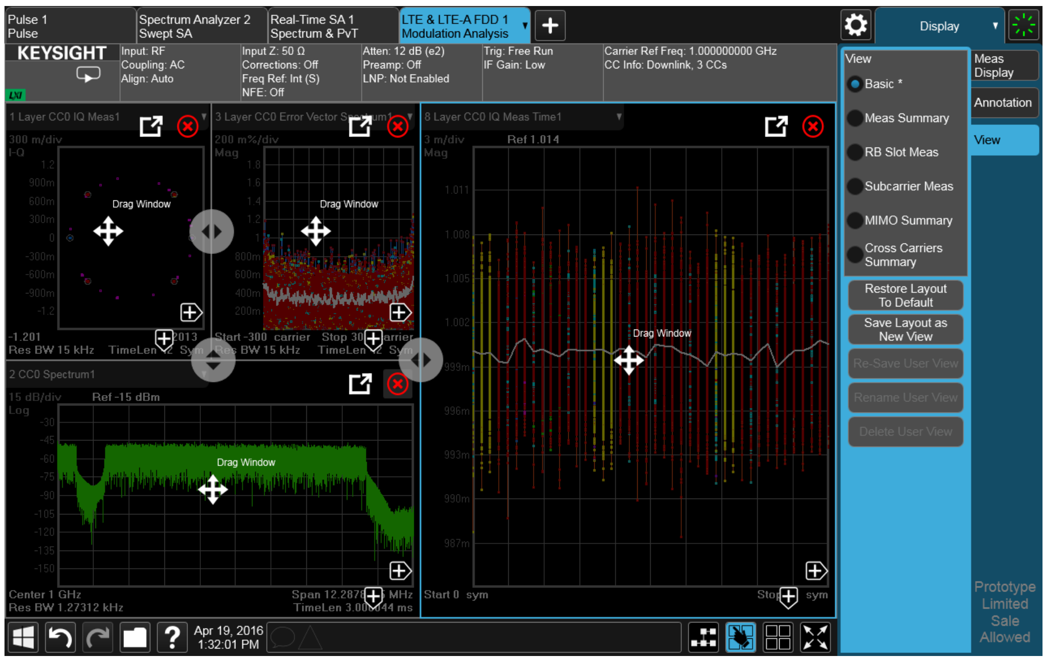


In either case, one or more of the remaining windows resize to occupy the space formerly occupied by the window you were dragging.

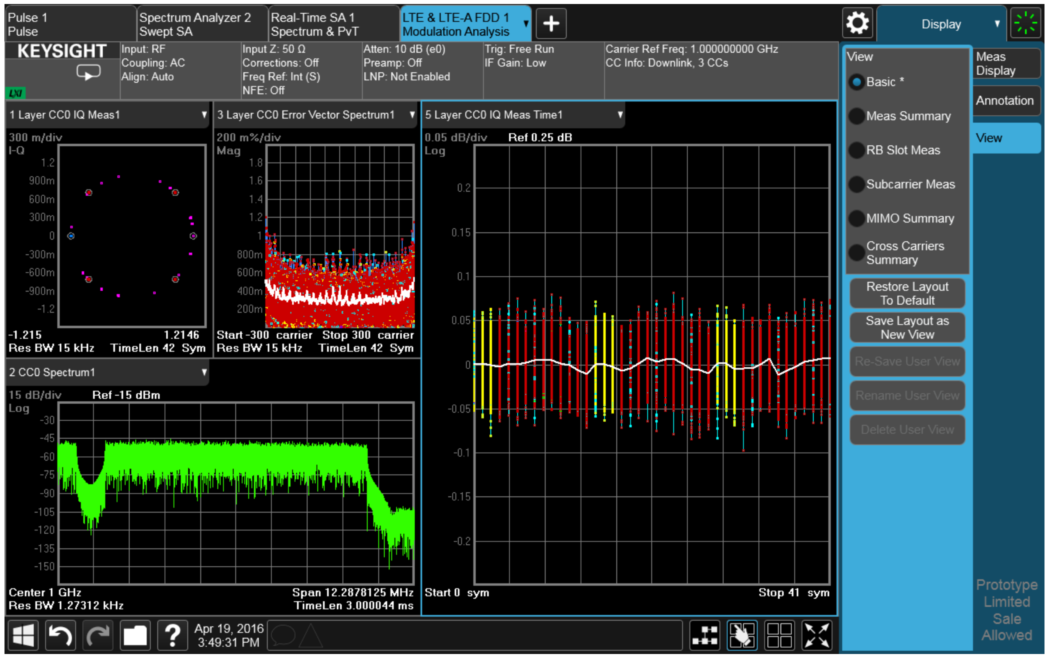
2.17.3 To Delete a Window from a View

The View Editor also lets you delete a window. To do this, tap one of the circled red X's, as shown below.

There has to be more than one window for you to see the circled red Xs.



Now press the View Editor button (the blue hand) to exit the View Editor. At this point, you have an edited Predefined View, as shown by the * next to Basic:



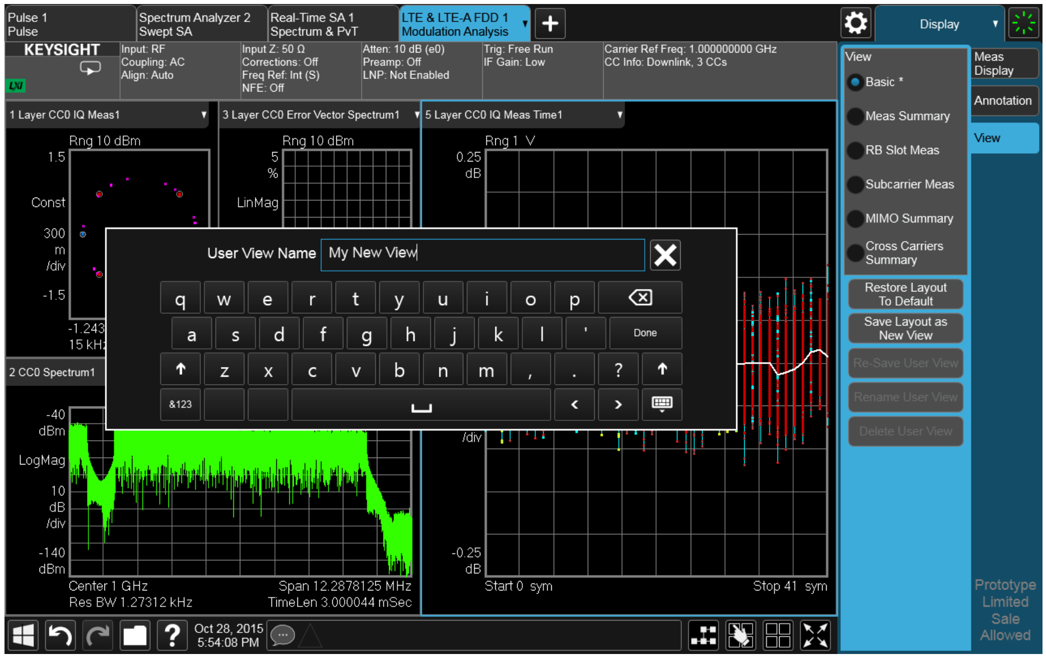
When you are finished with it, you can restore the Layout to the default for Basic by pressing “Restore Layout to Default”. Or you can save your edited View as a “User View” (if you exit the measurement without saving the edited View, the instrument will save it for you as a User View called “Autosaved”).

If you clone the current Screen by pressing the “+” tab, the modified Predefined View will be saved as a User View called “Autosaved”, and it will be available in the new Screen.

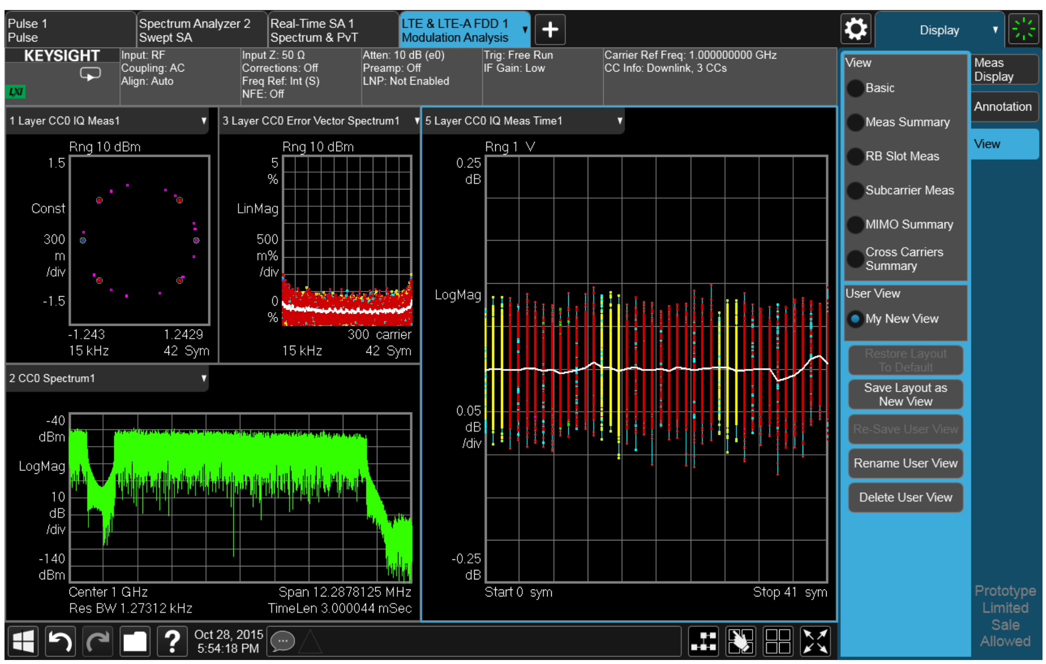
2.17.4 To Save a User View

See also "Transferring User Views Between Instruments" on page 168

To save your new View as a User View, tap the “Save Layout as New View” control. You will get an alpha keyboard that lets you name your new View; the default is the old View name with a number. Below, we have typed in “My New View”:

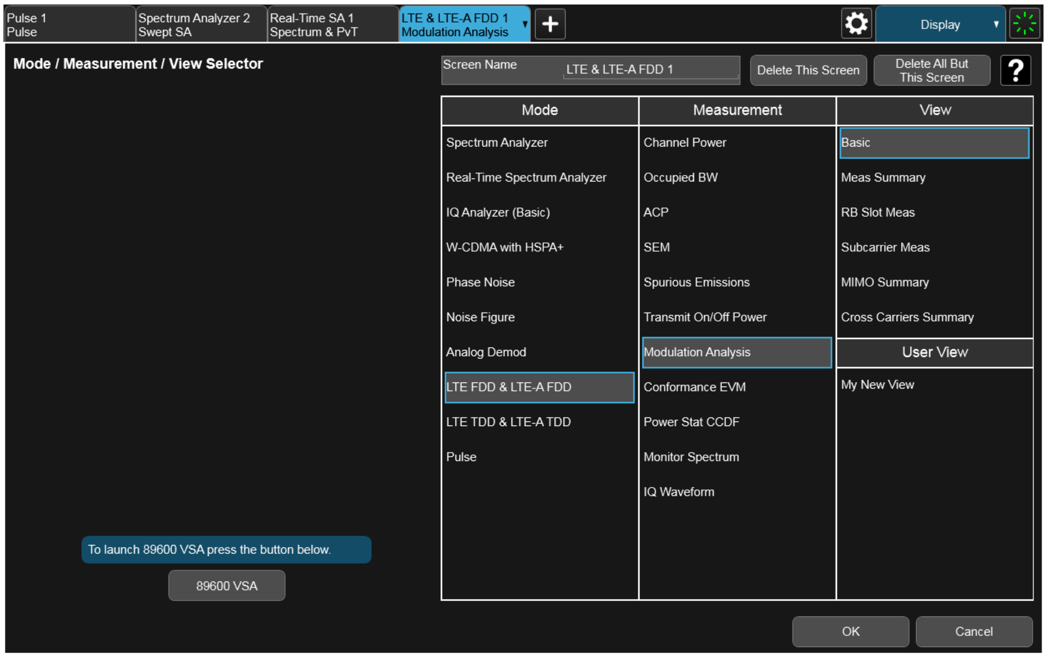


When you tap “Done”, the View is saved:



Notice the User View region which has appeared on the menu panel above, with the new User View called “My New View. Notice also that “Basic” has returned to its original, unedited state and the * is gone from its name. Note also that “Restore

Layout to Default" is grayed out. Note also that if you go to the Mode/Meas dialog, you will see the User View there as well:



When naming a new View, you must choose a name that is not already in use for any User View in any measurement; this is because User Views get written to permanent memory and are available to all instances of the Measurement in any screen. They survive a Mode Preset and also survive shutdown and restart of the application.

Transferring User Views Between Instruments

To transfer a User View to another instrument, you must copy the desired file to a portable drive or to your network and then copy it to the target instrument.

When you save a User View, a file is created (or updated if it already exists) containing all the User Views for the current measurement. All of these files are saved on the D: drive in the instrument, in the folder:

`D:\Users\Instrument\My Documents\UserViews`

(assuming you are logged in as Instrument, which is the default).

Look for the file for your measurement. The file naming convention is:

`ModeName.MeasName.layout`

Where `ModeName` is the long-form SCPI parameter for the `:INST:SEL` command for your Mode, and `MeasName` is the long-form SCPI parameter for the `:CONF` command for your Measurement.

For a full list of all `ModeName` parameters, see **Index to Modes** in "Mode" on page 87.

The following is a full list of all `MeasName` parameters.

Measurement Name	SCPI ID
ACP, Adjacent Channel Power	`ACPower`
AM	`AM`
AM Depth	`AMD`
Amplitude Probability Distribution	`APD`
Audio Distortion	`AUDDist`
Audio Frequency	`AUDFreq`
Audio Level	`AUDLevel`
Audio SINAD	`AUDSinad`
Automatic Direction Finder	`ADF`
Channel Power	`CHPower`
Code Domain	`CDPower`
Combined GSM	`CGSM`
Combined WCDMA	`CWCDma`
Complex Spectrum	`SPECtrum`
Conformance EVM	`CEVM`
Custom OFDM	`OFDM`
Digital Demod	`DDEMod`
Disturbance Analyzer	`DANalyzer`
EDR In-band Spurious Emissions	`IBSPurious`
EVM	`EEVM`
Fast Capture	`FCAPture`
Fast Spectrum	`FSPectrum`
FM	`FM`
FM Deviation	`FMDeviation`
FM Stereo	`FMStereo`
Frequency Counter	`FCOunter`
Frequency Scan	`FSCan`
GMSK Phase & Freq Error	`PFERror`
Group Delay	`GDELay`
Harmonics	`HARMonics`
HRP UWB Demodulation	`HUWB`
Instrument Landing System	`ILS`
IQ Waveform	`WAVeform`
LE In-band Emissions	`IBEMissions`
List Power Step	`LPSTep`

Measurement Name	SCPI ID
List Sequencer	LSEQuencer
List Sweep	LIST
Log Plot	LPLot
LoRa (CSS) Demodulation	LORA
Marker Beacon	MBE
Mod Accuracy	RHO
Modulation Analysis	EVM
Modulation Distortion	MODDist
Modulation Rate	MODRate
Modulation SINAD	MODSinad
Monitor Spectrum	MONitor
Noise Figure	NFIGure
Occupied BW / Output Spectrum BW	OBWidth
Output RF Spectrum	EORFspectr
Phase and Amplitude vs Time	PAVTime
PM	PM
PM Deviation	PMDeviation
Power Amplifier	PAMPlifier
Power Control	PCONtrol
Power Stat CCDF	PSTatistic
Power vs Time	EPVTime
Pulse	PULSe
QPSK EVM	EVMQpsk
Real Time Scan	RTSC
RF Power	RFPower
SEM	SEMask
Spectral Flatness	FLATness
Spectrum & PvT	RTSA
Spot Frequency	SFRequency
Spurious Emissions	SPURious
Streaming	STReaming
Strip Chart	SCHart
Swept SA	SANalyzer
TOI	TOI

Measurement Name	SCPI ID
Transmit Analysis	TX
Transmit On/Off Power	PVTime
Transmit Power (Burst Power)	TXPower
Tuned RF Level	TRFLevel
Tuned RF Level with Tracking	TTRF
Tx Band Spur	ETSPur
VHF Omni-Directional Range	VOR

Examples:

- The User View file for the Swept SA measurement is `SA.SANalyzer.layout`
- The User View file for the ACP measurement in the WCDMA mode is `WCDMA.ACPower.layout`

Copy the desired file to a thumb drive or to your network. Then go to the target instrument and copy the file into the `D:\Users\Instrument\My Documents\UserViews` directory on that instrument (again, assuming you are logged in as Instrument).

Note that copying this file to another instrument will overwrite the file already in that instrument, if any, and will destroy any User Views that might have been created on that instrument.

Note that when you delete the last User View for a measurement, the file is removed.

2.17.5 To Rename a User View

You can rename a User View by selecting that View and tapping “Rename User View.” You can also re-edit a User View; if you do this, an asterisk will appear next to the User View’s name. You can then tap “Re-Save User View to save it back to its existing name, or “Save Layout as New View” to add another, new User View.

2.17.6 To Delete a User View

You can delete a User View by doing the following:

1. From the "Mode/Meas/View Dialog" on page 86, *or* from the **View** menu, select the User View that you want to delete
2. Switch to the **Display** menu

3. Select the **View** tab

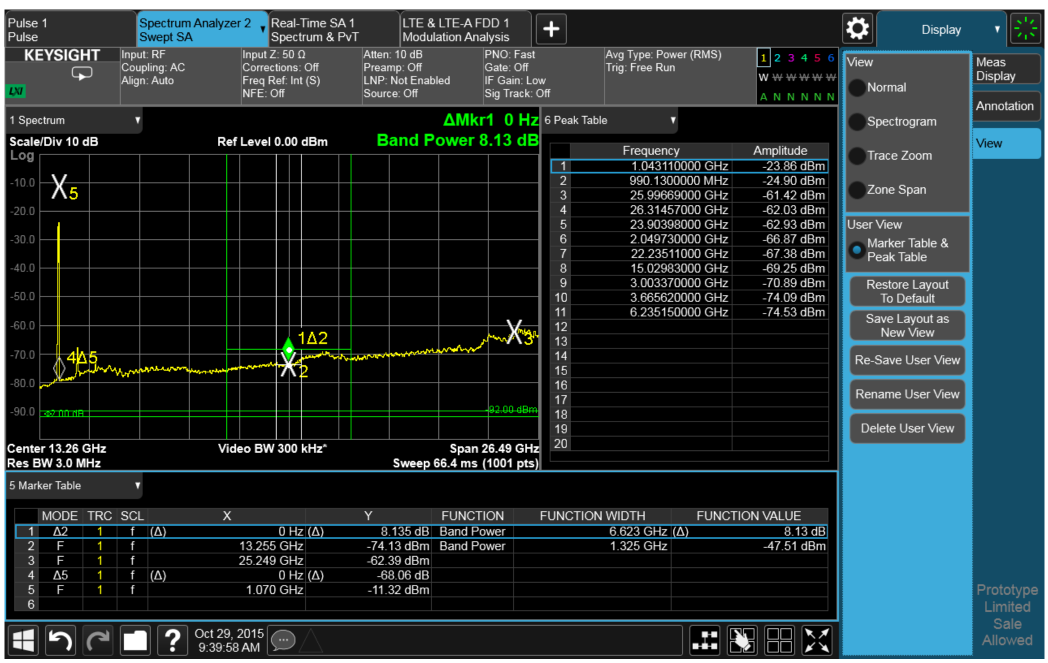
4. Tap **Delete User View**

2.17.7 To Delete All User Views

You can delete all User Views by tapping “Delete All User Views.” The default view becomes the current view for the Measurement if a User View was the current view when this control was pressed.

2.17.8 Use Case: Displaying Marker and Peak Tables

One common application for User Views is to create a View that allows the Spectrum Analyzer to display both a Marker Table and a Peak Table at the same time. To do this, simply add a Marker Table Window and a Peak Table window to the Spectrum window of the Swept SA measurement. The result is shown below; note that the new View has been named “Marker Table & Peak Table”:



NOTE: There are legacy displays like Marker Table, Peak Table, Measure at Marker and Gate View, which are not Views but special display modes. These are retained for backwards compatibility, however they are turned on and off with switches and do not use the View system. Turning on one of these switches does not create a modified View, it merely adds the specified window to the current View; turning the switch back off removes the window. While the switch is on, NO View shows as selected in the View menu. These switches are grayed out if you are in a modified View or a User View. Since only one of these switches can be on at a time, and because these switches turn off on a Preset, User Views offer a superior way of adding windows than using the switches.

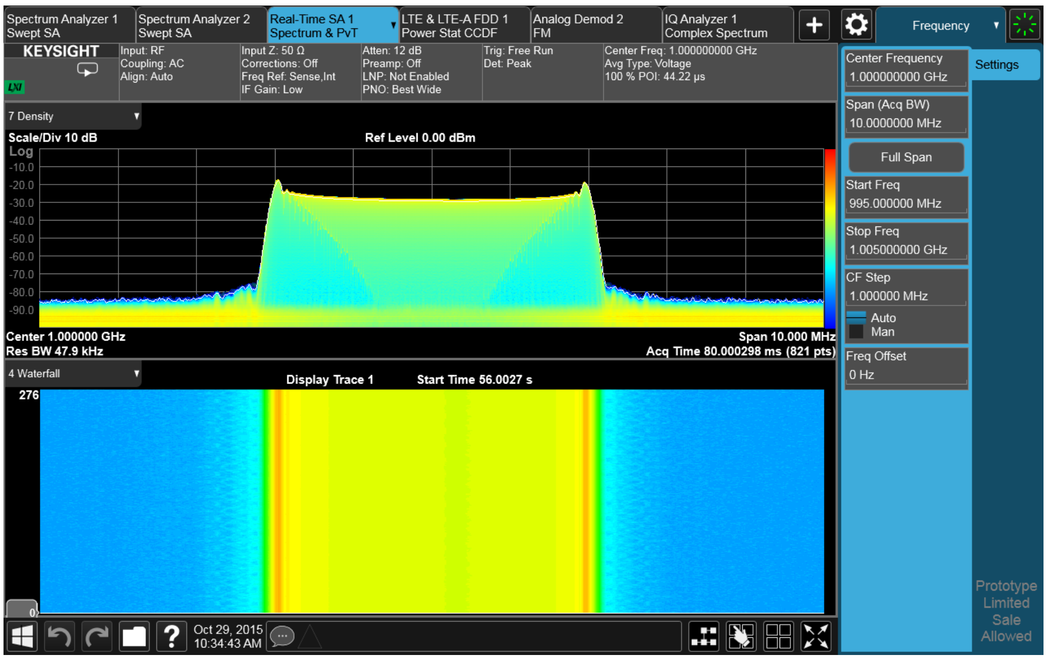
Some measurements do not support User Views; these do not allow adding, deleting or rearranging windows, however they do allow resizing windows. In these measurements you can get into the View Editor but the Add icons, Delete icons and Move icons will not appear. You can still resize the windows and in some cases (e.g. Noise Figure) you can still change window contents.

2.17.9 View Editor Remote Commands

Remote Commands for User Views can be found in the documentation for the **Display, View** tab.

2.18 Multiscreen

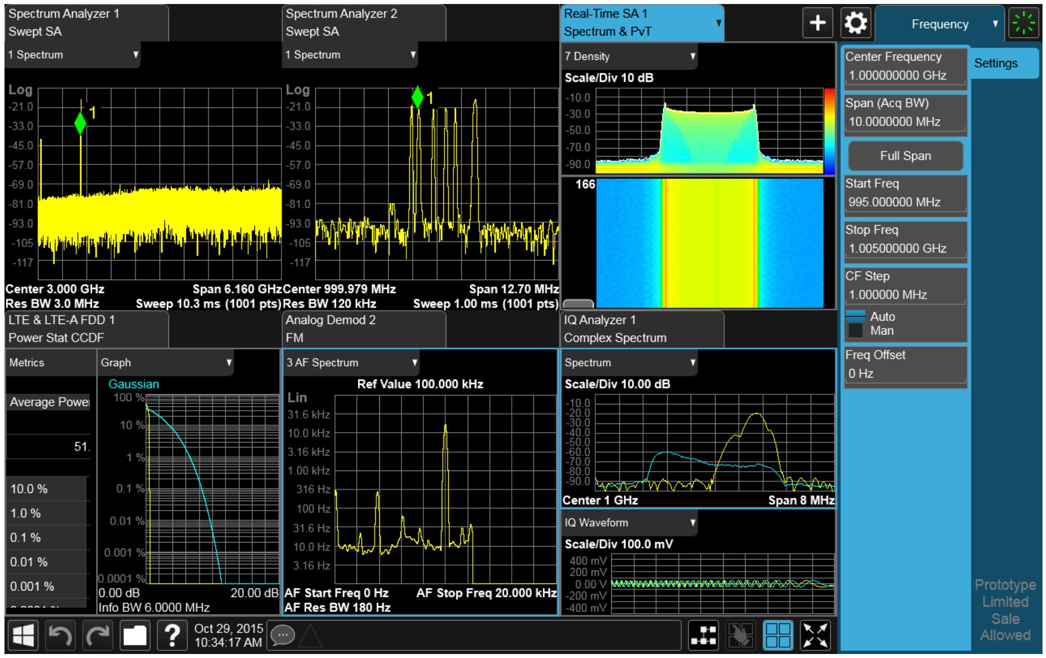
You can configure up to 16 different Screens at a time. Normally, you only see one Screen, and the set of configured screens is shown across the top of the display in a series of "Screen Tabs" on page 85. Touching any screen’s tab brings it to the foreground, makes it the current Screen and starts it updating.



Multiscreen view lets you display all of the configured Screens at once.

You can switch to Multiscreen View by pressing this button in the "Control Bar" on page 135 at the bottom right of the screen:

Multiscreen View looks like this:



While in Multiscreen View, the button changes from a black background to a blue background:

To exit Multiscreen view, tap the button again.

Multiscreen View cannot be activated if only one screen is configured.

Each Screen contains one Mode, each Mode contains one Measurement, and each Measurement contains a number of Windows arranged in Views. You can configure multiple instances of the same Mode along with any combination of other Modes.

In Multiscreen View, just as in Single Screen View, only one screen is active.

You switch Screens by tapping the Screen Tab you want, or when in Multiscreen View, you can tap the Screen itself. When you switch Screens, the current Screen’s state and measurement results are preserved, the new Screen’s previous state and data are loaded, and the new Screen starts running its Mode.

In Multiscreen View:

- The Meas Bar does not display
- The Screens are presented in an array of equal size boxes, except where the number of Screens means some have to be different sizes (as when you have 3 Screens, 5 Screens, etc.).

- Each Screen has a tab that contains the name of the Mode and Measurement in the box and a number associated with the instance of that Mode. You can enter a custom Screen name that replaces the Mode name, by going into the Mode/Meas dialog
- There is always one and only one selected Screen. It is indicated by a blue tab. Only the selected Screen is actually running a measurement and updating its display
- The selected window in the selected screen is the context for the current menus. It is the only window on the display with a blue border
- As you go from screen to screen, each screen remembers the last menu that was active in that screen and restores it as the active menu

In Multiscreen View, as in Single Screen View, tapping the blue tab or pressing the Mode/Meas front panel key opens the "Mode/Meas/View Dialog" on page 86 which allows you to change the Mode (or Measurement or View) being displayed in that Screen.

Remote Command	`:INSTrument:SCReen:MULTiple[:STATe] OFF | ON | 0 | 1` `:INSTrument:SCReen:MULTiple?`
Example	`:INST:SCR:MULT ON`
Notes	If only one screen is configured, attempting to set Multi-Screen ON generates the error “-221, Settings conflict; Multi-Screen requires >1 screen”
Preset	OFF

For more information, see the following:

- "Select Screen" on page 176
- "Screen List (Remote only command)" on page 177

2.18.1 Select Screen

You can select a screen by touching its tab or, in "Multiscreen" on page 174 mode, touching the screen itself. Selecting the Screen activates the screen and suspends the previously selected screen (if any).

Remote Command	`:INSTrument:SCReen:SELect <screen name>` `:INSTrument:SCReen:SELect?`
Example	`:INST:SCR:SEL “Baseband”`
Notes	If the <screen name> is specified but not found in the list of Screens, the error message “-224, Illegal parameter value; Screen Name not found” is generated If the display is disabled (via `:DISP:ENAB OFF`) then the error message “-221, Settings conflict; Screen SCPI cannot be used when Display is disabled” is generated

Preset	Returns the name of the active screen

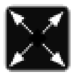
2.18.2 Screen List (Remote only command)

You can obtain a list of currently configured Screens. This permits your remote program to manage screens for selection, renaming, or deletion.

Remote Command	`:INSTrument:SCReen:CATalog?`
Example	`:INST:SCR:CAT?`
Notes	The query response is a comma separated list of Screen Names. If only 1 Screen is configured, there is no trailing comma For R&S compatibility, the following query is also available: `:INSTrument:SCReen:LIST?`
Preset	Returns list of currently configured Screens

2.19 Fullscreen

The Fullscreen button is in the "Control Bar" on page 135, at the lower right corner of the display.



When **Full Screen** is pressed the measurement window expands horizontally over the entire instrument display. The screen graticule area expands to fill the available display area.

It turns off the display of the menu panel, however the controls that drop down from the Meas Bar and on-screen annotation are still available, and you can still drag the trace and markers and perform a pinch zoom, so you can still operate the instrument.

Pressing **Full Screen** again while Full Screen is in effect cancels Full Screen.

You can get even more screen area for your data display by turning off the Meas Bar using the Annotation tab of the Display menu)

Full Screen is canceled by the **Preset** key.

Remote Command	`:DISPlay:FSCReen[:STATe] OFF | ON | 0 | 1` `:DISPlay:FSCReen[:STATe]?`
Notes	This was set to Off by :SYST:DEF MISC in MXA1, but not by Preset. It is no longer set Off by :SYST:DEF MISC, since it is now meas global instead of mode global
Preset	Unaffected by Preset but set to Off by Restore Misc Defaults or shutdown and restart
State Saved	Not saved in instrument state
Backwards Compatibility SCPI	`:DISPlay:MENU[:STATe] OFF | ON | 0 | 1` This emulates ESA full screen functionality, which is the same as the FSCReen command in PSA except that the sense of on/off is reversed (that is, OFF means the menus are OFF, so Fullscreen is ON) and the default is ON (meaning Fullscreen is OFF)
Backwards Compatibility Notes	In ESA/PSA, Full Screen was turned on with a softkey, so pressing any other key turned Full Screen off. In the X-Series, because a hardkey is provided to turn this function on and off, pressing any other key no longer turns off Full Screen

3 Spectrum Analyzer Mode

Spectrum Analyzer Mode is used for general purpose measurements. It consists of the Swept SA measurement, plus a set of measurements that are collectively referred to as the *PowerSuite*.

Swept SA Measurement

Measurement	SCPI ID	Notes
Swept SA	SANalyzer	Basic spectrum analysis measurement in swept and zero span (as well as "Swept FFT")

PowerSuite Measurements

Measurement	SCPI ID	Notes
Channel Power	CHPower	Used in this and other modes to make specific power measurements
Occupied Bandwidth	OBWidth	
Adjacent Channel Power	ACPower	
Power Stat CCDF	PStatistic	
Burst Power	BPOWer	
Spurious Emissions	SPURious	
Spectrum Emissions Mask	SEMask	
Phase and Amplitude vs Time	PAVTime	
TOI	TOI	Signal quality measurements
Harmonics	HARMonics	
List Sweep	LIST	Programs a list of frequency points to rapidly move between

To access the built-in help for this Mode, it must be the currently-active Mode. If it is not, exit help (**Esc** key), select this Mode, then reopen help.

Example	`:INST:SEL SA` `:INST:NSEL 1`
Dependencies	The Mode must be installed and licensed in your instrument before it is available for use The Swept SA measurement is available in this Mode if you have licenses N9060EM1E or N9060ES1E installed in your instrument

	Measurements in this Mode other than Swept SA are available only if you have licenses N9060EM1E, or N9060ES1E and N90EMPSMB, installed in your instrument
Status Bits/OPC dependencies	Changing Modes resets all SCPI status registers and mask registers to their power-on defaults. Therefore, event or condition register masks must be re-established after a Mode change

3.1 Measurement Commands

Commands for selecting each measurement are listed below. Commands relating to Views and Windows for each measurement are described in the documentation for that measurement.

Example	Having selected SA Mode, you can select the measurement using the following commands:
	Swept SA: `:CONFigure:SANalyzer`
	Channel Power: `:CONFigure:CHPower`
	Occupied Bandwidth: `:CONFigure:OBWidth`
	Adjacent Channel Power: `:CONFigure:ACPower`
	CCDF: `:CONFigure:PSTatistic`
	Burst Power: `:CONFigure:BPOWer`
	Spurious Emissions: `:CONFigure:SPURious`
	Spectrum Emissions Mask: `:CONFigure:SEMask`
	TOI: `:CONFigure:TOI`
	Harmonics: `:CONFigure:HARMonics`
	List Sweep: `:CONFigure:LIST`
	Phase and Amplitude vs Time: `:CONFigure:PAVTime`
	Query the currently-selected measurement: `:CONFigure?`
Preset	`SANalyzer`
State Saved	Instrument State

3.2 Swept SA Measurement

The Swept SA measurement lets you perform “traditional” Spectrum Analysis, that is, Swept and Zero Span measurements, as well as “Swept FFT” analysis (FFT analysis presented as though it were swept).

Swept Spectrum Analysis (Freq Domain)

The instrument sweeps the LO to generate a heterodyned IF signal that can be detected to analyze the signal content of a range of frequencies. The x-axis of the display is frequency, the Y Axis is amplitude.

Swept FFT Analysis (Freq Domain)

In some cases, there is an advantage to not actually sweeping the LO, but instead analyzing the signal by taking a time record and performing FFT analysis. This is what is done in swept FFT analysis, but the data is still presented as though it were a sweeping spectrum analyzer. The x-axis of the display is frequency, the Y Axis is amplitude.

Zero Span Analysis (Time Domain)

In Zero Span analysis, the instrument stops sweeping the LO, placing it at the center frequency, and then takes time data from the detector while stopped at that frequency. Because the LO is not moving, the frequency span is zero. The time data is presented left to right across the screen just like on an oscilloscope. The x-axis of the display is time, and the Y Axis is amplitude.

All of the tools such as markers, peak tables, limit lines, trace math, N dB points, and marker functions are available in Zero Span measurement analysis, although some work differently in the time and frequency domains. See the Span control description under the Freq front panel key for detail on the user interface differences between Swept analysis and Zero Span analysis.

Swept SA Measurement Commands

The general functionality of "CONFigure" on page 2732, "INITiate" on page 2733, "FETCh" on page 2733, "MEASure" on page 2735, and "READ" on page 2734 are described in the section **SCPI Operation and Results Query** in the topic **Programming the Instrument**.

Note that, in general, `:CONF:<Measurement>` resets the specified measurement settings to their defaults. X-Series permits the addition of the `NDEFault` node to the command, which prevents a measurement preset after a measurement switch.

The tables below list measurement commands for this measurement.

Command	Function
`:INITiate:SANalyzer`	Initiates a trigger cycle for the `SAN` measurement, but does not return any data. You must then use `:FETC:SAN[n]?` to retrieve data Does not change any measurement settings
`:CONFigure?`	Returns the long form name of current measurement, in this case, `SANalyzer`
`:CONFigure:SANalyzer`	Selects `SAN` measurement with Meas Setup settings in preset state – same as Meas Preset
`:CONFigure:SANalyzer:NDEFault`	Selects `SAN` measurement *without* affecting settings

The following queries are used to retrieve data. The type of data returned depends on the value of `n`.

Command	Function
`:FETCh:SANalyzer[n]?`	Retrieves the data defined by n
`:MEASure:SANalyzer[n]?`	Switches to `SAN` measurement, restores default values, starts the measurement, then retrieves the data defined by n
`:READ:SANalyzer[n]?`	Starts the measurement, then retrieves the data defined by n

For the measurement data queries `:FETCh`, `:MEASure` and `:READ`, the data returned depends on `n` as follows. Note that the marker values are x, y pairs.

n	Data Returned	
0	Returns the following comma-separated results:	
	1	1 if there is any margin or limit failure, otherwise 0
	2	0 (future)
	3	0 (future)
	4	0 (future)
	5	N dB points result (not a number if off)
	6	Terminal average count (the Average Number as set in the UI)
	7	Number of points in the sweep
	8	0 (future)
	9	0 (future)
	10	0 (future)
	11	Marker 1 value (y)

n	Data Returned	
	12	Marker 2 value (y)
	13	Marker 3 value (y)
	14	Marker 4 value (y)
	15	Marker 5 value (y)
	16	Marker 6 value (y)
	17	Marker 7 value (y)
	18	Marker 8 value (y)
	19	Marker 9 value (y)
	20	Marker 10 value (y)
	21	Marker 11 value (y)
	22	Marker 12 value (y)
Not specified, or 1	Returns Trace 1 data as a list of x,y pairs. The y-values are in the current Y Axis Unit of the instrument. The x-axis values are the values of the trace, in the x-axis scale units of the trace (Hz for frequency domain traces, seconds for time domain traces) When querying trace data, it is best if the instrument is not sweeping during the query. Therefore, select **Single Sweep, or Update**=`OFF` when querying trace data from the instrument	
2	Returns Trace 2 data as a series of x,y pairs	
3	Returns Trace 3 data as a series of x,y pairs	
4	Returns Trace 4 data as a series of x,y pairs	
5	Returns Trace 5 data as a series of x,y pairs	
6	Returns Trace 6 data as a series of x,y pairs	
7	Returns Peak Table data as a series of x,y pairs. If the Delta to Limit column is on it returns it as a series of x,y,delta triplets. If a cell is showing `---` it is returned as NaN. The data is returned in the current sort order as displayed in the Peak Table If a query of Peak Table results is requested and the Peak Table is not on, an error event is generated, “Settings Conflict; Pk Table must be on to query Pk Table results”	
8	Returns Marker Table data as a series of comma separated values. The marker table returns comma separated values in the following form: `<Marker Number>,<Marker Trace>,<X>,<Y>,<Marker Function Width>,<Marker Function Value>` Only markers that are enabled are included. If the Marker function is `OFF`, then Marker Width and Marker Function Value are returned as NaN (“Not a Number”, 9.91e+37). The data is returned in the current sort order as displayed in the Marker Table If a Marker Table results query is requested and the Marker Table is not on, an error event is generated, “Settings Conflict; Mkr Table must be on to query Mkr Table results”	
9	Returns Spectrogram data as a series of comma separated values. The spectrogram table returns comma separated values in the following form: `<Slice 0>,<Time of Slice 0>,<Slice 0 X[0]>,<Slice 0 Y[0]>, <Slice 0 X [1]>,<Slice 0 Y[1]>,…, <Slice 0 X[N]>,<Slice 0 Y[N]>,<Slice 1>,<Time of Slice`	

n	Data Returned
	`1>,…` This matches the data format of a saved Spectrogram Meas Results file If a Spectrogram results query is requested and the Spectrogram is not on, an error event is generated, "Settings Conflict; Spectrogram must be on to query Spectrogram results"
10 & above	Future use

Data Query (Backwards Compatibility)

Notes	Returns the same data as `:FETCh:SANalyzer[n]?`. As with `:FETCh`, if `n` is not sent, assumes `n` = 1, and returns the Trace 1 data Uses the data setting specified by the `:FORMat:BORDer` and `:FORMat:DATA` commands and can return real or ASCII data. (See command descriptions: "Format Data: Numeric Data (Remote Command Only)" on page 2739and "Format Data: Byte Order (Remote Command Only)" on page 2740)
Backwards Compatibility SCPI	`:CALCulate:DATA[1]|2|…|9?`

3.2.1 Views

The Swept SA measurement has four predefined views:

- "Normal" on page 186
- "Spectrogram" on page 186
- "Trace Zoom" on page 186
- "Zone Span" on page 187

Some are multiple-window views. When in a multiple-window view, you select a window by touching it. The menu controls may sometimes change depending on which window is selected.

Whenever the View changes, the default menu is **Frequency**, unless otherwise specified in the View description.

Remote Command	`:DISPlay:VIEW[:SELect] NORMal | TZOom | SPECtrogram | ZSPan`
Example	Set **Zone Span** view: `:DISP:VIEW ZSP`
Dependencies	All views except `NORMal` require option EDP to be licensed. If the SCPI is sent to select any other View and EDP is not licensed, an error is generated
Preset	`NORMal`
State Saved	Saved in instrument state

3.2.1.1 Normal

Windows: "Spectrum" on page 188

Single window view of the frequency domain or zero span. This is the classic SA view. This is also the view into which the instrument switches whenever you do anything that causes the frequency limits to change, for example:

– If you switch inputs (for example, if you switch from the RF Input to External Mixing)

– If, while in External Mixing, you edit the Harmonic Table

– If, while in External Mixing, the Mixer Preset changes (for example, if you change from A-band to V-band etc.)

Example	`:DISP:VIEW NORM`

3.2.1.2 Spectrogram

Windows: "Spectrum" on page 188, "Waterfall" on page 192

Provides a quick look at a history of 1000 traces. In **Spectrogram** View, the display opens a second window (the **Waterfall** window), in which trace history is displayed, below the main Swept SA display window (the **Spectrum** window). Each horizontal line in the spectrogram display represents one historical trace. The data streams upwards from newest to oldest; the latest trace displays on the bottom and the oldest trace on the top.

Note that whenever you save state while in **Spectrogram**, and then recall the state, **Spectrogram** returns with all the settings just as they were when you saved the state, but not including the Spectrogram data itself. If you want to save the Spectrogram data, you can export it using Meas Results, and import it into a PC, although you cannot load it back into the instrument.

For detailed information about **Spectrogram** View, see the window description for "Waterfall" on page 192.

Example	`:DISP:VIEW SPEC`

3.2.1.3 Trace Zoom

Windows: "Spectrum" on page 188

In this view, the screen is split into two windows. The top window is a normal spectrum instrument window, and the bottom window (**Zoomed Trace**) shows a “zoomed” representation of the traces in the top window.

For more about **Trace Zoom**, see the window description for "Zoomed Trace" on page 190.

Example	`:DISP:VIEW TZO`

3.2.1.4 Zone Span

Windows: "Spectrum" on page 188, "Zone Spectrum" on page 189

In this view, the screen is split into two windows. The top window is a normal spectrum analyzer window, and the bottom window (**Zone Window**) shows a window whose span represents a region (zone) within the top window.

For more about **Zone Span**, see the window description for "Zone Spectrum" on page 189.

Example	`:DISP:VIEW ZSP`
Dependencies	In the **Zone Span** View, **Signal Track** is not allowed and is blanked

3.2.2 Windows

This section describes the windows that are available in Swept SA measurement.

With the addition of User Views to X-Series, Swept SA can now display most of its available windows at the same time. Some of the windows depend on constructs in the **Spectrum** window. Specifically:

- The **Zoomed Trace** window depends on a blue bar in the **Spectrum** window
- The **Waterfall** window depends on a color bar on the left of the **Spectrum** window

For this reason, it is best to *add* a new window and select the result that you want for the new window (for example, **Marker Table**) rather than *replace* the **Spectrum** window with a new result.

Window numbers for this measurement are:

1	"Spectrum" on page 188
2	"Zone Spectrum" on page 189
3	"Zoomed Trace" on page 190
4	"Waterfall" on page 192
5	"Marker Table" on page 198
6	"Peak Table" on page 198
7	"Measure at Marker" on page 199
8	"Gate" on page 199

The **Zone Spectrum** window *cannot* be added using the Result dropdown. To add a **Zone Spectrum** window, select the "Zone Span" on page 187 View.

For more about using the Window Title dropdown to change the window result or the **Edit View** screen to add and rearrange windows, see "View Editor" on page 153.

When using Remote Commands, send `:DISPlay:WINDow` to select a specific window, followed by the window number (for example, to select the **Zoomed Trace** window, you send `:DISP:WIND 3`). You must select a specific window in the following cases:

- Selecting the **Zoomed Trace** window allows you to do a bounded **Peak Search** function

3.2.2.1 Spectrum

Window #1

This is the fundamental window used in the Swept SA measurement and several other measurements. It displays Amplitude versus frequency information (or, in **Zero Span**, amplitude versus time). Unless otherwise noted, behaviors described in the Swept SA measurement description are assumed to be behaviors of the **Spectrum** window.

The **Spectrum** window always displays and cannot be deleted.

It appears in several views, as follows:

View	Size	Position
"Normal" on page 186	Full	--
"Spectrogram" on page 186	Half height, full width	Top
"Trace Zoom" on page 186	Half height, full width	Top
"Zone Span" on page 187	Half height, full width	Top
"Marker Table" on page 316	Half height, full width	Top
"Peak Table On/Off" on page 329	Half height, full width	Top
"Gate View On/Off" on page 2665	Half height, full width	Top

The **Spectrum** window has several special modes:

- When a **Waterfall** window is also displayed, as in the **Spectrogram** View, a color bar appears to the left of the **Spectrum** window and functions as the key to amplitude-color mappings in the **Waterfall** window

- When a **Zoomed Trace** window is also displayed, as in the **Trace Zoom** View, a blue shaded region appears in the **Spectrum** window, representing the region occupied by the **Zoomed Trace** window

– When a **Zone Spectrum** window is also displayed, as in the **Zone Span** View, an orange shaded region appears in the **Spectrum** window, representing the region occupied by the **Zone Spectrum** window

– When a **Marker Table** window is also displayed, as in the **Marker Table** View, the markers in the **Spectrum** window are described in the **Marker Table** window

– When a **Peak Table** window is also displayed, as in the **Peak Table** View, the peaks in the **Spectrum** window are described in the **Peak Table** window

– When a **Gate** window is also displayed, as in the **Gate** View, the **Spectrum** window holds the Spectrum controlled by the gating function

3.2.2.2 Zone Spectrum

Window #2

In the **Zone Span** view, the screen is split into two windows. The top window is a normal spectrum analyzer window, and the bottom window (**Zone Window**) shows a window whose span represents a region (zone) within the top window.

Views in which the **Zone Spectrum** window appears:

View	Size	Position
"Zone Span" on page 187	Half height, full width	Bottom

The data in the two windows represents two completely separate sweeps; each window sweeps *only* when the focus (thick green border) is on that window. It is important to understand that the data in the window without the focus remains unchanged until the focus is moved to that window.

In the top window, the zone region is indicated by a light orange shading and solid orange boundary lines. The **Zone Window** is not shaded orange; this emphasizes the fact that, unlike **Trace Zoom**, the data in the **Zone Window** does not match the top window but is from a separate sweep. You can set the span of the **Zone Window** using "Zone Span" on page 297 (in the **Frequency** menu) and you can set the center frequency of the **Zoom Window** using "Zone Center" on page 296 (in the **Frequency** menu).

Note that in **Zone Span**, the span of the top window cannot go below 10 Hz. The **Zero Span** toggle does not appear in **Zone Span**. If, on entry to **Zone Span**, the **Span** is 0 Hz, **Span** reverts to the last nonzero span. Also, if the span of the top window is between 10 Hz and 100 Hz on transition, **Zone Span** initializes to 10 Hz, not 10% of **Span**.

More Information

In **Zone Span**, the window with the focus (the selected window) is the window that updates. The selected window has a thick green border around it. When you enter the **Zone Span** view, the focus is always in the **Zone Window**, so it is the window that is updating. To change the focus, tap another window. **Single** and **Continuous** settings apply, so if the instrument is in **Single**, no sweep actually happens until it is initiated, or you go to **Continuous**.

NOTE: The selected window is the window to which virtually all key presses and SCPI commands are directed. Most control functions, such as **Center Frequency**, **Reference Level**, etc., apply only to the selected window. Similarly, any traces that are exported or queried while in **Zone Span** return the data from the currently active window. Because of this dependency, it is important to allow the SCPI system to synchronize after switching windows. Therefore, if you have just switched windows via SCPI (using `:DISP:WIND`) you should wait at least one second before sending any window-dependent command, to ensure that SCPI will direct the command to the correct window.

Transition Rules

When you enter the **Zone Span** view, the top window takes on all of the traces, markers and settings that were present in the **Normal** view. **Zone Center** is the same as the instrument **Center Frequency**, and **Zone Span** is 10 % of the instrument **Span**.

When you leave the **Zone Span** View, the current window traces and settings carry over to the next view. The traces from the other window will all now be gone. To mitigate this fact, whenever you save state while in **Zone Span**, and then recall the state, **Zone Span** returns just as it was when you saved the state, including all trace data and settings for both windows (of course, any traces that were updating when you did the save will load in an updating state, so their data will be erased after the first sweep). So, if you want to preserve the data in both windows, make sure you put the traces in View and save the state before you exit.

3.2.2.3 Zoomed Trace

Window #3

In the **Trace Zoom** view, the screen is split into two windows. The top window is a normal spectrum analyzer window, and the bottom window (**Zoomed Trace**) shows a “zoomed” representation of the traces in the top window.

Views in which the **Zoomed Trace** window appears:

View	Size	Position
"Trace Zoom" on page 186	Half height, full width	Bottom

The data in both windows is identical, but the bottom window typically shows fewer data points, spread across the whole display, which allows you to see the data in those points more clearly, particularly when the trace data in the top window is very dense (sweep points much greater than 1000).

The zoom region is indicated by a blue shading. In the top window, this indicates which subset of the data is zoomed in the bottom window. In **Swept Span**, you set the span of the bottom window using "Zoom Span" on page 295 and you set the center frequency of the bottom window using "Zoom Center" on page 294 (both in the **Frequency** menu). In **Zero Span**, you set the width of the bottom window using "Zoom Sweep Time" on page 486 and the center using "Zoom Center" on page 487 (both in the **Sweep** menu). You can also drag and pinch either trace or the blue region to set these values.

It is important to emphasize that the data and state in the two windows is *identical*. The **Zoom Window** is simply a close-up view of a region of the top windows' traces. Therefore, all traces and markers are the same in both windows; and any state changes you make affect both windows.

You set the number of sweep points shown in the **Zoom Window** separately from the top window. Changing the number of points in the top window does not change **Zoom Span**; hence the number of points in the bottom window changes by the same proportion as the change in the top window. Conversely, changing the number of points in the bottom window *does* change **Zoom Span** and does *not* change the number of points in the top window, because the more points you show in the bottom window, the greater is the percentage of the top window which you are showing in the bottom.

Two functions in **Trace Zoom** depend on which window is selected (the selected window has a thick green border around it). When the **Zoom Window** (bottom window) is selected, the "Points" on page 499 control in the **Sweep** menu changes to **Zoom Points**, and adjusts the number of points in the bottom window. Also, for all **Peak Search** functions, if the bottom window is selected, the search function operates *only* within that window. This allows you to perform a **Peak Search** over a specified, limited frequency range, while still viewing the larger frequency range in the top window.

NOTE: If you have just switched to the **Zoom Window** via SCPI (using `:DISP:WIND`) you should wait at least one second before performing a **Peak Search**, to ensure that SCPI will direct the **Peak Search** command to the correct window.

When you are in **Zero Span** in **Trace Zoom**, both the top and bottom window are in **Zero Span**, but the bottom window has a different sweep time reflecting how much it is zoomed. When you switch between **Swept Span** and **Zero Span** (either direction), the blue bar in the top window remains fixed in position and size, and the number of points in the top window does not change. So, on the **Swept Span** to **Zero Span** transition, this determines the number of points in the bottom window.

Transition Rules

When you enter the **Trace Zoom** view, the top window takes on all of the traces, markers and settings that were present in the **Normal** view. **Zoom Center** is the same as the instrument **Center Frequency**, and **Zoom Span** is 10 % of the instrument **Span**. When you leave the **Trace Zoom** View, the top window traces and settings carry over to the next view.

When you enter the **Trace Zoom** view, the focus is always in the zoom window. To change the focus (switch between windows), tap another window. The window that has the focus is distinguished by a blue border.

3.2.2.4 Waterfall

Window #4

This window is an important component of the **Spectrogram** View. The **Waterfall** window shows a history of the last 1000 traces, and the **Spectrum** window shows the trace indicated by "Display Trace" on page 257 in the **Display** menu.

Waterfall is on by default in the **Spectrogram** View. If you add the **Waterfall** window using the Window Data dropdown, the color bar appears in the **Spectrum** window.

Views in which the **Waterfall** window appears:

View	Size	Position
"Spectrogram" on page 186	Half height, full width	Bottom

Note that since the spectrogram is intended to give a view of spectral behavior versus time, the **Periodic** Trigger, which generates triggers at known intervals, provides the most predictable and consistent starting times for the traces. Other triggers, like **Free Run** or **External**, may give non-linear or less predictable times. Similarly, turning **Auto Align** off improves the regularity of the trace starting times.

Display Trace

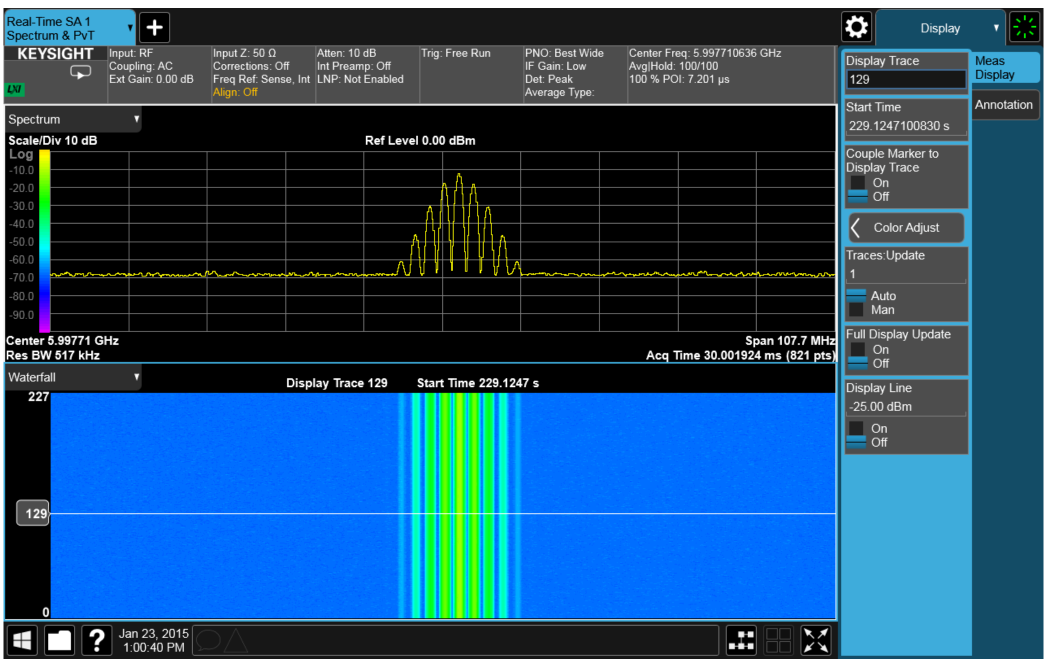
The **Display Trace** control determines which of the traces in the **Waterfall** (usually the lower) window is currently being viewed in the **Spectrum** (usually the top) window. A white line across the **Waterfall** window shows the current position of the **Display Trace**. On entry to the **Spectrogram** View, **Display Trace** has a value of 0; which means it is set to the “live” trace.

The “live” trace does not appear in the **Waterfall** window; **Display Trace 1** is the bottommost trace in the **Waterfall** window. Every time a sweep completes, the data from **Display Trace 0** is moved to **Display Trace 1**, and all the other traces “roll up.” Once the trace data has been written into the spectrogram, it is immutable.

Although all 6 traces can be used in the trace window, it is the data from the “live” Trace 1 that goes into **Display Trace 0** and then into the **Waterfall** window. Thus, the spectrogram represents the history of Trace 1; traces 2-6, although available, are not written into the spectrogram. As you change the value of **Display Trace**, you see the historical data only in Trace 1; Traces 2-6 still represent live data.

The **Waterfall** window itself can only hold 300 traces with the windows sized normally. Since the Spectrogram memory can hold 1000 traces, this means that often, many traces are off-screen above or below the **Waterfall** window. The oldest trace is the topmost trace. The value of **Display Trace** is annunciated at the top of the **Waterfall** window, along with the start time of that trace. You can tap the **Display Trace** annunciator to enter a value for **Display Trace**.

The display trace also has a handle that sticks out on the left and contains the display trace number. You can drag the display trace with this handle. The handle outline is white, like the display trace. The display trace top and bottom is annotated on the left side of the waterfall as in the figure below.



If the display trace is offscreen above, the handle outline is yellow, and the white line becomes a dashed yellow line.

The waterfall can be scrolled up and down with your finger (hint: this works best if you are in **Single**). Markers on the Waterfall can be dragged left, right, up or down to any position on the waterfall.

Any variable change that restarts a sweep clears out the spectrogram and start it over, unless you are in the idle state (**Single** sweep or waiting for a trigger), in which case it is cleared out when you start sweeping again. **Restart** clears out all spectrogram traces and start over. The **Waterfall** display is also cleared on exit from the **Spectrogram** View, so every time you enter the **Spectrogram** View, the **Waterfall** window is empty.

The colors in the Spectrogram represent signal amplitude. The key to these colors is displayed next to the Y Axis in the upper window. By changing the Y Axis parameters, you can change the scaling; that is, by changing the **Reference Level** or **Scale/Div**, the colors remap to new Amplitude values. Note that this does not restart the Spectrogram, unless "Attenuation" on page 1932 changes.

As this is swept spectrum analysis, each horizontal line in the **Waterfall** window represents a single trace, and the vertical axis represents time. You might thus expect each line to slope upwards from left to right to more correctly represent the point in time at which each point in the trace was taken. However, the lines are horizontal, so the display represents each trace as representing a single time, which is in fact its start time. If this distinction is important to you, use FFT sweeps (with an **FFT Width** greater than your span, of course) to ensure that each trace point in a line better represents the same moment in time.

If **Display Trace** = 0, the data for Trace 1 is written into the trace as the data is acquired, just as in **Normal** view. So, you see the data as it is acquired; for a slow sweep, for example, you see the trace fill as the points are taken. For any other value of **Display Trace**, Trace 1 appears static, as it represents an historical trace. As the traces roll up, the value of **Display Trace** does not change, so you see a different trace in Trace 1 every time the live trace finishes. To freeze the spectrogram, put Trace 1 into View, or put the instrument into **Single** sweep (note that unless **Average/Hold Number** = 1, putting the instrument into **Single** does not freeze the Spectrogram until the number of traces specified by **Average/Hold Number** have been taken).

When returning to the **Normal** view from the **Spectrogram** view, Trace 1 holds whatever data was in **Display Trace 0** on exit.

Differences with Spectrum window

While in **Spectrogram** View, all functions and settings work as normal, except as noted below.

- The **Single** key behaves differently than it does in **Normal** view. In the **Spectrogram** View, **Single** causes a specified number of traces to be read into the spectrogram from Trace 1, after which the acquisition stops. The number of traces to be read into the spectrogram is controlled by "Average/Hold Number" on page 379 in the **Meas Setup** menu. For example, if you set **Average/Hold Number** to 5, then every time you press **Single**, it takes 5 sweeps and puts the 5 traces one by one into the Spectrogram; then it stops sweeping. Note that you can set **Average/Hold Number** to 1 to capture a single trace into the

Spectrogram when **Single** is pressed, making the behavior similar to that of the **Normal** view

- In **Spectrogram** View, Sweep **Points** are limited to a maximum of 1001 due to memory concerns. On entry to this view, if the number of points is greater than 1001, it is forced to 1001; therefore, if you had a larger number of points on entry to **Spectrogram**, all the traces from the **Normal** view are cleared out
- In **Spectrogram** View, if Trace 1 is saved, exported or queried, the data that gets saved or returned is the data from the **Display Trace** in the spectrogram. All SCPI trace saves or queries for the other 5 traces return their data normally
- Trace Copy is available in **Spectrogram**. If Trace 1 is the “from” trace, **Copy** Trace copies the **Display Trace** to any other trace. **Display Trace** is one of up to 10000 historical versions of Trace 1, so, if the **Display Trace** is 150, then the 150th version of Trace 1 is copied to the destination trace. Since the historical trace data is immutable, copying a trace to Trace 1 is not possible. The same is true for Trace "Exchange" on page 1733; Trace 1 is not available to exchange
- Selecting or moving a marker that is turned on but not on the current **Display Trace** does *not* move the marker to the current **Display Trace**; it selects it, and/or moves it, but it stays on the Trace it is currently on
- Turning on a marker that is turned off turns it on in the center of the current **Display Trace**
- When a **Peak Search** is performed, if the selected marker is turned on but is not on the current **Display Trace**, it is first moved to the center of the current **Display Trace** before performing the search
- If **Couple Markers** is **On**, then moving a marker to a new **Display Trace** causes all the coupled markers to move by the same number of traces

NOTE

`:INIT` works in a slightly different fashion in the **Spectrogram** view. In the other views, the following two commands perform exactly the same function:

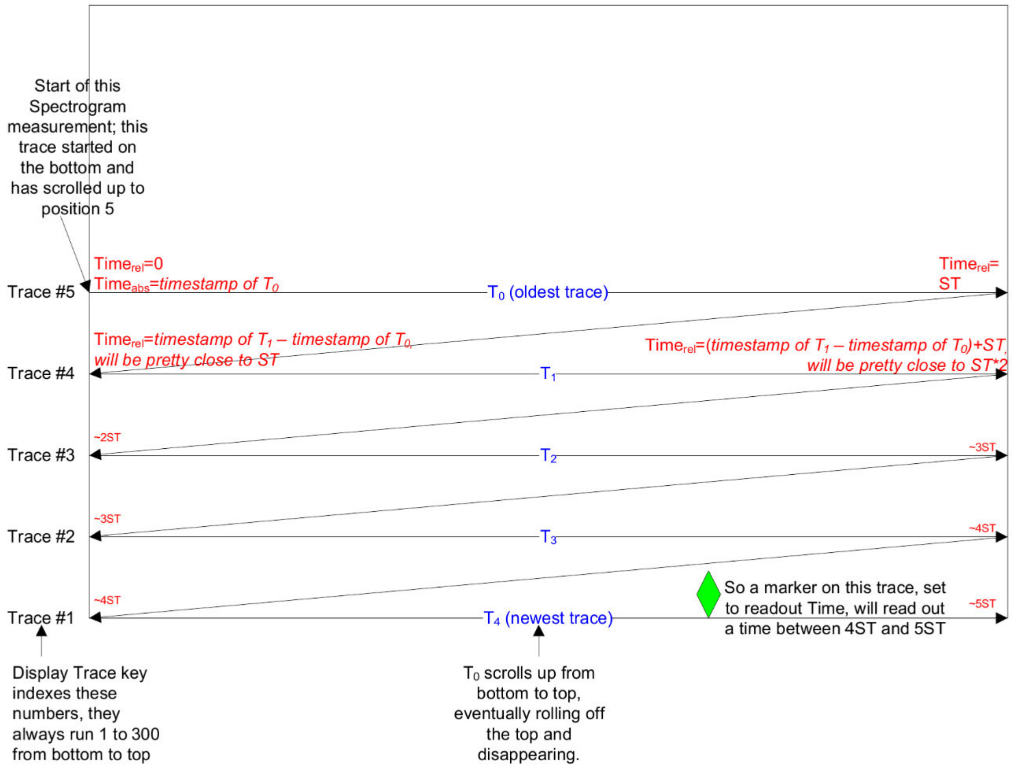
`:INITiate:RESTart`

`:INITiate:IMMediate`

However, in **Spectrogram** View, `:INITiate:RESTart` works like the **Restart** key, and clears out the Spectrogram trace history. `:INITiate:IMMediate` does not clear out the Spectrogram trace history but performs all other functions of performing a restart.

Representation of Time

In **Spectrogram** view, zero time is the point where the first trace started, meaning that each subsequent trace point is at a positive time that represents when that point was gathered, relative to the start point. Each trace is time stamped as it starts, and this time is remembered for each trace. As successive traces appear their start times get successively larger, relative to the start time of the oldest trace. If a marker is placed on the live trace and its readout is set to **Time**, the time of this marker will increment by about the sweep time for every new sweep. See the diagram below for a graphical representation of how this appears:



Each trace point has a time value; the value of the start time of the trace is accurately time stamped, but each point within the trace is the start value plus the proportion of sweep time represented by that position in the trace. This means the time value of the points within a trace is not as accurate as the start point, which is actually the case even in the **Normal** view, when you use a **Time** readout for markers in the frequency domain. This problem is particularly acute with "Sweep Type" on page 490 set to **FFT**, since the calculated nominal FFT sweep time estimate can be off by a large percentage. Therefore, in FFT sweeps, to prevent overlaps of time on traces, and to make **Sweep Type FFT** consistent with **Swept**, the end time for each trace is calculated to yield a continuous functional Z axis time value for each position on the trace. Since any inaccuracies within each trace are therefore reconciled with the start of the next sweep, you can consider the time values along a trace to be accurate enough for the purpose of making delta time measurements between traces.

`:TRACe:DISPlay:VIEW:SPECtrogram:TIME?` can be used to retrieve the time that the current trace in the spectrogram started.

Markers in Spectrogram

In **Spectrogram** View, you can put markers on any trace in the **Waterfall** window. To put a marker on a particular trace in the **Waterfall** window, set **Display Trace** to the trace upon which you want the marker, then position the marker as desired on Trace 1 in the trace window. When you turn a marker on, or do any kind of **Peak Search**, if the marker is a Trace 1 Marker, it appears on the current **Display Trace**. Then when you move the **Display Trace** to other traces in the **Waterfall** window, the marker stays on the **Waterfall** trace it is on.

Markers are displayed in the **Waterfall** window as little crosses, with one bar sitting on the trace in question and the other bar perpendicular to it. The selected marker's cross is green; the others are white.

You can right-click or touch-and-hold on the spectrogram to get a menu of functions including:

- Peak Search
- Peak Search all Traces
- Move Marker n here (n=whichever marker is selected)
- Add Marker Here

There are also two useful functions in the **Marker ->** menu:

- Move Marker -> Display Trace
- Move Display Trace -> Marker

Example

Set **Display Trace** to spectrogram trace number 125. Turn on **Marker 1**. Marker 1 appears on Trace 1, which is spectrogram trace number 125. A green diamond appears on trace 1 in the trace window, and a little cross appears on spectrogram trace number 125 in the **Waterfall** window. Now set **Display Trace** to 200. The trace window now shows spectrogram trace number 200; **Marker 1** disappears from that window because it is still on spectrogram trace number 125. You can still see the little cross sitting on spectrogram trace number 125 in the **Waterfall** window.

The selected marker displays in the upper right corner of the top window display, as always. If a **Delta** marker is referenced to a marker on another Spectrogram Trace, then when the Marker X-Axis Scale is **Time**, you see the delta that represents the Y-axis delta between the two markers, as always; but in this case the X-axis delta now includes the time between the two traces.

When you leave **Spectrogram** View, all Trace 1 Markers that were not on **Display Trace 0** are turned `OFF`.

3.2.2.5 Marker Table

Window #5

Displays a table containing detailed information about all of the markers in the current measurement. There is no specific view in which the **Marker Table** window turns on, it is on by demand.

Marker Table is turned on or off by "Marker Table" on page 316 in the **Marker** menu, or it can be selected from the Data control on the Window Title dropdown. Turning **Marker Table** on with the **Marker Table** switch does not modify the current view the way changing an existing window or adding a window does; it does not create a starred (modified) view, it merely adds the **Marker Table** window and shows *no* view as selected in the **View** menu.

Note that turning on **Marker Table** with the **Marker Table** switch turns off any of the other switched windows (**Peak Table**, **Gate**, **Measure at Marker**). Also note that the **Marker Table** switch is unavailable in all views except **Normal**; in that case you must use the Window Data dropdown to add a **Marker Table** window. (Although grayed-out, the switches display correctly, for example, the **Marker Table** switch shows **On** if a **Marker Table** window is on.)

Note that when you are in one of these “switched” views, you cannot create a **User View**; the **Edit View** icon is grayed-out. Note also that when you exit one of these “switched” views, you are not prompted to save the starred view, because it does not create a starred view; nor are you prompted to save the view when you leave the current measurement; and when you return to that measurement, the switch is on and just adds the window again.

3.2.2.6 Peak Table

Window #6

Provides a displayed list of up to 500 signal peaks from the selected trace. The maximum number of peaks listed in the peak table can be set by "Maximum Number of Peaks" on page 331. There is no specific view in which the **Peak Table** window turns on, it is on by demand.

Peak Table is turned on or off by "Peak Table On/Off" on page 329 in the **Marker** menu, or can be selected from the Data control on the **Window Title** dropdown. Turning **Peak Table** on with the **Peak Table** switch does not modify the current view the way changing an existing window or adding a window does; it does not create a starred (modified) view, it merely adds the **Peak Table** window and shows *no* view as selected in the **View** menu.

Note that turning on **Peak Table** with the **Peak Table** switch turns off any of the other switched windows (**Marker Table**, **Gate**, **Measure at Marker**). Also note that the **Peak Table** switch is unavailable in all views except **Normal**; in that case you have to use the **Window Title** dropdown to add a **Peak Table** window. (Although grayed-out, the switches display correctly, for example, the **Peak Table** switch shows **On** if a **Peak Table** window is on.)

Note that when you are in one of these "switched" views, you cannot create a **User View**; the **Edit View** icon is grayed-out. Note also that when you exit one of these "switched" views, you are not prompted to save the starred view, because it does not create a starred view; nor are you prompted to save the view when you leave the current measurement; and when you return to that measurement, the switch is on and just adds the window again.

3.2.2.7 Measure at Marker

Window #7

Executing "Measure at Marker" on page 360 turns on the **Measure at Marker Window**. It can be turned off by "Measure at Marker Window On/Off" on page 365. There is no specific view in which the **Measure at Marker** window turns on, it is on by demand.

Besides being turned on or off with controls under **Marker Function**, the **Measure at Marker** result can be selected from the Data control on the Window Title dropdown. Turning the **Measure at Marker** window on by executing **Measure at Marker** does not modify the current view the way changing an existing window or adding a window does; it does not create a starred (modified) view, it merely adds the **Measure at Marker** window and shows *no* view as selected in the **View** menu.

Note that **Measure at Marker** turns off any of the other switched windows (**Marker Table**, **Peak Table**, **Gate**). Also note that the **Measure at Marker** switch is unavailable in all views except **Normal**.

Note that when you are in one of these "switched" views, you cannot create a **User View**; the **Edit View** icon is grayed-out. Note also that when you exit one of these "switched" views, you are not prompted to save the starred view, because it does not create a starred view; nor are you prompted to save the view when you leave the current measurement; and when you return to that measurement, the switch is on and just adds the window again.

3.2.2.8 Gate

Window #8

Turning on **Gate** View shows the split-screen **Gate** View, with a **Spectrum** window on the top and a **Gate** window on the bottom.

Views in which the **Gate** window appears:

View	Size	Position
"Gate View On/Off" on page 2665	Half height, full width	Bottom

The **Gate** window is turned on or off by "Gate View On/Off" on page 2665 in the **Trigger** menu, or it can be selected from the Data control on the Window Title dropdown. Turning the **Gate** window on with the **Gate** View switch does not modify the current view the way changing an existing window or adding a window does; it does not create a starred (modified) view, it merely adds the **Gate** window and shows *no* view as selected in the **View** menu.

Note that turning on the **Gate** window with the **Gate** View switch turns off any of the other switched windows (**Marker Table**, **Peak Table**, **Measure at Marker**). Also note that **Gate** View is unavailable in all views except **Normal**.

Note that when you are in one of these "switched" views, you cannot create a **User View**; the **Edit View** icon is grayed-out. Note also that when you exit one of these "switched" views, you are not prompted to save the starred view, because it does not create a starred view; nor are you prompted to save the view when you leave the current measurement; and when you return to that measurement, the switch is on and just adds the window again.

3.2.3 Amplitude

Activates the **Amplitude** menu and selects **Reference Level** or **Reference Value** as the active function, depending on the measurement.

Some features in this menu apply to multiple measurements. Some other features apply only to specific measurements and their controls are blanked or grayed-out in measurements that do not support the feature.

3.2.3.1 Y Scale

Contains controls that pertain to the Y axis parameters of the measurement. These parameters control how data on the vertical (Y) axis is displayed and control instrument settings that affect the vertical axis.

Reference Level

Specifies the amplitude represented by the topmost graticule line.

In this measurement, changing the reference level does not restart a measurement, because it is a display function only. Instead, it vertically 'pans' all displayed traces and markers to the new value. If a change to the reference level changes the attenuation value (for example, via an auto coupling), then the measurement is restarted.

See "Amplitude Representations" on page 201

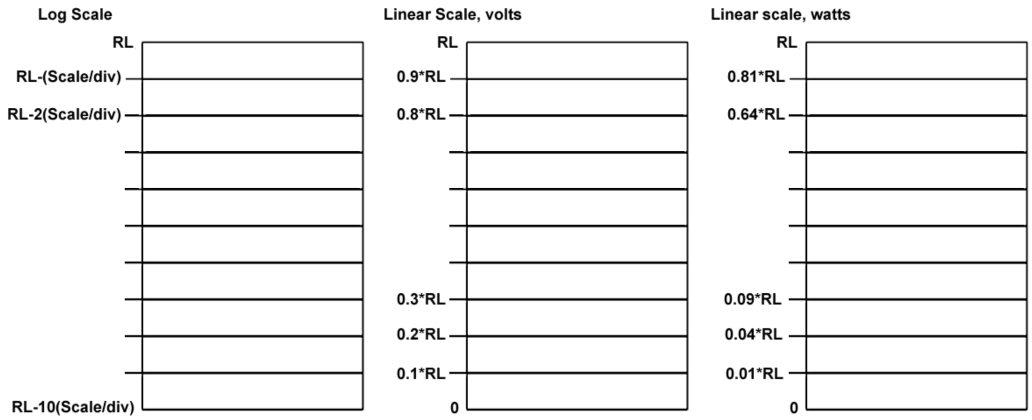
Remote Command	`:DISPlay:WINDow[1]:TRACe:Y[:SCALe]:RLEVel <real>` `:DISPlay:WINDow[1]:TRACe:Y[:SCALe]:RLEVel?`
Example	Set the reference level to 20 dBm, which displays in the current Y axis unit. For example, if the Y axis unit is dBmV, then 126.99 dBmV is displayed: `:DISP:WIND:TRAC:Y:RLEV 20 dBm`
Couplings	If you reduce the attenuation, the instrument may have to lower the reference level to keep it below its allowed maximum. This allowed maximum level is specified in the “Max” row, below, along with other variables that affect it When you increase attenuation, the reference level does not change Note that there is *no* coupling in N9042B
Preset	0 dBm
State Saved	Saved in instrument state
Min/Max	The minimum Ref Level is -170 dBm + RefLevelOffset - ExtGain The maximum Ref Level is typically: N9042B: +250, Note this value does not change EXA (except N9010N), CXA and CXA-m: +23 dBm + RL Offset – External Gain VXT model M9421A: +33 dBm + RL Offset – External Gain VXT models M9410A/11A/15A: +30 dBm + RL Offset – External Gain M8920A: Ant Port: +30 dBm + RL Offset – External Gain; T/R Port, Low Power Mode: +33 dBm + RL Offset – External Gain; T/R Port, High Power Mode: +47 dBm + RL Offset – External Gain All other models: +30 dBm + RL Offset – External Gain The maximum may be further limited by the current value of other parameters, including Mech Atten, Int Preamp Gain, Swept IF Gain, FFT IF Gain, Max Mixer Level, and the total attenuation currently available. This maximum value is determined by the maximum power that can be safely applied to the input circuitry Note that the maximum reference level is unaffected by the input choice of external mixing
Annotation	The reference level is displayed above and to the left of the graticule with the title “Ref”

Nested Min/Max table:

N9042B	+250, Note this value does not change
EXA (except N9010N), CXA and CXA-m	+23 dBm + RL Offset – External Gain
VXT model M9421A	+33 dBm + RL Offset – External Gain
VXT models M9410A/11A/15A	+30 dBm + RL Offset – External Gain
M8920A	Ant Port: +30 dBm + RL Offset – External Gain T/R Port, Low Power Mode: +33 dBm + RL Offset – External Gain T/R Port, High Power Mode: +47 dBm + RL Offset – External Gain
All other models	+30 dBm + RL Offset – External Gain

Amplitude Representations

The following is an illustration of the reference level and Y-Axis scales under various conditions:



Scale/Div

For measurements that support a logarithmic Y-Axis, **Scale/Div** sets the height of one division of the graticule in the current Y-Axis unit.

Scale/Div also determines the displayed amplitude range in the log plot graph. Since there are usually 10 vertical graticule divisions in the display, the total amplitude range of the graph is typically 10x this amount. For example, if **Scale/Div** is 10 dB, then the total range of the graph is 100 dB.

In measurements that support both `LOG` and `LIN` settings for "Display Scale" on page 203, this function is only available when **Display Scale (Log)** is selected, and the vertical scale is power. When **Display Scale (Lin)** is selected, **Scale/Div** is grayed-out.

Remote Command	`:DISPlay:WINDow[1]:TRACe:Y[:SCALe]:PDIVision <rel_ampl>` `:DISPlay:WINDow[1]:TRACe:Y[:SCALe]:PDIVision?`
Example	`:DISP:WIND:TRAC:Y:PDIV 5 DB` `:DISP:WIND:TRAC:Y:PDIV?`
Dependencies	In measurements that support both `LOG` and `LIN`**Display Scales**, **Scale/Div** is grayed-out in linear Y scale. Sending the equivalent SCPI command does change **Scale/Div**, though it has no affect while in `LIN`
Preset	10.00 dB / Div
State Saved	Saved in instrument state
Min	0.10 dB
Max	20 dB
Annotation	All measurements unless noted: <value> dB/ left upper of graph

In log scale, the Scale/Div is shown in the upper left side of the display. In Lin mode, no annotation is displayed

Display Scale

Selects a linear or logarithmic vertical scale for the display and for remote data readout:

`LOGarithmic`	The vertical graticule divisions are scaled in logarithmic units. The top line of the graticule is the Reference Level, and the Scale/Div value is used to assign values to the other locations on the graticule
`LINear`	The vertical graticule divisions are linearly scaled with the reference level value at the top of the display and zero volts at the bottom. Each vertical division of the graticule represents one-tenth of the Reference Level

NOTE The Y Axis Unit used for each type of display is set by pressing **Y Axis Unit**. The instrument retains separate **Y Axis Unit** settings for both Log and Lin.

Remote Command	`:DISPlay:WINDow[1]:TRACe:Y[:SCALe]:SPACing LINear | LOGarithmic` `:DISPlay:WINDow[1]:TRACe:Y[:SCALe]:SPACing?`
Example	`:DISP:WIND:TRAC:Y:SPAC LOG` `:DISP:WIND:TRAC:Y:SPAC?`
Dependencies	If "Normalize" on page 537 is ON, **Display Scale** is forced to LOG and is grayed-out
Couplings	Changing **Display Scale** always sets **Y Axis Unit** to the last unit specified for the current amplitude scale
Preset	LOG
State Saved	Saved in instrument state
Annotation	Log or Lin appears to the left of the graticule below the reference level

Y Axis Unit

Displays a dropdown menu that enables you to change the vertical (Y) axis amplitude unit. This setting affects how the data is read over the remote interface. When using the remote interface, only numerical values are returned, so you must know what the Y Axis Unit is to interpret the results. This is described in more detail in "Amplitude Data Query and Y Axis Unit" on page 206 below.

For measurements that support both Log and Lin scales, the instrument retains the entered Y Axis Unit separately for both Log and Lin amplitude Display Scales. For example, if Display Scale has been set to Log, and you set Y Axis Unit to dBm, pressing **Display Scale (Log)** sets the Y Axis Unit to dBm. If Display Scale has been set to Lin and you set Y Axis Unit to V, pressing **Display Scale (Lin)** sets the Y Axis Unit to V. Pressing **Display Scale (Log)** again sets the Y Axis Unit back to dBm.

If an Amplitude Correction is being applied that has an associated Transducer Unit, all selections but **Xducer Unit** are grayed-out. For more information, see "Transducer Unit" on page 207 below.

Remote Command	`:UNIT:POWer DBM | DBMV | DBMA | V | W | A | DBUV | DBUA | DBPW | DBUVM | DBUAM | DBPT | DBG` `:UNIT:POWer?`

Example	`:UNIT:POW dBmV`
	`:UNIT:POW?`
	See also "Remote Interface Examples" on page 205 below

Notes	The Y axis unit has either logarithmic or linear characteristics. The set of units that is logarithmic consists of dBm, dBmV, dBmA, dBmV, dBmA, dBmV/m, dBmA/m, dBpT, and dBG. The set of units that are linear consists of V, W, and A. The chosen unit will determine how the reference level and all the amplitude-related outputs like trace data, marker data, etc., read out
Dependencies	Appears only in Spectrum Analyzer Mode If an amplitude correction with a Transducer Unit other than None is applied and enabled: – The Transducer Unit selection is forced, and is the only Y Axis Unit available. The specific Transducer Unit is shown in square brackets in the dropdown, and all other Y Axis Unit choices are grayed-out – If you turn off that correction or set Apply Corrections to NO, the Y Axis Unit that existed before the Transducer Unit was applied is restored When Normalize is ON (in the **Trace**, **Normalize** menu), Y Axis Unit is grayed-out, and forced to dBm
Couplings	The instrument retains the entered Y Axis Unit separately for both Log and Lin amplitude Display Scales
Preset	dBm for log scale, V for linear. The true 'preset' value is dBm, since at preset the Y Display Scale is set to logarithmic
State Saved	Saved in instrument state
Annotation	The Y Axis Unit is shown after Ref Level value at the top of the graticule

Unit	Example	Notes
dBm	`:UNIT:POW DBM`	Y Axis Unit is set to dBm
dBmV	`:UNIT:POW DBMV`	Y Axis Unit is set to dBmV
dBmA	`:UNIT:POW DBMA`	Y Axis Unit is set to dBmA
W	`:UNIT:POW W`	Y Axis Unit is set to W
V	`:UNIT:POW V`	Y Axis Unit is set to V
A	`:UNIT:POW A`	Y Axis Unit is set to A
dBmV	`:UNIT:POW`	Y Axis Unit is set to dBmV

Unit	Example	Notes
	DBUV	
dBmA	:UNIT:POW DBUA	Y Axis Unit is dBmA. The unit dBuA can also appear as a Transducer Unit
dBpW	:UNIT:POW DBPW	Y Axis Unit is set to dBpW

Remote Interface Examples

Command examples and details appear in the table below. Note that each of the commands below sets the amplitude unit only for the *selected* amplitude scale (Log or Lin), the other scale is unaffected.

Unit	Example	Notes
dBm	:UNIT:POW DBM	dB relative to one milliwatt
dBmV	:UNIT:POW DBMV	dB relative to one millivolt
dBmA	:UNIT:POW DBMA	dB relative to one milliamp
W	:UNIT:POW W	Watts
V	:UNIT:POW V	Volts
A	:UNIT:POW A	Amperes
dBmV	:UNIT:POW DBUV	dB relative to one microvolt
dBmA	:UNIT:POW DBUA	dB relative to one microamp The unit dBuA can also appear as a "Transducer Unit" on page 207 When querying the Y-Axis unit, you can query the Transducer Unit to distinguish between regular dBuA and the dBuA transducer unit. If :CORR:CSET:ANT? returns NOC (for No Conversion), you are using a normal Y Axis dBuA. If it returns UA, you are using a Transducer Unit dBuA
dBpW	:UNIT:POW DBPW	dB relative to one picowatt
dBmV/m (Transducer Unit)	:UNIT:POW DBUVM	Sets the amplitude unit for the selected amplitude scale (log/lin) to dBmV/meter. This selection is only available if a Correction is turned on, and the Transducer Unit for that Correction is not None See "Transducer Unit" on page 207
dBmA/m (Transducer Unit)	:UNIT:POW DBUAM	Sets the amplitude unit for the selected amplitude scale (log/lin) to dBmA/meter. This selection is only available if a Correction is turned on, and the Transducer Unit for that Correction is not None See "Transducer Unit" on page 207
dBpT (Transducer Unit)	:UNIT:POW DBPT	Sets the amplitude unit for the selected amplitude scale (log/lin) to dBpT (dB relative to one picotesla). This selection is only available if a Correction is turned on, and the Transducer Unit for that Correction is not None

Unit	Example	Notes
		See "Transducer Unit" on page 207
dBG (Transducer Unit)	:UNIT:POW DBG	Sets the amplitude unit for the selected amplitude scale (log/lin) to dBG (dB relative to one Gauss). This selection is only available if a Correction is turned on, and the Transducer Unit for that Correction is not None See "Transducer Unit" on page 207
dBmA (Transducer Unit)	:UNIT:POW DBUA	Sets the amplitude unit for the selected amplitude scale (log/lin) to dBmA. This selection is only available as a Transducer Unit if a Correction is turned on, and the Transducer Unit for that Correction is not None See "Transducer Unit" on page 207 The unit dBuA can also appear as a normal Y Axis Unit (see above) dBuA as a Transducer Unit is used when using current probes, because current probes are often supplied with conversion tables that provide the transducer factors. When dBuA is used as a Transducer Unit, the normal conversion from power to amps for dBuA (based on the instrument input impedance) is not done, but instead the conversion is based solely on the Correction that contains the transducer factors. This is what distinguishes dBuA as a normal unit from dBuA as a transducer unit When querying the Y-Axis unit, you can query the Transducer Unit to distinguish between regular dBuA and the dBuA Transducer Unit. If :CORR:CSET:ANT? returns NOC (for No Conversion), you are using a normal Y-Axis dBuA. If it returns UA, you are using a Transducer Unit dBuA

Amplitude Data Query and Y Axis Unit

The settings of Y-Axis Unit and Display Scale affect how the data is returned over the remote interface in response to a query. When using the remote interface, no unit is returned, so you must know what the Y-Axis unit is to interpret the results:

Example 1

Set the following:

- Display Scale (Log)
- Y Axis Unit, dBm
- Scale/Div, 1 dB
- Ref Level, 10 dBm

This sets the top line to 10 dBm with each vertical division representing 1 dB. Thus, if a point on trace 1 is on the fifth graticule line from the top, it represents 5 dBm and will read out remotely as 5.

Example 2

Set the following:

- Display Scale (Lin)
- Y Axis Unit, Volts
- Ref Level, 100 mV (10 mV/div)

This sets the top line to 100 mV and the bottom line to 0 V, so each vertical division represents 10 mV. Thus, if a point on trace 1 is on the fifth graticule line from the top, it represents 50 mV and will read out remotely as 50.

NOTE **The units of current (A, dBmA, dBuA) are calculated based on 50 Ω input impedance.**

Transducer Unit

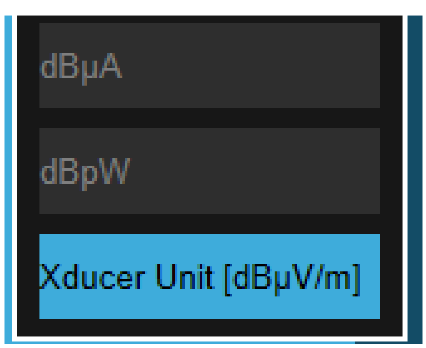
Transducer Units (formerly called Antenna Units) are units of field strength rather than amplitude, and are used when correcting the response of device such as antennas whose amplitude characteristics are measured in units of field strength. All five of the Transducer Units (dBmA/m, dBmV/m, dBG, dBpT, dBmA) are treated by the instrument exactly as though they were dBmV, when uncorrected. You must load an appropriate correction factor using Input/Output, Corrections for accurate and meaningful results.

If a remote command is sent to the instrument that uses one of the Transducer Units as a terminator, the instrument treats it as though DBUV had been sent as the terminator.

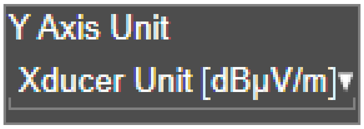
When a Correction is turned on that uses a Transducer Unit, the Y Axis Unit changes to that Transducer Unit. All of the selections in the **Y-Axis Unit** dropdown are then grayed-out, except the Transducer Unit selection. The unit being used is shown on this selection in square brackets, and appears on the control in square brackets preceded by **Xducer Unit**.

Example:

If the Transducer Unit in the Correction is dBmV/m, then the selection in the dropdown looks like this:



And on the control it looks like this:



NOTE

If a Transducer Unit is set, it is displayed as **Xducer Unit** in the **Y Axis Unit** dropdown. However, you can only *change* the Transducer Unit via the **Edit Correction** dialog in the **Input/Output**, **Corrections** menu. In that dialog, tap **Settings** then **Transducer Unit**. You can also turn off Transducer Unit from the same menu, by selecting **None**.

If a Transducer Unit is set, it is displayed as **Xducer Unit** in the **Y Axis Unit** dropdown. However, you can only *change* the Transducer Unit via the **Edit Correction** dialog in the **Input/Output**, **Corrections** menu. In that dialog, tap **Settings** then **Transducer Unit**. You can also turn off Transducer Unit from the same menu, by selecting **None**.

The Transducer Units are:

Units	Example
dBmV/m	:UNIT:POW DBUVM
dBmA/m	:UNIT:POW DBUAM
dBpT	:UNIT:POW DBPT
dBG	:UNIT:POW DBG
dBmA	:UNIT:POW DBUA
None	n/a

Reference Level Offset

Adds an offset value to the displayed reference level. The reference level is the absolute amplitude represented by the top graticule line on the display.

The on/off switch turns this function on and off. Setting a value for **Reference Level Offset** turns the function ON.

See "More Information" on page 209

Remote Command	:DISPlay:WINDow[1]:TRACe:Y[:SCALe]:RLEVel:OFFSet <rel_ampl> :DISPlay:WINDow[1]:TRACe:Y[:SCALe]:RLEVel:OFFSet?
Example	Set **Reference Level Offset** to 12.7 dB. The only valid suffix is dB. If no suffix is sent, dB is assumed: :DISP:WIND:TRAC:Y:RLEV:OFFS 12.7
Preset	0 dBm

State Saved	Saved in instrument state
Min	Variable Limited to values that keep the reference level within the range of -327.6 dB to 327.6 dB
Max	327.6 dB
Annotation	The offset is displayed as “Ref Offset <value>” to the right of the reference level annotation if nonzero. When the offset is zero, no annotation is shown

Auto Function

Remote Command	`:DISPlay:WINDow[1]:TRACe:Y[:SCALe]:RLEVel:OFFSet:STATe OFF | ON | 0 | 1` `:DISPlay:WINDow[1]:TRACe:Y[:SCALe]:RLEVel:OFFSet:STATe?`
Example	Turn **Reference Level Offset** On: `:DISP:WIND:TRAC:Y:RLEV:OFFS:STAT ON`
Preset	`OFF`

More Information

Offsets are used when gain or loss occurs between a device under test and the instrument input. Thus, the signal level measured by the instrument may be thought of as the level at the input of an external amplitude conversion device. Entering an offset does not affect the trace position or attenuation value, just the value of the top line of the display and the values represented by the trace data. Thus, the values of exported trace data, queried trace data, marker amplitudes, trace data used in calculations such as N dB points, trace math, peak threshold, and so forth, are all affected by Ref Level Offset.

NOTE **Changing the offset causes the instrument to immediately stop the current sweep and prepare to begin a new sweep, but the data will not change until the trace data updates, because the offset is applied to the data as it is taken. If a trace is exported with a nonzero Ref Level Offset, the exported data will contain the trace data with the offset applied.**

The maximum reference level available is dependent on the reference level offset. That is, **Reference Level** – **Reference Level Offset** must be in the range –170 to +30 dBm. For example, the reference level value range can be initially set to values from –170 dBm to 30 dBm with no **Reference Level Offset**. If the reference level is first set to –20 dBm, then **Reference Level Offset** can be set to values of –150 to +50 dB.

If **Reference Level Offset** is first set to –30 dB, then the reference level can be set to values of –200 dBm to 0 dBm. In this case, **Reference Level** is “clamped” at 0 dBm because the maximum limit of +30 dBm is reached with a reference level setting of 0 dBm with an offset of –30 dB. If instead, **Reference Level Offset** is first set to 30 dB, then **Reference Level** can be set to values of –140 to +60 dBm.

Number of Divisions

Lets you set the number of divisions vertically in the graticule. For example, set this to 12 to allow 120 dB of dynamic range with a scale of 10 dB/division.

Remote Command	`:DISPlay:WINDow[1]:TRACe:Y[:SCALe]:NDIVision 6 | 8 | 10 | 12 | 16 | 20` `:DISPlay:WINDow[1]:TRACe:Y[:SCALe]:NDIVision?`
Example	`:DISP:WIND:TRAC:Y:NDIV 12`
Preset	10
State Saved	Saved in instrument state

3.2.3.2 Attenuation

Controls the attenuator functions and interactions between the attenuation system components.

There are two attenuator configurations in the X-Series. One is a Dual-Attenuator configuration consisting of a mechanical attenuator and an optional electronic attenuator. The other configuration uses a single attenuator with combined mechanical and electronic sections that controls all the attenuation functions. Different models in the X-Series come with different configurations.

- See "Dual-Attenuator Configurations" on page 210
- See "Single-Attenuator Configuration" on page 211

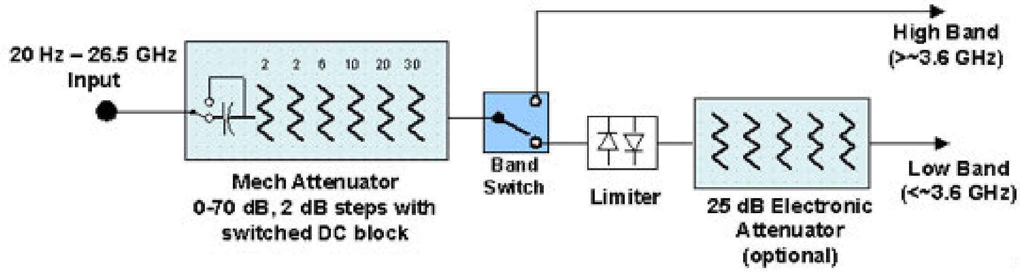
Most attenuation settings are the same for all measurements – they do not change as you change measurements. Settings like these are called “Meas Global” and are unaffected by **Meas Preset**.

Only available when the hardware set includes an input attenuator, which is typically only the case for Keysight’s benchtop instruments. For example, this tab does *not* appear in VXT models M9421A/10A/11A, nor in UXM. In UXM, all **Attenuation** and **Range** settings are disabled, as the expected input power level is handled by the Call Processing App that drives the DUT power control.

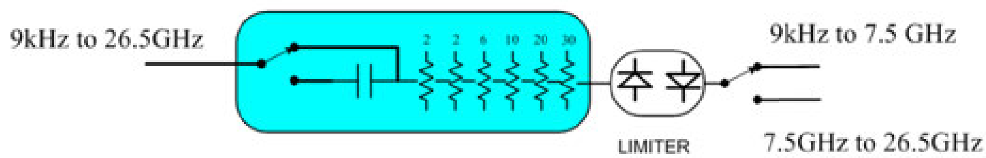
Dependencies	In measurements that support the I/Q inputs, unavailable when I/Q is the selected input. Replaced by the **Range** tab in that case

Dual-Attenuator Configurations

Configuration 1: Mechanical attenuator + optional electronic attenuator

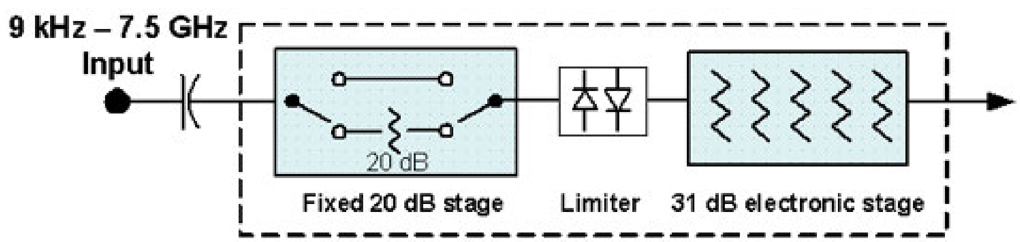


Configuration 2: Mechanical attenuator, no optional electronic attenuator

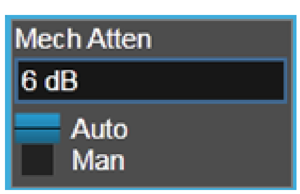


Note that Configuration 2 is not strictly speaking a dual-section attenuator, since there is no electronic section available. However, it behaves exactly like Configuration 1 without the Electronic Attenuator Option EA3, therefore for the sake of this document it is grouped into the "Dual-Attenuator" configuration.

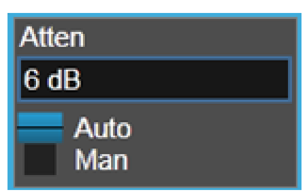
Single-Attenuator Configuration



You can tell which attenuator configuration you have by pressing the Attenuation tab, which (in most Modes) opens the Attenuation menu. If the first control in the Attenuation menu says **Mech Atten** you have the Dual-Attenuator configuration. If the first control says **Atten** you have the Single-Attenuator configuration.



Dual Attenuator



Single Attenuator

(Note that depending on the measurement, there may be no Auto/Man functionality on the Mech Atten control.)

In the Single-Attenuator configuration, you control the attenuation with a single control, as the fixed stage has only two states. In the Dual-Attenuator configuration, both stages have significant range, so you are given separate control of the mechanical and electronic attenuator stages.

When you have the Dual-Attenuator configuration, you may still have only a Single-Attenuator, because unless Option EA3 (the Electronic Attenuator option) is available, and you purchase it, you will have only the mechanical attenuator.

Full Range Atten

This control and **Attenuator Summary** only appear in N9041B, when the RF input is selected, the RF Input Port is set to RF Input 2, and the Full Range Attenuator is installed. The Full Range Attenuator adds a second input attenuator in front of RF Input 2, which enhances the protection and optimizes the performance of the extra internal mixers used by RF Input 2.

Remote Command	`[:SENSe]:POWer[:RF]:FRATten <rel_ampl>` `[:SENSe]:POWer[:RF]:FRATten?`
Example	`:POW:FRAT 14` `:POW:FRAT?`
Notes	When you enter an amplitude value that falls between valid values, the value will be incremented to the next smallest valid value
Dependencies	Only appears if input RF is selected, RF Input Port 2 is selected, and the Full Range Attenuator exists
Couplings	This value is never changed by any coupling, but other couplings use this value. See **Reference Level** and "Mech Atten" on page 1935 command descriptions
Preset	20 dB
State Saved	Saved in instrument state
Min	0 dB
Max	Only valid values are 0, 6, 14, 20 dB
Annotation	When the **Input** is **RF**, and the **Input Port** is **RF Input 2**, and the Full Range Attenuator is installed: On the Meas Bar, the field “Atten” displays as follows: – If the sweep is entirely < 50 GHz, the value shown after “Atten:” is equal to Mech Atten + Elec Atten + Full Range Atten – If the sweep is entirely > 50 GHz, the value shown after “Atten:” is equal to Full Range Atten – If the sweep straddles 50 GHz, the value shown after “Atten:” is preceded by the symbol “>=” and is equal to Full Range Atten

	In the **Amplitude**, "Y Scale" on page 1929 menu, and the Atten **Meas Bar** dropdown menu panel, a summary is displayed as follows: "Total Atten below 50 GHz" followed by the value of Full Range Atten + Mech Atten + Elec Atten "Total Atten above 50 GHz" followed by the value of Full Range Atten For example, if Mech Atten = 6 dB, Elec Atten = 4 dB, and Full Range Atten = 20 dB, the summary below is shown: – Attenuator summary: – Total Atten below 50 GHz: 30 dB – Total Atten above 50 GHz: 20 dB

Mech Atten

Labeled **Mech Atten** in Dual-Attenuator models and **Atten** in Single-Attenuator models. In the Dual-Attenuator configuration, this control only affects the mechanical attenuator.

Lets you modify the attenuation applied to the RF input signal path. This value is normally auto-coupled to the Ref Level, the Internal Preamp Gain, any External Gain that is entered, and the Max Mixer Level, as described in the table below.

See "Attenuator Configurations and Auto/Man" on page 215

Remote Command	`[:SENSe]:POWer[:RF]:ATTenuation <rel_ampl>`
	`[:SENSe]:POWer[:RF]:ATTenuation?`
	`[:SENSe]:POWer[:RF]:ATTenuation:AUTO OFF | ON | 0 | 1`
	`[:SENSe]:POWer[:RF]:ATTenuation:AUTO?`

Example	`:POW:ATT 20`
	Dual-Attenuator configuration: sets the mechanical attenuator to 20 dB
	Single-Attenuator mode: sets the main attenuation to 20 dB (see below for definition of "main" attenuation)
	In either case, if the attenuator was in Auto, it is set to Manual
	`:POW:ATT:AUTO ON`
	Turn Auto Mech Atten ON

Dependencies	Some measurements do not support Auto setting of "Mech Atten" on page 213. In these measurements, the **Auto/Man** selection is not available, and the Auto/Man toggle function is not available In Dual-Attenuator configurations, when the electronic attenuator is enabled, the mechanical attenuator has no auto setting, and the Auto/Man toggle function is not available. The state of Auto/Man is remembered and restored when the electronic attenuator is once again disabled. This is described in more detail in "Elec Atten" on page 1937 See "Attenuator Configurations and Auto/Man" on page 215 for more information on the Auto/Man

	functionality `:POW:ATT:AUTO` is only available in measurements that support Mech Atten Auto, such as Swept SA
Couplings	If the RF Input Port is the RF Input: – If the USB Preamp is connected to USB, use 0 dB for Mech Atten – Otherwise compute the auto-selected value of Mech Atten based on **Reference Level**, Int Preamp, External Gain, Ref Level Offset, Max Mixer Level, µW Path Control and IF Gain settings. Limit this value to be no less than 6 dB (total attenuation below 6 dB can never be chosen by Auto) – In the N9041B, if the RF Input Port is RF Input 2, use the formula above and subtract the Full Range Atten value from the result to determine the Mech Atten. Limit the value so that it is never lower than 0 dB and so that total attenuation, including Full Range Atten, is never less than 6 dB (total attenuation, including Full Range Atten below 6 dB, can never be chosen by Auto) In External Mixing and BBIQ, where the Attenuator is not in the signal path, the Attenuator setting changes as described above when "Mech Atten" on page 213 is in Auto, but no changes are made to the actual attenuator hardware setting until the input is changed back to the RF Input For CXA-m with option FSA (Fine-Step Attenuator or 2 dB steps), the FSA-like behavior is only available when the frequency setting is <= 7.5 GHz. So, when the frequency is changed from below 7.5 GHz to above 7.5 GHz, the attenuation setting will be changed to a multiple of 10 dB which will be no smaller than the previous setting. For example, 4 dB attenuation will be changed to 10 dB
Preset	The preset for Mech Attenuation is “Auto” The Auto value of attenuation is 10 dB `ON`
State Saved	Saved in instrument state
Min	0 dB The attenuation set by this control cannot be decreased below 6 dB with the knob or step keys. Values below 6 dB must be directly entered from the keypad or via SCPI. This protects against setting a dangerously small attenuation value, which can put the instrument at risk of damage to input circuitry. If the current mechanical attenuation is below 6 dB, it can be increased with the knob and step keys, but not decreased
Max	CXA Option 503 or 507: 50 dB EXA: 60 dB All other models: 70 dB Note that in the Single-Attenuator configuration, the total of ATT and EATT cannot exceed 50 dB. So, if the EATT is set to 24 dB first, the main attenuation cannot be greater than 26 dB and will be reduced accordingly; if the main attenuator is set to 40 dB first, EATT cannot be greater than 10 dB
Annotation	The current value for Total Atten is displayed in the Measurement Bar at the top of the display. A value appears for Electronic Attenuation only if the Electronic Attenuator is enabled. The annotation appears as Atten: <total> dB (e<elec>) The e letter is in amber in Single-Attenuator configurations For example:

Dual-Attenuator configuration:

Atten: 24 dB (e14)

Indicating the total attenuation is at 24 dB and the electronic attenuation is at 14 dB

Single-Attenuator configuration:

A: 24 dB (e14)

Indicating the total attenuation is at 24 dB and the “soft” attenuation is at 14 dB (see below for definition of “soft” attenuation)

When in Manual, a # sign appears in front of Atten in the annotation

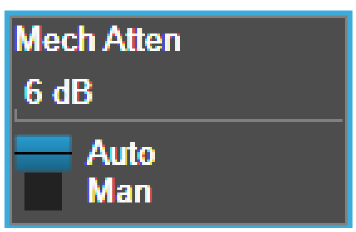
Attenuator Configurations and Auto/Man

As described under "Y Scale" on page 1929, there are two distinct attenuator configurations available in the X-Series, the single attenuator and Dual-Attenuator configurations. In Dual-Attenuator configurations, we have the mechanical attenuation and the electronic attenuation, and the current total attenuation is the sum of the electronic + mechanical attenuation. In Single-Attenuator configurations, we refer to the attenuation set using "Mech Atten" on page 213 (or `:POW:ATT`) as the “main” attenuation; and the attenuation that is set by `:POW:EATT` as the “soft” attenuation (`:POW:EATT` is honored even in the Single-Attenuator configuration, for compatibility purposes). Then the current total attenuation is the sum of the main + soft attenuation.

See "Elec Atten" on page 1937 for more about “soft” attenuation.

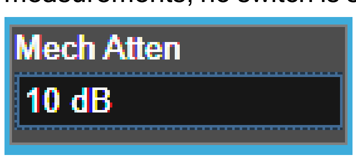
NOTE

In some measurements, the **Mech Atten** control has an Auto/Man function. In these measurements, an Auto/Man switch is shown on the **Mech Atten** control:



Note that in configurations that include an Electronic Attenuator, this switch is only shown when the Electronic Attenuator is disabled.

In other measurements, **Mech Atten** has no Auto/Man function. In these measurements, no switch is shown on the **Mech Atten** control:



Mech Atten also appears with no switch, as above, in configurations that include an Electronic Attenuator but when the Electronic Attenuator is enabled.

Elec Atten

Controls the Electronic Attenuator in Dual-Attenuator configurations. Does not appear in Single-Attenuator configurations, because the control of both the mechanical and electronic stages of the Single-Attenuator is integrated into the single **Atten** control.

This control includes an **Enable/Disable** toggle switch; it is only possible to enter a value for the Electronic Attenuator when this switch is in the **Enable** position.

For more details about the Electronic Attenuator, see "More Information" on page 217

Remote Command	`[:SENSe]:POWer[:RF]:EATTenuation <rel_ampl>`
	`[:SENSe]:POWer[:RF]:EATTenuation?`
	`[:SENSe]:POWer[:RF]:EATTenuation:STATe OFF | ON | 0 | 1`
	`[:SENSe]:POWer[:RF]:EATTenuation:STATe?`

Example	`:POW:EATT 10`
	`:POW:EATT?`
	`:POW:EATT:STAT ON`
	`:POW:EATT:STAT?`

Notes	Electronic Attenuation's specification is defined only when Mechanical Attenuation is 6 dB
Dependencies	Only appears in Dual-Attenuator models with an Electronic Attenuator installed and licensed. Does not appear in models with the Single-Attenuator configuration, because in the Single-Attenuator configuration there is no "electronic attenuator"; there is only a single integrated attenuator (which has both a mechanical and electronic stage). However, in the Single-Attenuator configuration, EATT SCPI commands are accepted for compatibility with other X-series instruments, and set a "soft" attenuation. The "soft" attenuation is treated as an addition to the "main" attenuation value set by the **Attenuation** control or `:POW:ATT`, and affects the total attenuation displayed on the **Attenuation** control and the Meas Bar The electronic attenuator, and the "soft" attenuation function provided in Single-Attenuator configurations, are unavailable above the low band (0-3.6 GHz, 0-3.4 GHz, 0-3 GHz, depending on the model). If the low band range is from 0-3.6 GHz, and Stop Frequency of the instrument is > 3.6 GHz, then the **Enabled/Disabled** section of the **Elec Atten** control will be `OFF` and grayed-out If "Internal Preamp" on page 1959 is `ON` (that is, set to Low Band or Full), the electronic attenuator (and the "soft" attenuation function provided in Single-Attenuator configurations) is unavailable. In this case the **Enabled/Disabled** section of the **Elec Atten** control will be `OFF` and grayed-out If either of the above is true, and the SCPI command is sent, an error indicating that the electronic attenuator is unavailable is returned If both the above are true, pressing the control generates error message -221, in other words, the frequency range lockout takes precedence If the electronic/soft Attenuator is enabled, then the **Stop Freq** of the instrument is limited to 3.6 GHz and **Internal Preamp** is unavailable

	If "LNA" on page 1960 is ON, the electronic attenuator (and the "soft" attenuation function provided in Single-Attenuator configurations) is unavailable. In this case the **Enabled/Disabled** section of the **Elec Atten** control will be OFF and grayed-out. This coupling works in the following modes/measurements: – Channel Power, Occupied BW, ACP, SEM, Spurious Emissions, Power Stat CCDF measurements in all Modes – Transmit On|Off Power measurement in 5GNR Mode – Power vs. Time and Transmit Power measurement in GSM/EDGE Mode – Burst Power measurement in Spectrum Analyzer Mode The SCPI-only "soft" electronic attenuation for the single-attenuator configuration is not available in all measurements; in particular, it is not available in the Swept SA measurement
Couplings	Enabling and disabling the Electronic Attenuator affects the setting of the Mechanical Attenuator (in Dual-Attenuator configurations). This is described in more detail below and in "Mechanical Attenuator Transition Rules" on page 217
Preset	0 dB OFF (Disabled) for Swept SA measurement ON (Enabled) for all other measurements that support the electronic attenuator
State Saved	Saved in instrument state
Min	0 dB
Max	Dual-Attenuator configuration: 24 dB Single-Attenuator configuration: the total of ATT and EATT cannot exceed 50 dB. So, if the EATT is set to 24 dB first, the main attenuation cannot be greater than 26 dB and will be reduced accordingly; if the main attenuator is set to 40 dB first, EATT cannot be greater than 10 dB
Annotation	See Annotation under the **Mech Atten** control description

More Information

The electronic attenuator offers finer steps than the mechanical attenuator, has no acoustical noise, is faster, and is less subject to wear. These advantages primarily aid in remote operation and are negligible for front panel use. See "Using the Electronic Attenuator: Pros and Cons" on page 218 for a detailed discussion of the pros and cons of using the electronic attenuator.

For the Single-Attenuator configuration, for SCPI backwards compatibility, the "soft" attenuation feature replaces the Dual-Attenuator configuration's electronic attenuator. All the same couplings and limitations apply. See "Attenuator Configurations and Auto/Man" on page 1937

Mechanical Attenuator Transition Rules

When the Electronic Attenuator is enabled, the Mechanical Attenuator transitions to a state that has no Auto function. Below are the rules for transitioning the Mechanical Attenuator. Note that the information below *only* applies to the Dual-

Attenuator configurations, and *only* when the Electronic Attenuator is installed:

When the Electronic Attenuation is enabled from a disabled state:

- The Mechanical Attenuator is initialized to 10 dB (this is its optimal performance setting). You can then set it as desired with SCPI, numeric keypad, step keys, or knob, and it behaves as it normally would in manual mode
- The Auto/Man state of (Mech) Atten is saved
- The Auto/Man toggle on the (Mech) Atten control disappears, and the auto rules are disabled
- The Electronic Attenuator is set to 10 dB less than the previous value of the Mechanical Attenuator, within the limitation that it must stay within the range of 0 to 24 dB of attenuation

Examples in the Dual-Attenuator configuration:

- Mech Atten at 20 dB. Elec Atten enabled, Mech Atten set to 10 dB, and Elec Atten set to 10 dB. New total attenuation equals the value before Elec Atten enabled
- Mech Atten at 0 dB. Elec Atten enabled, Mech Atten set to 10 dB, and Elec Atten set to 0 dB. New total attenuation does not equal the value before Elec Atten enabled
- Mech Atten at 40 dB. Elec Atten enabled, Mech Atten set to 10 dB, and Elec Atten set to 24 dB. New total attenuation does not equal the value before Elec Atten enabled

When the Electronic Attenuation is disabled from an enabled state:

- The Elec Atten control is grayed out
- The Auto/Man state of (Mech) Atten is restored
- If now in Auto, (Mech) Atten recouples
- If now in Man, (Mech) Atten is set to the value of total attenuation that existed before the Elec Atten was disabled. The resulting value is rounded up to the smallest value possible given the (Mech) Atten Step setting – (That is, 57 dB changes to 58 dB when (Mech) Atten Step is 2 dB)

Using the Electronic Attenuator: Pros and Cons

The electronic attenuator offers finer steps than the mechanical attenuator, has no acoustical noise, is faster, and is less subject to wear.

The “finer steps” advantage of the electronic attenuator is beneficial in optimizing the alignment of the instrument dynamic range to the signal power in the front panel as well as remote use. Thus, you can achieve improved relative signal measurement accuracy. Compared to a mechanical attenuator with 2 dB steps, the 1 dB resolution of the electronic attenuator only gives better resolution when the odd-decibel steps are used. Those odd-decibel steps are less accurately calibrated than the even-decibel steps, so one tradeoff for this superior relative accuracy is reduced absolute amplitude accuracy.

Another disadvantage of the electronic attenuator is that the spectrum analyzer loses its “Auto” setting, making operation less convenient.

Also, the relationship between the dynamic range specifications (TOI, SHI, compression, and noise) and instrument performance are less well-known with the electrical attenuator. With the mechanical attenuator, TOI, SHI, and compression threshold levels increase dB-for-dB with increasing attenuation, and the noise floor does as well. With the electronic attenuator, there is an excess attenuation of about 1 to 3 dB between 0 and 3.6 GHz, making the effective TOI, SHI, and so forth, less well known. Excess attenuation is the actual attenuation relative to stated attenuation. Excess attenuation is accounted for in the instrument calibration.

Mech Atten Step

Controls the step size used when making adjustments to the input attenuation.

Labeled **Mech Atten Step** in Dual-Attenuator models and **Atten Step** in Single-Attenuator models. In the Dual-Attenuator configuration, only affects the step size of the mechanical attenuator.

Remote Command	`[:SENSe]:POWer[:RF]:ATTenuation:STEP[:INCRement] 10 dB | 2 dB` `[:SENSe]:POWer[:RF]:ATTenuation:STEP[:INCRement]?`
Example	`:POW:ATT:STEP 2` `:POW:ATT:STEP?`
Notes	Has a toggle control on the front panel, but takes a specific value (in dB) when used remotely. The only valid values are 2 and 10
Dependencies	Blanked in EXA, CXA and CXA-m if option FSA (2 dB steps) is not present. If blanked, attempts to set it via SCPI yield an error
Couplings	When the attenuation step size changes, the current mechanical attenuation value is adjusted (if necessary) to be quantized to the new step size. That is, if step is set to 10 dB, mech atten is increased if necessary so it is a multiple of 10 dB
Preset	EXA, CXA and CXA-m: 10 dB (2 dB with option FSA) All other models: 2 dB
State Saved	Saved in instrument state

Max Mixer Level

Allows you to set the maximum level to be applied to the mixer for a signal at the top of the screen. By setting this value up or down you can allow more or less signal through the system.

The major impact of changes to **Max Mixer Level** is seen in changes to the value to which **Reference Level** is limited. Max Ref Level depends on Max Mixer Level and Attenuation, and therefore a higher Max Mixer Level may let you set Ref Level higher. However, changing this value can impact your TOI, compression, or dynamic range. The preset value of this function is best for most measurements.

See also "Max Mixer Lvl Rules" on page 1948.

Remote Command	`[:SENSe]:POWer[:RF]:MIXer:RANGe[:UPPer] <real>` `[:SENSe]:POWer[:RF]:MIXer:RANGe[:UPPer]?`
Example	`:POW:MIX:RANG -15 dBm` `:POW:MIX:RANG?`
Dependencies	Only appears in Swept SA and RTSA measurements
Preset	-10 dBm
State Saved	Saved in instrument state
Min	-50 dBm
Max	0 dBm

Max Mixer Lvl Rules

Allows you to optimize the Max Mixer Level setting for certain kinds of measurements.

`NORMal`	The historical, and thus backwards compatible, setting range (–50 to 0 dBm) and default setting (–10 dBm). The instrument has been designed so that, at the default setting, any signal below the Reference Level is extremely unlikely to create ADC overloads. At this mixer level the scale fidelity will be within specifications, thus compression with be negligible
`TOI`	Allows a range of settings of the "Max Mixer Level" on page 1947, –50 to –10 dBm, that can be optimum for measurements limited by the instrument third-order dynamic range. The default setting, –25 dBm, is commonly appropriate but RBW affects this. A good setting for Max Mixer Level would be higher than the optimum mixer level by half of the attenuator step size
`COMPression`	Allows a range of settings of the Max Mixer Level, –10 to +10 dBm or more, that can be optimum for measurements limited by the tradeoffs between instrument accuracy due to compression, and dynamic range due to the noise floor. The default setting, –3 dBm, is commonly appropriate, representing mixer drive

levels that cause 1 dB or less compression at most carrier frequencies

Typical measurements that would be optimized by this setting are the measurement of low sideband levels, including nulls, in angle-modulated signals (FM and PM). Also pulsed-RF measurements, including finding nulls to estimate pulse width, which are often best done with significant overdrive (compression) of the front end

Setting Name (readback)	Setting Name (verbose)	Max Mixer Level Preset Value, dBm	Max Mixer Level minimum value, dBm	Max Mixer Level maximum value, dBm
NORMal	Normal – balance TOI, noise, and compression	–10	–50	0
TOI	TOI-limited dynamic range	–25	–50	–10
COMPression	Compression-limited dynamic range	–3	–10	+30

Remote Command	`[:SENSe]:POWer[:RF]:MIXer:RULEs NORMal | TOI | COMPression` `[:SENSe]:POWer[:RF]:MIXer:RULEs?`
Example	`:POW:MIX:RULE:COMP`
Dependencies	Only appears in the Swept SA and RTSA measurements
Preset	`NORM`

3.2.3.3 Range (Non-attenuator models)

Only available for Keysight’s modular signal analyzers and certain other Keysight products, such as VXT

State Saved	No

Range

Represents the amplitude of the largest sinusoidal signal that could be present within the IF without being clipped by the ADC. For signals with high peak-to-average ratios, the range may need to exceed the rms signal power by a significant amount to avoid clipping.

This is a measurement global setting.

Remote Command	`[:SENSe]:POWer[:RF]:RANGe <real>` `[:SENSe]:POWer[:RF]:RANGe?`

Example	`:POW:RANG 10 dBm` `:POW:RANG?`
Notes	The MIN and MAX values are affected by the External Gain parameters, and by the **Center Frequency** The hardware compensates for frequency response and alters the Range setting
Preset	0 dBm
State Saved	Yes
Min	-100
Max	100
Annotation	Meas Bar

Adjust Range for Min Clipping

Sets the combination of attenuation and gain based on the current measured signal level so that clipping will be at a minimum.

This is an "immediate action" function, that is, it executes once, when the key is pressed.

This key does not appear in measurements that do not support this functionality.

Remote Command	`[:SENSe]:POWer[:RF]:RANGe:OPTimize IMMediate`
Notes	Executing Adjust Range for Min Clipping initiates the measurement
Dependencies	Does not appear in the Swept SA and Monitor Spectrum measurements

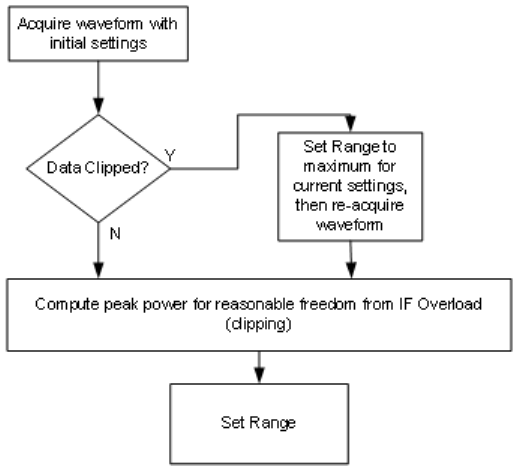
Pre-Adjust for Min Clipping

If this function is `ON`, it applies the adjustment described under Adjust Range For Min Clipping each time a measurement restarts. Therefore, in Continuous measurement mode, it only executes before the first measurement.

Remote Command	`[:SENSe]:POWer[:RF]:RANGe:OPTimize:ATTenuation OFF | ON | ELECtrical | COMBined` `[:SENSe]:POWer[:RF]:RANGe:OPTimize:ATTenuation?`
Notes	Because there is no attenuator control available in these models, the control displays only `ON` and `OFF` choices. However, for SCPI compatibility with other platforms, all three parameters (`ELECtrical`, `COMBined`, and `ON`) are honored and all are mapped to `ELECtrical`, so if any of these three parameters is sent, a subsequent query will return `ELEC`
Dependencies	Does not appear in the Swept SA and Monitor Spectrum measurements
Preset	`OFF` for Swept SA measurement; `ON` for all other measurements that support **Pre-Adjust for Min Clipping**
State Saved	Saved in instrument state

Adjustment Algorithm

The algorithm for the adjustment is documented below:



Peak-to-Average Ratio

Used with "Range (Non-attenuator models)" on page 1953 to optimize the level control in the instrument. The value is the ratio, in dB, of the peak power to the average power of the signal to be measured. A ratio of 0 should be used for sinusoidal signals; for 802.11g OFDM signals use 9 dB.

All Modes show the current value of Peak-to-Average ratio on the control. However, some Modes do not permit changing the value. In these situations, the control is grayed-out.

Remote Command	`[:SENSe]:POWer[:RF]:RANGe:PARatio <real>` `[:SENSe]:POWer[:RF]:RANGe:PARatio?`
Example	`:POW:RANG:PAR 12 dB`
Notes	In some Modes, this parameter is read-only; meaning the value will appear on the control and query via SCPI, but is not changeable. In such applications the control is grayed-out. Attempting to change the value via SCPI will be ignored but no error message will be generated
Dependencies	Does not appear in Spectrum Analyzer Mode
Preset	10 dB VXT Models M9410A/11A: 0 dB
State Saved	Saved in instrument state
Min	0 dB
Max	20 dB VXT Models M9410A/11A: 50 dB

Mixer Lvl Offset

This is an advanced setting to adjust target Range at the input mixer, which in turn affects the signal level in the instrument's IF. This setting can be used when additional optimization is needed after setting "Peak-to-Average Ratio" on page 1955. Positive values of offset optimize noise performance over distortion, negative values optimize distortion performance over noise.

Remote Command	`[:SENSe]:POWer[:RF]:RANGe:MIXer:OFFSet <real>` `[:SENSe]:POWer[:RF]:RANGe:MIXer:OFFSet?`
Example	`:POW:RANG:MIX:OFFS -5 dB`
Preset	0 dB
State Saved	Saved in instrument state
Min	-35 dB VXT Models M9410A/11A: -34 dB
Max	30 dB

3.2.3.4 Signal Path

Contains controls that pertain to the routing of the signal through the frontend of the instrument.

In general, only appears in instruments whose hardware supports this signal routing. For example, this tab does not appear in many of the modular instrument products, including VXT Model M9421A, or UXM.

This tab *does* appear in VXT Models M9410A/11A, because "Software Preselection" on page 1971 is under this tab, and VXT Models M9410A/11A implement a version of Software Preselection.

Presel Center

Adjusts the centering of the preselector filter to optimize the amplitude accuracy at the frequency of the selected marker. If the selected marker is not on when **Presel Center** is pressed, the instrument turns on the selected marker, performs a peak search, and then performs centering on the marker's center frequency. If the selected marker is already on and between the start and stop frequencies of the instrument, the instrument performs the preselector calibration on that marker's frequency. If the selected marker is already on, but outside the frequency range between **Start Freq** and **Stop Freq**, the instrument first performs a peak search, and then performs centering on the marker's center frequency.

The value displayed on "Preselector Adjust" on page 1958 changes to reflect the new preselector tuning.

Certain considerations should be observed to ensure proper operation, as detailed in "Proper Preselector Operation" on page 225.

Remote Command	`[:SENSe]:POWer[:RF]:PCENter`
Example	`:POW:PCEN`
Notes	The rules outlined above under the control description apply for the remote command as well as the key. The result of the command depends on marker position, etc. Any message generated by the control press is also generated in response to the remote command
Dependencies	Does not appear in CXA-m, nor in VXT Models M9410A/11A Grayed-out if the microwave preselector is off – If the selected marker's frequency is below Band 1, an advisory message is generated "Preselector not used in this frequency range" and no action is taken – Grayed-out if entirely in Band 0, that is, if **Stop Freq** is below about 3.6 GHz Grayed-out if entirely above 50 GHz, that is, if **Start Freq** is above 50 GHz – Blanked in models that do not include a preselector, such as Option 503. If the remote command is sent in these instruments, accepted without error, and the query always returns 0 – Grayed-out in the Spectrogram View
Couplings	The active marker position determines where the centering will be attempted If the instrument is in a measurement such as averaging when centering is initiated, the act of centering the preselector restarts averaging, but the first average trace will not be taken until the centering is completed The offset applied to do the centering appears in "Preselector Adjust" on page 1958
Status Bits/OPC dependencies	When centering the preselector, `*OPC` does not return true until the process is complete and a subsequent measurement has completed, nor are results returned in response to `:READ` or `:MEASure` queries The `Measuring` bit remains set (true) while this command is operating, and does not go false until the subsequent sweep/measurement has completed

Proper Preselector Operation

Certain considerations should be observed to ensure proper operation:

1. If the selected marker is **Off**, the instrument turns on a marker, performs a peak search, and adjusts the preselector using the selected marker's frequency. It uses the "highest peak" peak search method unqualified by threshold or excursion, so that there is no chance of a 'no peak found' error. It continues with that peak, even if it is the peak of just noise. Therefore, for this operation to work properly, there should be a signal on-screen in a preselected range for the peak search to find

2. If the selected marker is already **On**, the instrument attempts the centering at that marker's frequency. There is no preselector for signals below about 3.6 GHz, so if the marker is on a signal below 3.6 GHz, no centering is attempted, and an advisory message is generated
3. In some models, the preselector can be bypassed. If it is bypassed, no centering is attempted in that range and a message is generated

Preselector Adjust

Lets you manually adjust the preselector filter frequency to optimize its response to the signal of interest. Only available when "Presel Center" on page 1956 is available.

For general purpose signal analysis, using **Presel Center** is recommended. Centering the filter minimizes the impact of long-term preselector drift. **Preselector Adjust** can be used instead to manually optimize the preselector. One application of manual optimization would be to peak the preselector response, which both optimizes the signal-to-noise ratio and minimizes amplitude variations due to small (short-term) preselector drifting.

When **Presel Center** is performed, the offset applied to do the centering becomes the new value of **Preselector Adjust**.

Remote Command	`[:SENSe]:POWer[:RF]:PADJust <freq>` `[:SENSe]:POWer[:RF]:PADJust?`
Example	`:POW:PADJ 100KHz` `:POW:PADJ?`
Notes	The value on the control is displayed to 0.1 MHz resolution
Dependencies	– Does not appear in CXA-m – Does not appear in VXT Models M9410A/11A – Grayed-out if microwave preselector is off – Grayed-out if entirely in Band 0, that is, if Stop Freq is lower than about 3.6 GHz – Grayed-out if entirely above 50 GHz, that is, if Start Freq is higher than 50 GHz – Blank in models that do not include a preselector, such as Option 503. If the command is sent in these instruments, it is accepted without error, and the query always returns 0 – Grayed-out in the Spectrogram View
Preset	0 MHz
State Saved	The **Preselector Adjust** value set by "Presel Center" on page 1956, or by manually adjusting **Preselector Adjust** Not saved in instrument state, and does not survive a Preset or power cycle

Min	-500 MHz
Max	500 MHz
Backwards Compatibility SCPI	`[:SENSe]:POWer[:RF]:MW:PADJust` `[:SENSe]:POWer[:RF]:MMW:PADJust`

Notes	The command has no effect, and the query always returns `MWAVe`
Backwards Compatibility SCPI	`[:SENSe]:POWer[:RF]:PADJust:PRESelector MWAVe | MMWave | EXTernal` `[:SENSe]:POWer[:RF]:PADJust:PRESelector?`

Internal Preamp

Accesses a menu of controls for the internal preamps. Turning on the preamp gives a better noise figure, but a poorer inter-modulation distortion (TOI) to noise floor dynamic range. You can optimize this setting for your measurement.

The instrument takes the preamp gain into account as it sweeps. If you sweep outside of the range of the preamp, the instrument will also account for that. The displayed result always reflects the correct gain.

For some measurements, when the preamp is on and any part of the displayed frequency range is below the lowest frequency for which the preamp has specifications, a warning condition message appears in the status line. For example, for a preamp with a 9 kHz lowest specified frequency: "Preamp: Accy unspec'd below 9 kHz".

Selection	Example	Note
Off	`:POW:GAIN OFF`	
Low Band	`:POW:GAIN ON` `:POW:GAIN:BAND LOW`	Sets the internal preamp to use only the low band. The frequency range of the installed (optional) low-band preamp is displayed in square brackets on the Low Band selection in the dropdown
Full Range	`:POW:GAIN ON` `:POW:GAIN:BAND FULL`	Sets the internal preamp to use its full range. The low band (0-3.6 GHz, 0-3.4 GHz, 0-3 GHz, depending on the model) is supplied by the low band preamp and the frequencies above low band are supplied by the high band preamp The frequency range of the installed (optional) low-band preamp is displayed in square brackets on the Full Range selection in the dropdown. If the high band option is not installed the Full Range selection does not appear

NOTE The maximum **Center Frequency** for Low Band, displayed in square brackets, can change based on the selected IFBW for measurements that support IFBW (for example, Waveform measurement across all Modes that support it). In certain models (such as N9042B & N9032B), IFBW values <= 40 MHz have a maximum Low Band frequency of 3.6 GHz, while 40 MHz < IFBW <= 1 GHz have a maximum of 3.3 GHz, and 1 GHz < IFBW <= 1.5 GHz have a maximum of 3.5 GHz. IFBW values > 1.5 GHz do not support a **Center Frequency** that can reach the Low Band maximum frequency. In these cases, **N/A** is displayed in the square brackets for Low Band.

Remote Command	`[:SENSe]:POWer[:RF]:GAIN:BAND LOW | FULL`
	`[:SENSe]:POWer[:RF]:GAIN:BAND?`
	`[:SENSe]:POWer[:RF]:GAIN[:STATe] OFF | ON | 0 | 1`
	`[:SENSe]:POWer[:RF]:GAIN[:STATe]?`

Example	`:POW:GAIN:BAND LOW`
	`:POW:GAIN:BAND?`
	`:POW:GAIN OFF`
	`:POW:GAIN?`

Dependencies	Not available on all hardware platforms. If the preamp is not present or is unlicensed, this control is not shown Does not appear in VXT Models M9410A/11A/15A/16A If `:POW:GAIN:BAND FULL` is sent when a low band preamp is available, the preamp band parameter is set to `LOW` instead of `FULL`, and an "Option not installed" message is generated Not available when the electronic/soft attenuator is enabled
Preset	`LOW` `OFF`
State Saved	Saved in instrument state
Annotation	When the USB Preamp is not connected to USB, the Preamp annotation in the Meas Bar says “Off” if the preamp is off and displays the frequency range of the low band or full range preamp depending on the setting. For example, if the Preamp is set to Low Band and the Low Band is 3.6 GHz the annotation says “3.6 GHz”. If it is a 13.6 GHz preamp and it is set to Full Range the annotation says “13.6 GHz” When the USB Preamp is connected to USB, the Preamp annotation says “Preamp: USB” if the internal preamp is off or “Preamp: USB, Int” if the internal preamp is on (only for measurements that support the USB preamp)

LNA

Lets you turn the Low Noise Amplifier (LNA) on or off.

LNA is an additional preamplifier that provides superior DANL and frequency range compared to "Internal Preamp" on page 1959. LNA provides lower system noise

figure, especially at frequencies above 100 MHz, and can be operated up to the full range of 50 GHz instruments.

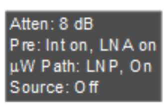
For best possible sensitivity, **LNA** can be turned on *together* with "Internal Preamp" on page 1959, although if you operate both preamps together, note that the TOI (distortion) specifications are impacted. The sensitivity improvement of this combination is substantial when operating in high band (frequencies above 3.6 GHz).

For more details about annotation, see "More Information" on page 229

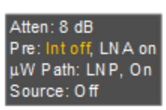
Remote Command	`[:SENSe]:POWer[:RF]:GAIN:LNA[:STATe] OFF | ON | 0 | 1` `[:SENSe]:POWer[:RF]:GAIN:LNA[:STATe]?`
Example	`:POW:GAIN:LNA ON`
Dependencies	Requires Option LNA, except for VXT models M9415A/16A Does not appear in VXT models M9421A/10A/11A May not appear in some measurements **LNA** is not available when the electronic/soft attenuator is enabled
Preset	`OFF`
State Saved	Saved in State

More Information

When **LNA** is installed, the preamp annotation changes to show the state of both **LNA** and **Internal Preamp**. Below is an example:



Note that when operating entirely in the low band (below about 3.6 GHz), if **LNA** is on, **Internal Preamp** is switched off (even if you have its switch set to `ON`). This is because the noise performance is actually degraded in low band if both preamps are on. In this case, the annotation reflects the actual state of the two preamps, but the **Internal Preamp** annotation displays in amber, to warn you that the actual state of **Internal Preamp** does not match its switch control display:



µW Path Control

Options for this control include **µW Preselector Bypass** (Option MPB), **Low Noise Path** (Option LNP) and **Full Bypass Enable** in the High Band path circuits.

When the µW Preselector is bypassed, flatness is improved, but will be subject to spurs from out of band interfering signals. When **Low Noise Path Enable** is selected, the instrument automatically bypasses certain circuitry in the high frequency bands that can contribute to noise, when it is appropriate based on other instrument settings.

For most applications, the preset state is **Standard Path**, which provides the best remote-control throughput, minimizes acoustic noise from switching and minimizes the risk of wear in the hardware switches, particularly in remote test scenarios where both low band and high band setups will follow in rapid succession. In this path, the bypass of the low band/high band switch and microwave preamp is never activated, which can cause some noise degradation but preserves the life of the bypass switch.

For applications that utilize the wideband IF paths, the preset state is **µW Preselector Bypas**s, if option MPB is present. This is because, when using a wideband IF such as the 140 MHz IF, the µW Preselector's bandwidth can be narrower than the available IF bandwidth, causing degraded amplitude flatness and phase linearity, so it is desirable to bypass the preselector in the default case.

You may choose **Low Noise Path Enable** for a lower noise floor, especially in the 21-26.5 GHz region, though without improving many measures of dynamic range, and without giving the best possible noise floor. The preamp, if purchased and used, gives better noise floor than does **Low Noise Path Enable**, but the preamp's compression threshold and third-order intercept are much poorer than that of **Low Noise Path Enable**.

A fourth choice is **Full Bypass Enable**, which combines **µW Preselector Bypass** and **Low Noise Path Enable**. Because this can bypass most of the circuitry between the input and the first mixer, care should be taken when using this setting to avoid damaging the mixer. **Full Bypass Enable** is only available if both options LNP and MPB are present, as well as option FBP.

Path	Example	Note
Standard Path	`:POW:MW:PATH STD`	Normal setting for most measurements. µW Preselector in circuit, Low Noise Path disabled
Low Noise Path Enable	`:POW:MW:PATH LNP`	See "Low Noise Path Enable" on page 234
µW Preselector Bypass	`:POW:MW:PATH MPB`	See "µW Preselector Bypass" on page 236
Full Bypass Enable	`:POW:MW:PATH FULL`	See "Full Bypass Enable" on page 237

Remote Command	`[:SENSe]:POWer[:RF]:MW:PATH STD | LNPath | MPBypass | FULL` `[:SENSe]:POWer[:RF]:MW:PATH?`

Example	`:POW:MW:PATH LNP`
	Enables the Low Noise path
	`:POW:MW:PATH?`

Notes	If "Presel Center" on page 1956 is performed, the instrument will momentarily switch to the Standard Path, regardless of the setting of **µW Path Control** The DC Block will always be switched in when the low noise path is switched in, to protect succeeding circuitry from DC. Note that this does not mean “when the low noise path is enabled” but when, based on the Low Noise Path rules, the path is actually switched in. This can happen when the selection is **Low Noise Path Enable** or **Full Bypass Enable**. In the case where the DC Block is switched in the instrument is now AC coupled. However, if you selected DC coupling, the UI would still behave as though it were DC coupled, including all annunciation, warnings, status bits, and responses to SCPI queries. This is because, based on other settings, the instrument could switch out the low noise path at any time and hence go back to being DC coupled Alignment switching ignores the settings in this menu, and restores them when finished
Dependencies	Does not appear in CXA-m, VXT Models M9410A/11A, nor in BBIQ and External Mixing – The **Low Noise Path Enable** selection does not appear unless Option LNP is present and licensed – The **µW Preselector Bypass** selection does not appear unless Option MPB is present and licensed – The **Full Bypass Enable** selection does not appear unless options LNP and MPB are both present as well as option FBP In any of these cases, if the required options are not present and the SCPI command is sent, error -241, "Hardware missing; Option not installed" is generated **Low Noise Path Enable** and **Full Bypass Enable** are grayed-out if the current measurement does not support them **Low Noise Path Enable** and **Full Bypass Enable** are not supported in Avionics and MMR Modes (non-modulation measurements). In any of these cases (that is, the feature is not supported in either measurement or Mode), if the SCPI command is sent, the following error is generated: -221, “Setting Conflict; Feature not supported for this measurement”
Preset	**Mode** / **Value** IQ Analyzer, Pulse, Avionics: MPB option present and licensed: `MPB`; MPB option not present and licensed: `STD` All other Modes: `STD`
State Saved	Save in instrument state
Range	Standard Path | Low Noise Path Enable | µW Presel Bypass | Full Bypass Enable
Annotation	In the Meas Bar, if the Standard path is chosen: µW Path: Standard If Low Noise Path is enabled but the LNP switch is not thrown: µW Path: LNP,Off If the Low Noise Path is enabled and the LNP switch *is* thrown: µW Path: LNP,On If the preselector is bypassed: µW Path: Bypass

If Full Bypass Enable is selected but the LNP switch is not thrown:

µW Path: FByp,Off

If Full Bypass Enable is selected and the LNP switch *is* thrown:

µW Path: FByp,On

µW Path Control Auto

In VMA, WLAN, 5G NR, CQM Modes, an **Auto/Man** switch is added to **µW Path Control**:

This allows the function to automatically switch based on certain Auto Rules as shown below:

VMA Mode

Measurement	When µW Path Control is in Auto
Digital Demod	Use Standard Path unless tuned frequency > 3.6 GHz and IFBW > 15 MHz, in which case choose Preselector Bypass
Monitor Spectrum	Always Presel Bypass
IQ Waveform	Use Standard Path unless tuned frequency > 3.6 GHz and IFBW > 15 MHz, in which case choose Preselector Bypass
Custom OFDM	Use Standard Path unless tuned frequency > 3.6 GHz and IFBW > 15 MHz, in which case choose Preselector Bypass
Channel Power	Always Presel Bypass
Occupied BW	Always Presel Bypass
CCDF	Use Standard Path unless tuned frequency > 3.6 GHz and IFBW > 15 MHz, in which case choose Preselector Bypass
ACP	Always Presel Bypass
SEM	Always Presel Bypass
Spurious Emissions	Always Standard Path

WLAN Mode

Measurement	When µW Path Control is in Auto
Modulation Analysis	Always Presel Bypass

Measurement	When µW Path Control is in Auto
Spectral Flatness	Always Presel Bypasss
Power vs Time	Always Presel Bypass
Monitor Spectrum	Always Presel Bypass
IQ Waveform	Always Presel Bypass
Channel Power	Always Presel Bypass
Occupied BW	Always Presel Bypass
CCDF	Always Presel Bypass
SEM	For 11be 320M, when ‘Enabled Wideband IF for FFT’ is OFF or ‘Sweep Type Rule’ is Best Dynamic Range, auto µW path is standard For other cases, auto µW path is presel bypass if presel bypass is enabled, auto µW path is standard if presel bypass is not enabled
Spurious Emissions	Always Standard Path

5G NR Mode

Measurement	When µW Path Control is in Auto
Modulation Analysis	Use Standard Path unless tuned frequency > 3.6 GHz and IFBW > 15 MHz, in which case choose Full Bypass if conditions warrant(FBP Option is available and “Allow Full Bypass in Auto” is On), otherwise choose Preselector Bypass
Monitor Spectrum	Always Standard Path
IQ Waveform	Use Standard Path unless tuned frequency > 3.6 GHz and IFBW > 15 MHz, in which case choose Full Bypass if conditions warrant(FBP Option is available and “Allow Full Bypass in Auto” is On), otherwise choose Preselector Bypass
Channel Power	Always Standard Path
Occupied BW	Always Standard Path
CCDF	Use Standard Path unless tuned frequency > 3.6 GHz and IFBW > 15 MHz, in which case choose Preselector Bypass
ACP	Always Standard Path
SEM	Always Standard Path
Spurious Emissions	Always Standard Path
Transmit On|Off Power	Use Standard Path unless tuned frequency > 3.6 GHz and Info BW > 15 MHz, in which case choose Preselector Bypass

Channel Quality Mode

Measurement	When µW Path Control is in Auto
Group Delay	Use Standard Path unless tuned frequency > 3.6 GHz and IFBW > 15 MHz, in which case choose Full Bypass if conditions warrant(FBP Option is available and “Allow Full Bypass in Auto” is On), otherwise choose Preselector Bypass

Measurement	When µW Path Control is in Auto
Monitor Spectrum	Always Standard Path
IQ Waveform	Use Standard Path unless tuned frequency > 3.6 GHz and IFBW > 15 MHz, in which case choose Preselector Bypass
CCDF	Use Standard Path unless tuned frequency > 3.6 GHz and IFBW > 15 MHz, in which case choose Preselector Bypass

Remote Command	`[:SENSe]:POWer[:RF]:MW:PATH:AUTO ON | OFF | 1 | 0` `[:SENSe]:POWer[:RF]:MW:PATH:AUTO?`
Example	`:POW:MW:PATH:AUTO ON` `:POW:MW:PATH:AUTO?`
Dependencies	Only appears in VMA, WLAN, 5G NR and CQM Modes
Couplings	See the tables above
Preset	`ON`
Range	`ON|OFF`

Low Noise Path Enable

Low Noise Path Enable provides a lower noise floor under some circumstances, particularly when operating in the 21–26.5 GHz region. With the Low Noise Path enabled, the low band/high band switch and microwave preamp are bypassed whenever *all* the following are true:

- The instrument is not in the Low Band, meaning:
- the start frequency is above 3.5 GHz and
- the stop frequency is above 3.6 GHz
- The internal preamp is not installed, or if installed, is set to **Off** or **Low Band**

Note that this means that, when any part of a sweep is done in Low Band, the Low Noise Path is not used, whether or not the **Low Noise Path Enable** is selected in the user interface. Also, if the preamp is turned on, the Low Noise Path is not used, whether or not the **Low Noise Path Enable** is selected in the user interface. The only time the Low Noise Path is used is when **Low Noise Path Enable** is selected, the sweep is completely in High Band (> 3.6 GHz) and no preamp is in use.

For measurements that use IQ acquisition, the low noise path is used when **Center Frequency** is in High Band (> 3.6 GHz) and no preamp is in use. In other words, the rules above are modified to use only the center frequency to qualify which path to switch in. This is not the case for FFTs in the Swept SA measurement; they use the same rules as swept measurements.

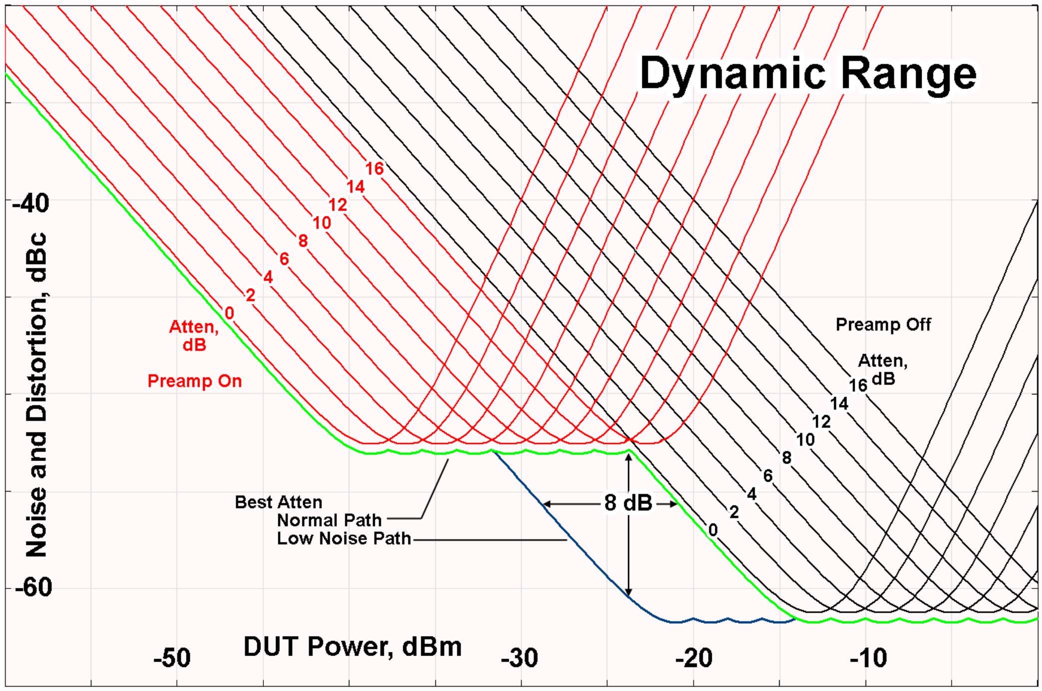
Note that the Low Noise Path, while giving improved DANL, has the disadvantage of decreased TOI performance and decreased gain compression performance relative to the standard path.

Note also that the bypass switch is a mechanical switch and has finite life, so if the **Low Noise Path Enable** is selected, it is possible to cause frequent cycling of this switch by frequently changing instrument settings such that the above conditions hold true only some of the time. A user making tests of this nature should consider opting for the **Standard Path**, which will never throw the bypass switch, at the expense of some degraded noise performance.

The low noise path is useful for situations where the signal level is so low that the instrument performance is dominated by noise even with 0 dB attenuation, but still high enough that the preamp option would have excessive third-order intermodulation or compression. The preamp, if purchased and used, gives better noise floor than does the "Low Noise Path." However, its compression threshold and third-order intercept are much poorer than that of the non-preamp path.

There are some applications, typically for signals around –30 dBm, for which the third-order dynamic range of the standard path is good enough, but the noise floor is not low enough even with 0 dB input attenuation. When the third-order dynamic range of the preamp path is too little and the noise floor of the standard path is too high, the Low Noise Path can provide the best dynamic range

The graph below illustrates the concept. It shows, in red, the performance of an instrument at different attenuation settings, both with the preamp on and off, in a measurement that is affected by both instrument noise and instrument TOI. The green shows the best available dynamic range, offset by 0.5 dB for clarity. The blue shows how the best available dynamic range improves for moderate signal levels with the low noise path switched in. In this illustration, the preamp improves the noise floor by 15 dB while degrading the third-order intercept by 30 dB, and the low noise path reduces loss by 8 dB. The attenuator step size is 2 dB.



There are other times where selecting the low noise path improves performance, too. Compression-limited measurements such as finding the nulls in a pulsed-RF spectrum can profit from the low noise path in a way similar to the TOI-limited measurement illustrated. Accuracy can be improved when the low noise path allows the optimum attenuation to increase from a small amount like 0, 2 or 4 dB to a larger amount, giving better return loss at the instrument input. Harmonic measurements, such as second and third harmonic levels, are much improved using the low noise path because of the superiority of that path for harmonic (though not intermodulation) distortion performance.

µW Preselector Bypass

Toggles the preselector bypass switch for band 1 and higher. When the microwave presel is on, the signal path is preselected. When the microwave preselector is off, the signal path is not preselected. The preselected path is the normal path for the instrument.

The preselector is a tunable bandpass filter which prevents signals away from the frequency of interest from combining in the mixer to generate in-band spurious signals (images). The consequences of using a preselector filter are its limited bandwidth, the amplitude and phase ripple in its passband, and any amplitude and phase instability due to center frequency drift.

Option MPB or pre-selector bypass provides an unpreselected input mixer path for certain X-Series signal analyzers with frequency ranges above 3.6 GHz. This signal path allows a wider bandwidth and less amplitude variability, which is an advantage when doing modulation analysis and broadband signal analysis. The disadvantage is that, without the preselector, image signals will be displayed. Another disadvantage of bypassing the preselector is increased LO emission levels at the front panel input port.

Image responses are separated from the real signal by twice the 1st IF. For IF Paths of 10 MHz and 25 MHz, the 1st IF is 322.5 MHz, so the image response and the real signal will be separated by 645 MHz. The 1st IF will be different for other IF Path settings. When viewing a real signal and its corresponding image response in internal mixing, the image response will be to the left of the real signal.

Also, the image response and the real signal typically have the same amplitude and exhibit the same shape factor.

However, if Option FS1 (Fast Sweep Capability) is enabled, the image response in the Swept SA measurement appears lower in amplitude and has a much wider shape factor compared to the real signal.

Full Bypass Enable

With **Full Bypass Enable** selected, the microwave preselector is bypassed. In addition, the low band/high band switch and microwave preamp are bypassed whenever *all* the following are true:

- The instrument is not in the Low Band, meaning:
- the start frequency is above 3.5 GHz and
- the stop frequency is above 3.6 GHz.
- the internal preamp is not installed or if installed, is set to **Off** or **Low Band**

Note that this means that, when any part of a sweep is done in Low Band, the Low Noise Path is not used, whether or not the **Full Bypass Enable** is selected in the user interface. Also, if the preamp is turned on, the Low Noise Path is not used, whether or not the **Full Bypass Enable** is selected in the user interface. The only time the Low Noise Path is used is when **Full Bypass Enable** is selected, the sweep is completely in High Band (> 3.6 GHz) and no preamp is in use.

CAUTION **When Full Bypass Enable is selected, and "Y Scale" on page 1929 is set to 0 dB, there will be a direct AC connection between the input and the first converter when the Low Noise Path switches in (when Start Freq >3.6 GHz and the Preamp is either not licensed, set to Low Band, or Off). This puts the first converter at considerable risk to be damaged by high AC power. Consequently,**

whenever **Full Bypass Enable** is selected, a warning message appears in the status bar:

"Full Bypass Enabled, maximum safe input power reduced"

Microwave Preselector Bypass Backwards Compatibility

Example	`:POW:MW:PRES OFF` Bypasses the microwave preselector
Notes	Included for Microwave Preselector Bypass backwards compatibility The `ON` parameter sets the `STD` path (`:POW:MW:PATH STD`) The `OFF` parameter sets path `MPB` (`:POW:MW:PATH MPB`)
Preset	`ON`
Backwards Compatibility SCPI	`[:SENSe]:POWer[:RF]:MW:PRESelector[:STATe] ON | OFF | 0 | 1` `[:SENSe]:POWer[:RF]:MW:PRESelector[:STATe]?`

Frequency Extender Preselection Bypass

Only applies to the high frequency path of the Frequency Extender, and only if the Frequency Extender allows it. For example, the V3050A high frequency path is 50 – 110 GHz and *does* allow control of the preselector bypass.

When the Frequency Extender's preselection is bypassed, flatness is improved, but will be subject to spurs from out-of-band interfering signals. For bandwidths greater than 2.5 [GHz], it is recommended that the signal bypass the Frequency Extender Preselector since the max bandwidth of the Preselector can be as narrow as 2.5 [GHz].

For most applications, the preset state is `OFF`, which gives the best remote-control throughput, minimizes acoustic noise from switching, minimizes out of band spurs, and minimizes the risk of wear in the hardware switches.

Preselector and Bandwidth Conflict

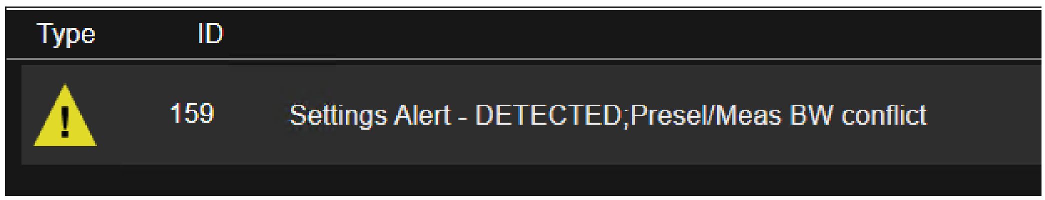
When the Frequency Extender Preselector is applied and the signal bandwidth is greater than 2.5 [GHz], then a settings alert message will show to warn the user that the signal may be distorted due to the limitation of the Frequency Extender Preselector bandwidth.

An example of the settings alert message is shown below.

Settings Alert message in the Status Bar at the bottom of the display.

Settings Alert message in the error queue

.



Software Preselection

Provided in some instruments, either to compensate for issues with provided hardware preselection or to provide the preselection function when there is no hardware preselector.

N9041B

Software Preselection compensates for the frequency range limit of the microwave preselector. Since the microwave preselector only goes up to 50 GHz, software preselection must be used to suppress and separate images above 50 GHz. The specific algorithm used for software preselection is specified by the SW Preselection Type selection – Normal or Advanced.

In N9041B, **Software Preselection** only applies for frequencies above 50 GHz, therefore it is only used for RF Input 2. Even if turned on, it is not used for other inputs, and never for frequencies below 50 GHz. This is why the label of this control contains the parenthetical note “(>~50 GHz)”.

Note that in N9041B, in Swept SA measurement, **Software Preselection** works even if the measurement is using an FFT Sweep Type. In measurements other than Swept SA, Software Preselection is not used if the measurement is using an FFT sweep type.

N9042B+V3050A

Software Preselection compensates for the frequency range limit of the microwave preselector. Since the microwave preselector only goes up to 50 GHz, software preselection must be used to suppress and separate images above 50 GHz. The specific algorithm used for software preselection is specified by the SW Preselection Type selection – Normal or Advanced.

For N9042B+V3050A, Software Preselection only applies for frequencies above 50 GHz, therefore it is only used for External RF. Even if it is turned on, it will not be used for other inputs and never for frequencies below 50 GHz. This is why the label of this control contains the parenthetical note “(>~50 GHz)”.

Note that for N9042B+V3050A, in the Swept SA measurement, Software Preselection works even if the measurement is using an FFT Sweep Type. In measurements other than Swept SA, Software Preselection is not used if the measurement is using an FFT Sweep Type.

VXT models M9410A/11A

Software Preselection is used to provide the preselection function, as there is no hardware preselector in these models. Two background traces are taken and compared point by point, and the point with the lowest amplitude from the two traces is used. This provides a method to reduce spurs that are internally generated within the VXT, but you should note the following when using Software Preselection:

– There is some speed cost due to the need to take multiple captures

– Taking the point with the lowest amplitude in each trace will make the average noise level lower at all points that do not have a spur. This can reduce the accuracy of the measurement of noise and noise-like signals

Because of the difficulty in identifying spurs manually, you are recommended to leave Software Preselection ON at all times in VXT models M9410A/11A. If you turn it off in order to speed up your measurement or improve noise accuracy, be aware of unwanted onscreen spurs.

Remote Command	`[:SENSe]:POWer[:RF]:SWPResel:STATe 0 | 1 | ON | OFF` `[:SENSe]:POWer[:RF]:SWPresel:STAT?`
Example	`:POW:SWPR:STAT 1` `:POW:SWPR:STAT?`
Dependencies	Only appears in N9041B, N9042B+V2050A, and VXT models M9410A/11A. Does not appear in all measurements
Couplings	Affects **Sweep Time** **Auto Tune** supports **Software Preselection**, so **Auto Tune** should be performed after setting the **Software Preselection** state
Preset	N9041B: OFF N9042B+V3050A: ON M9410A/11A: ON
State Saved	Saved in instrument state

SW Preselection Type

Specifies the algorithm used for software preselection.

Two hidden sweeps occur in succession. The second sweep is offset in LO frequency by 2 * IF / N. For each point in each trace, the smaller amplitude from the two traces is taken and placed in that point in the selected trace. The Peak detector is auto-selected to improve the image suppression effectiveness. Responses of each trace that lie on top of one another will remain and are valid signals. Other signals are images, which are suppressed. The action of taking the smaller of the two traces will make the average noise level lower in all points that do not have an image, thus reducing the accuracy of the measurement of noise and noise-like signals.

– `NORMal` - mathematically removes all image and multiple responses of signals present at the input

– `ADVanced` - any trace processing (such as "max hold" or trace averaging) is performed on the points of both candidate traces before the "select minimum" operation occurs. This form of processing works better for non-stationary signals, such as pulsed-RF signals

Remote Command	`[:SENSe]:POWer[:RF]:SWPResel NORMal | ADVanced` `[:SENSe]:POWer[:RF]:SWPResel?`
Example	`:POW:SWPR NORM` `:POW:SWPR?`
Dependencies	Only appears in N9041B and N9042B+V3050A. Only appears in measurements that use the Swept method Grayed-out when "Software Preselection" on page 1971 is `OFF`. The grayout message is "Unavailable unless SW Presel enabled"
Preset	N9041B: `ADVanced` N9042B+V3050A: `NORMal`
State Saved	Saved in instrument state

SW Preselection BW

Specifies the effective bandwidth to be used for Software Preselection.

The options are:

– `NORMal` – when making Swept measurements, a software preselection algorithm is used which takes up to 4 background acquisitions, then post-processes the result. This algorithm can remove images from signals with an occupied

bandwidth up to around 3 GHz. (Default/Preset setting). When making FFT measurements, this algorithm is not used, instead the same algorithm is used as for NARRow (below)

– NARRow– a software preselection algorithm is used which takes two background acquisitions, then post-processes the result to detect and remove images from wideband signals with occupied bandwidths up to 2 GHz. This increases the risk of images failing to be rejected, but improves the measurement speed

Remote Command	`[:SENSe]:POWer[:RF]:SWPResel:BW NORMal | NARRow` `[:SENSe]:POWer[:RF]:SWPResel:BW?`
Example	`:POW:SWPR:BW NARR`
Dependencies	Only appears in N9041B and N9042B+V3050A. Only appears in measurements that use the Swept method Grayed-out when "Software Preselection" on page 1971 is OFF. The grayout message is "Unavailable unless SW Presel enabled" For N9042B+V3050A, the parameter is SCPI-only, and always set to NARRow when **Software Preselection** is enabled
Preset	N9041B: NORMal N9042B+V3050A: NARRow
State Saved	Saved in instrument state

High Freq Prefilter

Lets you set the state of Prefilter for center frequencies above 1310 MHz.

In VXT Models M9410A/11A, the Receiver RF path has a bank of filters that come after the RF Attenuator in the signal path. Since this bank of filters precedes the mixer they are known as the "Prefilter" bank. Their purpose is to eliminate unwanted in-band mixing products by filtering out all but the desired frequencies before the signals get to the mixer. There are 13 prefilter bands to cover the frequencies between 9 kHz and 6000 MHz. The Prefilter provides the necessary rejection of the unwanted signal.

Remote Command	`[:SENSe]:<measurement>:PFILter[:STATe] ON | OFF | 1 | 0` `[:SENSe]:<measurement>:PFILter[:STATe]?`

Example	Enable High Freq Prefilter for the Complex Spectrum Measurement in BASIC Mode:
	`:SPEC:PFIL ON`
	Enable High Freq Prefilter for the IQ Waveform Measurement, in multiple Modes:
	`:WAV:PFIL ON`
	Enable High Freq Prefilter for the Swept SA Measurement in SA Mode:

	:SAN:PFIL ON
Dependencies	Only appears in VXT models M9410A/11A with center frequency above 1310 MHz
Preset	See "Prefilter Presets" on page 243 below
State Saved	Saved in instrument state

Prefilter Presets

Meas	Mode	Preset
SPEC	BASIC	OFF
WAV	BASIC, WCDMA, WLAN, LTEAFDD, LTEATDD, 5GNR, VMA	OFF
MON	WCDMA, WLAN, LTEAFDD, LTEATDD, 5GNR, VMA	OFF
RHO	WCDMA	OFF
CDP	WCDMA	OFF
PCON	WCDMA	OFF
EVMQ	WCDMA	OFF
CHP	WCDMA, WLAN, LTEAFDD, LTEATDD, 5GNR, VMA, SA	OFF
OBW	WCDMA, WLAN, LTEAFDD, LTEATDD, 5GNR, VMA, SA	OFF
ACP	WCDMA, LTEAFDD, LTEATDD, 5GNR, VMA, SA	OFF
SEM	WCDMA, WLAN, LTEAFDD, LTEATDD, 5GNR, VMA, SA	OFF
PST	WCDMA, WLAN, LTEAFDD, LTEATDD, 5GNR, VMA, SA	OFF
PVT	WLAN, LTEAFDD, LTEATDD, 5GNR	OFF
EVM	WLAN, LTEAFDD, LTEATDD, 5GNR	OFF
FLAT	WLAN	OFF
EVMM	WLAN	OFF
CEVM	LTEAFDD, LTEATDD	OFF
PAVT	5GNR, VMA	OFF
DDEM	VMA	OFF
OFDM	VMA	OFF
SAN	SA	ON
HARM	SA	ON

3.2.4 BW

Opens the Bandwidth (**BW**) menu, which contains controls for the Resolution Bandwidth and Video Bandwidth functions of the instrument.

The **Resolution BW** functions control filter bandwidth and filter type. There are two filter types, Gaussian and Flattop. The Gaussian filters have a response curve that is parabolic on a log scale. The Flattop filter shape is a close approximation of a rectangular filter.

NOTE The Average functions, which appeared in the **BW** menu in earlier instruments, can now be found in the **Trace** and **Meas Setup** menus.

In the **Trace** menu, you may turn **Trace Averaging** on or off for the desired traces (rather than globally as in the past).

In the **Meas Setup** menu, you may configure Averaging, by setting Average Number and Average Type.

3.2.4.1 Settings

This is the only tab in the BW menu.

Res BW

Activates the resolution bandwidth active function, which allows you to manually set the resolution bandwidth (RBW) of the instrument. Normally, Res BW (Auto) selects automatic coupling of the Res BW to Span using the ratio set by the Span:3 dB RBW control. To decouple the resolution bandwidth, press the Auto/Man toggle on the Res BW control, or simply enter a different value for Res BW.

When the Res BW is manually selected, it may be returned to the coupled state by pressing the Auto/Man toggle on the Res BW control. This may also be done by pressing "Auto Couple" on page 1995or by performing a Preset.

Normally the maximum Res BW is 8 MHz, but the Wide Bandwidths control lets you access a set of Resolution Bandwidths that are wider than the standard RBW's while in Zero Span. See "Wide Bandwidths" on page 255

See "More Information" on page 245

Remote Command	`[:SENSe]:BANDwidth|BWIDth[:RESolution] <freq>` `[:SENSe]:BANDwidth|BWIDth[:RESolution]?`
Example	`:BAND 1 KHZ` `:BAND?`
Notes	For numeric entries, all RBW Types choose the nearest (arithmetically, on a linear scale, rounding up) available RBW to the value entered The setting and querying of values depends on the current bandwidth type
Dependencies	When in Zero Span with no EMI Standard selected, there is no Auto setting for Res BW. The Auto/Man toggle disappears in this case, and if `[:SENSe]:BWID[:RESolution]:AUTO ON` is sent, it generates an error message While using the Tracking Generator, you must make sure the Start Frequency is high enough to avoid capturing LO feedthrough in the trace. How high you must make the Start Frequency to avoid this depends on the Res BW you have set. The instrument displays a condition warning message if the Start Frequency falls below roughly 2.5 times the current RBW. The warning is "Source Uncal; adj

	Start Freq|RBW|Points". When you see this warning, you should increase the Start Freq, narrow the RBW, or increase the number of Sweep Points For CXA-m, if the requested setting of **Res BW** is less than 100 kHz in Tracking Source mode, a condition warning message is generated: 301, "Meas Uncal"
Couplings	**Res BW** is normally coupled to **Span**; if **Res BW** is set to **Auto**, as **Span** decreases, so does **Res BW**, to maintain the ratio set by the **Span:3 dB RBW** control (or 106:1 for measurements that do not have a **Span:3 dB RBW** control). In Zero Span, this coupling is normally turned off and **Res BW** has no **Auto** setting When a CISPR or MIL EMI Standard is in use, **Res BW** is coupled to "Center Frequency" on page 279 and not to "Span" on page 285, and this is true even in Zero Span
Preset	Auto (unless noted in the table below)
State Saved	Saved in instrument state
Min	1 Hz
Max	8 MHz is the max equivalent –3 dB RBW, which means that the named RBW can actually exceed 8 MHz if using a filter other than –3 dB Gaussian When Option FS1 or FS2 is installed and the filter type is Gaussian, the max RBW is 10 MHz For VXT, max -3 dB RBW is limited to the current span or 8 MHz, whichever is smaller
Annotation	In the lower left corner of the screen, "RBW <(type)> <value>" will indicate the current setting of resolution bandwidth where <(type)> summarizes the filter type and bandwidth. <(type)> is not displayed for the –3 dB Filter Type A "#" mark appears before "RBW" in the annotation when it is switched from Auto to Manual coupling. Note that this # does NOT appear when in zero span with an EMC standard of None, as then there is neither an autocoupled nor a manual state in zero span; there is no coupling at all
Backwards Compatibility Notes	For backwards compatibility this command obeys both the `BANDwidth` and `BWIDth` forms

Auto Function

Remote Command	`[:SENSe]:BANDwidth|BWIDth[:RESolution]:AUTO OFF | ON | 0 | 1` `[:SENSe]:BANDwidth|BWIDth[:RESolution]:AUTO?`
Example	`:BWID:AUTO ON` `:BWID:AUTO?`
Preset	`ON`

More Information

When **Res BW** is set to **Auto**, the bandwidth selected depends on "RBW Filter Type" on page 251

Only certain discrete resolution bandwidths are available. The available bandwidths depend on **RBW Filter Type** or **EMC Standard**. If an unavailable bandwidth is entered with the numeric keypad, the closest available bandwidth is selected.

The zero-span case in the Swept SA measurement deserves some mention, because **Res BW** is coupled to **Span** when in a swept (non-zero) span and in zero span there is normally no meaningful **Res BW** coupling. However, when a MIL or CISPR EMC Standard is selected, there *is* a meaningful coupling for **Res BW** in Zero Span – in fact, it is coupled to **Center Frequency**, to make measurements according to the EMI specifications.

Video BW

Lets you change the instrument post-detection filter (VBW or "video bandwidth") from 1 Hz to 8 MHz in approximately 10% steps. In addition, a wide-open video filter bandwidth may be chosen by selecting 50 MHz. The VBW is annotated at the bottom of the display, in the center.

NOTE **An asterisk (*) is displayed next to the VBW annotation when certain detector types (Average, EMI Average, Quasi Peak, and RMS Average) are in use. This is because the VBW filter is out of the circuit for these detectors and does not affect any traces that use them. If there is any active trace using one of these detectors, * is displayed. See "Annotation Examples" on page 248.**

Normally, **Video BW (Auto)** selects automatic coupling of **Video BW** to **Res BW** using the ratio set by "VBW:3dB RBW" on page 248. To decouple the resolution bandwidth, press the **Auto/Man** toggle on **Video BW**, or simply enter a different value for **Video BW**.

When **Video BW** is manually selected, it may be returned to the coupled state by pressing the **Auto/Man** toggle on **Video BW**. This may also be done by pressing "Auto Couple" on page 1995 or by performing a **Preset**.

Remote Command	`[:SENSe]:BANDwidth|BWIDth:VIDeo <freq>` `[:SENSe]:BANDwidth|BWIDth:VIDeo?`
Example	`:BAND:VID 1 KHZ` `:BAND:VID?`
Notes	For numeric entries, the instrument selects the nearest (arithmetically, on a linear scale, rounding up) available **Video BW** to the value entered. The 50 MHz VBW is defined to mean "wide open" The values shown in this table reflect the conditions after **Mode Preset**
Dependencies	Sometimes the displayed **Video BW** is not actually used to process the trace data: – When the **Average**"Detector" on page 518 is selected and **Sweep Type** is set to **Swept**, the video bandwidth filter cannot be used, because it uses the same hardware as the **Average Detector** – When the **Quasi-Peak**, **EMI Average**, or **RMS AverageDetector** is selected, **Video BW** is implemented by the digital IF as part of the detector When this is the case, **Video BW** still acts to change "Sweep Time" on page 479, if **Sweep Time** is in **Auto**, and still affects the data on other traces for which this is not the case

	In VXT, when in Zero Span, this control does not appear
Couplings	**Video BW** (VBW) is normally coupled to **Res BW**. If **VBW** is set to **Auto**, then **Video BW** changes as **Res BW** changes, to maintain the ratio set by **VBW:3 dB RBW** (usually 10:1 for measurements that do not have **VBW:3 dB RBW**)
Preset	Auto (unless noted in table below)
State Saved	Saved in instrument state
Min	1 Hz
Max	50 MHz
Annunciation	A "#" mark appears before "VBW" in the annotation when it is not coupled
Annotation	In the bottom center of the screen, "VBW <value> <units>" indicates the current video bandwidth value. Note that for some detectors this is not the value actually used for VBW (see above)
Backwards Compatibility Notes	For backwards compatibility this command obeys both the `BANDwidth` and `BWIDth` forms

Auto Function

Remote Command	`[:SENSe]:BANDwidth|BWIDth:VIDeo:AUTO OFF | ON | 0 | 1` `[:SENSe]:BANDwidth|BWIDth:VIDeo:AUTO?`
Example	`:BWID:VID:AUTO ON` `:BWID:VID:AUTO?`
Preset	`ON`

Video BW Presets

Unless noted in the table below, the Preset value of VBW is **Auto**.

Measurement	Mode	Preset Value
Channel Power	WCDMA	2.40 MHz
Occupied BW	WCDMA	300 kHz
	BLUETOOTH	30 kHz
ACP	WCDMA	1 MHz
Monitor Spectrum	WLAN	1 MHz
	LTE, LTETDD, LTEAFDD, LTEATDD	1 MHz
TOI	SA	Determined by RBW

Annotation Examples

All active traces using VBW

One or more active traces not using VBW

VBW:3dB RBW

Selects the ratio between the video bandwidth and the equivalent 3 dB resolution bandwidth to be used for setting **Video BW** when VBW is in **Auto**.

VBW:3dB RBW (Auto) selects automatic coupling of the **Video BW**:3 dB **Res BW** ratio to "Detector" on page 518, using the rules described below in "Coupling Auto Rules" on page 249. To decouple the ratio, press the **Auto/Man** toggle on **VBW:3dB RBW**, or simply enter a different value for **VBW:3dB RBW**.

When **VBW:3dB RBW** is manually selected, it may be returned to the coupled state by setting the toggle on **VBW:3dB RBW** back to **Auto**. This may also be done by pressing "Auto Couple" on page 1995, or by performing a **Preset**.

Remote Command	`[:SENSe]:BANDwidth|BWIDth:VIDeo:RATio <real>` `[:SENSe]:BANDwidth|BWIDth:VIDeo:RATio?`
Example	`:BAND:VID:RAT 2` `:BAND:VID:RAT?`
Notes	The values shown in this table reflect the conditions after **Mode Preset**
Dependencies	In VXT, when in Zero Span, this control does not appear
Couplings	See "Coupling Auto Rules" on page 249
Preset	1
State Saved	Saved in instrument state
Min	0.00001
Max	3000000
Backwards Compatibility Notes	For backwards compatibility this command obeys both the `BANDwidth` and `BWIDth` forms

Auto Function

Remote Command	`[:SENSe]:BANDwidth|BWIDth:VIDeo:RATio:AUTO OFF | ON | 0 | 1` `[:SENSe]:BANDwidth|BWIDth:VIDeo:RATio:AUTO?`
Example	`:BAND:VID:RAT:AUTO 0` `:BAND:VID:RAT:AUTO?`
Preset	`ON`
Backwards Compatibility SCPI	`[:SENSe]:SFRequency:BWIDth:VIDeo:RATio:AUTO`

Coupling Auto Rules

The Auto Rules for the **VBW:3dB RBW** function are as follows.

First, if Source Mode is set to "Tracking": Use 1.0

Otherwise, go through the following list of detector numbers and find the lowest numbered detector being used on any active traces (traces for which **Update** is **On**):

1. Peak
2. Normal
3. Average
4. Sample
5. Negative Peak
6. EMI Average
7. Quasi Peak
8. RMS Average

Use that detector to pick the ratio based on the following criteria:

1. If the measurement supports EMC Standard, and the detector is Peak and the EMC Standard is set to either CISPR or MIL, use 10.0 (we use wide VBWs to capture peak levels accurately)
2. Otherwise, if the detector is **Negative Peak**, use 1.0 (in the Negative Peak case, there are no known significant use models, so we use a medium ratio)
3. Otherwise, if the detector is **Normal**, use 1.0
4. Otherwise, if the detector is **Average**, and the span is nonzero, use 0.1. The use of a small ratio in Average detection is desirable because of its effect on the sweep time equations. The VBW filter is not actually in-circuit when the average

detector is on. If the detector is Average, and the span is zero, use 10.0, which gives optimal behavior for Interval Markers in zero span. Note that only the Swept SA measurement supports Zero Span

5. Otherwise, if the detector is EMI Average, Quasi Peak or RMS Average, use 10.0. In fact, this is a "don't care" since no VBW is used for these detectors, as noted under "Dependencies" for the VBW control

6. Otherwise, the detector is simply **Peak** or **Sample**. These two detectors can use the same rules. In these cases, if any active trace is in max hold or min hold, use 10.0, because Max and Min Hold operations will usually be intended to capture peaks and pits without smoothing from the VBW filter; otherwise, use 1.0 as a compromise, because you have not set the instrument in a way that implies that you are measuring noise, pulsed-RF or CW signals, and for backward compatibility with earlier instruments

Note that because the above couplings depend on which traces are active, they are re-examined whenever any trace goes active or inactive, except when this leaves no traces active. Transitioning to the state where no traces are active should not affect the couplings; in that way, the annotation will always reflect the state of the last trace which was active.

Not also that some detectors are not available in some measurements, but because of the way the above rules that does not change the logic of the rules.

Span:3dB RBW

Selects the ratio between "Span" on page 285 and "Res BW" on page 244.

Normally, **Span:3dB RBW (Auto)** selects a **Span**: 3 dB **Res BW** ratio of 106:1. If you manually enter the ratio, the toggle on **Span:3dB RBW** changes to **Man.** This enables you to manually select ratios more suitable for certain measurements.

When **Span:3dB RBW** is manually selected, it may be returned to the coupled state by setting the toggle on **RBW:3 dB RBW** back to **Auto**. This may also be done by pressing "Auto Couple" on page 1995, or by performing a **Preset**.

Remote Command	`[:SENSe]:FREQuency:SPAN:BANDwidth[:RESolution]:RATio <integer>` `[:SENSe]:FREQuency:SPAN:BANDwidth[:RESolution]:RATio?`
Example	Set a ratio of 200:1, and turn off **Auto** coupling: `:FREQ:SPAN:BAND:RAT 200`
Notes	The values shown in this table reflect the conditions after **Mode Preset**
Dependencies	In the Swept SA measurement, this is grayed-out when the EMC Standard is set to CISPR or MIL, since **Res BW** is coupled to **Center Frequency** rather than **Span** in this case If the SCPI command is sent, the command is acted upon, but does not affect the current measurement

Preset	106
State Saved	Saved in instrument state
Min	2
Max	10000

Auto Function

Remote Command	[:SENSe]:FREQuency:SPAN:BANDwidth[:RESolution]:RATio:AUTO OFF | ON | 0 | 1 [:SENSe]:FREQuency:SPAN:BANDwidth[:RESolution]:RATio:AUTO?
Example	:FREQ:SPAN:BAND:RAT:AUTO ON :FREQ:SPAN:BAND:RAT:AUTO?

RBW Filter Type

Selects the type for the resolution bandwidth filters. In the X-Series, the **RBW Filter BW** menu lets you choose between a Gaussian and Flat Top filter shape, for varying measurement conditions.

Filter Type	SCPI Example
Gaussian	:BAND:SHAP GAUS
Flattop	:BAND:SHAP FLAT

See "More Information" on page 252

Remote Command	[:SENSe]:BANDwidth|BWIDth:SHAPe GAUSsian | FLATtop [:SENSe]:BANDwidth|BWIDth:SHAPe?
Example	:BAND:SHAP GAUS :BAND:SHAP?
Notes	GAUSsian= Gaussian FLATtop = Flattop
Dependencies	In the Swept SA measurement, the **RBW Filter Type** control is grayed-out if the **EMC Standard** is set to **CISPR** or **MIL**. In this case the **Filter Type** is always Gaussian; the **Filter BW** is chosen as appropriate for the filter and the standard. Any attempt to set it to Flattop will give an error
Preset	"Auto Couple" on page 1995 selects the preset value
State Saved	Saved in instrument state
Annotation	The annotation under RBW in the bottom left of the screen shows the type of filter or bandwidth that is being used. The following examples illustrate this: –3 dB (Normal) filter BW: Res BW 300 Hz –6 dB filter BW: Res BW (–6 dB) 422 Hz Noise filter BW: Res BW (Noise) 317 Hz

Impulse filter BW	Res BW (Impulse) 444 Hz
CISPR filter BW	Res BW (CISPR) 200 Hz
MIL filter BW	Res BW (MIL) 1 kHz
Flattop filter type	Res BW (Flattop) 300 Hz

More Information

Gaussian filters

When the Gaussian filter type is chosen, a set of 160 RBW filters are available whose shape is approximately Gaussian. The actual bandwidths used to realize the X-Series' Gaussian filters are chosen to come as close as possible, within the limitations of the digital IF, to a 24 step per decade series from 1 Hz through 3 MHz, plus the 4, 5, 6 and 8 MHz settings.

For Gaussian filters, the annotation at the bottom of the screen shows the filter bandwidth type (unless it is Normal) parenthetically between the words “Res BW” and the value, for example:

Res BW 10.0 Hz	(Normal bandwidth)
Res BW (Impulse) 14.8 Hz	(Impulse bandwidth)

Flattop filters

When the Flattop filter type is chosen, a new set of 134 RBW hardware settings are available. These settings realize filters that are approximately rectangular in shape. When this shape is chosen the filter bandwidth options are irrelevant and therefore unavailable.

The annotation at the bottom of the screen shows that the Flattop shape is being used, for example:

Res BW (Flattop) 10 Hz

RBW Filter BW

Selects the type of filter bandwidth used to specify the width of the Gaussian RBW filters. Historically, the Gaussian Res BW filters in HP/Agilent/Keysight spectrum analyzers were specified using the –3 dB bandwidth of the filter. That is, a 10 MHz Res BW filter was a Gaussian shape with its –3 dB points 10 MHz apart. For certain types of applications, it can be useful to specify the filter width using points other than the –3 dB points. In the X-Series, the RBW Filter BW function allows you to pick the filter based on its –3 dB (Normal) bandwidth, its –6 dB bandwidth, its Noise bandwidth, or its Impulse bandwidth. Note that in all four cases the –3 dB bandwidth is the same. The filter does not change, but the way you specify it changes.

Example

Set **Res BW** to 1.0 kHz with **RBW Filter BW** set to **Normal**. Now, set **RBW Filter BW** to –6 dB. The bandwidth displayed for **Res BW** changes to 1.41 kHz. The shape and bandwidth of the filter have not changed, only the way the filter is annotated and the value that appears in the **Res BW** active function area have.

Filter BW	SCPI Example	Displayed bandwidth of a filter with 1 kHz -3 dB bandwidth
-3 dB (Normal)	:BAND:TYPE DB3	1.0 kHz
–6 dB	:BAND:TYPE DB6	1.41 kHz
Noise	:BAND:TYPE NOIS	1.06 kHz
Impulse	:BAND:TYPE IMP	1.48 kHz

See "More Information" on page 254

Remote Command	`[:SENSe]:BANDwidth|BWIDth:TYPE DB3 | DB6 | IMPulse | NOISe` `[:SENSe]:BANDwidth|BWIDth:TYPE?`
Example	`:BAND:TYPE NOIS` `:BAND:TYPE?`
Notes	`DB3` –3 dB (Normal) `DB6` –6 dB `IMPulse` Impulse `NOISe` Noise
Dependencies	Grayed-out and displays --- if the Flattop filter type is selected When **EMC Standard** is set to **CISPR** or **MIL**, the **RBW Filter BW** control is grayed-out. This is because **RBW Filter BW** is selected as appropriate for the filter and the standard, and *not* selected by this control. Any attempt to set it otherwise generates an error
Preset	"Auto Couple" on page 1995 selects the preset value
State Saved	Saved in instrument state
Annotation	The annotation under **RBW** in the bottom left of the screen shows the type of filter or bandwidth that is being used. The following examples illustrate this:

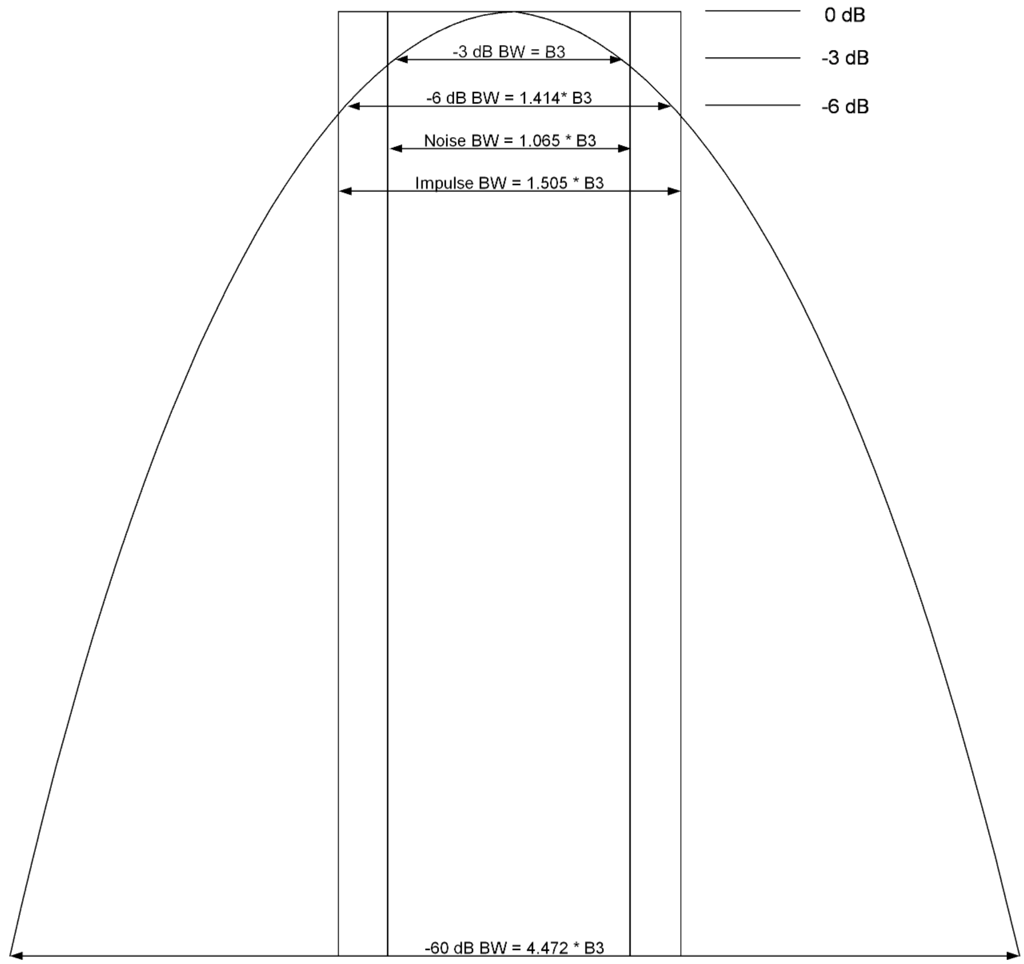
–3 dB (Normal) filter BW:	Res BW 300 Hz
–6 dB filter BW	Res BW (–6 dB) 422 Hz
Noise filter BW	Res BW (Noise) 317 Hz
Impulse filter BW	Res BW (Impulse) 444 Hz
CISPR filter BW	Res BW (CISPR) 200 Hz
MIL filter BW	Res BW (MIL) 1 kHz
Flattop filter type	Res BW (Flattop) 300 Hz

More Information

The instrument provides four ways of specifying the bandwidth of a Gaussian filter:

1. The –3 dB bandwidth of the filter
2. The –6 dB bandwidth of the filter
3. The equivalent Noise bandwidth of the filter, which is defined as the bandwidth of a rectangular filter with the same peak gain which would pass the same power for noise signals
4. The equivalent Impulse bandwidth of the filter, which is defined as the bandwidth of a rectangular filter with the same peak gain which would pass the same power for impulsive (narrow pulsed) signals

The following figure shows the relationships of the various filter bandwidths for filters with the X-Series' shape factor (shape factor is defined as the ratio of the –60 dB bandwidth to the – 3 dB bandwidth):



The **Filter Type** menu lets you choose the filter bandwidth (–3 dB, –6 dB, Noise or Impulse) that is used when specifying the width of the filter. Note that for a given Gaussian filter, changing the filter bandwidth specification does not affect the filter width at all but only the means of specifying it. For example, the filter whose –3 dB bandwidth is 1.0 kHz is the same as the filter whose –6 dB bandwidth is 1.41 kHz, whose Noise bandwidth is 1.06 kHz, and whose Impulse bandwidth is 1.48 kHz. As you cycle through these various filter bandwidths the filter does not change, but the way the filter is annotated and the value which appears in the active function area and on the control does.

Wide Bandwidths

Lets you access a set of Resolution Bandwidths that are wider than the standard **Res BWs**. These wide bandwidths only appear in the Swept SA measurement. The **Wide**

Bandwidths option can only be used under certain conditions:

- When **Span** is set to **Zero Span**
- When the **Sweep Type** is set to **FFT**, "µW Path Control" on page 1961 is set to `MPBypass`, and **FFT Width** is larger than **Res BW**

If these conditions are not met, this option is not available.

When **Wide Bandwidths** are `ON`:

- The minimum **Res BW** is 10 MHz. To select **Res BWs** 8 MHz or narrower, **Wide Bandwidths** must be `OFF`
- In **Zero Span**, a channel filter shape is used that is nearly square (shape factor 1.2:1), rather than Gaussian or Flattop, "RBW Filter Type" on page 251 is grayed-out and displays **Channel**. When **Sweep Type** is **FFT**, Gaussian and Flattop are still available
- In **Zero Span**, "RBW Filter BW" on page 252 is grayed-out, and shows **–3 dB**
- In **Zero Span**, no VBW filter is used, so VBW averaging is not available. Since VBW averaging is not available, the VBW annotation has the * symbol added (meaning no video averaging). When no VBW averaging is available, this is equivalent to having a VBW setting that is greater than **Res BW**
- The available "Detector" on page 518 types are **Peak** or **Average**. Only one detector can be used at a time
- In **Zero Span**, **Gate** is not available
- **TV Trigger** is not available
- In **Zero Span**, the minimum (fastest) sweep time is limited to a value that is typically between 200-400 µs, depending on the bandwidth and number of points you have set. This means you will not be able to set sweep times shorter than this value while **Wide Bandwidths** is `ON`

The instrument independently remembers the **Res BW** settings for when **Wide Bandwidths** is `OFF` and when **Wide Bandwidths** is `ON`. For example, if a **Res BW** of 300 kHz was set before **Wide Bandwidths** was turned `ON`, then the instrument will return to a **Res BW** of 300 kHz when **Wide Bandwidths** is turned `OFF`.

As with the standard set of **Res BWs**, there is a set of specific **Res BWs** available when **Wide Bandwidths** is `ON`.

In **Zero Span**, these are:

- Wideband IFs with information bandwidth less than 160 MHz : 10 MHz, 15 MHz, 20 MHz, 25 MHz, 30 MHz, 40 MHz, 50 MHz, 60 MHz, 70 MHz

– Wideband IFs with 160 MHz information bandwidth: add 80 MHz, 100 MHz and 133 MHz RBWs

– Wideband IFs with information bandwidth of 255 MHz or 510 MHz: add 150 MHz, 200 MHz and 212 MHz RBWs

When **Sweep Type** is **FFT**, these are:

– 10 MHz, 15 MHz, 20 MHz, 25 MHz, 30 MHz, 40 MHz, 50 MHz RBWs

Remote Command	`[:SENSe]:BANDwidth|BWIDth[:RESolution]:WIDE ON | OFF | 0 | 1` `[:SENSe]:BANDwidth|BWIDth[:RESolution]:WIDE?`
Example	`:BAND:WIDE ON` `:BAND:WIDE?`
Dependencies	Only appears if at least one of Options B85, B1A, B1X, B1Y, B2X, B5X is installed Only appears if Option RBE is installed Only appears in the Swept SA measurement Grayed-out unless in **Zero Span**, or **Swept** Type FFT with "µW Path Control" on page 1961 set to `MPBypass`, and **FFT Width** larger than **Res BW**
Preset	`OFF`
State Saved	Saved in instrument state

3.2.5 Display

Opens the **Display** menu, which lets you configure display items for the current Mode, Measurement View or Window.

3.2.5.1 Meas Display

Contains controls for setting up the display for the current Measurement, View or Window.

Display Trace

Specifies which spectrogram trace to display in the trace window. This function determines which of the traces stored in the Spectrogram is currently being viewed in the trace window.

The display trace selection can be made by trace number or by trace time, depending on the setting of **Trace Selection**. **Display Trace 0** shows the latest trace.

The `TIME` form of this command (below) can be used to determine the time that the current trace in the spectrogram started, or to select as the display trace the trace whose start time is closest to the specified time. This time displays on **Display Trace** when **Trace Selection** is set to **Time**.

Remote Command	`:TRACe:DISPlay:VIEW:SPECtrogram:POSition <integer>` `:TRACe:DISPlay:VIEW:SPECtrogram:POSition?`
Example	`:TRAC:DISP:VIEW:SPEC:POS 146`
Dependencies	Only appears when the **Waterfall** window is visible, and either the **Waterfall** or **Spectrum** window is selected If the command is sent at any other time, it is accepted without error, but you will not see the result until you once again display the **Waterfall** window
Couplings	The input to this parameter can be trace number or trace time When Spectrogram occupies a window that has half vertical size, only 300 traces can be displayed in the trace window at any one time
Preset	Unaffected by **Mode Preset,** but set to 0 by **Restore Mode Defaults**. The value is remembered when you change in or out of **Spectrogram** View
State Saved	Saved in instrument state
Min	0
Max	1000

Start Time

Can be used to determine the time that the current trace in the spectrogram started or set the display trace to the approximate start time of the entered time.

The selection of the display trace can be by trace number or by trace start time. The `NUMBER` form (see "Display Trace" on page 257) can be used to select as the display trace the trace with the desired number.

Remote Command	`:DISPlay:WINDow4:TRACe:TIME <time>` `:DISPlay:WINDow4:TRACe:TIME?`
Example	Set the **Waterfall** display trace to be at the given start time. If the time is not exact, the approximate start will be calculated: `:DISP:WIND4:TRAC:TIME 250 ms`
Notes	Window 4 is the **Waterfall** window, associated with the Spectrogram
Dependencies	Only appears when a **Waterfall** window is visible, and either that window or its associated window (**Spectrum**) is selected If the command is sent at any other time, it is accepted without error, but you will not see the result until you once again display the **Waterfall** window
Preset	0 s
State Saved	Saved in instrument state
Backwards Compatibility SCPI	`:TRACe:DISPlay:VIEW:SPECtrogram:TIME <time>`

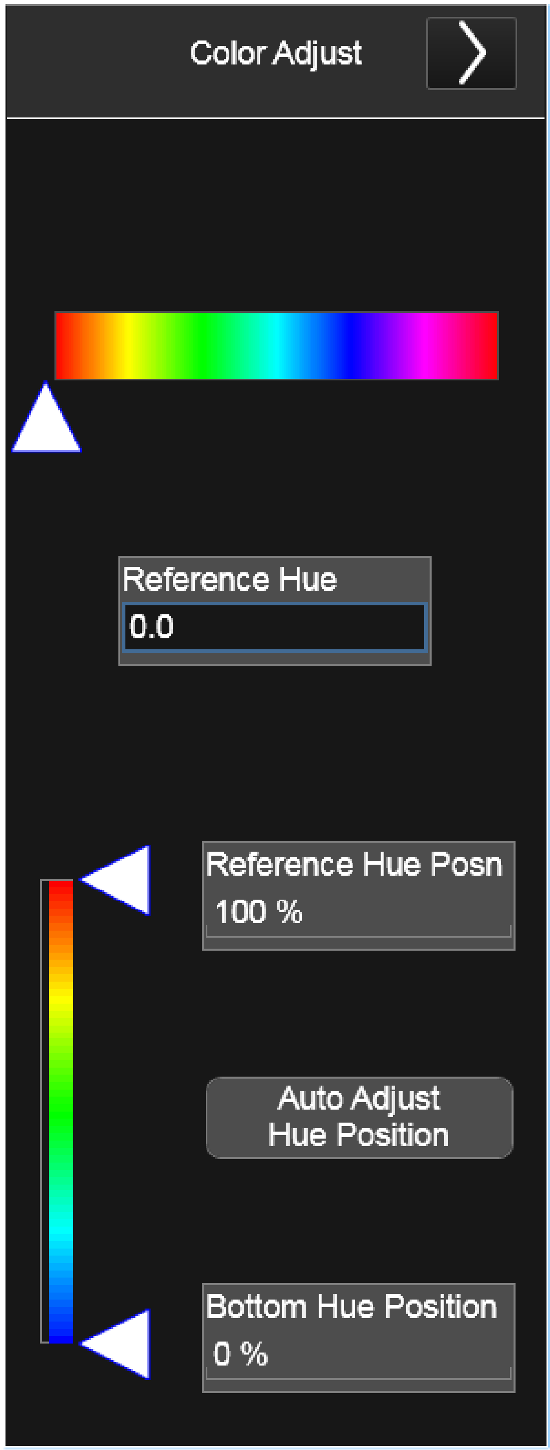
Couple Marker To Display Trace

Couples the marker to the selected "Display Trace" on page 257. When OFF, this allows you to fix the marker to the **Display Trace** that was active when the marker was turned on. When ON, the marker stays with the selected **Display Trace** as it is changed.

Remote Command	`:DISPlay:VIEW:SPECtrogram:TRACe:COUPle ON | OFF | 1 | 0` `:DISPlay:VIEW:SPECtrogram:TRACe:COUPle?`
Example	`:DISP:VIEW:SPEC:TRAC:COUP ON`
Dependencies	Only appears when the **Waterfall** window is visible, and either the **Waterfall** or **Spectrum** window is selected If the command is sent at any other time, it is accepted without error, but you will not see the result until you once again display the **Waterfall** window
Preset	`OFF`
State Saved	Saved in instrument state

Color Adjust

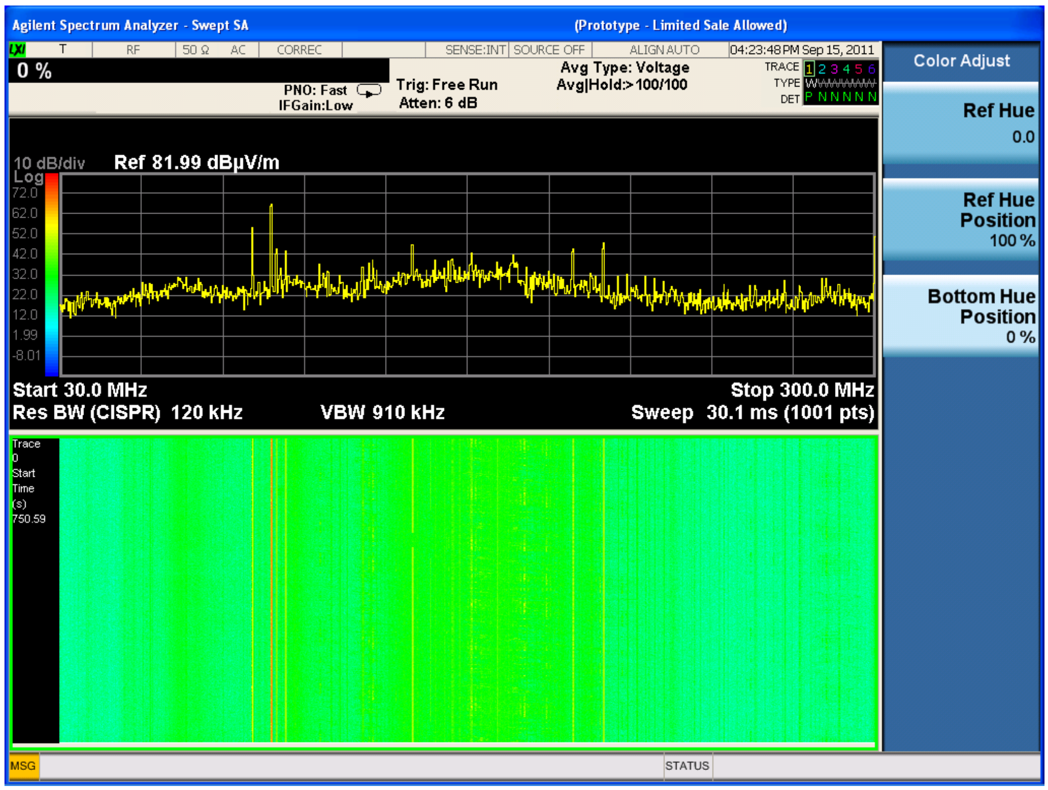
Lets you adjust the color mapping of the Spectrogram display. Adjusting the color map can help you find an array of colors whose contrast is more ideally suited to your signal, or to exclude regions of the display that you do not wish to see. See "Examples" on page 261 below.


Color Adjust
Reference Hue
0.0
Reference Hue Posn
100 %
Auto Adjust
Hue Position
Bottom Hue Position
0 %

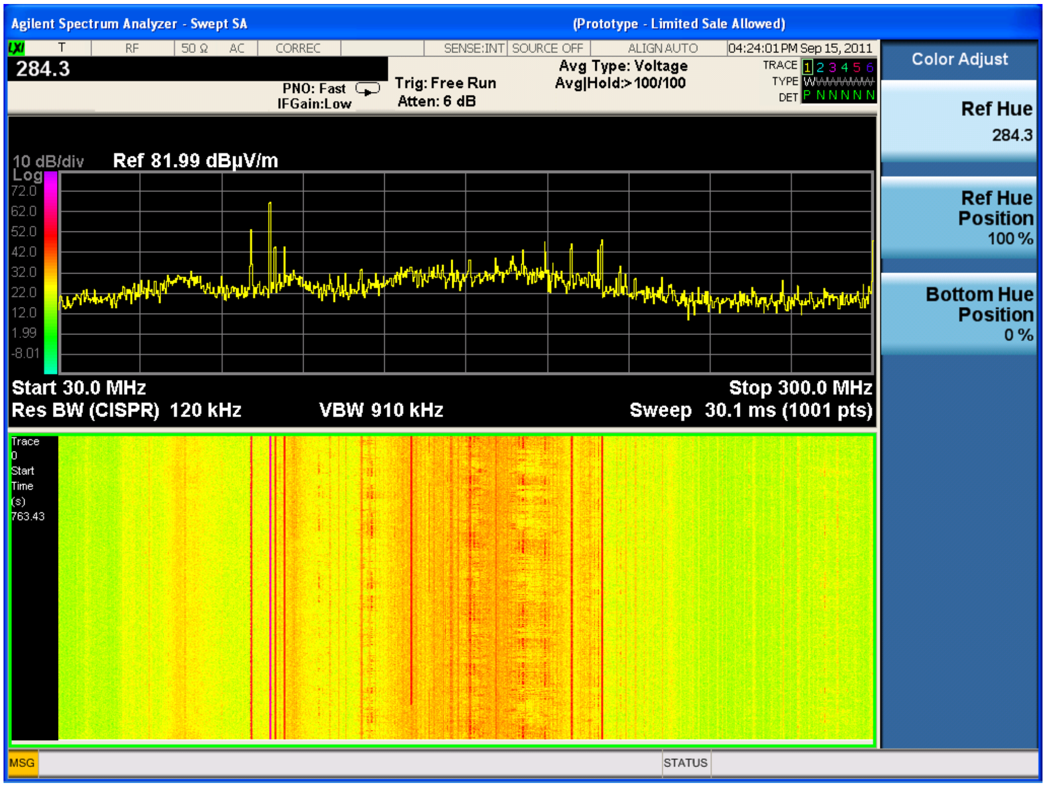
Dependencies	Only appears when the **Waterfall** window is visible, and either the **Waterfall** or **Spectrum** window is selected If the command is sent at any other time, it is accepted without error, but you will not see the result until you once again display the **Waterfall** window

Examples

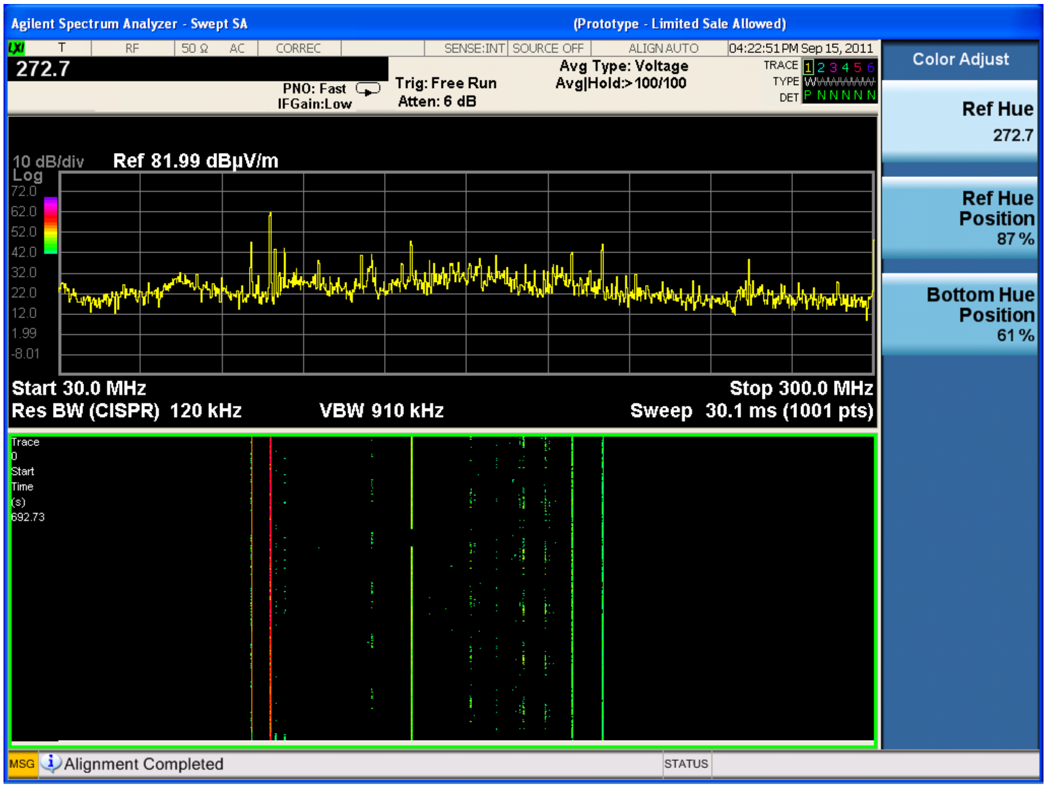
An example of Ref Hue in action appears below. Here is a typical Spectrogram display:



Here is the same display with "Reference Hue" on page 263 adjusted for better contrast:



Here is the same display with **Reference Hue**, "Reference Hue Position" on page 265, and "Bottom Hue Position" on page 266 all adjusted to exclude unwanted signals and optimally show desired signals:



Reference Hue

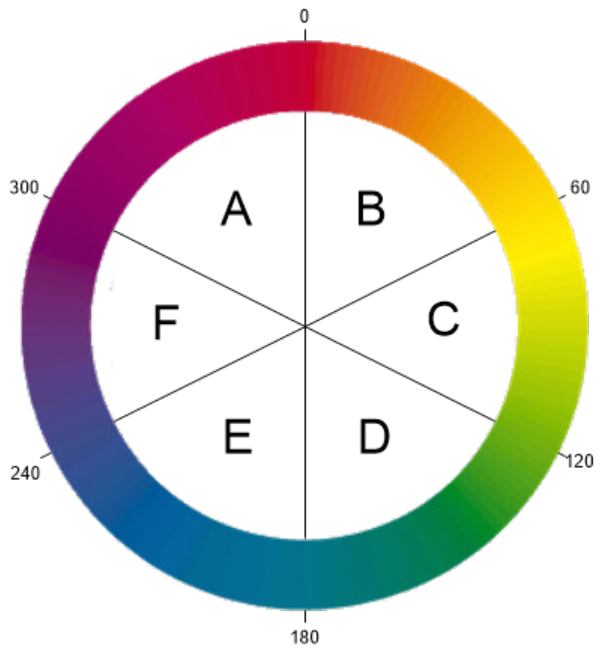
Adjusts the hue at the top of the spectrogram color bar. The Spectrogram color bar is the bar placed next to the trace display to map colors into the **Spectrogram** window. You can adjust using the Active Function or move the top arrow up and down with your finger.

"Explaining Hue concept" on page 264

Remote Command	`:DISPlay:VIEW:SPECtrogram:HUE <real>` `:DISPlay:VIEW:SPECtrogram:HUE?`
Example	`:DISP:VIEW:SPEC:HUE 120`
Preset	0
State Saved	Saved in instrument state
Min	0, but the next decrement takes you to 359
Max	359.9, but the next increment takes you back to 0

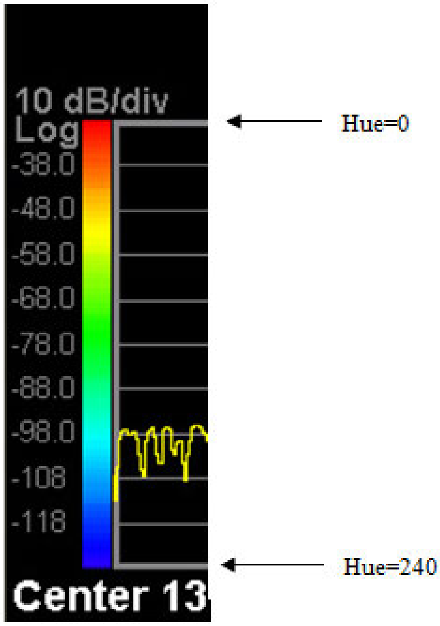
Explaining Hue concept

To understand how **Reference Hue** works, we need to understand the concept of "Hue". The hues of colors run from 0 to 359 (360 is the same as 0) as shown on the color wheel below:

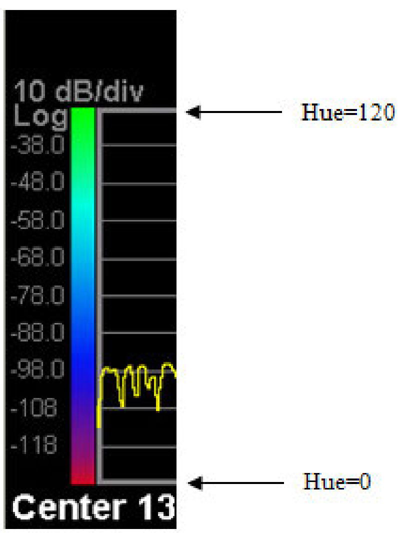


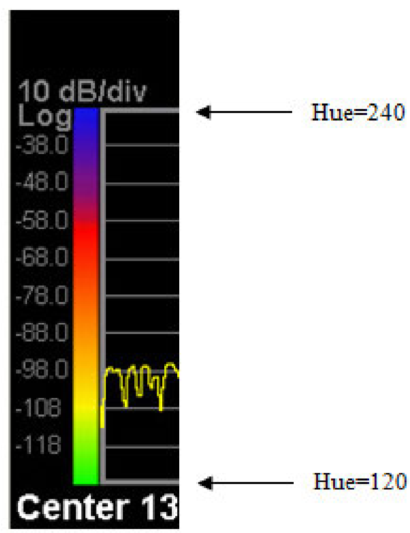
Hue 0 is Red (255,0,0), Hue 120 is Green (0,255,0) and Hue 240 is Blue (0,0,255). Hue 60 is Yellow (255,255,0), Hue 180 is Cyan (0,255,255) and Hue 300 is Magenta (255,0,255). In region A-B, the red value is constant (255), in C-D, the green value is constant (255), and in E-F, the blue value is constant (255). There is no green in region F-A, there is no Red in E-D, and there is no Blue in B-C.

When you adjust **Reference Hue**, you are adjusting the hue at the top of the color bar. The bottom of the color bar shows the hue that is 240 degrees clockwise from the **Reference Hue**. Thus, in the normal case, the color bar appears like this:



Here are other examples of Ref Hue settings:

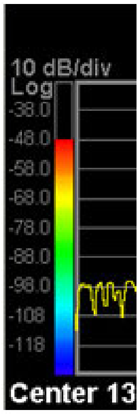




Reference Hue Position

Lets you adjust where, as a percentage of the graticule, the "Reference Hue" on page 263 appears. Above the **Reference Hue Position**, any amplitudes simply map as black.

As an example, here is what the color bar looks like when **Reference Hue Position** is set to 80%:

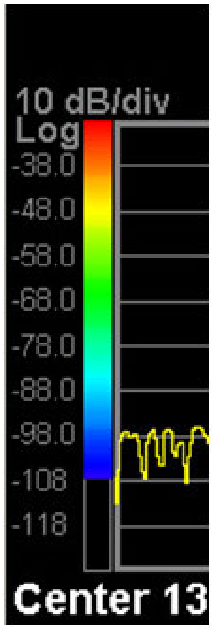


See "Color Adjust" on page 259 for more examples

Remote Command	`:DISPlay:VIEW:SPECtrogram:REFerence <integer>` `:DISPlay:VIEW:SPECtrogram:REFerence?`
Example	`:DISP:VIEW:SPEC:REF 60`
Preset	100
State Saved	Saved in instrument state
Min	Cannot go any lower than 10%, or "Bottom Hue Position" on page 266 + 10, whichever is higher
Max	100

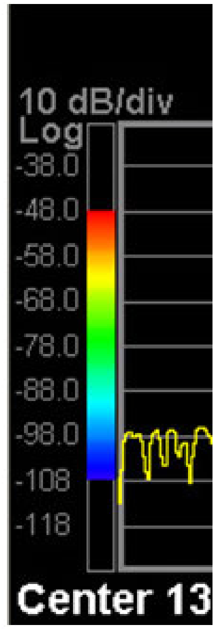
Bottom Hue Position

Lets you adjust where, as a percentage of the graticule, the bottom of the color bar appears. Below the color bar is black, and any amplitudes in this region simply map as black.



Ref Hue Position = 100%

Bottom Hue Position = 20%



Ref Hue Position = 80%

Bottom Hue Position = 20%

See "Color Adjust" on page 259 for more examples

Remote Command	`:DISPlay:VIEW:SPECtrogram:BOTTom <integer>` `:DISPlay:VIEW:SPECtrogram:BOTTom?`
Example	`:DISP:VIEW:SPEC:BOTT 40`
Preset	0
State Saved	Saved in instrument state
Min	0
Max	Cannot go any higher than 90%, or "Reference Hue Position" on page 265 – 10, whichever is lower

Auto Adjust Hue Position

Sets "Reference Hue Position" on page 265 to the highest amplitude value found in the Spectrogram, and sets "Bottom Hue Position" on page 266 to the lowest amplitude value found in the Spectrogram.

Remote Command	`:DISPlay:VIEW:SPECtrogram:AADJust`
Example	`:DISP:VIEW:SPEC:AADJ`

Select Display Line

Allows you to select the display line currently being controlled by "Display Line" on page 268.

Preset	1

Display Line

Activates an adjustable horizontal line that is used as a visual reference line. The line’s vertical position corresponds to its amplitude value. The value of the display line (for example, –20.3 dBm) appears right-justified above the line itself on the right side of the display, marked **DL** for measurements that support only one **Display Line**. For measurements that support more than one; **DL1** for **Display Line 1**, “**DL2**” for **Display Line 2**, etc.

In measurements that support multiple **Display Lines**, this control affects whichever **Display Line** has been selected by "Select Display Line" on page 268.

The **Display Line** can be adjusted using the step keys, knob, or numeric keypad. It can also be dragged on the display with your finger or a mouse. The unit of **Display Line** is determined by "Y Axis Unit" on page 1832 under **Amplitude**. If more than one window has a display line, the display line of the selected window is controlled.

If the **Display Line** is off the screen, it shows as a line at the top/bottom of the screen with an arrow pointing up or down. As with all such lines (Pk Thresh, Trigger Level, etc.) it is drawn on top of all traces.

Unaffected by "Auto Couple" on page 1995.

Remote Command	`:DISPlay:WINDow[1]:TRACe:Y:DLINe[1]|2|…|4 <ampl>` `:DISPlay:WINDow[1]:TRACe:Y:DLINe[1]|2|…|4?`

Example	Turn on **Display Line**; or if multiple display lines, turns on **Display Line 1**:
	`:DISP:WIND:TRAC:Y:DLIN:STAT ON`
	Adjust **Display Line 2**:
	`:DISP:WIND:TRAC:Y:DLIN2 -32 dBm`

Couplings	When a value is set for the display line, it is turned `ON` When **Display Line** switches from `OFF` to `ON`, if it is off-screen, it is set to either the top or bottom of screen, depending on which direction off-screen it was The **Display Line**'s value does not change when it is turned `OFF`
Preset	**Display Line 1** selected, `OFF`, and set to -25 dBm
State Saved	Saved in instrument state
Min/Max	–/+∞ (minus/plus infinity) in current units

Auto Function

Remote Command	`:DISPlay:WINDow[1]:TRACe:Y:DLINe[1]|2|…|4:STATe OFF | ON | 0 | 1` `:DISPlay:WINDow[1]:TRACe:Y:DLINe[1]|2|…|4:STATe?`
Preset	`OFF`

Select Freq Line

Lets you select the display line currently being controlled by "Freq Line" on page 269.

Preset	1

Freq Line

Activates an adjustable vertical line that is used as a visual reference line. The line’s horizontal position corresponds to its frequency value. The value of the frequency line (for example, 2.5 GHz) appears at the top of the display, to the right or left of the line justified as required for it to be on screen, marked **FL1** for **Freq Line 1**, **FL2** for **Freq Line 2**, etc.

This control affects whichever **Freq Line** has been selected by "Select Freq Line" on page 269.

The **Freq Line** can be adjusted using the step keys, knob, or numeric keypad. It can also be dragged on the display with your finger or a mouse. If more than one window has a **Freq Line**, the **Freq Line** of the selected window is controlled.

If the **Freq Line** is off-screen, it shows as a line at the left or right of the screen. As with all such lines (Pk Thresh, Trigger Level, etc.) it is drawn on top of all traces.

Unaffected by "Auto Couple" on page 1995.

Remote Command	`:DISPlay:WINDow[1]:TRACe:X:FLINe[1]|2|…|4 <ampl>` `:DISPlay:WINDow[1]:TRACe:X:FLINe[1]|2|…|4?`

Example	Turn **Freq Line 1** on:
	`:DISP:WIND:TRAC:X:FLIN:STAT ON`
	Set **Freq line 3** to 1 GHz:
	`:DISP:WIND:TRAC:X:FLIN3 1 GHz`

Dependencies	Freq Lines, and this control, only display in Swept Spans
Couplings	When a value is set for **Freq Line**, it is turned `ON` When **Freq Line** goes from `OFF` to `ON`, if it is off-screen, it is set to either the left or right of screen, depending on which direction off-screen it was The **Freq Line**'s value does not change when it is turned `OFF`
Preset	**Freq Line 1** selected, `OFF`, and set to 1 GHz
State Saved	Saved in instrument state

Auto Function

Remote Command	`:DISPlay:WINDow[1]:TRACe:X:FLINe[1]|2|…|4:STATe OFF | ON | 0 | 1` `:DISPlay:WINDow[1]:TRACe:X:FLINe[1]|2|…|4:STATe?`
Preset	`OFF`

Select Time Line

Allows you to select the display line currently being controlled by "Time Line" on page 270.

Preset	1

Time Line

Activates an adjustable vertical line that is used as a visual reference line. The line's horizontal position corresponds to its time value. The value of the **Time Line** (for example, 1 ms) appears at the top of the display, to the right or left of the line justified as required for it to be on-screen, marked **TL1** for **Time Line 1**, **TL2** for **Time Line 2**, etc.

This key controls whichever **Time Line** has been selected by "Select Time Line" on page 270.

The **Time Line** can be adjusted using the step keys, knob, or numeric keypad. It can also be dragged on the display with your finger or a mouse. If more than one window has a **Time Line**, the **Time Line** of the selected window is controlled.

If the **Time Line** is off-screen, it shows as a line at the left or right of the screen. As with all such lines (Pk Thresh, Trigger Level, etc.) it is drawn on top of all traces.

Unaffected by "Auto Couple" on page 1995.

Remote Command	`:DISPlay:WINDow[1]:TRACe:X:TLINe[1]|2|…|4 <ampl>` `:DISPlay:WINDow[1]:TRACe:X:TLINe[1]|2|…|4?`

Example	Turn **Time Line 1** on:
	`:DISP:WIND:TRAC:X:TLIN:STAT ON`
	Set **Time Line 3** to 1.2 ms:
	`:DISP:WIND:TRAC:X:TLIN3 1.2 ms`

Dependencies	Time Lines, and this control, only display in **Zero Span**
Couplings	When a value is set for **Time Line**, it is turned `ON` When **Time Line** switches from `OFF` to `ON`, if it is off-screen, it is set to either the left or right of screen, depending on which direction off-screen it was The **Time Line**'s value does not change when it is turned `OFF`

Preset	**Time Line 1** selected, OFF, and set to 1 ms
State Saved	Saved in instrument state

Auto Function

Remote Command	:DISPlay:WINDow[1]:TRACe:X:TLINe[1]|2|…|4:STATe OFF | ON | 0 | 1 :DISPlay:WINDow[1]:TRACe:X:TLINe[1]|2|…|4:STATe?
Preset	OFF

3.2.5.2 Annotation

Contains controls for setting up the annotation for the current Mode or Measurement.

Graticule

Turns the display graticule On or Off for all windows with graticules in all measurements in the current Mode. Also turns the graticule Y-Axis annotation on and off.

Remote Command	:DISPlay:GRATicule[:STATe] OFF | ON | 0 | 1 :DISPlay:GRATicule[:STATe]?
Example	:DISP:GRAT OFF
Notes	The graticule is the set of horizontal and vertical lines that make up the grid/divisions for the X-Axis and Y-Axis
Preset	ON
State Saved	Saved in instrument state
Backwards Compatibility SCPI	:DISPlay:WINDow[1]:TRACe:GRATicule:GRID[:STATe] OFF | ON | 0 | 1 :DISPlay:WINDow[1]:TRACe:GRATicule:GRID[:STATe]? This command is accepted for backwards compatibility with older instruments, but the WINDow, TRACe and GRID parameters are ignored

Screen Annotation

Controls the display of the annunciation and annotation around the graticule, including any annotation on lines (such as the display line, the threshold line, etc.) and the Y-Axis annotation, for all windows with screen annotation in all measurements in the current Mode.

This does *not* include marker annotation (or the N dB result). When OFF, the graticule expands to fill the entire graticule area, leaving only the 1.5% gap above the graticule, as described in the **Trace** section.

Remote Command	`:DISPlay:ANNotation:SCReen[:STATe] OFF | ON | 0 | 1` `:DISPlay:ANNotation:SCReen[:STATe]?`
Example	`:DISP:ANN:SCR OFF`
Dependencies	Grayed-out and forced to `OFF` when **System Display Settings**, **Annotation** is `OFF`
Preset	`ON` This remains `OFF` through a Preset when **System Display Settings**, **Annotation** is set to `OFF`
State Saved	Saved in instrument state

Trace Annotation

Turns on and off the labels on the traces, showing their detector (or their Math Mode) as described in the **Trace** section, for all windows in all measurements in the current Mode for which Trace Annotation on/off is supported.

If Trace Math is being performed on a trace, then the Trace Math annotation replaces the detector annotation.

For measurements that support limit lines, this key also turns on and off the labels on the Limit Lines. The label is the Limit number annotation and Limit Comment displayed on the graph. If the length of the comment is greater than 20 characters, the first 8 characters and the last 8 characters are displayed, joined with ....

Remote Command	`:DISPlay:ANNotation:TRACe[:STATe] ON | OFF | 1 | 0` `:DISPlay:ANNotation:TRACe[:STATe]?`
Example	`:DISP:ANN:TRAC OFF`
Preset	`OFF`
State Saved	Saved in instrument state

Control Annotation

Turns on and off the display of values on the Active Function controls for all measurements in the current Mode. This is a security feature.

Remote Command	`:DISPlay:ACTivefunc[:STATe] ON | OFF | 1 | 0` `:DISPlay:ACTivefunc[:STATe]?`
Example	`:DISP:ACT OFF`
Dependencies	Grayed out and forced to `OFF` when **System Display Settings**, **Annotation** is `OFF`
Preset	`ON` This remains `OFF` through a Preset when **System Display Settings**, **Annotation** is set to `OFF`
State Saved	Saved in instrument state

Frequency Annotation

Turns on and off the absolute frequency annotation in the main display for all windows in all measurements in the current Mode for which Frequency Annotation on/off is supported.

The affected annotations include Center Frequency, Start/Stop Frequency, Frequency Offset, Marker Frequency. Any relative frequency annotation such as Span and Marker Delta are not affected.

The frequency annotations in any other associated display, such as in Active Function, Softkey label, Limit Editor, Amp Corr Editor and Marker Table are not changed.

Frequency annotations that are not associated with the spectrum, such as RBW, IBW, Sweep Time, are excluded and they are shown regardless of this selection.

Remote Command	`:DISPlay:ANNotation:FREQuency[:STATe] ON | OFF | 1 | 0` `:DISPlay:ANNotation:FREQuency[:STATe]?`
Example	`:DISP:ANN:FREQ OFF`
Dependencies	Only appears in the Swept SA measurement in Spectrum Analyzer Mode
Preset	`ON`

Meas Bar

Turns the Measurement Bar at the top of the screen on and off for all measurements in the current Mode. When `OFF`, the graticule area expands to fill the area formerly occupied by the Measurement Bar.

Remote Command	`:DISPlay:ANNotation:MBAR[:STATe] OFF | ON | 0 | 1` `:DISPlay:ANNotation:MBAR[:STATe]?`
Example	`:DISP:ANN:MBAR OFF`
Dependencies	Grayed out and forced to `OFF` when **System Display Settings**, **Annotation** is `OFF`
Preset	`ON` This remains `OFF` through a Preset when **System Display Settings**, **Annotation** is set to `OFF`
State Saved	Saved in instrument state

Display Enable (Remote Command Only)

Turns the display on/off, including the display drive circuitry. The backlight stays lit to confirm that the instrument is on. The display enable setting is mode global. Theare three reasons for turning the display off:

1. To increase speed as much as possible by freeing the instrument from having to update the display
2. To reduce emissions from the display, drive circuitry
3. For security purposes

If you have turned off the display:

– and you are in local operation, the display can be turned back on by pressing any key or by sending `:SYSTem:DEFaults MISC` or `:DISPlay:ENABle ON` (neither `*RST` nor :SYSTem:PRESet enable the display)

– and you are in remote operation, the display can be turned back on by pressing the **Local** or **Esc** keys, or by sending `:SYSTem:DEFaults MISC` or `:DISPlay:ENABle ON` (neither `*RST` nor `:SYSTem:PRESet` enable the display)

– and you are using either the `:SYSTem:KLOCk` command or GPIB local lockout, then *no* front-panel key press will turn the display back on. You must turn it back on remotely.

If the display is `OFF`, many SCPI commands related to User Views and Multiscreen functionality do not work, and return the error messages "-221, Settings conflict; Screen SCPI cannot be used when Display is disabled" or "221, Settings conflict; View SCPI cannot be used while Display is disabled". These commands include:

Name	Command
Select User View	`:DISPlay:VIEW:ADVanced:SELect`
Rename User View	`:DISPlay:VIEW:ADVanced:REName`
Delete User View	`:DISPlay:VIEW:ADVanced:DELete`
Create User View	`:DISPlay:VIEW:ADVanced:NAME`
Select Screen	`:INSTrument:SCReen:SELect`
Delete Screen	`:INSTrument:SCReen:DELete`
Delete All But This Screen	`:INSTrument:SCReen:DELete:ALL`
Add Screen	`:INSTrument:SCReen:CREate`
Rename Screen	`:INSTrument:SCReen:REName`
Sequencer On/Off	`:SYSTem:SEQuencer`

Remote Command	`:DISPlay:ENABle OFF | ON | 0 | 1` `:DISPlay:ENABle?`
Example	`:DISP:ENAB OFF`
Couplings	`:DISP:ENAB OFF` turns Backlight `OFF` and `:DISP:ENAB ON` turns Backlight `ON`, but changing Backlight settings does *not* change the state of `:DISP:ENAB`

Preset	ON Set by :SYST:DEF MISC, but not affected by *RST or :SYSTem:PRESet
State Saved	Not saved in instrument state
Backwards Compatibility Notes	:SYST:PRES no longer turns on :DISPlay:ENABle as it did in legacy analyzers

3.2.5.3 View

Contains controls for selecting the current **View**, and for editing User Views.

View

See "Views" on page 185

User View

Lets you choose a View from the saved User Views for the current measurement. This panel only appears if a User View exists for the current measurement.

Remote Command	:DISPlay:VIEW:ADVanced:SELect <alphanumeric> :DISPlay:VIEW:ADVanced:SELect?
Example	Select Baseband as the current View :DISP:VIEW:ADV:SEL “Baseband”
Notes	You must be in the measurement whose View you are trying to set to send the command. You can only set Views for the current measurement using this command For predefined views, the parameter is derived from the view name that is shown in the View list in the user interface. For example, if you are trying to select the Trace Zoom view in the Swept SA measurement, you send: :DISP:VIEW:ADV:SEL "Trace Zoom" because “Trace Zoom” is the name of the View as seen in the Mode/Meas dialog or in the Display, View menu You *cannot* use the legacy View parameter (which in this case would be TZOom) with :DISP:VIEW:ADV:SEL <alphanumeric> is case insensitive; you can specify mixed case, however the name will be evaluated on a single case. Thus, both of the following forms work: :DISP:VIEW:ADV:SEL "Trace Zoom" :DISP:VIEW:ADV:SEL "TRACE ZOOM" If the specified view is not a valid View, the query returns the error message “-224, Illegal parameter value; View with the name <alphanumeric> does not exist” If the display is disabled (via :DISP:ENAB OFF) then the error message “-221, Settings conflict;

	View SCPI cannot be used while Display is disabled" is generated
Backwards Compatibility SCPI	The legacy node `:DISPlay:VIEW[:SELect]` is retained for backwards compatibility, but it only supports predefined views

Restore Layout to Default

Restores the Layout to the default for Basic.

Modified Views are very temporary; if you exit the current measurement they are discarded, and they are not saved in State. To retain this View for later use, and to be able to return easily to your original Basic View, you can save your edited View as a "User View".

Save Layout as New View

Saves your new View as a User View. An alpha keyboard appears, which lets you name your new View; the default is the old View name plus a number.

Remote Command	`:DISPlay:VIEW:ADVanced:NAME <alphanumeric>`
Example	`:DISP:VIEW:ADV:NAME "Baseband"` Creates a new View named `Baseband` from the current View, and selects it as the current View
Notes	`<alphanumeric>` is case insensitive; you can specify mixed case, however the name will be evaluated on a single case If `<alphanumeric>` name already exists as a View, the error message "-224, Illegal parameter value; View <alphanumeric> already exists" is generated If the display is disabled (via `:DISP:ENAB OFF`) then the error message "-221, Settings conflict; User View SCPI cannot be used while Display is disabled" is generated

Re-Save User View

You can re-edit a User View; if you make changes, then an asterisk will appear next to the User View's name. You can then tap **Re-Save User View** to save it back to its existing name, or **Save Layout as New View** to add another, new User View.

This is a front panel function only, there is no remote command available to perform this function. To do this remotely, you must first perform **Save Layout as New View**, then delete the old User View and rename the new one with the name of the View you just deleted.

Rename User View

You can rename the current View by giving it a new unique name. Only User Views can be renamed, if the current View is a Predefined View, an error occurs.

Remote Command	`:DISPlay:VIEW:ADVanced:REName <alphanumeric>`
Example	`:DISP:VIEW:ADV:REN “Baseband”`
Notes	`<alphanumeric>` is case insensitive; you can specify mixed case, however the name will be evaluated on a single case If the `<alphanumeric>` specifying the new name is already present in the list of View names, the error message “-224, Illegal parameter value; View <alphanumeric> already exists” is generated If the current View is a Predefined View, the error message “-224, Illegal parameter value; Cannot rename a Predefined View” is generated If the display is disabled (via `:DISP:ENAB OFF`) then the error message “-221, Settings conflict; View SCPI cannot be used while Display is disabled” is generated

Delete User View

You can delete the current View if it is a User View. The default view becomes the current view for the Measurement.

Remote Command	`:DISPlay:VIEW:ADVanced:DELete`
Example	`:DISP:VIEW:ADV:DEL`
Notes	`<alphanumeric>` is case insensitive; you can specify mixed case, however the name will be evaluated on a single case If the `<alphanumeric>` is not present in the list of View names, the error message “-224, Illegal parameter value; View <alphanumeric> does not exist” is generated If the current View is a Predefined View, the error message “-224, Illegal parameter value; Cannot delete a Predefined View” is generated If the display is disabled (via `:DISP:ENAB OFF`) then the error message “-221, Settings conflict; View SCPI cannot be used while Display is disabled” is generated

Delete All User Views

Deletes all previously saved User Views. The default view becomes the current view for the Measurement if a User View was the current view when this command was executed.

Remote Command	`:DISPlay:VIEW:ADVanced:DELete:ALL`

Example	`:DISP:VIEW:ADV:DEL:ALL`
Notes	Disabled if there are no User Views

View Editor Remote Commands

The following remote commands help you manage Views and User Views. Note that the SCPI node for User Views handles both Predefined and User Views. The legacy nodes, `:DISPlay:VIEW[:SELect]` and `:DISPlay:VIEW:NSEL`, are retained for backwards compatibility, but they only support predefined views.

View Listing Query

Returns a string containing a comma-separated list of names for *all* the Views, including User Views, available for the current Measurement.

Remote Command	`:DISPlay:VIEW:ADVanced:CATalog?`
Example	`:DISP:VIEW:ADV:CAT?`
Notes	Returns a quoted string of the available Views for the current measurement, separated by commas. The list includes names for *all* the Views, including User Views, available for the current Measurement Example: `"Normal,Trace Zoom,Spectrogram,Baseband,myView1,yourView1"` No distinction is made between Predefined and User Views If you switch measurements with the display disabled (via `:DISP:ENAB OFF`), then query the list of available Views, the result is undefined

User View Listing Query

Returns a string containing a comma-separated list of names for *only* the User Views available for the current Measurement.

Remote Command	`:DISPlay:VIEW:ADVanced:USER:CATalog?`
Example	`:DISP:VIEW:ADV:USER:CAT?`
Notes	Returns a quoted string of the available User Views for the current measurement, separated by commas. Example: `"Baseband,myView1,yourView1"` If you switch measurements with the display disabled (see "Display Enable (Remote Command Only)" on page 1983), then query the list of available Views, the result is undefined

3.2.6 Frequency

Allows you to control the **Frequency** parameters of the instrument.

Some features in the **Frequency** menu are the same for all measurements in the current Mode – they do not change as you change measurements. Settings like these are called “Meas Global” and are unaffected by **Meas Preset**. For example, the "Center Frequency" on page 279 setting is the same for all measurements – it does not change as you change measurements.

3.2.6.1 Settings

Contains controls that pertain to the X-Axis parameters of the measurement. These parameters control how data on the horizontal (X) axis is displayed and control instrument settings that affect the horizontal axis.

Center Frequency

Sets the frequency that corresponds to the horizontal center of the graticule (when frequency Scale Type is set to linear). While adjusting **Center Frequency**, **Span** is held constant, which means that both "Start Freq" on page 290 and "Stop Freq" on page 292 will change.

Pressing **Center Frequency** sets the frequency entry mode to Center/Span. In Center/Span mode, the center frequency and span values are displayed below the graticule, and the default active function in the **Frequency** menu is **Center Frequency**. In the Start/Stop annotation mode, **Start Freq** and **Stop Freq** are displayed below the graticule instead of **Center Frequency** and **Span**.

Pressing **Center Frequency** also sets the frequency entry mode to Center/Span. In Center/Span mode, the center frequency and span values are displayed below the graticule, and the default active function in the **Frequency** menu is **Center Frequency**.

When **Display Scale Type** is set to `LOG`, pressing **Center Frequency** sets the frequency that corresponds to the arithmetic mean of the start frequency and stop frequency, which is not at the horizontal center of the graticule.

The center frequency setting is the same for all measurements within a Mode, that is, it is Meas Global. Some Modes are also able to share a Mode Global center frequency value. If this is the case, the Mode has a **Global** tab in its **Meas Setup** menu.

Center Frequency sets (and queries) the center frequency for the currently selected input. If your instrument has multiple inputs, and you select another input, **Center Frequency** changes to the value for that input. SCPI commands are available to directly set **Center Frequency** for a specific input (see "RF Center Frequency" on page 283 and "Ext Mix Center Freq" on page 284).

Center Frequency is remembered as you go from input to input. Thus, you can set a **Center Frequency** of 10 GHz with the RF Input selected, change to BBIQ and set a **Center Frequency** of 20 MHz, then switch to External Mixing and set a **Center Frequency** of 60 GHz. When you return to the RF Input, **Center Frequency** reverts to 10 GHz; back to BBIQ and it is 20 MHz; back to External Mixing and it is 60 GHz.

Remote Command	`[:SENSe]:FREQuency:CENTer <freq>` `[:SENSe]:FREQuency:CENTer?`

Example	Set Center Frequency to 50 MHz:
	`:FREQ:CENT 50 MHz`
	Increment **Center Frequency** by the value of "CF Step" on page 298:
	`:FREQ:CENT UP`
	Return the current value of **Center Frequency**:
	`:FREQ:CENT?`

Notes	Sets the RF, External Mixing or I/Q Center Frequency depending on the selected input: – For RF input it is equivalent to `:FREQ:RF:CENT` – For I/Q input it is equivalent to `:FREQ:IQ:CENT` – For External Mixer it is equivalent to `:FREQ:EMIX:CENT` Preset and Max values depend on Hardware Options If no terminator (for example, MHz) is sent, the terminator Hz is used. If a terminator with unit other than frequency is used, an invalid suffix error message is generated
Dependencies	**Center Frequency** can be limited by **Start Freq** or **Stop Freq** limits, if **Span** is so large that start or stop reach their limits
Couplings	When operating in "swept span", any value of **Center Frequency** or **Span** that is within the frequency range of the instrument is allowed, *if* the value is being set through the front panel numeric key pad or the SCPI command. The other parameter is forced to a different value if needed, to keep Start and Stop Frequencies within the instrument's frequency range Coupling between center frequency and span: numeric (keypad) entries are treated differently than changing the value using the step keys (**Up/Down Arrows**) or the knob. Similarly, for remote operation, sending a numeric frequency value is treated differently than the `UP|DOWN` keywords: – Numeric entries (keypad or remote): Any value of **Center Frequency** or **Span** (within the frequency range of the instrument) is allowed. The other parameter is changed, as necessary, to keep the Start Freq and Stop Freq within the instrument frequency range – Knob or Step keys (up/down arrows) or `UP|DOWN` keywords: The value of the parameter being changed (**Center Frequency** or **Span**) is limited so the other parameter is not forced to a new value. Thus, if only the step keys and knob are used, you can return to the initial **Center Frequency** and **Span** by changing only the current parameter Note that, since out-of-range **Start Freq** and **Stop Freq** are never allowed, markers and trace math

	work correctly without requiring any special handling for out-of-range conditions
Preset	Depends on instrument maximum frequency, mode, measurement, and selected input See "Center Frequency Presets" on page 281 and "Ext Mix Center Freq" on page 284
State Saved	Saved in instrument state
Min/Max	Depends on instrument maximum frequency, mode, measurement, and selected input See "Center Frequency Presets" on page 281 and "Ext Mix Center Freq" on page 284
Annotation	Center <value> appears in the lower left corner of the display
Status Bits/OPC dependencies	Non-overlapped

Center Frequency Presets

The following table provides the Center Frequency Presets for the Spectrum Analyzer mode, and the Max Freq, for the various frequency options:

Freq Option	CF after Mode Preset	Stop Freq after Mode Preset	Max Freq (can't tune above)
503 (all but CXA)	1.805 GHz	3.6 GHz	3.7 GHz
503 (CXA)	1.505 GHz	3.0 GHz	3.08 GHz
507 (all but CXA)	3.505 GHz	7.0 GHz	7.1 GHz
507 (CXA)	3.755 GHz	7.5 GHz	7.58 GHz
508 (all but MXE)	1.805 GHz	3.6 GHz	8.5 GHz
508 (MXE)	4.205 GHz	8.4 GHz	8.5 GHz
513	6.805 GHz	13.6 GHz	13.8 GHz
526 (except CXA and MXE)	13.255 GHz	26.5 GHz	27.0 GHz*
526 (CXA)	13.255 GHz	26.5 GHz	26.55 GHz
526 (MXE)	1.805 GHz	3.6 GHz	27.0 GHz
532	16.005 GHz	32.0 GHz	32.5 GHz
540	20.005 GHz	40.0 GHz	40.5 GHz
543	21.505 GHz	43.0 GHz	43.0 GHz
544	22.005 GHz	44.0 GHz	45.0 GHz
550	25.005 GHz	50.0 GHz	52 GHz
F03 (CXA-m)	1.505 GHz	3.0 GHz	3.08 GHz
F07 (CXA-m)	3.755 GHz	7.5 GHz	7.575 GHz
F13 (CXA-m)	6.805 GHz	13.6 GHz	13.8 GHz
F26 (CXA-m)	13.255 GHz	26.5 GHz	26.55 GHz
504 (M9421A, M8920A)	2.145 GHz	3.88GHz	3.88 GHz

Freq Option	CF after Mode Preset	Stop Freq after Mode Preset	Max Freq (can't tune above)
506 (M9421A, M8920A)	3.245 GHz	6.08GHz	6.08 GHz
F06 (M9410A/11A)	1.0 GHz	6.08 GHz	6.08 GHz
F06 (M9415A)	1 GHz	1.08 GHz	6.6 GHz
F08 (M9415A)	1 GHz	1.08 GHz	8.6 GHz
F12 (M9415A)	1 GHz	1.08 GHz	12.9 GHz

*For option 526, the Max CF in RTSA is 26.999999995 GHz.

N9041B Center Freq Presets

Input	CF after Mode Preset	Stop Freq after Mode Preset	Max Freq (can't tune above)
Input 1, all models	25.005 GHz	50.0 GHz	52 GHz
Input 2, opt 585	42.505 GHz	85.0 GHz	86 GHz
Input 2, opt 590	45.005 GHz	90.0 GHz	92 GHz
Input 2, opt 5CX	55.005 GHz	110.0 GHz	110 GHz

Input 2, CXA and MXE

Model	CF after Mode Preset	Stop Freq after Mode Preset	Max Freq (can't tune above)
CXA opt C75	0.7505 GHz	1.5 GHz	1.58 GHz
MXE	505 MHz	1 GHz	1.000025 GHz

Tracking Generator Frequency Limits (CXA only)

Tracking Generator Option	Min Freq (clips to this freq when turn TG on and can’t tune below while TG on)	If above this Freq, Stop Freq clipped to this Freq when TG turned on	Max Freq (can't tune above) while TG on
T03	9 kHz	3.0 GHz	3.08 GHz
T06	9 kHz	6.0 GHz	6.05 GHz

Tracking Generator Frequency Limits(CXA-m only)

Tracking Generator Option	Min Freq (clips to this freq when turn TG on and can’t tune below while TG on)	If above this Freq, Stop Freq clipped to this Freq when TG turned on	Max Freq (can't tune above) while TG on
T03	2 MHz	3.08 GHz	3.08 GHz
T07	2 MHz	7.575 GHz	7.575 GHz

Tracking Generator Option	Min Freq (clips to this freq when turn TG on and can't tune below while TG on)	If above this Freq, Stop Freq clipped to this Freq when TG turned on	Max Freq (can't tune above) while TG on
T13	2 MHz	13.8 GHz	13.8 GHz
T26	2 MHz	26.55 GHz	26.55 GHz

VXT Models with Radio Heads/CIU Frequency Range

The following table shows the Center Frequency Presets and Range for VXT modes with Radio Heads/CIU.

Products with Radio Heads/CIU	Preset	Start frequency	Stop frequency
M9421A + CIU	6 GHz	5.9 GHz	12 GHz
M9410A + CIU	6 GHz	5.9 GHz	12 GHz
M9410A + CIU + RRH	25 GHz	24.25 GHz	43.5 GHz

RF Center Frequency

Specifies the RF Center Frequency. Sets the center frequency to use when the RF input is selected, even if the RF input is not the input that is selected at the time the command is sent. Note that **Center Frequency** in the **Frequency** menu on the front panel always applies to the currently selected input.

Remote Command	`[:SENSe]:FREQuency:RF:CENTer <freq>` `[:SENSe]:FREQuency:RF:CENTer?`
Example	`:FREQ:RF:CENT 30 MHz` `:FREQ:RF:CENT?`
Notes	This command is the same in all Modes, but the parameter is Measurement Global. So, the value is independent in each Mode and common across all the measurements in the Mode
Dependencies	If the electronic/soft attenuator is enabled, any attempt to set **Center Frequency** such that the Stop Frequency would be >3.6 GHz fails and results in an advisory message. If the equivalent SCPI command is sent, this same message is generated as part of a "-221, Settings conflict" warning If Source Mode is set to Tracking, and the Max or Min **Center Frequency** is therefore limited by the limits of the source, a warning message is generated, "Data out of range; clipped to source max/min" if these limits are exceeded. Note that for an external source, these limits can be affected by the settings of Source Numerator, Source Denominator, and Power Sweep
Preset	See "Center Frequency Presets" on page 281
State Saved	Saved in instrument state

Min	<table><tr><th>Instrument Types</th><th>Value</th></tr><tr><td>VXT model M9421A</td><td>55.000005 MHz</td></tr><tr><td>VXT models M9410A/11A</td><td>6.505 kHz with Option LFE 330.000005 MHz without Option LFE 330.000005 MHz</td></tr><tr><td>VXT model M9415A</td><td>330.000005 MHz</td></tr><tr><td>M8920A</td><td>80.005 kHz</td></tr><tr><td>All other instruments *Unless* Source Mode is set to Tracking, in which case it is limited by the minimum frequency of the Source</td><td>–79.999995 MHz</td></tr></table>
Max	See table above. Basically, instrument maximum frequency – 5 Hz. Note that, if the Source Mode is set to Tracking, the effective instrument maximum frequency may be limited by the source maximum frequency If the knob or step keys are being used, also depends on the value of the other three interdependent parameters: **Span**, **Start Frequency** and **Stop Frequency**

Ext Mix Center Freq

Specifies the External Mixer Center Frequency. Sets the center frequency to use when the External Mixer is selected, even if the External Mixer input is not the input which is selected at the time the command is sent. Note that the **Center Frequency** function in the **Frequency** menu on the front panel always applies to the currently selected input.

Remote Command	`[:SENSe]:FREQuency:EMIXer:CENTer <freq>` `[:SENSe]:FREQuency:EMIXer:CENTer?`
Example	`:FREQ:EMIX:CENT 60 GHz` `:FREQ:EMIX:CENT?`
Notes	This command is the same in all Modes, but the parameter is Measurement Global. So, the value is independent in each Mode and common across all the measurements in the Mode
Couplings	When you return to External Mixing after using one of the other inputs (for example, RF), you return to the settings that you had when you left External Mixing. So, you return to the band you were in with the **Center Frequency** that you had. However, **Span** is *not* an input-dependent parameter, so it does not change. Therefore, the instrument comes back with the **Span** from the previous input, limited as necessary by the current mixer setup
Preset	When **Mode Preset** is performed while in External Mixing, the start frequency of the current Mode is set to the nominal Min frequency of the lowest harmonic range in the Harmonic Table for the current mixer setup. Similarly, the stop frequency of the current Mode is set to the nominal Max frequency of the

	highest harmonic range in the Harmonic Table. **Center Frequency** thus presets to the point arithmetically equidistant from these two frequencies Note that, if the current measurement has a limited **Span** available to it, and cannot achieve the span shown in the table (**Span** = **Stop Freq** – **Start Freq**), the instrument uses the maximum span that the measurement allows, and still sets **Center Frequency** to the midpoint of the **Start Freq** and **Stop Freq** values in the Harmonic Table When **Restore Input/Output Defaults** is performed, the mixer presets to the 11970A, whose Start and Stop frequencies are 26.5 and 40 GHz respectively. The center of these two frequencies is 33.25 GHz Therefore, after **Restore Input/Output Defaults**, if you switch to External Mixing and do a **Mode Preset** while in the Spectrum Analyzer Mode, the resulting **Center Frequency** is 33.25 GHz
State Saved	Yes
Min	The minimum frequency in the currently selected mixer band + 5 Hz
Max	The maximum frequency in the currently selected mixer band - 5 Hz If the knob or step keys are being used, also depends on the value of the other three interdependent parameters **Span**, **Start Freq** and **Stop Freq**

Span

Changes the displayed frequency range symmetrically about the center frequency. While adjusting **Span**, "Center Frequency" on page 279 is held constant, which means that both "Start Freq" on page 290 and "Stop Freq" on page 292 will change.

Pressing **Span** also sets the frequency entry mode to Center/Span. In Center/Span mode, the **Center Frequency** and **Span** values are displayed below the graticule, and the default active function in the **Frequency** menu is **Center Frequency**.

Span also includes a toggle switch to go back and forth between **Swept Span** and **Zero Span**. **Zero Span** is a special sweep type in which the instrument stops sweeping over a range of frequencies, and stays at the **Center Frequency**. In **Zero Span**, the instrument sweeps in the time domain, showing you the instantaneous amplitude versus time at the **Center Frequency**. For more details, see "Zero Span" on page 288. Selecting **Swept Span** places the instrument in Center/Span frequency entry mode.

When in **Zero Span**, you can return to your last **Swept Span** by pressing the Swept Span/Zero Span toggle on **Span**. (This replaces the **Last Span** function found on older HP/Agilent/Keysight Analyzers.)

NOTE	We use the term **Swept Span** to mean spans *other* than **Zero Span**, even though sometimes when we are in what we call a **Swept Span** we might be performing an FFT-style sweep, which is not a true **Swept Span**.

If **Span** is set to a value greater than the maximum allowable span of the instrument, an error message is generated indicating the data is out of range and was clipped to upper limit.

Remote Command	`[:SENSe]:FREQuency:SPAN <freq>` `[:SENSe]:FREQuency:SPAN?`
Example	Set the span to 2 GHz: `:FREQ:SPAN 2GHz`
Dependencies	If the electrical attenuator is enabled, any attempt to set **Span** such that the **Stop Freq** would be >3.6 GHz results in an error If Source Mode is set to Tracking, and **Span** is therefore limited by the limits of the source, a warning message is generated, "Data out of range; clipped to source max/min" if these limits are exceeded. Note that for an external source, these limits can be affected by the settings of Source Numerator, Source Denominator, and Power Sweep In instruments with an RF Preselector, such as MXE, you cannot sweep across the band break at 3.6 GHz while the RF Preselector is on in **Continuous** sweep, because there is a mechanical switch that bypasses the RF Preselector above 3.6 GHz. For details, see **Stop Freq**
Couplings	**Span** affects **Res BW**, **Sweep Time**, FFT & Sweep choice (including FFT Width, Phase Noise Optimization and ADC Dither auto couplings) When operating in **Swept Span**: – When the value is being set through the front panel numeric keypad or the SCPI command, any value of **Center Frequency** or **Span** that is within the frequency range of the instrument is allowed. The other parameter is forced to a different value, if necessary, to keep **Start Freq** and **Stop Freq** within the instrument's frequency range – When using the knob or the step up/down keys, or the `UP |DOWN` keywords in SCPI, the value that is being changed, that is, **Center Frequency** or **Span**, is limited so that the other parameter is not forced to a new value **Span** cannot be set to zero by setting **Start Freq** = **Stop Freq**. The value of the last setting changes to maintain a minimum difference of 10 Hz between **Start Freq** and **Stop Freq**
Preset	Depends on instrument maximum frequency, mode, measurement, and selected input See "Span Presets" on page 287
State Saved	Saved in instrument state
Min	10 Hz, unless entered directly, then 0 Hz is allowed, but no value *between* 0 and 10 is ever allowed If the **Zoomed Trace** window is visible, **Zero Span** is not allowed, so **Span** may not go below 10 Hz If the **Zone Spectrum** window is visible, **Zero Span** is not allowed in the **Spectrum** window, so **Span** may not go below 10 Hz in the **Spectrum** window
Max	Depends on instrument maximum frequency, mode, measurement, and selected input. See "Span Presets" on page 287 If the knob or step keys are being used, depends on the value of the other three interdependent parameters: **Center Frequency**, **Start Freq**, **Stop Freq** Note that, if the Source Mode is set to **Tracking**, the effective instrument maximum Span may be limited by the source maximum frequency

Annotation	Span <value> appears on the first line of the annotation in the lower right corner of display
Status Bits/OPC dependencies	Overlapped if Signal Track is on (OPC does not return or clear until the zooming has completed for the new span)

Span Presets

The following table provides the Max Span, for the various frequency options:

Freq Option	Max Span (can't set higher than this)
503 (all but CXA)	3.7 GHz
503, F03 (CXA, CXA-m)	3.08 GHz
507 (all but CXA)	7.1 GHz
507 (CXA, CXA-m)	7.575 GHz
508 (all but MXE)	8.5 GHz
508 (MXE)	8.5 GHz
513, F13	13.8 GHz
526 (all but CXA and MXE)	27.0 GHz
526 (MXE)	27.0 GHz
526, F26 (CXA, CXA-m)	26.55 GHz
544	45.08 GHz
550	52 GHz
F06 & EP6 (VXT models M9410A/11A)	6.27 GHz
F06 & LFE & EP6 (VXT models M9411A)	6.5999935 GHz
M9415A-F06	6.27 GHz
M9415A-F08	8.27 GHz
M9415A-F12	12.57 GHz

Input 2:

Model	Max Span (can't set higher than this)
CXA opt C75	1.58 GHz
MXE	1.000025 GHz

Note that if you are in External Mixing, the maximum Span will be equal to the Maximum Stop Frequency – Minimum Start Frequency for the currently selected mixer.

Span Presets by Mode

Mode	Preset Value
SA	8 MHz

Mode	Preset Value
WCDMA	24.6848 MHz
WIMAX OFDMA	50 MHz
C2K	4.5 MHz
TD-SCDMA	8 MHz
1xEVDO	4.05 MHz
DVB-T/H	40 MHz
DTMB (CTTB)	72 MHz
ISDB-T	30 MHz
CMMB	72 MHz
LTE, LTETDD, LTEAFDD, LTEATDD, MSR	25 MHz
Digital Cable TV	40 MHz
5G NR	500 MHz
Radio Test	175 kHz

N9041B Span Presets

Input/Freq Option	Span after Mode Preset	Max Span (can't set higher than this)
Input 1, all models	49.99 GHz	52 GHz
Input 2, opt 585	84.99 GHz	86 GHz
Input 2, opt 590	89.99 GHz	92 GHz
Input 2, opt 5CX	109.99 GHz	110 GHz

Note that if you are in External Mixing, the maximum **Span** is equal to Maximum **Stop Freq** – Minimum **Start Freq** for the currently selected mixer.

Zero Span

While in **Swept Span**, pressing the **Swept Span/Zero Span** toggle on **Span** puts you in **Zero Span**. You can also switch to **Zero Span** by setting **Span** to 0 Hz through SCPI or the front panel numeric keypad. However, you *cannot* switch to **Zero Span** by setting "Start Freq" on page 290 = "Stop Freq" on page 292 using the numeric keypad, nor by using the **Step** keys and the **RPG** to "roll" down to zero, because **Span** can only go as far down as 10 Hz by this means.

Example	Set **Span** to zero, switch to **Zero Span**: `:FREQ:SPAN 0 Hz` Sending `:FREQ:SPAN 1 MHz`, while in **Zero Span**, switches to Swept span
Dependencies	If the **Zoomed Trace** window is visible, **Zero Span** is not allowed If the **Zone Spectrum** window is visible, **Zero Span** is not allowed in the **Spectrum** window

Couplings	Switching to **Zero Span**: – Turns off **Signal Track** – Turns off the auto-coupling of **Res BW** and sweep time – Places the instrument in Center/Span frequency entry mode

When you enter **Zero Span**, the instrument changes the displayed frequency span to 0 Hz. The horizontal axis changes to time rather than frequency. The amplitude displayed is the input signal level at the current center frequency. This is a time-domain mode that changes several measurement functions and couplings. The instrument behavior is similar to an oscilloscope with a frequency selective detector installed in front of the oscilloscope. See Application Note 150 for more information on how to use **Zero Span**.

While in **Zero Span**, setting **Span** to a non-zero value through SCPI or the front Panel returns the instrument to **Swept Span**. You can also return to your last **Swept Span** by pressing the **Swept Span/Zero Span** toggle on the **Span** control.

The following table summarizes the differences between **Zero Span** and **Swept Span**:

Zero Span	Swept Spans
X axis is time	X axis is frequency
There is no auto-**Res BW** selection unless the EMC Standard is CISPR or MIL	**Res BW** coupled to **Span** when **Res BW** in **Auto**
There is no auto sweep time	Sweep time coupled to Res BW when sweep time in auto
Interval Power calculated in Mkr Function	Band Power calculated in Mkr Function
Can only define time limits when in zero span	Can only define frequency limits when in Swept SA
Marker Count counts at the center frequency	**Marker Count** counts at the marker frequency
CF Step size set to **Res BW** value	**CF Step** autocouples to 10% of **Span**
Some **Marker ->** commands not available	Other **Marker ->** commands not available
Freq entry mode always Center/Span	Freq entry mode can be Center/Span or Start/Stop
N dB points reports a time difference	N dB points reports a frequency difference

Full Span

Changes the frequency span of the instrument to the Preset frequency span of the instrument and sets the **Frequency** entry mode to Center/Span.

Span depends on the currently selected input. For example, when using external mixing, **Full Span** changes the frequency to the Preset frequency range specified for the selected external mixing band.

Pressing this control while in **Zero Span** returns the instrument to **Swept Span**.

Remote Command	`[:SENSe]:FREQuency:SPAN:FULL`
Example	Set the span to full frequency range of the instrument: `:FREQ:SPAN:FULL`
Couplings	Turns off signal tracking (span zoom). Does *not* turn off markers, or the current active function

Start Freq

Sets the frequency at the left side of the graticule. While adjusting **Start Freq**, "Stop Freq" on page 292 is held constant, which means that both "Center Frequency" on page 279 and "Span" on page 285 will change.

Start Freq also sets the frequency entry mode to **Start** or **Stop**. In **Start** or **Stop** mode, the start frequency and stop frequency values are displayed below the graticule, and the default active function in the **Frequency** menu is **Start Freq.**

Remote Command	`[:SENSe]:FREQuency:STARt <freq>` `[:SENSe]:FREQuency:STARt?`
Example	`:FREQ:STAR 200 MHz` `:FREQ:STAR?`
Notes	Max value depends on Hardware Options
Dependencies	By direct entry: – You cannot set **Start Freq** > **Stop Freq** – You cannot set **Start Freq** = **Stop Freq** – You cannot select Zero Span by setting **Start Freq** = **Stop Freq** – You cannot set **Start Freq** to a value that would create a span of less than 10 Hz If you try to do any of the above, **Stop Freq** changes to maintain a minimum of 10 Hz for the difference between **Start Freq** and **Stop Freq** With the knob or step keys: – You cannot increment **Start Freq** to a value greater than **Stop Freq** – 10 Hz. If already in **Zero Span**, you cannot increment at all, and the first decrement is forced to at least 10 Hz **Start Freq** can be limited by **Span** limits, if **Stop Freq** is below its preset value If the electronic/soft attenuator is enabled, any attempt to set **Start Freq** such that **Stop Freq** would be >3.6 GHz fails, and results in an advisory message. If the equivalent SCPI command is sent, this same message is generated as part of a “-221, Settings conflict” warning

	If "Source Mode" on page 456 is set to **Tracking**, and the Max or Min **Start Freq** is therefore limited by the limits of the source, a warning message is generated, "Data out of range; clipped to source max/min" if these limits are exceeded. Note that for an external source, these limits can be affected by the settings of Source Numerator, Source Denominator, and Power Sweep
Couplings	The four parameters **Center Frequency**, **Start Freq**, **Stop Freq** and **Span** are interdependent, as changing one necessarily affects one or more of the others. The couplings between **Center Frequency** and **Span** are detailed under the control descriptions for those controls. These couplings also affect **Start Freq** and **Stop Freq**
Preset	**Start Freq** does not preset. On **Mode Preset**, **Span** & **Center Frequency** preset, and **Start Freq** is derived. On **Meas Preset**, only **Span** presets, but **Center Frequency** does not, so **Start Freq** will vary depending on **Center Frequency** When **Mode Preset** is performed while in External Mixing, the Start frequency of the current Mode is set to the nominal Min Freq of the lowest harmonic range in the Harmonic Table for the current mixer setup Note that, if the current measurement has a limited **Span** available to it, and cannot achieve the **Span** shown in the table (**Span** = **Stop Freq** – **Start Freq**), the instrument uses the maximum **Span** the measurement allows, and sets **Center Frequency** to the midpoint of the **Start Freq** and **Stop Freq** values in the Harmonic Table. Thus, in this case, **Start Freq** presets to a frequency below the preset **Center Frequency** by ½ of the maximum **Span** When **Restore Input/Output Defaults** is performed, the mixer presets to the 11970A, whose Start frequency is 26.5 GHz Therefore, after **Restore Input/Output Defaults**, if you switch to External Mixing and do **Mode Preset** while in Spectrum Analyzer Mode, the resulting **Start Freq** is 26.5 GHz
State Saved	Saved in instrument state
Min	-80 MHz, unless **Source Mode** is set to **Tracking**, in which case it is limited by the minimum frequency of the Source

Instrument Type	Min Value
VXT model M9421A	55 MHz
VXT models M9410A/11A	330 MHz
VXT models M9410A/11A	With Option LFE: 6.5 kHz Without Option LFE: 330 MHz
VXT model M9415A	330 MHz
M8920A	80 kHz

	If the knob or step keys are being used, depends on the value of the other three interdependent parameters While in External Mixing, the minimum **Start Freq** you can set is determined by the external mixing parameters. It will be close to the minimum LO frequency (3.8 GHz if undoubled, 8.6 GHz if doubled) times the harmonic number, for the lowest harmonic range in the Harmonic Table for the current mixer setup. It can be queried with `:FREQ:STARt? MIN`
Max	Depends on the instrument maximum frequency – 10 Hz. Note that, if **Source Mode** is set to **Tracking**, the effective instrument maximum frequency may be limited by the source maximum frequency If the knob or step keys are being used, it depends on the value of the other three interdependent

	parameters While in External Mixing, the maximum **Start Freq** you can set is determined by the external mixing parameters. It will be close to the maximum LO frequency (7 GHz if undoubled, 14 GHz if doubled) times the harmonic number, for the highest harmonic range in the Harmonic Table for the current mixer setup. It can be queried with `:FREQ:STARt? MAX`
Annotation	Start <value> appears in the lower left corner of the display. This replaces Center <value>
Status Bits/OPC dependencies	Non-overlapped

Stop Freq

Sets the frequency at the right side of the graticule. While adjusting **Stop Freq**, "Start Freq" on page 290 is held constant, which means that both "Center Frequency" on page 279 and "Span" on page 285 will change.

Stop Freq also sets the frequency entry mode to **Start** or **Stop**. In **Start** or **Stop** mode, the start frequency and stop frequency values are displayed below the graticule, and the default active function in the **Frequency** menu is **Start Freq**.

Remote Command	`[:SENSe]:FREQuency:STOP <freq>` `[:SENSe]:FREQuency:STOP?`
Example	`:FREQ:STOP 220 MHz` `:FREQ:STOP?`
Notes	Preset and Max values depend on Hardware Options
Dependencies	By direct entry: – You cannot set **Start Freq** > **Stop Freq** – You cannot set **Start Freq** = **Stop Freq** – You cannot select Zero Span by setting **Start Freq** = **Stop Freq** – You cannot set **Start Freq** to a value that would create a span of less than 10 Hz If you try to do any of the above, **Stop Freq** changes to maintain a minimum of 10 Hz for the difference between **Start Freq** and **Stop Freq** With the knob or step keys: You cannot increment **Start Freq** to a value greater than **Stop Freq** – 10 Hz. If already in **Zero Span**, you cannot increment at all, and the first decrement is forced to at least 10 Hz **Stop Freq** can be limited by **Span** limits, if **Start Freq** is above its preset value If the electronic/soft attenuator is enabled, any attempt to set **Stop Freq** >3.6 GHz fails and results in an advisory message. If the equivalent SCPI command is sent, this same message is generated as part of a "-221, Settings conflict" warning If "Source Mode" on page 456 is set to **Tracking**, and the Max or Min **Start Freq** is therefore limited by the limits of the source, a warning message is generated, "Data out of range; clipped to source

	max/min" if these limits are exceeded. Note that for an external source, these limits can be affected by the settings of Source Numerator, Source Denominator, and Power Sweep
Couplings	The four parameters **Center Frequency**, **Start Freq**, **Stop Freq** and **Span** are interdependent, as changing one necessarily affects one or more of the others. The couplings between **Center Frequency** and **Span** are detailed under the control descriptions for those controls. These couplings also affect **Start Freq** and **Stop Freq**
Preset	On **Mode Preset**, **Span** and **Center Frequency** preset, and **Stop Freq** is derived. See **Center Frequency Presets** in "Center Frequency" on page 279 for the **Stop Freq** after Preset for various model and option numbers On **Meas Preset**, only **Span** presets, but **Center Frequency** does not, so **Stop Freq** will vary depending on **Center Frequency** When **Mode Preset** is performed while in External Mixing, the **Stop Freq** of the current Mode is set to the nominal Max Freq of the highest harmonic range in the Harmonic Table for the current mixer setup If the current measurement has a limited **Span** available to it, and cannot achieve the **Span** shown in the table (**Span** = **Stop Freq** – **Start Freq**), the instrument uses the maximum **Span** the measurement allows, and sets **Center Frequency** to the midpoint of the **Start Freq** and **Stop Freq** values in the Harmonic Table. Thus, in this case, **Stop Freq** presets to a frequency above the preset **Center Frequency** by ½ of the maximum **Span** When **Restore Input/Output Defaults** is performed, the mixer presets to the 11970A, whose Stop frequency is 40 GHz Therefore, after **Restore Input/Output Defaults**, if you switch to External Mixing and do **Mode Preset** while in the Spectrum Analyzer Mode, the resulting **Stop Freq** is 40 GHz
State Saved	Saved in instrument state
Min	-79.999990 MHz, unless **Source Mode** is set to **Tracking**, in which case it is limited by the minimum frequency of the Source **Instrument Types** — **Min Value** VXT models M9421A — 55.000010 MHz VXT models M9410A/11A — 330.000010 MHz VXT models M9410A/11A — With Option LFE: 6.510 kHz; Without Option LFE: 330.000010 MHz VXT models M9415A — 330.000010 MHz M8920A — 80.010 kHz If the knob or step keys are being used, depends on the value of the other three interdependent parameters While in External Mixing, the minimum **Stop Freq** you can set is determined by the external mixing parameters. It will be close to the minimum LO frequency (3.8 GHz if undoubled, 8.6 GHz if doubled) times the harmonic number, for the lowest harmonic range in the Harmonic Table for the current mixer setup. It can be queried with `:FREQ:STOP? MIN`
Max	Depends on instrument maximum frequency. Note that, if **Source Mode** is set to **Tracking**, the effective instrument maximum frequency may be limited by the source maximum frequency If the knob or step keys are being used, depends on the value of the other three interdependent

	parameters While in External Mixing, the maximum **Stop Freq** you can set is determined by the external mixing parameters. It will be close to the maximum LO frequency (7 GHz if undoubled, 14 GHz if doubled) times the harmonic number, for the highest harmonic range in the Harmonic Table for the current mixer setup. It can be queried with `:FREQ:STOP? MAX`
Annotation	Stop <value> appears in the lower right corner of the display. This replaces Span <value>
Status Bits/OPC dependencies	Non-overlapped

Auto Tune

The purpose of **Auto Tune** is to quickly take you to the most likely signal of interest, and position it optimally on the display. When pressed, it causes the instrument to change its "Center Frequency" on page 279 to the strongest signal in the tunable span of the instrument, and sets **Ref Level** based on the strength of that signal.

This is an immediate action control, with no configurable parameters. It operates based on preset values based on real world situations.

NOTE **Auto Tune performs a Preset as part of its function. It leaves you in your current View and leaves the AC/DC coupling and Single/Cont state unaffected, but it resets most other measurement parameters.**

NOTE **You will see an hourglass, and you may see a slight pause, until the signal of interest is presented at midscreen.**

Remote Command	`[:SENSe]:FREQuency:TUNE:IMMediate`
Example	`:FREQ:TUNE:IMM`
Dependencies	**Auto Tune** is not available (grayed-out) when "Source Mode" on page 456 = **Tracking**

Zoom Center

Allows you to change the frequency of the zoom region, and hence of the lower window, without changing Zoom Span, when you are in **Swept Span**.

The **Zoom Center** value is displayed in the lower left corner of the zoom window (below the graticule) when the frequency entry mode is Center/Span (pressing "Center Frequency" on page 279 or "Span" on page 285 sets the frequency entry mode to Center/Span). When the frequency entry mode is Start/Stop, **Zoom Start** is displayed in this lower left annotation position (pressing "Start Freq" on page 290 or "Stop Freq" on page 292 sets the frequency entry mode to **Start/Stop**).

Remote Command	`[:SENSe]:FREQuency:TZOom:CENTer <frequency>` `[:SENSe]:FREQuency:TZOom:CENTer?`
Example	`:FREQ:TZO:CENT 20 MHz`
Dependencies	Only appears if the **Zoomed Trace** window is visible Grayed-out in **Zero Span**. If the SCPI command is sent in **Zero Span**, an error is reported
Couplings	The center frequency for the lower window is limited by the start and stop frequencies in the upper window. You cannot move the zoom region out of the upper window, nor does changing the **Zoom Center** frequency ever change the **Zoom Span**. When **Zoom Center** increases or decreases to a value that causes the zoom region to touch an edge of the top window, the **Zoom Center** is clipped at that value. If the instrument Start and/or Stop frequencies change such that the Zoom Region is no longer between them, the Zoom Region is moved to the far left or right of the top window as appropriate Affected by "Freq Offset" on page 299, exactly the same as is **Center Frequency**
Preset	On entry to Trace Zoom, the **Zoom Center** frequency is the same as the instrument **Center Frequency**. So, if you do **Mode Preset** and then immediately go into Trace Zoom, **Zoom Center** matches the Preset values listed in the table under the **Center Frequency** control description
State Saved	Saved in instrument state
Min	Start Frequency of top window
Max	Same as the maximum instrument **Center Frequency**, which is basically the instrument maximum frequency –5 Hz. See the table under **Center Frequency**
Annotation	In the Center Freq position of the Zoom Window

Zoom Span

Allows the span of the zoom region to be changed without changing the zoom center.

The center frequency for the lower window is limited by the start and stop frequencies in the upper window. You cannot move the zoom region out of the upper window. Consequently, if the zoom region hits either the left or right edge of the upper window, **Zoom Span** starts to shrink to keep the zoom region from going outside the upper window.

The **Zoom Span** value is displayed in the lower right corner of the zoom window (below the graticule) when the frequency entry mode is Center/Span (pressing "Center Frequency" on page 279 or "Span" on page 285 sets the frequency entry mode to Center/Span). When the frequency entry mode is Start/Stop, **Zoom Start** is displayed in this lower left annotation position (pressing "Start Freq" on page 290 or "Stop Freq" on page 292 sets the frequency entry mode to **Start/Stop**).

Remote Command	`[:SENSe]:FREQuency:TZOom:SPAN <frequency>` `[:SENSe]:FREQuency:TZOom:SPAN?`
Example	`:FREQ:TZO:SPAN 20 MHz`
Notes	As **Zoom Span** increases, if the edge of the zoom region hits either edge of the graticule, then as **Zoom**

	Span continues to increase, "Zoom Center" on page 294 changes to keep the zoom region from leaving the upper window
Dependencies	Only appears if the **Zoomed Trace** window is visible Grayed-out in **Zero Span**. If the SCPI command is sent in **Zero Span**, an error is reported
Preset	On entry to Trace Zoom, **Zoom Span** is 10% of the span of the upper window. So, if you do **Mode Preset** and then immediately switch to Trace Zoom, **Zoom Span** is 10% of the Span Preset value listed in the table under **Span**
State Saved	Saved in instrument state
Min	10 Hz
Max	Constrained by the top window (instrument) span. It cannot get so large that Zoom Start goes below the instrument **Start Freq**, or so that Zoom Stop goes above the instrument **Stop Freq**. Thus, the limit is 2*(**Zoom Center – Start Freq**) or 2*(**Stop Freq – Zoom Center**), whichever is smaller
Annotation	In the Span annotation spot of the lower window
Status Bits/OPC dependencies	non-overlapped

Zone Center

Allows you to change the frequency of the zone without changing the zone span. As **Zone Center** is changed, the center frequency of the lower window is changed. Note that the lower window is not updated to reflect the change unless it is selected as the active window.

The center frequency for the lower window is not limited by the selected start and stop frequencies in the upper window. However, if the frequency span of the lower window is at all outside of the span for the upper window, an orange arrow pointing left or right is displayed at the left or right edge of the top window.

Remote Command	`[:SENSe]:FREQuency:ZSPan:CENTer <frequency>` `[:SENSe]:FREQuency:ZSPan:CENTer?`
Example	`:FREQ:ZSP:CENT 20 MHz`
Notes	Min and Max values depend on Hardware Options
Dependencies	Only appears if the **Zone Spectrum** window is visible
Couplings	Center Frequency of lower window changes so that it is always the same as **Zone Center**, and vice-versa Affected by Freq Offset exactly the same as is Center Frequency
Preset	On entry to Zone Span, the **Zone Center** frequency is the same as the instrument **Center Frequency**. So, if you do **Mode Preset** and then immediately switch to Zone Span, **Zone Center** matches the Preset values listed in the table under **Center Frequency**
State Saved	Saved in instrument state
Min	Hardware dependent; Zone Span dependent

	Zone Center cannot go so low as to force Zone Left to be <0
Max	The maximum **Zone Center** frequency is the same as the maximum instrument **Center Frequency**, which is basically the instrument maximum frequency –5 Hz. See the table under **Center Frequency**
Annotation	As the Center Freq of the Zone Window
Status Bits/OPC dependencies	Non-overlapped

Zone Span

Allows the span of the zone markers to be changed without changing the center frequency. The zone markers are vertical lines marking the zone in the upper window. They determine the frequency range displayed in the lower window. As the zone markers are moved, the span of the lower window is changed but the lower window will not be updated to reflect the change unless it is selected as the active window.

The span limit of the lower window is the same as the span limit of the instrument. The span for the lower window is not limited to the selected span of the upper window. However, if the frequency span of the lower window is at all outside of the span for the upper window, an orange arrow pointing left or right is displayed at the left or right edge of the top window.

Remote Command	`[:SENSe]:FREQuency:ZSPan:SPAN <frequency>` `[:SENSe]:FREQuency:ZSPan:SPAN?`
Example	`:FREQ:ZSP:SPAN 20 MHz` `:FREQ:ZSP:SPAN?`
Notes	Min and Max values depend on Hardware Options
Dependencies	Only appears if the **Zone Spectrum** window is visible Only appears in the **Zone Span** View in measurements that support this View. If the command is sent in other Views, generates an error
Couplings	Span of lower window changes so that it is always the same as **Zone Span**, and *vice versa*
Preset	On entry to the Zone Span View, **Zone Span** is 10% of the span of the upper window. So, if you do **Mode Preset** and then immediately switch to Zone Span, **Zone Span** is 10% of the Span Preset value listed in the table under **Span**
State Saved	Saved in instrument state
Min	0 Hz
Max	Cannot go so high as to force the zone region outside the top window
Annotation	As the Span of the Zone Window
Status Bits/OPC dependencies	Non-overlapped

CF Step

Changes the step size for the center frequency and start and stop frequency functions. Once a step size has been selected and the center frequency function is active, the step keys (and the UP|DOWN parameters for **Center Frequency** from remote commands) change the center frequency by the step-size value. The step size function is useful for finding harmonics and sidebands beyond the current frequency span of the instrument.

Note that the start and stop frequencies also step by the **CF Step** value.

Remote Command	`[:SENSe]:FREQuency:CENTer:STEP[:INCRement] <freq>` `[:SENSe]:FREQuency:CENTer:STEP[:INCRement]?`

Example	Increase the current center frequency value by 500 MHz:
	`:FREQ:CENT:STEP 500 MHz`
	`:FREQ:CENT UP`

Notes	Preset and Max values depend on Hardware Options
Dependencies	Span, RBW, Center frequency If the electronic/soft attenuator is enabled, any attempt to change the value of the center frequency >3.6 GHz by pressing the Up-arrow key, fails and results in an advisory message. If the equivalent SCPI command is sent, this same message is generated as part of a “-221, Settings conflict” warning
Couplings	When auto-coupled in a non-zero span, the center frequency step size is set to 10% of the span. When auto-coupled in **Zero Span**, the center frequency step size is set to the equivalent -3 dB RBW value
Preset	Auto
State Saved	Saved in instrument state
Min/Max	–/+ (the maximum frequency of the instrument). That is, 27 GHz max freq instrument has a CF step range of +/- 27 GHz. Note that this is the maximum frequency given the current settings of the instrument, so in External Mixing, for example, it is the maximum frequency of the current mixer band
Status Bits/OPC dependencies	non-overlapped

Auto Function

Remote Command	`[:SENSe]:FREQuency:CENTer:STEP:AUTO OFF | ON | 0 | 1` `[:SENSe]:FREQuency:CENTer:STEP:AUTO?`
Example	`:FREQ:CENT:STEP:AUTO ON` `:FREQ:CENT:STEP:AUTO?`
Preset	`ON`

Freq Offset

Lets you set a frequency offset value to account for frequency conversions outside of the instrument. This value is added to the display readout of the marker frequency, center frequency, start frequency, stop frequency, and all other absolute frequency settings in the instrument including frequency count. When a frequency offset is entered, the value appears below the center of the graticule. To eliminate an offset, perform a **Mode Preset**, or set **Freq Offset** to 0 Hz.

For further details, see "More Information" on page 299.

Remote Command	`[:SENSe]:FREQuency:OFFSet <freq>` `[:SENSe]:FREQuency:OFFSet?`
Example	`:FREQ:OFFS 10 MHz` `:FREQ:OFFS?`
Notes	Preset and Max values depend on Hardware Options
Dependencies	Not available in External Mixing. In this case, the **Freq Offset** control is grayed-out and shows a value of zero. However, the value of CF Offset that was set for the RF Input is retained and restored when you switch back to the RF Input Not available when the frequency scale is set to `LOG`, or when segmented sweep is enabled
Preset	See **Center Frequency Presets** in "Center Frequency" on page 279
State Saved	Saved in instrument state
Min	-500 GHz
Max	500 GHz
Annotation	If Frequency Offset is not zero, "Freq Offset <value>" appears on the upper line of the annotation, below the graticule, in the center
Status Bits/OPC dependencies	Non-overlapped
Backwards Compatibility SCPI	`:DISPlay:WINDow[1]:TRACe:X[:SCALe]:OFFSet`
Backwards Compatibility Notes	The `DISPlay` version of the command is in the instrument for compatibility across platforms and is not recommended for new development

More Information

This command does not affect any bandwidths or the settings of relative frequency parameters such as delta markers or span. It does not affect the current hardware settings of the instrument, but only the displayed frequency values. Entering an offset does not affect the trace position or display, just the value of the start and stop frequency and the values represented by the trace data. The frequency values of exported trace data, queried trace data, markers, trace data used in calculations such as N dB points, trace math, etc., are all affected by Freq Offset. Changing the offset, even on a trace that is not updating will immediately change all of the above, without taking new data.

NOTE **If a trace is exported with a nonzero Freq Offset, the exported data will contain the trace data with the offset applied. Therefore, if that trace were to be imported back into the instrument, you would want Freq Offset to be 0, or the offset would be applied again to data that is already offset. No such care need be taken when saving a State+Trace file because the data and state are saved together.**

X Axis Scale Log | Lin

Selects either `LINear` or `LOGarithmic` scaling for the frequency axis.

The scaling can be changed at any time and determines only how the data is displayed; it has no impact on the actual sweep or measurement of trace data (with the exception that the detector auto-rules never select the `NORMal` **Detector** while in `LOGarithmic` Scale Type). Changing the scaling does not restart the sweep (unless the detector changes) and has no impact on the number of sweep points. The scaling can be changed while traces are in view, and they will scale appropriately. Markers stay at their set frequency, so they may move on the display.

Note that the actual trace data does not change as you go between Log and Linear Scale Type; hence trace data saved while the display is in log will look identical to trace data saved while the display is in linear. When recalling trace data, the current value of Scale Type is used to display the data. (**Trace +State** files will of course recall with whatever Scale Type setting was in effect when they were saved, since the State is saved with them).

This function has no effect on the **Zero Span** display, although it is available while in **Zero Span**.

See "More Information" on page 301

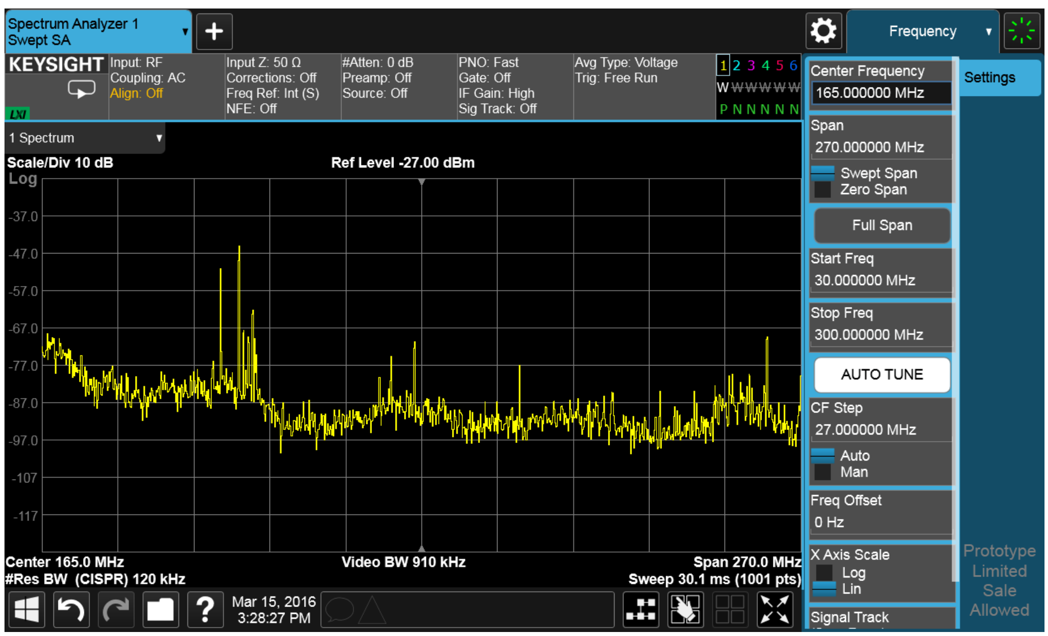
Remote Command	`:DISPlay:WINDow[1]:TRACe:X[:SCALe]:SPACing LINear | LOGarithmic` `:DISPlay:WINDow[1]:TRACe:X[:SCALe]:SPACing?`
Example	`:DISP:WIND:TRAC:X:SPAC LOG`
Dependencies	Has no effect in **Zero Span**, but if changed while in **Zero Span**, will be changed on returning to non-zero span The `NORMal` **Detector** is never selected by the detector auto-rules while in `LOG`, the rules select `SAMPle` if `NORMal` would have been selected
Couplings	In `LINear`, the Frequency controls and notation at the bottom of the screen default to Center/Span. In `LOGarithmic`, they default to Start/Stop. When switching from `LINear` to `LOGarithmic`, the notation at the bottom of the screen changes to Start/Stop, and, if the active function was one of the

	frequency controls (**Center Frequency**, **Start Freq**, **Stop Freq**, or **Span**), it changes to **Start Freq**. When switching from `LOG` to `LIN`, the notation at the bottom of the screen changes to Center/Span, and if the active function was one of the frequency controls (**Center Frequency**, **Start Freq**, **Stop Freq**, or **Span**), it changes to **Center Frequency** When switching to `LOG`, if **Start Freq** is 0 Hz, it is changed to 10 Hz
Preset	`LIN`
State Saved	Saved in Instrument State
Backwards Compatibility SCPI	`[:SENSe]:SWEep:SPACing LINear | LOGarithmic`

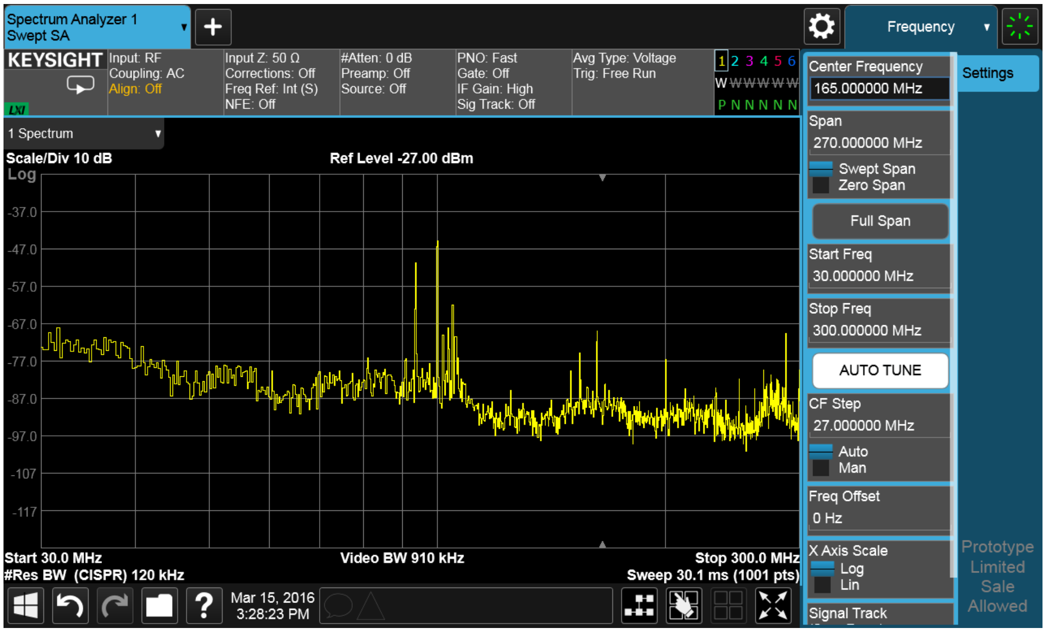
More Information

The log graticule is drawn to optimize the display based on the range of frequencies being shown. The center frequency is marked with a small triangle at the top and bottom of the display, regardless of whether the scaling is log or linear.

The center frequency mark in Linear Scale Type is in the center of the display:



Center Freq mark in Log Scale Type is to the right of center:



Signal Track (Span Zoom)

When Marker 1 is placed on a signal, and **Signal Track** is pressed, the marker remains on the signal while the instrument retunes the center frequency to the marker frequency. The instrument keeps the signal at the center of the display, as long as the amplitude of the signal does not change by more than +/–3 dB from one sweep to another. If **Marker 1** is not in **Normal** or **Delta**, turning on **Signal Track** sets it to **Normal**, performs a peak search, and centers the marker on the display.

See "More Information" on page 303.

Remote Command	`:CALCulate:MARKer:TRCKing[:STATe] OFF | ON | 0 | 1` `:CALCulate:MARKer:TRCKing[:STATe]?`
Example	Turn on **Signal Track** using Marker 1: `:CALC:MARK:TRCK ON`
Dependencies	Not available (grayed-out) when the **Waterfall** window is visible Associated with **Marker 1**. When Marker 1 is **Off**, or set to **Fixed**, **Signal Track** is also turned off Not available (grayed-out) when **Source Mode** = **Tracking** Not available (grayed-out) when Signal ID = on **Signal Track** and **Continuous Peak Search** cannot be used with each other. If one is on, the other is grayed-out **Signal Track** is grayed-out if in **Zero Span** But if **Zero Span** is entered while in **Signal Track**, **Signal Track** is turned off Can only function properly if the trace Marker 1 is on is updating. Therefore, if **Signal Track** is on and

	the trace Marker 1 is on is put into view, **Signal Track** is turned off and the **Signal Track** control grayed-out. Whenever the trace Marker 1 is on is not updating, the **Signal Track** control is grayed-out Only available in the Swept SA measurement
Couplings	Can only function properly if the trace Marker 1 is on, is in Trace Update = Active. Therefore, if the trace Marker 1 is in Update = Off when **Signal Track** is turned on, it is changed to Update = On. If the trace Marker 1 is set to Update = Off while **Signal Track** is on, it turns off **Signal Track**
Preset	`OFF`
State Saved	Saved in instrument state
Annunciation	"Sig Track: On" appears in the Meas Bar

More Information

If Marker 1 is **Off** when Signal Track is turned on, marker 1 is turned on in the center of the screen and a peak search is performed. If marker 1 is already on, it stays on and is used where it is. If it is **Fixed**, it is set to **Normal**.

If you move the marker during **Signal Track**, a **Mkr-> CF** is performed, and the signal track function starts over.

If the signal is lost, an attempt is made to find it again and continue tracking. If there are other signals on screen that are near the same amplitude, one of them may be found instead since the algorithm is seeking a signal with amplitude similar to the amplitude of the original signal.

Signals near 0 Hz cannot be tracked effectively as they cannot be distinguished from the LO feed-through, which is excluded by intent from the search algorithm.

As a speed optimization, the center frequency is only changed if it differs from the marker position by 1% or more of the span.

If the instrument is in Single Sweep and Signal Track is turned on, then nothing happens until a sweep is actually initiated (that is, by `:INIT:IMM` or **Single** key, and a trigger). Once the sweep is initiated, the entire set of sweeps necessary to complete a pass through the signal track algorithm ensues before the instrument returns `*OPC` true, returns results to `:READ` or `:MEASure`, or returns to the idle state.

If **Span** is changed while in **Signal Track**, either by you, or because moving the instrument to the signal frequency results in Span Limiting (as described under **Frequency**), an "auto-zoom" algorithm is executed to get to the new span without losing the signal. In "auto zoom", the span is reduced in stages, with a sweep between each stage. You will see this zooming occur as each sweep is performed, and the new span is set. When auto-zooming, the set of steps necessary to achieve the target span is to be considered a "measurement," thus the entire process executes even if the instrument is in single sweep. `*OPC` will not return true until the process is complete, nor will results be returned to `:READ` or `:MEASure` queries. Note further that if the instrument is in a measurement such as averaging when this happens, the act of changing the span restarts averaging but the first average trace is the last trace of the auto zoom.

This function is intended to track signals with a frequency that is changing (drifting), and an amplitude that is not changing. It keeps tracking if you are in continuous-sweep mode. If in single-sweep mode, as described above, the instrument only does one center frequency adjustment as necessary.

Last Span (Remote Command Only)

Changes the displayed frequency span to the previous span setting. If this command is sent immediately after **Signal Track** is turned `OFF`, then the span setting returns to the span that was in effect before **Signal Track** was turned on.

If this command is sent while in a non-zero span, and the previous value of span was 0, it returns the instrument to **Zero Span**. If it is sent while in **Zero Span**, it returns the instrument to its last non-zero span.

Sending this command places the instrument in Center/Span frequency entry mode.

Remote Command	`[:SENSe]:FREQuency:SPAN:PREVious`
Example	Set the span to the previous value: `:FREQ:SPAN:PREV`
Dependencies	If the electrical attenuator is enabled, any attempt to set **Span** such that **Stop Freq** would be >3.6 GHz results in an error Turns off segmented sweep

3.2.7 Marker

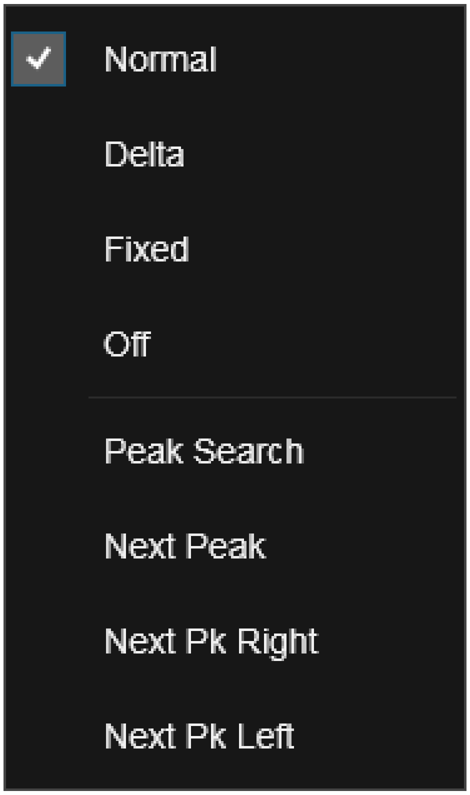
Accesses the **Marker** menu. A marker can be placed on a trace to allow the value of the trace at the marker point to be determined precisely.

The fundamental marker operation involves setting a Marker's X-Axis value and then reading the marker's Y-Axis value. From the front panel you do this using the **Marker** menu, the knob and the green marker readout in the upper right corner of the display.

Markers may also be used in pairs to read the difference (or delta) between two data points. They can be used in Marker Functions to do advanced data processing, or to specify operating points in functions like Signal Track and N dB Points.

Marker Right-Click Menu

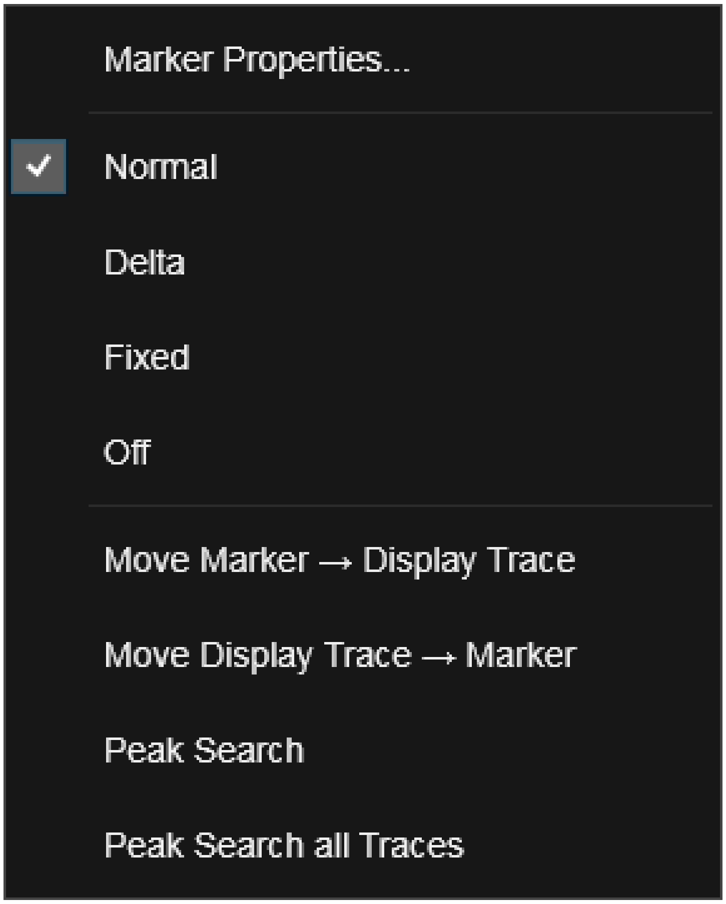
If you right-click on a marker (or touch and hold a marker and wait for the circle to close) you will see this menu:



If you tap or click on one of the menu items, it will perform the corresponding function:

- Normal, Delta, Fixed or Off set the Marker Mode (see "Marker Mode" on page 312)
- Peak Search, Next Peak, Next Pk Right or Next Pk Left move the Marker to the appropriate peak (see "Peak Search" on page 317)

If you right-click on a marker (or touch and hold a marker and wait for the circle to close) in the **Waterfall** window (for example, in the **Spectrogram** View) you will see this menu:



- Normal, Delta, Fixed and Off work as for the standard menu above
- Marker Properties opens the Marker Properties tab (see "Properties" on page 333). Move Marker -> Display Trace and Move Display Trace -> Marker work the same way as the corresponding buttons in the Marker -> menu (see "Marker To" on page 368)
- Peak Search finds the highest peak on the current Display Trace
- Peak Search all Traces finds the highest peak in the Waterfall window (see "Peak Search All Traces" on page 319)

NOTE In earlier HP/Agilent/Keysight analyzers, markers stayed at the same position on the display even when you changed frequency. In the X-Series, markers stay at the frequency they are set to, even if you change Center Frequency. So, your marker will move, possibly offscreen, when you change frequency. This is a superior method for a number of reasons, but it may take some getting used to if you are used to placing a marker at center screen and then changing Center Frequency and having the marker stay there. See "Marker Backwards Compatibility" on page 308 for more on this.

NOTE: Markers can be on and not be visible if they are offscreen. This may occur if you set a marker to a frequency outside of the current settings of the Start and Stop frequencies, or in **Spectrogram** View, you place a marker on a Display Trace other than 0. To move the marker on to the display, press the **Peak Search** hardkey.

3.2.7.1 Select Marker

Specifies the selected marker. The term "selected marker" is used throughout this document to specify which marker is affected when you change marker settings, perform a **Peak Search**, etc.

The **Select Marker** control appears above the menu panel, indicating that it applies to all controls in the **Marker** menu panels. Select Marker is blanked if you select a tab whose controls do *not* depend on the selected marker (for example., **Counter**).

For any menu that includes **Select Marker**, the first control is always **Marker Frequency | Time**.

Notes	The selected marker is remembered even when not in the **Marker** menu and is used if a search is done, or a Band Function is turned on, or for Signal Track or Continuous Peak
Preset	Marker 1
State Saved	The number of the selected marker is saved in instrument state
Annunciation	Appears in the marker results block label for **Normal, Delta** and **Fixed** markers

3.2.7.2 Settings

The controls on this tab include the **Marker** active function and a radio button selection for the marker control mode (**Normal**, **Delta**, **Fixed**, or **Off**) for the selected marker, as well as additional functions that help you use markers.

Marker Frequency | Time

This is the fundamental control that you use to move a marker around on the trace. It is the default active function in the **Marker** menu, so all you need to do is press **Marker** and turn the knob to move the marker left and right on the display. This is always the first control on any **Marker** menu page that follows the Selected Marker.

When in **Zero Span** (for measurements that support **Zero Span**), the label on this control changes to **Marker Time**. When Marker Mode is **Delta**, the label changes to **Marker Δ Frequency** or **Marker Δ Time**.

The remote command sets the marker X-Axis value in the current marker X-Axis Scale unit. The marker that is addressed becomes the selected marker. It has no effect (other than to cause the marker to become selected) if the control mode is **Off**, *but* it is the SCPI equivalent of entering an X value if the control mode is **Normal,Delta,** or **Fixed**.

Remote Command	`:CALCulate:MARKer[1]|2|…|12:X <freq | time>` `:CALCulate:MARKer[1]|2|…|12:X?`

Example	Turn on Marker 2 as a **Normal** marker
	`:CALC:MARK2:MODE POS`
	Move Marker 2 to 20 GHz:
	`:CALC:MARK2:X 20 GHZ`
	Query the amplitude of Marker 2:
	`:CALC:MARK2:Y?`

Notes	If no suffix is sent, **Marker Frequency | Time** uses the fundamental units for the current marker X Axis Scale. If a suffix is sent that does not match the current marker X Axis Scale unit, an invalid suffix message is generated If the specified marker is **Fixed**, and a Marker Function is on, a message is generated. If the control is pressed, an advisory message is generated. If the equivalent SCPI command is sent, this same message is generated as part of a "–221, Settings conflict" warning The query returns the marker's absolute X Axis value if the control mode is **Normal** or **Fixed**. It returns the offset from the marker's reference marker if the control mode is **Delta**. The query is returned in the fundamental units for the current marker X Axis scale: Hz for **Frequency** and **Inverse Time**, seconds for **Period** and **Time**. If the marker is **Off**, the response is Not a Number The Marker Amplitude query is discussed under "Marker Amplitude" on page 310
Dependencies	Grayed-out, and displays three dashes for the value, when the selected Marker is **Off** You cannot directly set the X value of a **Fixed** marker that has a marker function turned on If an attempt is made to adjust it while a Marker Function is on, a warning message is generated
Preset	After preset, if X is queried with no value sent first, the center of screen value is returned. The actual value depends on the frequency range of the instrument
Min/Max	–/+¥ (minus infinity) Unlike legacy analyzers, where the markers were forced to be on screen, X-Series marker values are not limited and do not clip

Marker Backwards Compatibility

– In earlier HP/Agilent/Keysight analyzers, markers were position markers, which means that **Normal** and **Delta** markers stayed at the same screen position when X Axis parameters were changed. So, a marker at center screen stayed at center screen even if **Center Frequency** was changed (which means that the marker's frequency changed). In the X-Series, markers are value markers, which means that when the instrument's X Axis settings are changed, the marker's X Axis value in fundamental X Axis units remains unchanged. For example, if you put a marker at a particular frequency, it will stay at that frequency regardless of whether you change the instrument **Center Frequency**, even if that means that the marker ends up offscreen

- While this change resulted in an overall higher level of usability of the marker system, there are some use cases where the user depends on the marker staying at the center of the screen. The most common one is where the user turns on a marker at center screen and uses it to measure the trace amplitude at the center frequency or at a series of center frequencies, without the need to ever move the marker. In the X-Series, to mimic the legacy behavior for this use case, you must turn the marker off and then back on after changing the center frequency of the instrument. This causes the marker to reappear in the center of the screen
- Also, as a result of the change from position markers to value markers, markers can be at a frequency that is offscreen, whereas in the past, they were clipped to the screen edges and hence were never offscreen. If your remote programming depended on this clipping behavior to force markers to the edges of the screen, you will need to modify the code. Furthermore, since markers could never be offscreen they always returned a valid result. In the X-Series, markers that are offscreen return Not a Number as a result; hence the potential now exists for Not a Number to be returned for a marker query

Setting the Marker X Position in Trace Points

Sets the marker X position in trace points. It has no effect if the marker control mode is **Off**, but it is the SCPI equivalent of entering a value if the control mode is **Normal**, **Delta**, or **Fixed** – except the setting is in trace points rather than X-Axis Scale units.

NOTE	The entered value in Trace Points is immediately translated into the current X Axis Scale units for setting the value of the marker. The marker's value in X Axis Scale Units, *not* trace points, is preserved if a change is made to the X Axis scale settings. Thus, if you use this command to place a marker on bucket 500, which happens at that time to correspond to 13 GHz, and then you change **Start Freq** so that bucket 500 is no longer 13 GHz, the marker will stay at 13 GHz, *not* at bucket 500! This is important to realize as it differs from the behavior of past HP/Agilent/Keysight analyzers.

Remote Command	`:CALCulate:MARKer[1]|2|…|12:X:POSition <real>` `:CALCulate:MARKer[1]|2|…|12:X:POSition?`
Notes	If the specified marker is **Fixed**, and a Marker Function is on, a message is generated. If the control is pressed, an advisory message is generated. If the equivalent SCPI command is sent, this same

	message is generated as part of a "–221, Settings conflict" warning The query returns the marker's absolute X Axis value in trace points if the control mode is **Normal** or **Fixed**. It returns the offset from the marker's reference marker in trace points if the control mode is **Delta**. The value is returned as a real number, not an integer, corresponding to the translation from X Axis Scale units to trace points The Max value shown in this table, just like the Preset value, is for the case where the number of trace points set for the measurement is 1001
Preset	After preset, if X is queried with no value sent first, the center-of-screen value is returned. So, if per default, the number of Trace points is 1001, the returned value will be 500
Min	0
Max	Number of trace points – 1
Backwards Compatibility SCPI	`:CALCulate:MARKer[1]|2|…|4:X:POSition:CENTer`

Marker Amplitude

Sets or returns the Y-Axis value of the specified marker.

When "Marker Mode" on page 312 is **Fixed**, a **Marker Amplitude** control also appears on the menu panel, and you can set the marker amplitude directly.

The SCPI command is primarily used to query the Marker's X-Axis value. In the command form, it selects the marker and sets the marker Y Axis value; the default unit is the current Y Axis unit. The command has no effect (other than selecting the marker) unless the marker control mode is **Fixed**. No error is generated if the marker is not **Fixed**, but no action is taken, either.

Remote Command	`:CALCulate:MARKer[1]|2|…|12:Y <real>` `:CALCulate:MARKer[1]|2|…|12:Y?`

Example	Query the amplitude of Marker 3:
	`:CALC:MARK3:Y?`
	Move marker 3 to a Y value of 0 dBm:
	`:CALC:MARK3:Y -10 dBm`

Notes	`:CALCulate:MARKer[1]|2|3|4|5|6|7|8|9|10|11|12:Y?` returns the marker Y-axis result, either absolute or delta, in the current Y axis Unit, if the control mode is **Normal, Fixed**, or **Delta**. If the marker is **Off** the response is 9.91e37 (Not a Number) For the command version (only used for **Fixed** markers), if no suffix is sent, uses the current Y Axis unit. If a suffix is sent that does not have units of absolute amplitude, an invalid suffix error is generated. If a marker function is on for the specified marker, a Settings Conflict message is generated
Dependencies	You cannot directly set the Y value of a **Fixed** marker that has a marker function turned on If an attempt is made to adjust it while a Marker Function is on, a warning message is generated

	You cannot directly set the Y value of a **Fixed** marker while **Normalize** is turned on. If an attempt is made to do so while **Normalize** is on, a warning message is generated
Preset	Trace value at center of screen. There is no way to predict what this will be after a preset
Min/Max	–/+ ∞ (minus/plus infinity)
Backwards Compatibility Notes	As a result of the change from position markers to value markers (see below), markers can be at a frequency which is offscreen, whereas in the past, they were clipped to the screen edges and hence were never offscreen. In the past, since markers could never be offscreen, they always returned a valid result. In X-Series, markers that are offscreen return Not a Number as a result; hence the potential now exists for Not a Number to be returned for a marker Y-Axis query

Marker Z

In the **Spectrogram** View, the marker takes on a third dimension, which we refer to as **Marker Z**. In this case, a **Marker Z** control appears on the menu panel. You can use **Marker Z** to choose on which trace in a historical set of traces you want to place the Marker.

This command sets the **Marker Z** position in the **Spectrogram** View only. Setting the Z position sets which of the many traces in the **Spectrogram** the selected marker will appear on. In each case the marker that is addressed becomes the selected marker. It has no effect (other than to cause the marker to become selected) if the control mode is **Off**, but is the SCPI equivalent of making a **Marker Z** entry if the control mode is **Normal,Delta**, or **Fixed**.

The **Marker Z** position cannot be set above the maximum trace in the **Spectrogram** window and, unlike the Marker X position, will not move off screen in the **Spectrogram** Window if the storage size is smaller than the number of traces that can be viewed.

If **Spectrogram** is ON, the marker result block has a third line displaying the time value of **Marker Z**. If the marker is a **Delta** marker, the delta time value is displayed. Although the Z marker position can be moved to trace 0, this is not recommended, as the current trace value is constantly being updated by new acquisitions and therefore the Z time value for trace 0 is not completely registered until the trace is completed.

Remote Command	`:CALCulate:MARKer[1]|2|…|12:Z:POSition <integer>` `:CALCulate:MARKer[1]|2|…|12:Z:POSition?`

Example	Set Marker 2 to **Fixed**:
	`:CALC:MARK2:MODE FIX`
	Put Marker 2 on Trace 150:
	`:CALC:MARK2:Z:POS 150`

Notes	Sets or queries the Z Axis position. In the **Spectrogram** View, this value correlates to be one of the 300 stored traces. Each Z Axis position represents a different stored trace

Preset	0
Min	0
Max	Number of traces stored is limited to 300

Querying the Marker Z Axis Value (Remote Query Only)

Queries the Z-axis time value of the marker in the **Spectrogram** View only. The marker that is addressed becomes the selected marker.

Remote Command	`:CALCulate:MARKer[1]|2|…|12:Z?`
Notes	Returns the marker's absolute Z Axis value if the control mode is **Normal** or **Fixed**. It returns the offset from the marker's reference marker if the control mode is **Delta** For **Spectrogram**, the Z Axis value represents the amount of time transpired since the start of the recording of traces
Dependencies	Only appears when the **Waterfall** window is visible, and either the **Waterfall** or **Spectrum** window is selected If the query is sent at any other time, it is accepted without error, but you will not see the result until you once again display the **Waterfall** window
Preset	9.91E+37
Min/Max	–/+Infinity

Marker Mode

There are four control modes for markers:

Normal	`POSition`	A marker that can be moved to any point on the X Axis by specifying its X Axis value, and whose absolute Y Axis value is then the value of the trace point at that X Axis value
Delta	`DELTa`	A marker that can be moved to any point on the X Axis by specifying its X Axis offset from a reference marker, and whose absolute Y Axis valueis then the value of the trace point at that X Axis value
Fixed	`FIXed`	A marker whose X Axis and Y Axis values may be directly or indirectly specified by you, but whose Y Axis value remains fixed, once specified, and does not follow the trace. Fixed markers are useful as reference markers for Delta markers, as operands in a Peak Search operation, and as arbitrary reference points settable by you. These markers are represented on the display by an "X" rather than a diamond. Not every measurement supports Fixed markers
Off	`OFF`	A marker that is not in use

For more details, see "More Information" on page 314.

The SCPI command in the table below selects the marker and sets the marker control mode as described under **Normal**, **Delta**, **Fixed** and **Off**, below. All interactions and dependencies detailed under the control description are enforced when the remote command is sent.

Remote Command	`:CALCulate:MARKer[1]|2|…|12:MODE POSition | DELTa | FIXed | OFF` `:CALCulate:MARKer[1]|2|…|12:MODE?`
Example	`:CALC:MARK2:MODE POS` `:CALC:MARK:MODE?`
Notes	Two additional parameters, `SPAN` and `BAND`, are supported for backwards compatibility only and should *not* be used for new designs. Both the `SPAN` and `BAND` legacy parameters are aliased to `POSition`. They are never returned to a query. See "Band Function Backwards Compatibility" on page 343 for more information Upon receipt of this command, for any parameter except **Off**, if the selected marker was **Off**, it is set to the specified mode and placed at the center of the screen on the trace specified by the marker's Trace attribute
Couplings	The marker specified by this command becomes the selected marker on the front panel
Preset	`OFF` (all markers)
State Saved	The marker control mode (**Normal**, **Delta**, **Fixed**, **Off**) and X-Axis value are saved in instrument state
Annunciation	Annunciation in the marker result block in the upper-right corner of the display indicates the X-Axis value and Y-Axis result of the marker
Backwards Compatibility SCPI	`:CALCulate:MARKer[1]|2|…|12:STATe ON | 1`
Backwards Compatibility Notes	In legacy analyzers, only a Reference marker could be **Fixed**, and it was always **Fixed**. Additionally, it could not be moved. In X-Series, any marker can be set to **Fixed** and can be moved to any X or Y value Setting a marker that is `OFF` to `ON` (1) selects the marker, puts it in **Normal** mode and places it at the center of the screen Setting a marker that is not `OFF` to `ON` has no effect (does not change its control mode) The response to the query is `ON` unless the marker is `OFF` In pre-X-Series analyzers, pressing **Delta** (or sending `:CALC:MARK:MODE:DELTa`) always moved the reference marker to the **Delta** marker. Now it only does so if the marker was already a **Delta** marker

Notes	Provided for ESA/PSA backwards compatibility
Preset	`OFF`
Backwards Compatibility SCPI	`:CALCulate:MARKer[1]|2|…|12:STATe OFF | ON | 0 | 1` `:CALCulate:MARKer[1]|2|…|12:STATe?`

More Information

Value	SCPI	Notes
Normal	POS	A **Normal** marker can be moved to any point on the X Axis by specifying its X Axis value. Its absolute Y Axis value is then the value of the trace point at that X Axis value
Delta	DELT	In **Delta** mode, the marker result shows the relative result between the selected (Delta) marker and its reference marker. A **Delta** marker can be moved to any point on the X Axis by specifying its X Axis offset from a reference marker. Its absolute Y Axis value is then the value of the trace point at that X Axis value
Fixed	FIX	A **Fixed** marker is fixed in the sense that it stays where you place it. It can be directly moved in both X and Y. It can be moved by a **Peak Search**. It can also be indirectly moved by re-zeroing the delta, if it is a relative marker. If it is moved, it again becomes fixed at the X Axis point it moved to and it has a Y-axis result that it took on when it moved there. If a **Normal** or **Delta** marker is changed to **Fixed**, it becomes fixed at the X Axis point it was at, and with the Y-axis result it had when it was set to **Fixed** In **Fixed** mode, the marker result shows: – If no Marker Function is on, the absolute X Axis and Y axis value of the marker – If a Marker Function is on, the X Axis value and the Y-axis function result the marker had when it became **Fixed**
Off	OFF	Turns off the marker, removes the marker annunciation from the display, turns off any active function and any marker function, and resets the following properties to their default value: – X Axis scale: Auto – Band Span: 0 – Auto Trace: On **Off** does not affect which marker is selected

Setting Fixed Marker Values

Normal markers

When an X Axis value is entered, or set using the knob or step keys, the marker moves to the trace point nearest to that X Axis value. The value is retained in all its precision whether it is at the center of a trace point or not, and future increments are applied to that value.

Delta markers

When the **Delta** control is selected:

- If the selected marker was not already in **Delta** mode:

- the selected marker becomes a **Delta** marker
- If the marker's reference marker is off, it is turned on as a **Fixed** marker at the selected marker's X Axis value on the selected marker's trace and takes on the selected marker's X Axis value and Y-axis result. The reference marker's Trace attribute (including **Auto**, if on) becomes that of the selected marker. Note that if a marker function was on, the result that the reference marker then takes on is that of the function
- If the marker's reference marker was already on, it is unaffected
- If the selected marker was already in **Delta** mode: the reference marker is moved (even if **Fixed**), to the selected marker's trace at its X Axis value. The reference marker's Trace attribute (including **Auto**, if on) becomes that of the selected marker

When an X Axis value is entered, or set using the knob or step keys, the marker moves, relative to its reference marker, to the trace point nearest to that value. The value is retained in all its precision whether it is at the center of a trace point or not, and future increments are applied to that value.

Fixed markers

If the selected marker was **Off**, it is placed at the center of the screen on the trace specified by the marker's trace attribute (although subsequent sweeps will not affect its amplitude).

A **Fixed** marker is fixed in the sense that it does not follow the trace. You can directly move it in both X and Y directions, and it can also be indirectly moved. In the latter case, once it moves, it again becomes **Fixed** at the X Axis point it moved to and with the Y-axis result it took on when it moved there.

If a **Normal** or **Delta** marker is changed to **Fixed**, it becomes fixed at the X Axis point it was at and with the Y-axis result it had when it was set to **Fixed**.

When a Y Axis value is entered, or set using the knob or step keys, the marker moves vertically to the amplitude specified. When an X Axis value is entered, or set using the knob or step keys, the marker moves to the trace point nearest to that X Axis value. The value is retained in all its precision whether it is at the center of a trace point or not, and future increments are applied to that value. However, the Y Axis value of the marker does *not* take on that of the trace.

Delta Marker (Reset Delta)

Pressing this button has exactly the same effect as pressing the **Delta** selection in **Marker Mode**. The selected marker becomes a **Delta** marker. If the selected marker is already a **Delta** marker, the reference marker is moved to the current position of the selected marker, thus resetting the delta to zero.

Marker Table

When set to ON, the display is split into a measurement window and a marker data display window. For each marker that is on, information is displayed in the data display window, which includes the marker number, control mode, trace number, X axis scale, X axis value, and the Y-axis result. Additional information is shown for markers that have marker functions turned on.

Turning on **Marker Table** turns off "Peak Table On/Off" on page 329, and *vice versa*.

Remote Command	`:CALCulate:MARKer:TABLe[:STATe] OFF | ON | 0 | 1` `:CALCulate:MARKer:TABLe[:STATe]?`
Example	Turn on **Marker Table**: `:CALC:MARK:TABL ON`
Dependencies	Only available as a switch in the **Normal** View. **Marker Table** is also available as a selection in the **Window Data** dropdown in all Views
Preset	`OFF`
State Saved	The on/off state of **Marker Table** is saved in instrument state

Marker Settings Diagram

Lets you configure the **Marker** system using a visual utility, which displays all the markers at once.

The top row (labeled **Marker**) shows each of the 12 markers, with a label showing the Mode and also a visual representation of the Mode (diamond for **Normal** or **Delta**, X for **Fixed**, nothing for **Off**). The selected **Marker** has a blue outline and the figure in green.

The second row (labeled **Reference Marker**) shows the Reference Marker for each marker in the top row. If a marker in the top row is a **Delta** marker, an arrow points down to its Reference Marker. You can drag a top row marker down to any position in the bottom row to make it the reference marker for any other marker.

At the bottom is a large image of the **Selected Marker**, and dropdowns allowing you to change the Mode and Trace of the selected **Marker**. The **Marker Trace** number appears in the Trace color of the trace in question.

All Markers Off

Turns off all markers.

Remote Command	`:CALCulate:MARKer:AOFF`

Example	:CALC:MARK:AOFF
Couplings	In the Swept SA measurement, sets the selected marker to 1

Couple Markers

When this function is ON, moving any marker causes an equal X Axis movement of every other marker that is not **Fixed** or **Off**. By "equal X Axis movement", we mean that we preserve the difference between each marker's X Axis value (in the fundamental x-axis units of the trace that marker is on), and the X Axis value of the marker being moved (in the same fundamental x-axis units).

Note that **Fixed** markers do not couple. They stay where they were while all the other markers move. Of course, if a **Fixed** marker is *being* moved, all the non-fixed markers do move with it.

This may result in markers going off screen.

Remote Command	:CALCulate:MARKer:COUPle[:STATe] OFF | ON | 0 | 1 :CALCulate:MARKer:COUPle[:STATe]?
Example	Set **Couple Markers** on: :CALC:MARK:COUP ON
Preset	OFF Presets on **Mode Preset** and "All Markers Off" on page 316
State Saved	Saved in instrument state

3.2.7.3 Peak Search

The controls on this tab allow you to move the marker to selected peaks of the signal, giving you enormous analysis capabilities, particularly when combined with the **Delta** marker function.

In the Swept SA measurement, for a signal to be identified as a peak it must meet certain criteria. Signals in the negative frequency range, and signals very close to 0 Hz, are ignored. If either the peak excursion or peak threshold functions are on, then the signal must satisfy those criteria before being identified as a peak.

When "Peak Excursion" on page 325 and "Peak Threshold" on page 324 are both off:

– **Peak Search, Continuous Peak Search,** and the maximum part of **Pk-Pk Search**, search the trace for the point with the highest y-axis value that does not violate the LO feedthrough rules. A rising and falling slope are not required for these three peak search functions

– The remaining search functions **Next Peak, Next Pk Right**, etc. only consider trace points that have a rising and falling slope on the left and right respectively

NOTE Pressing the **Peak Search** hardkey automatically moves you to the **Peak Search** page of the **Marker** menu *and* performs a peak search.

Pressing the **Peak Search** tab once you are already *in* the **Marker** menu does *not* perform a peak search.

BANDED PEAK SEARCH: For all **Peak Search** functions, if you are in the **Trace Zoom** View of the Swept SA measurement, and the bottom window is selected, the search function operates *only* within that window. This allows you to perform a **Peak Search** over a specified, limited frequency range, while still viewing the larger frequency range in the top window.

Marker Frequency | Time

This is the fundamental control that you use to move a marker around on the trace. It is the same as "Marker Frequency | Time" on page 307 on the **Settings** tab.

Peak Search

Moves the selected marker to the trace point that has the maximum y-axis value for that marker's trace, subject to "Peak Search Mode" on page 328 on the **Pk Search Config** tab.

NOTE Pressing the **Peak Search** hardkey automatically moves you to the **Peak Search** page of the **Marker** menu *and* performs a peak search.

The **Pk Search Config** menu enables you to define specific search criteria to determine which signals can be considered peaks, excluding unwanted signals from the search.

BANDED PEAK SEARCH: For all **Peak Search** functions, if you are in the **Trace Zoom** View of the Swept SA measurement, and the bottom window is selected, the search function operate *only* within that window. This allows you to perform a **Peak Search** over a specified, limited frequency range, while still viewing the larger frequency range in the top window.

See "More Information" on page 319.

Remote Command	`:CALCulate:MARKer[1]|2|…|12:MAXimum`

Example	Perform a peak search using marker 2:
	`:CALC:MARK2:MAX`
	Query the marker amplitude (Y-axis) value for marker 2:
	`:CALC:MARK2:Y?`
	Query the marker frequency or time (X-axis) value for marker 2:

	:CALC:MARK2:X? :SYST:ERR? can be used to query the errors to determine if a peak is found. The message “No peak found” is returned after an unsuccessful search
Notes	Sending this command selects the subopcoded marker

More Information

The behavior of **Peak Search** depends on settings under the **Peak Search Config** tab. If the setting of **Peak Search Mode** is **Use Excursion and Threshold**, and either **Pk Excursion** or **Pk Threshold** are on, a signal must meet those criteria to be considered a peak. If no valid peak is found, a “No peak found” message is generated, and the marker is not moved.. When **Highest Peak** is on, or both **Pk Excursion** and **Pk Threshold** are off, the marker is always placed at the point on the trace with the maximum y-axis value, even if that point is on the very edge of the trace (exception: negative frequencies and signals close to the LO are not searched at all).

Pressing **Peak Search** with the selected marker **Off** causes the selected marker to be set to **Normal** at the center of the screen, then a peak search is immediately performed.

Pressing the front panel **Peak Search** key *always* does a peak search. Occasionally, you may need to get to the **Peak Search** menu key functions without doing a peak search. You can do this by first accessing the **Marker** menu, then pressing the **Peak Search** tab. The **Peak Search** menu appears without performing a **Peak Search.**

Peak Search All Traces

In the **Spectrogram** View, when **Peak Search All Traces** is pressed, a **Peak Search** is executed that finds the highest point on *all* of the drawn traces in the **Spectrogram** window. The marker moves there, and the **Display Trace** changes to the trace on which the peak was found.

This function obeys the criteria in the **Pk Search Config** menu in the same way that the normal **Peak Search** function does.

Remote Command	:CALCulate:MARKer[1]|2|…|12:MAXimum:ALL
Example	:CALC:MARK2:MAX:ALL :SYST:ERR? can be used to query the errors to determine if a peak is found. The message “No peak found” is returned after an unsuccessful search
Notes	Sending this command selects the subopcoded marker
Dependencies	Only appears in the **Spectrogram** View. If sent outside of **Spectrogram**, generates an error

Next Peak

Moves the selected marker to the peak that is next lower in amplitude than the current marker value. Only peaks that meet all enabled peak criteria are considered (see "Pk Search Config" on page 324). If there is no valid peak lower than the current marker position, a “No peak found” message is generated, and the marker is not moved.

In the LTE/LTE-Advanced Modulation Analysis measurements, if the format is complex (vector or constellation) then the marker moves to the closest point that has a lower magnitude than the marker's current position.

If the selected marker was **Off**, then it is turned on as a **Normal** marker, and a peak search is performed.

Remote Command	`:CALCulate:MARKer[1]|2|…|12:MAXimum:NEXT`
Example	Select Marker 2 and move it to the peak that is closest in amplitude to the current peak, but the next lower value: `:CALC:MARK2:MAX:NEXT`
Notes	Sending this command selects the subopcoded marker
State Saved	Not part of saved state

Next Pk Right

Moves the selected marker to the nearest peak right of the current marker that meets all enabled peak criteria (see "Pk Search Config" on page 324). If there is no valid peak to the right of the current marker position, a “No peak found” message is generated, and the marker is not moved.

If the selected marker was **Off**, then it is turned on as a **Normal** marker, and a peak search is performed.

Remote Command	`:CALCulate:MARKer[1]|2|…|12:MAXimum:RIGHt` `:CALCulate:<meas>:MARKer[1]|2|…|12:MAXimum:RIGHt`
Example	Select Marker 2 and move it to the next peak to the right of the current marker position: `:CALC:MARK2:MAX:RIGH`
Notes	Sending this command selects the subopcoded marker
State Saved	Not part of saved state

Next Pk Left

Moves the selected marker to the nearest peak left of the current marker that meets all enabled peak criteria (see "Pk Search Config" on page 324). If there is no valid peak to the left of the current marker position, a “No peak found” message is generated, and the marker is not moved.

If the selected marker was **Off**, then it is turned on as a **Normal** marker, and a peak search is performed.

Remote Command	`:CALCulate:MARKer[1]|2|…|12:MAXimum:LEFT` `:CALCulate:<meas>:MARKer[1]|2|…|12:MAXimum:LEFT`
Example	Select Marker 2 and move it to the next peak to the left of the current marker position: `:CALC:MARK2:MAX:LEFT`
State Saved	Not part of saved state

Minimum Peak

Moves the selected marker to the minimum y-axis value on the current trace. Minimum (negative) peak searches do not have to meet the peak search criteria. It just looks for the lowest y-axis value. If the selected marker is **Off**, it is turned on before the minimum search is performed.

Remote Command	`:CALCulate:MARKer[1]|2|…|12:MINimum` `:CALCulate:<meas>:MARKer[1]|2|…|12:MINimum`
Example	Select Marker 1 and move it to the minimum amplitude value: `:CALC:MARK:MIN`
Notes	Sending this command selects the subopcoded marker
State Saved	Not part of saved state

Pk-Pk Search

Finds and displays the amplitude and frequency (or time, if in **Zero Span**) differences between the highest and lowest y-axis value. It places the selected marker on the minimum value on its selected trace. And it places that marker’s reference marker on the peak of its selected trace.

This function turns on the reference marker and sets its mode to **Fixed** or **Normal** if it is not already on. (These markers may be on two different traces.)

The rules for finding the maximum peak are the same as for **Peak Search**, including the use of the peak criteria rules. However, the minimum trace value is not required to meet any criteria other than being the minimum y-axis value in the trace.

If the selected marker is **Off**, a **Delta** type marker is turned on, and the peak-to-peak search is done. If the selected marker is on, but it is not a **Delta** marker, then it is changed to **Delta**, which turns on the reference marker if needed, and then it performs the peak-to-peak function.

Remote Command	`:CALCulate:MARKer[1]|2|…|12:PTPeak` `:CALCulate:<meas>:MARKer[1]|2|…|12:PTPeak`
Example	Query the delta amplitude value for marker 1: `:CALC:MARK:PTP`
Notes	Turns on the Marker D active function Sending this command selects the subopcoded marker
Dependencies	Pk-Pk Search is not available when **Coupled Markers** is on
Couplings	The selected marker becomes a **Delta** marker if not already in **Delta** mode
State Saved	Not part of saved state

Marker Delta

Pressing this button has the same effect as pressing **Delta** in "Marker Mode" on page 312 on the **Settings** tab. The selected marker becomes a **Delta** marker. If the selected marker is already a **Delta** marker, the reference marker is moved to the current position of the selected marker, thus resetting the delta to zero.

The control is duplicated here to allow you to conveniently perform a peak search and change the marker's control mode to **Delta** without having to access two separate menus.

Mkr->CF

Assigns the selected marker's frequency to "Center Frequency" on page 279.

The control is duplicated here to allow you to conveniently perform a peak search and **Marker to CF** without having to access two separate menus.

Mkr->Ref Lvl

Assigns the selected marker's level to **Reference Level**. See "Marker To" on page 368 for the description of this function. The control is duplicated here to allow you to conveniently perform a peak search and **Mkr->Ref Lvl** without having to access two separate menus.

Continuous Peak Search

Turns **Continuous Peak Search** on or off. When `ON`, a peak search is automatically performed for the selected marker after each sweep. The rules for finding the peak are the same as for **Peak Search**, including the use of the peak criteria rules. If no valid peak is found, a "No peak found" message is generated after each sweep.

See "More Information" on page 323.

Remote Command	`:CALCulate:MARKer[1]|2|…|12:CPSearch[:STATe] ON | OFF | 1 | 0` `:CALCulate:MARKer[1]|2|…|12:CPSearch[:STATe]?`
Example	Turn on **Continuous Peak Search**: `:CALC:MARK:CPS ON`
Notes	Sending this command selects the subopcoded marker
Couplings	Grayed-out when the selected marker is **Fixed**. Also, if **Continuous Peak Search** is `ON`, and the selected marker becomes a **Fixed** marker, then **Continuous Peak Search** is turned `OFF`, and the control is grayed-out **Signal Track** and **Continuous Peak Search** are mutually exclusive so if **Signal Track** is on, **Continuous Peak Search** is grayed-out and *vice versa*
Preset	Mode Preset
State Saved	Saved in instrument state
Status Bits/OPC dependencies	The Measuring bit remains set while this command is operating and does not go false until the marker position has been updated

More Information

When **Continuous Peak Search** is turned on, a peak search is immediately performed and then is repeated after each sweep. If **Continuous Peak Search** is turned on with the selected marker **Off**, the selected marker is set to **Normal** at the center of the screen, and then a peak search is immediately performed and subsequently repeated after each sweep.

When in Continuous Peak Search, `*OPC` will not return true, nor will `:READ` or `:MEASure` return any data, until the sweep is complete, and the marker has been re-peaked. Note further that if the instrument is in a measurement such as averaging, and **Continuous Peak Search** is `ON`, the entire measurement is allowed to complete (that is, all the averages taken up to the average number) before the re-peak takes place, and only *then* will `*OPC` go true and `:READ` or `:MEASure` return data.

Note that this function is not the "Continuous Peak" function found in some other instruments. That function was designed to track the signal; this function simply does a **Peak Search** after each sweep.

When **Continuous Peak Search** is turned on for a marker, a small “hat” is placed above the marker.

3.2.7.4 Pk Search Config

Contains controls that allow you to setup the **Peak Search** functions.

Since the **Pk Search Config** functions are independent of the selected Marker, the **Select Marker** control does not display while in **Pk Search Config**.

Peak Threshold

Turns the peak threshold requirement on/off and sets the threshold value. The peak threshold value defines the minimum signal level (or min threshold) that the peak identification algorithm uses to recognize a peak.

When both "Peak Excursion" on page 325 and "Peak Threshold" on page 324 are ON, a signal must rise above the **Peak Threshold** value by at least the **Peak Excursion** value and then fall back from its local maximum by at least the **Peak Excursion** value to be considered a peak.

For example, if a threshold value of –90 dBm is selected, the peak search algorithm will only consider signals with amplitude greater than the –90 dBm threshold. If a threshold value of –90 dBm is selected, and **Peak Excursion** is ON and set to 6 dB, the peak search algorithm will only consider signals with amplitude greater than the –90 dBm threshold that rise 6 dB above the threshold and then fall back to the threshold.

NOTE **If a signal comes onto the screen falling and falls all the way to the threshold without ever rising, it is considered a peak at the far-left edge of the display. Similarly, if a signal rises from the threshold and leaves the screen without ever falling, it is considered a peak at the far-right edge of the display. See the diagram below.**

Remote Command	`:CALCulate:MARKer:PEAK:THReshold <ampl>` `:CALCulate:MARKer:PEAK:THReshold?`
Example	Turn on the threshold criterion: `:CALC:MARK:PEAK:THR:STAT ON`

	Set the threshold to -60 dBm: `:CALC:MARK:PEAK:THR -60 dBm`
Dependencies	When **Ref Level Offset** changes, **Peak Threshold** must change by the same amount
Couplings	Whenever you adjust the value of **Peak Threshold** manually, "Pk Threshold Line" on page 327 is turned ON, and, if **Peak Excursion** is also on, the Peak Excursion Region is displayed
Preset	Automatically computed
State Saved	Saved in instrument state
Min	The current displayed Ref Level – 200 dB. The current displayed Ref Level is the current Ref Level, offset by the Ref Level Offset
Max	The current displayed Ref Level. This means the current Ref Level, offset by the Ref Level Offset

Auto Function

Remote Command	`:CALCulate:MARKer:PEAK:THReshold:STATe OFF | ON | 0 | 1` `:CALCulate:MARKer:PEAK:THReshold:STATe?`
Preset	ON

Auto Threshold

Toggles whether the **Peak Threshold** is determined automatically or manually.

The default is ON, which means that **Peak Threshold** is automatically calculated. Manually setting the **Peak Threshold** value sets **Auto Threshold** to `OFF`.

Remote Command	`:CALCulate:MARKer:PEAK:THReshold:AUTO[:STATe] 0 | 1 | ON | OFF` `:CALCulate:MARKer:PEAK:THReshold:AUTO[:STATe]?`
Example	`:CALC:MARK:PEAK:THR:AUTO:STAT ON`
Preset	ON
State Saved	Saved in instrument state

Peak Excursion

Turns the **Peak Excursion** requirement on/off, and sets the excursion value. The value defines the minimum amplitude variation (rise and fall) required for a signal to be identified as peak. For example, if a value of 6 dB is selected, peak search functions like the marker **Next Pk Right** function move only to peaks that rise and fall 6 dB or more.

When both "Peak Excursion" on page 325 and "Peak Threshold" on page 324 are ON, a signal must rise above the **Peak Threshold** value by at least the **Peak Excursion** value and then fall back from its local maximum by at least the **Peak Excursion** value to be considered a peak.

NOTE: In the event that a sequence of trace points with precisely the same values represents the maximum, the leftmost point is found. If a signal comes onto the screen falling and falls all the way to the threshold without ever rising, it is considered a peak at the far-left edge of the display. Similarly, if a signal rises from the threshold and leaves the screen without ever falling, it is considered a peak at the far-right edge of the display.

See "More Information" on page 326.

Remote Command	`:CALCulate:MARKer:PEAK:EXCursion <rel_ampl>` `:CALCulate:MARKer:PEAK:EXCursion?`

Example	`:CALC:MARK:PEAK:EXC:STAT ON`
	Set the minimum peak excursion requirement to 30 dB:
	`:CALC:MARK:PEAK:EXC 30 DB`

Dependencies	Available only when Y axis unit is amplitude units, otherwise grayed-out
Couplings	Whenever you adjust the value of **Peak Excursion** manually(with the knob, step keys, or by completing a numeric entry), if **Peak Threshold** is ON, "Pk Threshold Line" on page 327 is turned ON, and the Peak Excursion Region is displayed
Preset	Automatically computed
State Saved	Saved in instrument state
Min	0.0 dB
Max	100.0 dB

Auto Function

Remote Command	`:CALCulate:MARKer:PEAK:EXCursion:STATe OFF | ON | 0 | 1` `:CALCulate:MARKer:PEAK:EXCursion:STATe?`
Preset	ON

More Information

If two signals are very close together and the peak excursion and threshold criteria are met at the outside edges of the combined signals, this function finds the highest of these two signals as a peak (or next peak). However, if a signal appears near the edge of the screen such that the full extent of either the rising or falling edge cannot be determined, and the portion that is on screen does not meet the excursion criteria, then the signal cannot be identified as a peak.

When measuring signals near the noise floor, you can reduce the excursion value even further to make these signals recognizable. To prevent the marker from identifying noise as signals, reduce the noise floor variations to a value less than the peak-excursion value by reducing the video bandwidth or by using trace averaging.

Auto Excursion

Toggles whether "Peak Excursion" on page 325 is determined automatically or manually.

The default is ON, which means that **Peak Excursion** is automatically calculated. Manually setting the **Peak Excursion** value sets **Auto Peak Excursion** to OFF.

Remote Command	`:CALCulate:MARKer:PEAK:EXCursion:AUTO[:STATe] 0 | 1 | ON | OFF` `:CALCulate:MARKer:PEAK:EXCursion:AUTO[:STATe]?`
Example	`:CALC:MARK:PEAK:EXC:AUTO:STAT ON`
Preset	ON
State Saved	Saved in instrument state

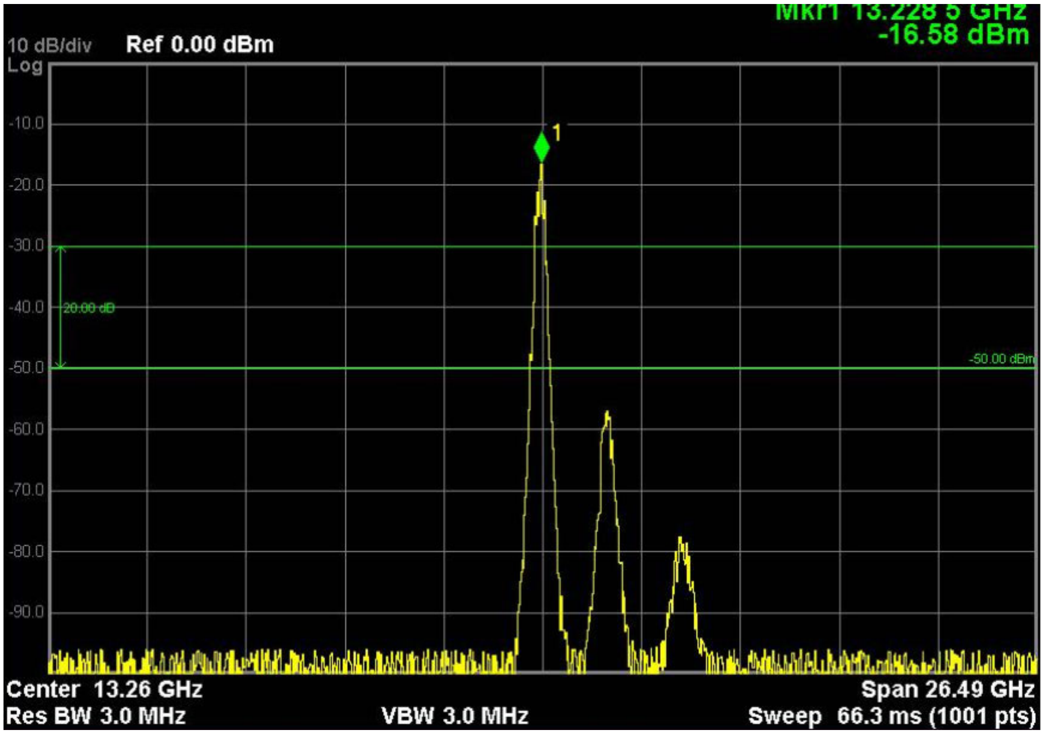
Pk Threshold Line

Turns the peak threshold line on or off. Preset state is OFF.

Remote Command	`:CALCulate:MARKer:PEAK:THReshold:LINE[:STATe] OFF | ON | 0 | 1` `:CALCulate:MARKer:PEAK:THReshold:LINE[:STATe]?`
Example	Turn **Pk Threshold Line** on: `:CALC:MARK:PEAK:THR:LIN:STAT 1`

The Peak Threshold line is green and has the value of the peak threshold (for example, “–20.3 dBm”) written above its right side, above the line itself. If **Peak Excursion** is ON, it shows on the left side as a region above the **Pk Threshold Line**. As with all such lines (Display Line, Trigger Level line, etc.) it is drawn on top of all traces.

The **Peak Threshold** and **Peak Excursion** lines can be adjusted using the step keys, knob, or numeric keypad. They can also be dragged on the display with your finger or a mouse.



This function is automatically set `ON` (thus turning on the Peak Threshold line) whenever the value of **Peak Threshold** or **Peak Excursion** becomes the active function, unless **Peak Threshold** is `OFF`. It is automatically set `OFF` whenever **Peak Threshold** is set to `OFF`. Manually turning it `ON` automatically turns on **Peak Threshold**.

The **Peak Excursion** part is `ON` whenever the **Peak Threshold** part is `ON`, unless **Peak Excursion** is `OFF`.

Peak Search Mode

Lets you specify what kind of search you want to do when **Peak Search** is pressed (or the equivalent command sent).

Note that there are two “types” of peak search functions. One type is the “Peak Search” type, the other type is the “Next Peak” type. “Next Peak” searches (for example, **Next Peak**, **Next Pk Left**, **Next Pk Right**) are qualified by using the Excursion and Threshold criteria. The “Peak Search” type of search simply finds the highest point on the trace.

However, using the **Peak Search Mode** control, you can change the “Peak Search” type of search so that it also uses the Excursion and Threshold criteria. This allows you to find the Maximum point on the trace that also obeys the Excursion and/or

Threshold criteria. This would be useful if, for example, you did not want to perform the Peak Search at all unless there was a signal on the screen above a certain level.

When **Highest Peak** is selected, pressing **Peak Search** simply finds the highest peak on the marker's trace. When **Use Excursion & Threshold** is selected, the search is also qualified by the Excursion and Threshold values (as long as these criteria are On).

Note that this control also affects "Continuous Peak Search" on page 323, and the **Peak Search** half of "Pk-Pk Search" on page 321.

Remote Command	`:CALCulate:MARKer:PEAK:SEARch:MODE MAXimum | PARameter` `:CALCulate:MARKer:PEAK:SEARch:MODE?`

Example	Set Highest Peak mode:
	`:CALC:MARK:PEAK:SEAR:MODE MAX`
	Set Excursion & Threshold mode:
	`:CALC:MARK:PEAK:SEAR:MODE PAR`

Preset	`MAXimum`
State Saved	Saved in instrument state
Range	Highest Peak | Excursion & Thr

Peak Table On/Off

Turns **Peak Table** on or off. When `ON`, the display is split into a measurement window and a peak table display window.

Turning **Peak Table** `ON` turns `OFF`"Marker Table" on page 316, and *vice versa*.

Remote Command	`:CALCulate:MARKer:PEAK:TABLe:STATe OFF | ON | 0 | 1` `:CALCulate:MARKer:PEAK:TABLe:STATe?`
Example	Turn on and display the peak table: `:CALC:MARK:PEAK:TABL:STAT ON`
Dependencies	Only available as a switch in the **Normal** View. **Peak Table** is also available as a selection in the **Window Data** dropdown in all Views When **Peak Table** turns on, if **Peak Threshold** is `ON`, then it becomes the active function
Preset	`OFF`
State Saved	Saved in instrument state

Peak Table Sort

Sets the peak table sorting routine to list the peaks in order of descending amplitude, ascending frequency or descending "Delta to Limit" value. The remote command can also be used to sort the peaks found using `:CALCulate:DATA:PEAKs`.

You can also sort the table and change the order between ascending and descending by tapping a column header once or twice.

Remote Command	`:CALCulate:MARKer:PEAK:SORT FREQuency | AMPLitude | DELTa` `:CALCulate:MARKer:PEAK:SORT?`
Example	Set sorting routine to list peaks in order of descending amplitude: `:CALC:MARK:PEAK:SORT AMPL`
Preset	`AMPLitude`
State Saved	Saved in instrument state
Backwards Compatibility SCPI	`:TRACe:MATH:PEAK:SORT`

Peak Table Readout

Shows up to twenty signal peaks as defined by the setting:

All	`ALL`	Lists all the peaks defined by the peak criteria, in the current sort setting
Above Display Line	`GTDLine`	Lists the peaks that are greater than Display Line 1, and that meet the peak criteria. They are listed in the current sort order
Below Display Line	`LTDLine`	Lists the peaks that are less than Display Line 1, and that meet the peak criteria. They are listed in the current sort order

If **Peak Threshold** and/or **Peak Excursion** are `ON`, then only peaks that meet the defined criteria are found.

See "More Information" on page 331.

Remote Command	`:CALCulate:MARKer:PEAK:TABLe:READout ALL | GTDLine | LTDLine` `:CALCulate:MARKer:PEAK:TABLe:READout?`

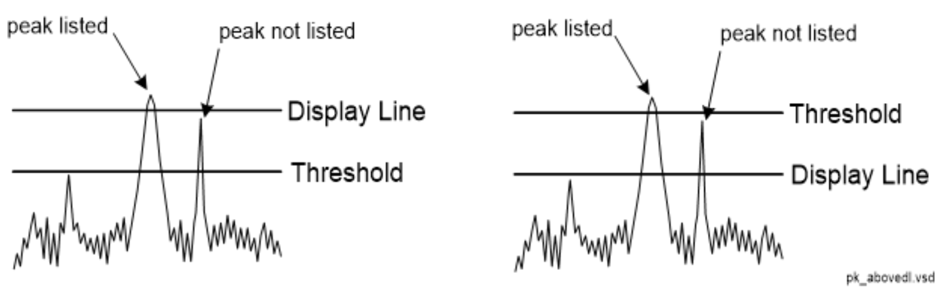
Example	All peaks:
	`:CALC:MARK:PEAK:TABL:READ ALL`
	Peaks above display line 1:
	`:CALC:MARK:PEAK:TABL:READ GTDL`
	Peaks below display line 1:
	`:CALC:MARK:PEAK:TABL:READ LTDL`

Dependencies	Turning Display Line 1 off forces Readout to `ALL`
Couplings	If `GTDL` or `LTDL`, then if Display Line 1 is not already on, it is turned on (it has to be on or it cannot be

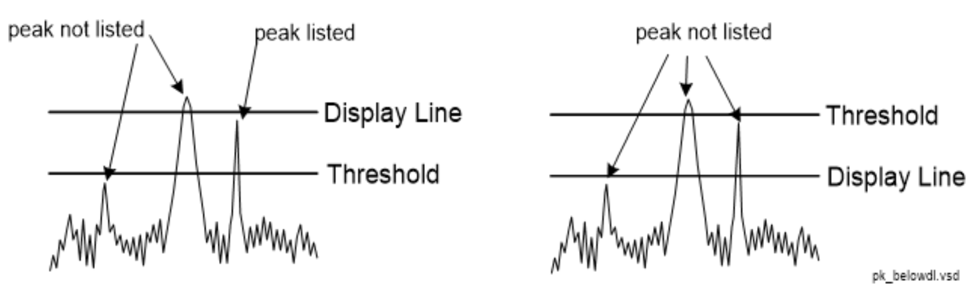
	used to exclude peaks)
Preset	`ALL`
State Saved	Saved in instrument state

More Information

If "Display Line" on page 268 is `ON`, the Peak Table can be selected to include all peaks, or only those above the **Display Line**, or only those below the **Display Line**. See the figures below to understand what happens if both **Display Line** and **Peak Threshold** are `ON`.



Above Display Line Peak Identification



Below Display Line Peak Identification

Maximum Number of Peaks

Sets the maximum number of peaks shown in the Peak Table.

Remote Command	`:CALCulate:MARKer:PEAK:MPEaks <max_peaks>` `:CALCulate:MARKer:PEAK:MPEaks?`
Example	`:CALC:MARK:PEAK:MPE 50`

	:CALC:MARK:PEAK:MPE?
Preset	20
State Saved	Saved in instrument state
Min	1
Max	500

Δ to Limit

Selects the Limit to be used for the Δ to Limit column in the **Peak Table**, and turns the Δ to Limit column on and off.

When ON, this column shows the difference between each peak and the specified Limit.

Remote Command	:CALCulate:MARKer:PEAK:TABLe:DTLimit LLINE1 | … | LLINE6 :CALCulate:MARKer:PEAK:TABLe:DTLimit?
Example	:CALC:MARK:PEAK:TABL:DTL:STAT ON :CALC:MARK:PEAK:TABL:DTL LLINE1
Preset	LLINE1

Auto Function

Remote Command	:CALCulate:MARKer:PEAK:TABLe:DTLimit:STATe ON | OFF :CALCulate:MARKer:PEAK:TABLe:DTLimit:STATe?
Preset	OFF

Query the Signal Peaks (Remote Query Only)

Returns a list of peaks of the specified trace that are above **Peak Threshold** (if ON) and have an excursion above **Peak Excursion** (if ON).

Remote Command	:CALCulate:DATA[n]:PEAKs? <threshold>,<excursion>[,AMPLitude | FREQuency | TIME,[ALL | GTDLine | LTDLine]]
Example	:CALC:DATA1:PEAKs? -90, 6 Response: :1.000000000E+01, -1.804702691E+01, 1.320202000E+10, -1.831304020E+01, 1.325500000E+10, -2.069423795E+01, 1.312255000E+10, -4.752705087E+01, 1.293712000E+10, -5.737315428E+01, 1.497685000E+10, -5.898005784E+01, 1.492387000E+10, -5.968565135E+01, 1.505632000E+10, -6.822387883E+01, 1.518877000E+10, -7.021781263E+01, 1.476493000E+10, -7.404477322E+01, 1.471195000E+10 Note: The first value is the number of peaks that meets the specified limits

The following query is provided for backwards compatibility with ESA and PSA. It is recommended that you use `:CALC:DATA:PEAK` instead.

Returns the signal peaks by frequency or by amplitude. This query uses only Trace 1 data. The sort mode is determined by `:TRACe:MATH:PEAK:SORT`. The commands `:CALCulate:MARKer:PEAK:EXCursion` and `:CALCulate:MARKer:PEAK:THReshold` are used to determine what is a signal peak. To query the number of signals found meeting the specified limits, use `:TRACe:MATH:PEAK:POINts?`

Example	`:TRAC:MATH:PEAK?` Identifies the peaks of trace 1 that are above **Peak Threshold** (if Threshold is ON) and have an excursion above **Peak Excursion** (if Excursion is ON)
Backwards Compatibility SCPI	`:TRACe:MATH:PEAK[:DATA]?`

Query Number of Peaks Found (Remote Query Only)

Provided for backwards compatibility with ESA and PSA. It is recommended that you use `:CALC:DATA:PEAK` instead.

Returns the number of signal peaks identified. The amplitude of the peaks can then be queried with `:TRACe:MATH:PEAK:DATA?` This query uses only Trace 1 data.

Example	`:TRAC:MATH:PEAK:POINts?` Identifies the number of peaks of trace 1 that are above **Peak Threshold** (if Threshold is ON) and have an excursion above **Peak Excursion** (if Excursion is ON)
Backwards Compatibility SCPI	`:TRACe:MATH:PEAK:POINts?`

3.2.7.5 Properties

The controls on this tab are used to set certain properties of the selected marker.

Marker Frequency | Time

This is the fundamental control that you use to move a marker around on the trace. It is the same as the "Marker Frequency | Time" on page 307 control on the **Settings** tab.

Relative To

Selects the marker to which the selected marker is relative (its reference marker).

Every marker has another marker to which it is relative. This marker is referred to as the “reference marker” for that marker. This attribute is set by **Marker, Properties**, "Relative To" on page 333. The marker must be a **Delta** marker to make this attribute relevant. If it is a **Delta** marker, the reference marker determines how the marker is controlled and how its value is displayed. A marker cannot be relative to itself.

Remote Command	`:CALCulate:MARKer[1]|2|…|12:REFerence <integer>` `:CALCulate:MARKer[1]|2|…|12:REFerence?`
Example	Set the marker 1 reference marker to 2, and turn marker 1 on as a **Delta** marker: `:CALC:MARK1:REF 2`
Notes	This command causes the marker specified with the subopcode to become selected Range (for SCPI command): 1 to 12. If the range is exceeded the value is clipped A marker cannot be relative to itself so that choice is not available, and if sent from SCPI generates error -221: “Settings conflict; marker cannot be relative to itself” When queried, a single value is returned (the specified marker number’s relative marker)
Couplings	The act of specifying the selected marker’s reference marker makes the selected marker a **Delta** marker If the reference marker is **Off**, it is turned on in **Fixed or Normal** mode at the delta marker location
Preset	The preset default “Relative To” marker (reference marker) is the next higher numbered marker (current marker + 1). For example, if Marker 2 is selected, then it’s default reference marker is Marker 3. The exception is Marker 12, which has a default reference of Marker 1 Set to the defaults by using **Restore Mode Defaults**. This is not reset by **Marker Off**, **All Markers Off**, or **Preset**
State Saved	Saved in instrument state. Not affected by **Marker Off** and hence not affected by Preset or power cycle
Min	1
Max	12
Annunciation	Appears in the marker label of a **Delta** marker

X Axis Scale

Determines how the X-Axis information for the selected marker is displayed in the marker area (top-right of display) and the active function area of the display, and how the marker is controlled. The available settings for the X Axis Scale are Frequency, Period, Time, and Inverse Time.

Remote Command	`:CALCulate:MARKer[1]|2|…|12:X:READout FREQuency	TIME	ITIMe	PERiod` For option details, see "Options" on page 335 `:CALCulate:MARKer[1]|2|…|12:X:READout?`
Example	Set the Marker 3 X Axis Scale to Time: `:CALC:MARK3:X:READ TIME`
Notes	If in **Delta** marker mode, the value used for X Axis Scale of both the marker and the reference marker (for calculating the delta) is that of the marker, independent of what the reference marker is set to This command causes the specified marker to become selected

Preset	AUTO = ON Marker Preset (selected when a marker is turned **Off**): **Auto** (see below). In most measurements, the **Auto** setting results in Frequency being the preset readout Note that the marker trace should first be preset according to the Marker Trace rules before this preset is applied
State Saved	Saved in instrument state

Auto Function

Remote Command	`:CALCulate:MARKer[1]|2|…|12:X:READout:AUTO ON | OFF | 1 | 0` `:CALCulate:MARKer[1]|2|…|12:X:READout:AUTO?`
Preset	ON

Options

Value	SCPI	Notes
Frequency	FREQuency	Displays the absolute frequency of a normal marker or the frequency of the delta marker relative to the reference marker
Period	PERiod	Displays the reciprocal of the frequency of the marker, or the reciprocal of the frequency separation of the two markers in a delta-marker mode. The units are those of time (sec, msec, etc.) If the markers are at the same frequency in a delta marker mode, the result is the reciprocal of 0, which is infinitely large. The display shows "---" and the SCPI query returns infinity
Time	TIME	Displays the time interval between a normal marker and the start of a sweep or the time of the delta marker relative to the reference marker. Time is the auto setting for time domain traces. In a delta-marker mode it is the (sweep) time interval between the two markers
Inverse Time	ITIMe	Displays the reciprocal time. It is useful in a delta mode to show the reciprocal of (sweep) time between two markers. This function is only meaningful when on a time domain trace and in the **Delta** control mode. If the markers are at the same X Axis value, the time between them is 0, so the reciprocal of sweep time is infinitely large. The display shows "---" and the SCPI query returns *infinity*

The **X Axis Scale** of a marker is the scale of its X Axis value. This affects the units displayed in the Marker Result block and used to specify the marker's X Axis location. The X Axis Scale is specified using **Marker, Properties, X Axis Scale**.

All markers in swept spans have both a time and frequency value. Which of these is used for the result display, and for positioning the marker, depends on the **X Axis Scale** setting. The **X Axis Scale** setting can be **Frequency** or **Time**, as well as the reciprocal of either (**Period** or **Inverse Time**). There is also an **Auto** setting – when in **Auto**, a marker's **X Axis Scale** changes whenever the domain of the trace, upon which it set, changes. All choices for **X Axis Scale** are allowed. Note that this behavior differs from the behavior in previous instruments: previously the instrument remembered a different **X Axis Scale** (formerly called **Readout**) for each domain, and the choices of **X Axis Scale** were restricted. These restrictions were based on the current domain of the instrument.

When in **Auto**, the X-Axis Scale is **Frequency** if the Marker Trace is a frequency domain trace, **Time** if the Marker Trace is a time domain trace. When in **Auto**, if the marker changes traces, or the domain of the trace the marker is on changes, the auto result is re-evaluated. If the X Axis Scale is chosen manually, that scale is used regardless of the domain of the trace.

If **Frequency** or **Period** is selected for a time domain trace, all points in the trace show the same value. Attempting to use the knob or step keys to adjust the X Axis value of the marker or entering an X Axis value from the numeric keypad or remotely has no effect, but generates no error.

Frequency domain traces taken in FFT mode have no valid time data. Therefore, when **Time** or **Inverse Time** is selected for markers on such traces, the X Axis value is taken as the appropriate percentage of the displayed sweep time, which is a calculated estimate.

Lines

When `ON`, displays a vertical line of graticule height and a horizontal line of graticule width, intersecting at the indicator point of the marker (that is, the center of the X or the bottom tip of the diamond. The lines are blue .

Remote Command	`:CALCulate:MARKer[1]|2|…|12:LINes[:STATe] OFF | ON | 0 | 1` `:CALCulate:MARKer[1]|2|…|12:LINes[:STATe]?`
Example	Turn **Lines** on for Marker 2: `:CALC:MARK2:LIN:ON`
Couplings	Sending the remote command causes the addressed marker to become selected
Preset	`OFF`
State Saved	Saved in instrument state

Marker Trace

Selects the trace on which you want your marker placed. A marker is associated with one and only one trace. This trace is used to determine the placement, result, and X Axis Scale of the marker. All markers have an associated trace, even **Fixed** markers; it is from that trace that they determine their attributes and behaviors, and it is to that trace that they go when they become **Normal** or **Delta** markers.

In measurements that support **Auto Initialize**, if **Auto Initialize** is `ON` (the default state) the trace is automatically chosen when the Marker is turned on, based on rules described under "Auto Initialize" on page 337.

Specifying a **Marker Trace** manually or with this command associates the marker with the specified trace and turns **Auto Initialize**`OFF` for that marker. If the marker is not **Off**, it moves the marker from the trace it was on to the new trace. If the marker is **Off**, it stays off but is now associated with the specified trace.

The query returns the number of the trace on which the marker is currently placed, even if that marker is in Auto mode.

Remote Command	`:CALCulate:MARKer[1]|2|…|12:TRACe 1 | … | 12` `:CALCulate:MARKer[1]|2|…|12:TRACe?`
Example	Place Marker 1 on trace 2: `:CALC:MARK1:TRAC 2`
Notes	A marker may be placed on a blanked and/or inactive trace, even though the trace is not visible and/or updating An application may register a trace name to be displayed on the control instead of a trace number
Couplings	The state of **Marker Trace** is not affected by "Auto Couple" on page 1995 If **Marker Trace** is set manually, **Auto Initialize** goes to `OFF` for that marker Sending the remote command causes the addressed marker to become selected
Preset	1 (Presets on **Meas Preset**, or **All Markers Off**)
State Saved	The **Marker Trace** and state of **Auto Initialize** for each marker is saved in instrument state
Min	1
Max	6

Auto Initialize

When **Auto Initialize** is `ON` for a given marker, the marker's trace is re-determined automatically by the instrument whenever the marker turns on (**Normal**, **Delta** or **Fixed**) from an **Off** state. This is the default state of Markers. (The trace attribute is also determined for all markers that are on, whenever **Auto Initialize** is turned on).

When **Auto Initialize** is turned `OFF` for a given marker, the Marker remains associated with the trace it is currently on regardless of whether the marker and/or the marker's trace is subsequently turned on or back off. If the marker is **Off**, it stays off but is now associated with the specified trace.

Auto Initialize is turned off automatically whenever "Marker Trace" on page 336 is used to directly specify a marker's trace.

For more details, see "Auto Init Rules Flowchart" on page 338 below.

Remote Command	`:CALCulate:MARKer[1]|2|…|12:TRACe:AUTO OFF | ON | 0 | 1` `:CALCulate:MARKer[1]|2|…|12:TRACe:AUTO?`
Notes	Turning Marker Trace **Auto Initialize** off has no effect on the trace on which the marker is currently placed

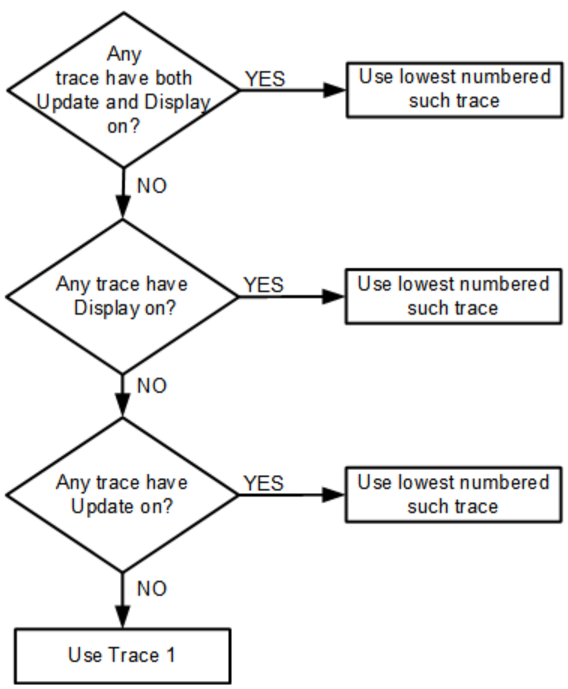
	The response to the query is 0 if OFF, 1 if ON
Couplings	The state of **Auto Initialize** is not affected by "Auto Couple" on page 1995 **Auto Initialize** is set to ON by Preset or **All Markers Off** If **Auto Initialize** is ON for a marker and that marker is on, that marker's **Marker Trace** is immediately set according to the above flowchart Sending the remote command causes the addressed marker to become selected
Preset	ON

When the marker moves between traces the marker's X position in trace points is retained as it moves. For moving between active traces this generally means the x-axis value of the marker does not change. But for moving to or from an inactive trace, the x-axis value takes on that of the new trace at the bucket the marker was on the old trace (and is still on, on the new trace, since the bucket doesn't change).

Note this is true even if the marker is off screen. Thus, a marker that is at the center of the screen on the old trace stays at the center of the screen on the new trace. A marker that is off screen one whole screen to the left on the old trace remains off screen one whole screen to the left on the new trace – even if this means it is at negative time!

Auto Init Rules Flowchart

The following flowchart depicts the **Auto Initialize** rules:



This flowchart makes it clear that putting all lower-numbered traces in View is the simplest way to specify which trace you want the markers to go to when they turn on. For example, if you want all Markers to go to Trace 2 when they turn on, put Trace 1 in View.

Marker Settings Diagram

Lets you configure the **Marker** system using a visual utility. It is the same as "Marker Settings Diagram" on page 316 on the **Settings** tab.

3.2.7.6 Marker Function

The controls on this tab allow you to control the Marker Functions of the instrument. Marker Functions perform post-processing operations on marker data.

The **Marker Function** menu controls which marker functions are turned on and allows you to adjust the setup parameters for each function. These parameters include the following, but only one parameter can be assigned to a given marker:

- Marker Noise
- Interval Power
- Interval Density
- Off

Marker Frequency | Time

This is the fundamental control that you use to move a marker around on the trace. It is the same as "Marker Frequency | Time" on page 307 on the **Settings** tab.

Band Function

Band Functions are Marker Functions that allow you to define a band of frequencies around the marker. The band defines the region of data used for the numerical calculations. These marker functions also allow you to perform mathematical calculations on trace and marker data and report the results of these calculations in place of the normal marker result.

NOTE

Unlike regular markers, Band Function markers are not placed directly on the trace. They are placed at a location which is relative to the result of the function calculation.

If any of the band adjust SCPI commands (including the `BAND:SPAN` command and the legacy compatibility commands documented under "Band Function Backwards Compatibility" on page 343) are sent while the marker function is off, they are accepted and the value stored. If sent while the marker is **Off**, they are accepted and *ignored*.

See:

– "Fixed marker functions" on page 342
– "Interval Markers" on page 343
– "Offscreen Markers and Band Functions" on page 343
– "Band Function Backwards Compatibility" on page 343

Remote Command	`:CALCulate:MARKer[1]|2|…|12:FUNCtion NOISe | BPOWer | BDENsity | OFF`
	For option details, see "Options" on page 341
	`:CALCulate:MARKer[1]|2|…|12:FUNCtion?`

Example	Turn on Marker 1 as a noise marker:
	`:CALC:MARK:FUNC NOIS`
	Turn on Marker 1 as a band density marker:
	`:CALC:MARK:FUNC BDEN`
	Turn off marker functions for marker 1:
	`:CALC:MARK:FUNC OFF`
	Return the current band function for marker 1. For Marker Noise, returns `NOIS`, for Band Power returns `BPOW`, and for Band Density returns `BDEN`:
	`:CALC:MARK:FUNC?`
	Return the y-axis value of marker 1, which means it returns the Band Function value if a Band Function is on for Marker 1. Note that the delta value when the Y axis unit is Watts is the square of the delta value when the Y axis unit is Volts. For example, when the percent ratio with Y axis unit in Volt is 0.2, the percent ratio with Y axis unit in Watt is 0.22 = 0.04. When you read the value out remotely, you must know whether your Y Axis Unit is log (dB), linear (V or A), or power (W)
	`:CALC:MARK:Y?`

Notes	The zero-width case and the case of a width less than .499 buckets is treated as one bucket wide although it shows a width of 0 When the trace the marker is on crosses domains, the width crosses domains as well, to remain the same percentage of the traceSending this command selects the specifies marker The marker function result is queried in the same way as the Marker Result, as outlined in the Marker section, with `:CALC:MARK:Y?`
Dependencies	Fixed markers: It is not possible to change the Band Function for a **Fixed** marker; so, the Band Function selections are grayed-out for a **Fixed** marker If a marker function was already on when the marker became **Fixed**, then the selected **Band Function** is shown but cannot be changed. Therefore, you cannot directly set the X or Y value of a **Fixed** marker that has a marker function turned on. To turn off the function, turn off the marker

	Average detector and Power Averaging are auto selected when **Marker Noise** on If the selected (specified) marker is **Off**, selecting **Marker Noise** via front panel or SCPI turns the marker on
Couplings	When you choose any Band Function and **Band Span Auto/Man** is in the **Auto** state, the **Band Span** is set to 5% of the screen width Adjusting the Band Span sets **Band Span Auto/Man** to **Man** While in **Marker Noise** and with **Band Span Auto/Man** in the **Auto** state, if the analyzer Span is changed, **Band Span** stays at 5% of the new span If the selected (specified) marker is off, selecting a **Band Function** via front panel or SCPI turns the marker on If the detector mode for the detector on the marker's trace is set to **Auto**, the `AVERage` detector is selected. If the Average type is set to **Auto**, Power Averaging is selected. Other choices for the detector or Average type may cause measurement inaccuracy
Preset	`OFF`
State Saved	The band function for each marker is saved in instrument state
Annunciation	The band function for the selected marker appears in the Marker Result block and in the Marker Table

Options

The Band Functions are **Marker Noise**, **Band Power**, and **Band Density,** only one of which can be on for a given marker.

Value	SCPI	Notes
Marker Noise	`NOISe`	When **Marker Noise** is on, the marker's Y Axis Result is the average noise level, normalized to a 1 Hz noise power bandwidth, in the band specified under the **Band Adjust** key To guarantee accurate data for noise-like signals, a correction for equivalent noise bandwidth is made by the instrument The **Marker Noise** function accuracy is best when the detector is set to Average or Sample, because neither of these detectors will peak-bias the noise. The tradeoff between sweep time and variance of the result is best when Average Type is set to Power Averaging. Therefore, Auto coupling chooses the Average detector and Power Averaging when Marker Noise is on. Though the Marker Noise function works with all settings of detector and Average Type, using the positive or negative peak detector gives less accurate measurement results Noise Markers assume that the signal to be measured is noise-like. Based on this assumption, we can actually make reasonable measurements under very non-ideal conditions: any detector may be used, any averaging type, any VBW. In contrast, the Band Power and Band Density markers make no assumption about the statistics of the signal
Band Power	`BPOWer`	Computes the total power within a span in a nonzero span. The results computation must include the RBW In **Zero Span**, measures the average power across a time interval. This is sometimes referred to as the interval power

Value	SCPI	Notes
Band Density	`BDENsity`	On frequency domain traces, the band density across a band is the total band power divided by the bandwidth over which it is measured In **Zero Span**, measures the average power across a time interval, divided by Bn. Bn is the noise bandwidth of the RBW filter, as noted and used within the Band Power computation. This is sometimes referred to as the interval density It may seem like the band density marker function is exactly like a function of a noise marker with variable width. But they are somewhat different. The Noise marker assumes that the signal to be measured is noise-like and applies a correction based on that assumption. The Band Density markers make no assumption about the statistics of the signal
Off	`OFF`	Turns off all Band Functions Turning off the marker function has no effect on the band span, nor does it turn the marker **Off**

The unit to be used for displaying Band Function results is automatically chosen based on the control mode (Normal, Delta, Fixed) of the marker and the reference marker. For example, dB/Hz is used when the marker is a noise marker, and the reference marker is a band power marker.If the selected marker is **Off**, pressing **Marker Function** sets it to **Normal** and places it at the center of the display on the trace determined by the Marker Trace rules. However, if the selected marker was **Off**, **Marker Function Off** had to be the selected function, and it remains so even after the marker is thus turned on, although you may then change it.

Fixed marker functions

In the case of a **Fixed** marker, it is not possible to turn on or change a band function. This is because a **Fixed** marker holds the value it had when it became fixed; the trace it was on may keep on changing, so the function value, which depends on trace data, could not be calculated on an ongoing basis.

It is possible to have a **Marker Function** on for a **Fixed** marker, in the case where a function was already on when the marker became Fixed. In this case the function value is retained in the marker. It is also possible to have a **Marker Function** on for a **Fixed** marker in the case when the marker was off and was turned on as **Fixed** because **Delta** was pressed to create a reference marker, in which case the marker function, marker function width, Y Axis value and marker function result that the **Delta** marker had when **Delta** was pressed are copied into the **Fixed** marker. If **Delta** is pressed again, causing the fixed reference marker to move to the delta marker's position, the marker function, marker function width, Y Axis value and marker function result that the **Delta** marker had when **Delta** was pressed are again copied into the fixed reference marker.

If a **Marker Function** is on for a **Fixed** marker, the marker's reported value is derived by the function. Therefore, you cannot directly set the X or Y value of a **Fixed** marker which has a marker function turned on. Indirect setting as detailed above or when a

Peak Search is performed is allowed, as the Fixed marker is always placed on a trace and can derive its function value from the trace at the moment when it is placed.

Interval Markers

What is an interval marker?

The interval power marker measures the average power across some time interval in zero span.

Interval Density is defined to be Interval Power divided by Bn. Bn is the noise bandwidth of the RBW filter, as noted and used within the Band Power computation.

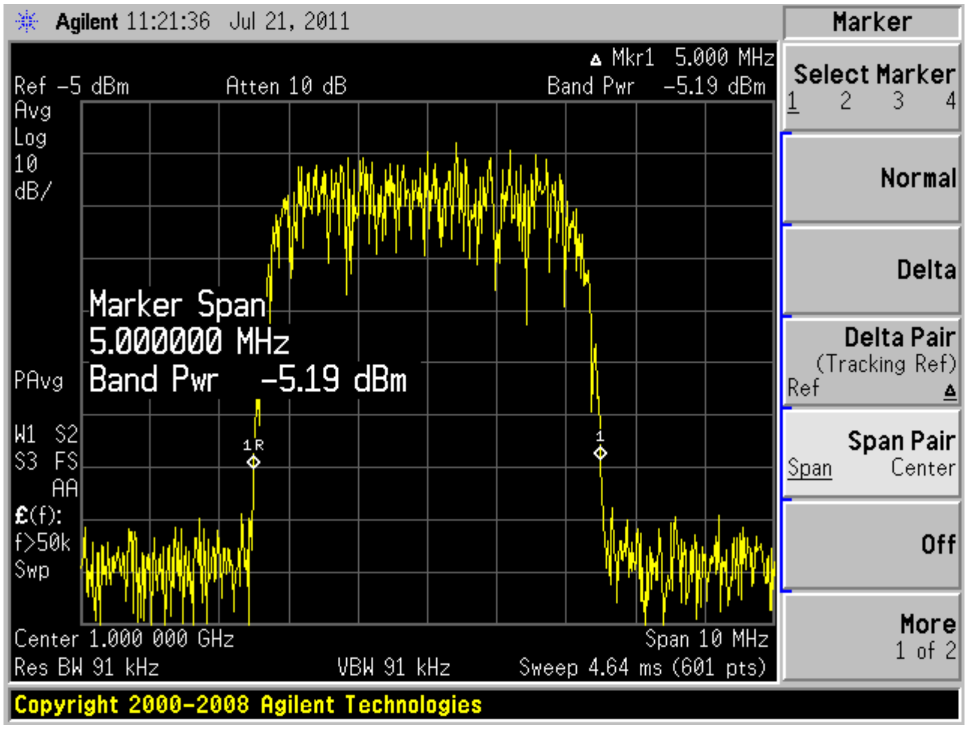
Offscreen Markers and Band Functions

If a Normal or Delta noise marker is so near to the left or right edge of the trace that some of the band is off-screen, then it uses only that subset of the Band Width that is on-trace.

Neither Band power nor Band density markers are defined if any part of the band is off the screen (unless they are Fixed with a stored function value in them), except that when the edges of the bandwidth are trivially off-screen, due to mathematical limitations in the instrument or in the controlling computer, the result is still considered valid.

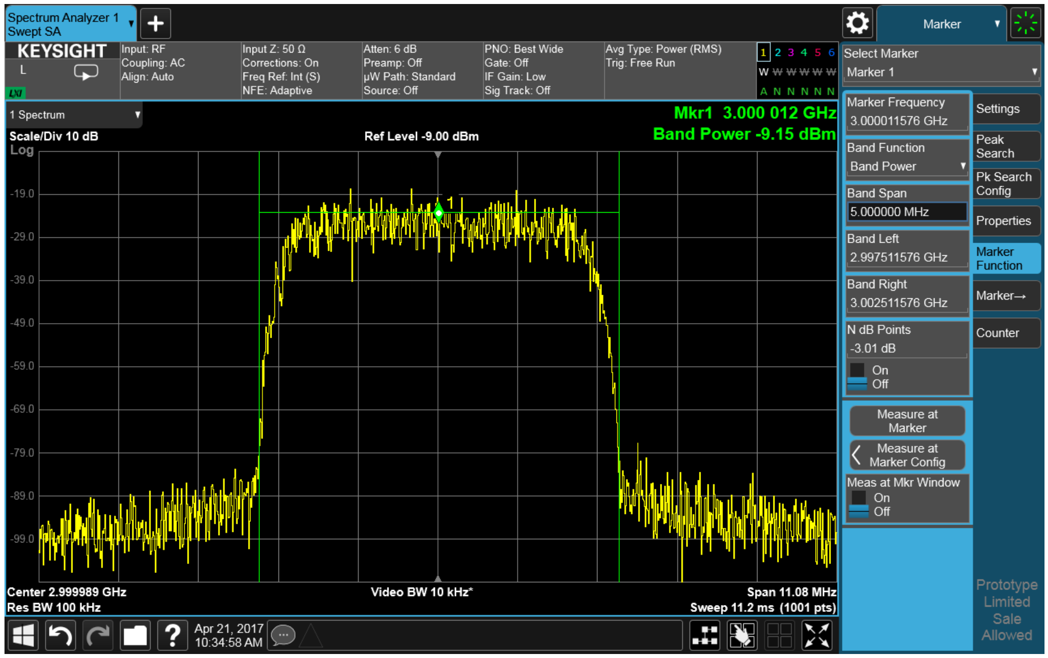
Band Function Backwards Compatibility

To define the Band Power function, the ESA and PSA analyzers used Delta marker functionality with two markers, for example, Marker 1 and its Reference Marker, as shown below:



The marker modes known as Span Pair and Delta Pair (Band Pair in ESA) were used to set two markers for the primary purpose of defining the band of a Band Power function. The two markers were set by adjusting their span and center point (Span Pair mode) or by adjusting their locations independently to directly define the Start and Stop edges of the band (Band Pair/Delta Pair modes).

In X-Series, the introduction of adjustable-width Band Functions fundamentally changes the way Band Power markers are controlled, by using a single marker to completely define the function, as shown below:



In X-Series the marker itself has a width attribute, which you set using the Band Span function. The marker shows “wings” that define the edges of the band in which the Band Power is being measured. You only need one marker, not a pair of markers, to completely define a Band Power function (making it possible to do Delta Band Power, which PSA and ESA could not do).

Additional control functions of Band Left and Band Right are provided for the case when you need to precisely set the band edges. Note that the marker itself always remains centered in the band.

To map the old Span Pair and Band Pair/Delta Pair functions to the X-Series for code compatibility, aliases and compatibility commands were added. Since Span Pair and Band Pair/Delta Pair were primarily used for making band power measurements, the aliases are provided for setting the parameters of a Band Function. If the user was using the old commands for anything other than Band Power these aliases will likely not yield compatible results.

For example, some users took advantage of the fact that the Band Pair commands let you arbitrarily set the frequency (time) of a delta marker and its non-fixed reference marker. In these cases, which had nothing to do with band Power, the new commands will not be compatible. For these use cases the user must use two markers and position each using the `:CALC:MARK:X` commands, since “marker pairs” do not exist anymore.

Note that all the alias commands described below cause the specified marker to become selected.

Marker Mode compatibility

To setup Band Power measurements in the ESA and PSA, you had to send the `:CALCulate:MARKer[1]|2|3|4:MODE POSition|DELTa|BAND|SPAN|OFF` command with either the `BAND` or `SPAN` parameter, in order to turn on the marker control modes that let you use a pair of delta markers as Band Power markers. In the X-Series this is no longer necessary, as there are no special marker modes for Band power. So, when this command is sent with either a `BAND` or `SPAN` parameter it is aliased to simply turn on Normal markers. Thus:

Old command	Aliased to
`:CALCulate:MARKer[1]|2|…|4:MODE:BAND`	`:CALCulate:MARKer[1]|2|…|4:MODE:POSition`
`:CALCulate:MARKer[1]|2|…|4:MODE:SPAN`	`:CALCulate:MARKer[1]|2|…|4:MODE:POSition`

Span Pair Compatibility

In the past, the Span Pair function was used with a marker pair to set the band for Band Power. The following SCPI commands were used when performing this setup programmatically:

```
:CALCulate:MARKer[1]|2|…|4:X:CENTer <param>
:CALCulate:MARKer[1]|2|…|4:X:CENTer?
:CALCulate:MARKer[1]|2|…|4:X:SPAN <param>
:CALCulate:MARKer[1]|2|…|4:X:SPAN?
```

These commands are now aliased as follows to preserve the old functionality as much as possible:

Old command	Aliased to
`:CALCulate:MARKer[1]|2|…|4:X:CENTer`	`:CALCulate:MARKer[1]|2|…|4:X`
`:CALCulate:MARKer[1]|2|…|4:X:SPAN`	`:CALCulate:MARKer[1]|2|…|4:FUNCtion:BAND:SPAN`

Delta Pair/Band Pair functionality

Another way to set the marker pair for Band Power was with the Delta Pair function (Band Pair in ESA). The following SCPI commands were used when performing this setup programmatically:

```
:CALCulate:MARKer[1]|2|…|4:X:STARt <param>
:CALCulate:MARKer[1]|2|…|4:X:STARt?
:CALCulate:MARKer[1]|2|…|4:X:STOP <param>
:CALCulate:MARKer[1]|2|…|4:X:STOP?
```

These commands are now aliased as follows to preserve the old functionality as much as possible:

Old command	Aliased to
`:CALCulate:MARKer[1]|2|…|4:X:STARt`	`:CALCulate:MARKer[1]|2|…|4:FUNCtion:BAND:LEFT`
`:CALCulate:MARKer[1]|2|…|4:X:STOP`	`:CALCulate:MARKer[1]|2|…|4:FUNCtion:BAND:RIGHt`

Arbitrary Marker Pair functionality

Another use case was to use the STARt and STOP commands to arbitrarily set the frequency (time) of a delta marker and its reference marker without being in Band Power mode. This use case is not supported with a backwards compatibility command, but since in the X-Series you can arbitrarily set any marker's value and any reference marker's value, it is easy to fix this problem in code; but the user will have to change their code.

Old command	User must change to
`:CALCulate:MARKer1:X:STARt <param>`	`:CALCulate:MARKer1:X <param>`
`:CALCulate:MARKer1:X:STOP <param>`	`:CALCulate:MARKer2:X <param>`

(in the example marker 1 and marker 2 are used; in practice, use the reference marker number for the STOP marker number, which is usually marker number+1)

Band changes with instrument settings

In the past, when a marker pair was used to set the width of the band for Band Power, the markers held their screen positions when instrument frequency settings such as Span changed. The result of this was that as the Span changed, the frequency difference and hence the width of the band changed as well. In the X-Series, as a result of the change from position markers to value markers, the width of the band remains constant as frequency settings of the instrument change.

Offscreen Markers

As a result of the change from position markers to value markers, markers can be at a frequency which is offscreen, whereas in the past, they were clipped to the screen edges and hence were never offscreen. Users who depended on this clipping behavior by setting Band Span to a high value in order to force Band Power markers to the left and right edges of the screen will have to rewrite their code.

Furthermore, since markers could never be offscreen, Band Power always returned a valid result. In the X-Series, if either edge of the Band is offscreen, Band Power returns not a number as a result.

Direct Marker Positioning

The following commands were used in ESA and PSA to directly set the marker to a specific trace point ("bucket") position when they were being used in Span Pair and Delta Pair/Band Pair modes:

```
:CALCulate:MARKer[1]|2|…|4:X:POSition:CENTer <param>
:CALCulate:MARKer[1]|2|…|4:X:POSition:CENTer?
```

```
:CALCulate:MARKer[1]|2|…|4:X:POSition:SPAN <param>
:CALCulate:MARKer[1]|2|…|4:X:POSition:SPAN?
:CALCulate:MARKer[1]|2|…|4:X:POSition:STARt <param>
:CALCulate:MARKer[1]|2|…|4:X:POSition:STARt?
:CALCulate:MARKer[1]|2|…|4:X:POSition:STOP <param>
:CALCulate:MARKer[1]|2|…|4:X:POSition:STOP?
```

They are aliased very similarly to the non-position commands (above) however a translation to/from trace points (buckets) is also performed:

Old command	Aliased to
:CALCulate:MARKer[1]|2|…|4:X:POSition:CENTer	:CALCulate:MARKer[1]|2|…|4:X:POSition
:CALCulate:MARKer[1]|2|…|4:X:POSition:SPAN	:CALCulate:MARKer[1]|2|…|4:FUNC:BAND:SPAN
:CALCulate:MARKer[1]|2|…|4:X:POSition:STARt	:CALCulate:MARKer[1]|2|…|4:FUNC:BAND:LEFT
:CALCulate:MARKer[1]|2|…|4:X:POSition:STOP	:CALCulate:MARKer[1]|2|…|4:FUNC:BAND:RIGHt

In each case but the first (`:X:POSition:CENTer`),the instrument first converts the specified value in trace points to the current X Axis Scale Units (for example, frequency or time) of the trace upon which the marker resides. Then, that value is used in the alias command to set the desired value.

The query form of the command returns the marker function span in trace points (buckets) by translating back based on the X Axis Scale settings at the time the query is sent.

NOTE The value in Trace Points is translated into the current X Axis Scale units for the purpose of setting the value of the marker. However, the marker's span value, `LEFT` value, or `RIGHt` value in X Axis Scale Units, *not* trace points, is preserved if a change is made to the X Axis scale settings. For example, if you use this command to set a marker function span of 500 buckets, which happens at that time to correspond to 13 GHz, and then you change the instrument's **Start Freq** so that 500 buckets is no longer 13 GHz, the span will stay at 13 GHz, *not* at 500 buckets! This is important to realize as it differs from the legacy behavior.

NOTE The `UP/DOWN` parameters will increment/decrement by one bucket. For this the instrument performs a conversion to buckets and back.

Band Span

Sets the width of the span for the selected marker. The “Band Span” control name is used for all measurements that make frequency domain measurements (even if they have a time-domain mode, such as **Zero Span**). For measurements that have no Frequency Domain measurement mode, such as the Waveform measurement, this function is called “Interval Span”.

Remote Command	`:CALCulate:MARKer[1]|2|…|12:FUNCtion:BAND:SPAN <freq>` `:CALCulate:MARKer[1]|2|…|12:FUNCtion:BAND:SPAN?`

Example	Set the band span of marker 12 to 20 MHz:
	`:CALC:MARK12:FUNC:BAND:SPAN 20 MHz`
	Query the band span of Marker 1:
	`:CALC:MARK:FUNC:BAND:SPAN?`

Notes	Units are those of the trace’s domain, Hz for frequency domain, s for time domain The zero-width case and the case of a width less than .499 buckets are treated as one bucket wide Sending this command selects the subopcoded marker The unit of the parameter must match the current domain of the trace the selected marker is on, or an invalid suffix error is generated. If no unit is sent the fundamental unit for the trace domain is used (Hz for freq domain traces, s for time domain traces) Note that all the values provided in this table are only valid for frequency domain traces. If the current domain of the trace is time domain, values and unit are different. In frequency domain, the Preset value is dependent on the frequency range of the instrument. The default value 1.3245 GHz is appropriate only if the instrument is a 26.5 GHz instrument (Option 526). In a 26.5 GHz Instrument, the default span is 26.49 GHz, so 5% of the span corresponds to 1.3245 GHz
Couplings	When you choose any Band Function and **Band Span Auto/Man** is in the **Auto** state, the **Band Span** is set to 5% of the screen width Adjusting the Band Span sets **Band Span Auto/Man** to Man While in **Marker Noise** and with **Band Span Auto/Man** in the **Auto** state, if the instrument Span is changed **Band Span** will stay at 5% of the new span Changing the Band Span necessarily changes the Band Left and Band Right values Band Span is set to 0 when the marker is turned off
Preset	If 0, set to 5% of span, when a marker function is turned on Swept SA, Log Plot Depends on X axis range of selected Trace Monitor Spectrum
State Saved	Saved in instrument state
Min	0 Hz
Max	Infinity. Unlike legacy instruments, where the markers were forced to be on screen, X-Series marker values are not limited and do not clip
Backwards Compatibility SCPI	`:CALCulate:MARKer[1]|2|…|4:X:SPAN`

Backwards Compatibility Command

Preset	50
Backwards Compatibility SCPI	`:CALCulate:MARKer[1]|2|…|4:X:POSition:SPAN <param>` `:CALCulate:MARKer[1]|2|…|4:X:POSition:SPAN?`

Backwards Compatibility Notes	The old command,
	`:CALCulate:MARKer[n]:X:POSition:SPAN <param>`
	was used to set the span between a delta marker and its reference marker in trace points (buckets) in Span Pair mode. There is no new command for setting the span of a Band Function in trace points. So, when this command is received, the instrument first converts the specified span in trace points to the current X Axis Scale Units (for example, frequency or time) of the trace upon which the marker resides. Then, that value is sent to the
	`:CALC:MARKer[n]:FUNCtion:BAND:SPAN <param>`
	command to set the span of the marker's Band Function
	The query form of the command will return the marker function span in trace points (buckets) by translating back based on the X Axis Scale settings at the time the query is sent
	See "Band Function Backwards Compatibility" on page 343 for more information

Band Left

Sets the left edge frequency or time for the band of the selected marker. The right edge is unaffected.

Remote Command	`:CALCulate:MARKer[1]|2|…|12:FUNCtion:BAND:LEFT <freq>` `:CALCulate:MARKer[1]|2|…|12:FUNCtion:BAND:LEFT?`

Example	`:CALC:MARK12:FUNC:BAND:LEFT 20 GHz`
	sets the left edge of the band span of marker 12 to 20 GHz
	`:CALC:MARK:FUNC:BAND:LEFT?`
	queries the band span of Marker 1

Notes	Units are those of the trace's domain, Hz for frequency domain, s for time domain. When the left edge is moved, the right edge stays anchored; thus, the marker's frequency will change Excess Active Function resolution may require up to 15 digits to allow sub-bucket resolution in narrow spans with many points. Our calculations indicate 15 digits plus decimal point may be required. This will not fit on the control; so the control value can only display to 12 digits, but the value in the active function area should display to the full sub-bucket resolution Sending this command selects the subopcoded marker The unit of the parameter must match the current domain of the trace the selected marker is on, or an invalid suffix error is generated.If no unit is sent, the fundamental unit for the trace domain is used (Hz for freq domain traces, s for time domain traces) Note that all the values provided in this table are only valid for frequency domain traces. If the current domain of the trace is time domain, values and unit are different. In frequency domain, the Preset value is dependent on the frequency range of the instrument. The default value 1.3245 GHz is appropriate

	only if the instrument is a 26.5 GHz instrument (Option 526). In a 26.5 GHz Instrument, the default span is 26.49 GHz, so 5% of the span corresponds to 1.3245 GHz
Couplings	Changing **Band Left** necessarily changes **Band Span** and **Band Center** **Band Span** is set to 0 when the marker is turned off, which means **Band Left** is set to the center value at this time **Band Span** is set to 5% of span when any marker function is turned on if and only if it is zero at that time
Preset	If 0, **Band Span** is set to 5% of span, when a marker function is turned on, which affects **Band Left**
State Saved	Saved in instrument state
Min	0 Hz
Max	Infinity. Unlike legacy instruments, where the markers were forced to be on screen, X-Series marker values are not limited and do not clip

Backwards Compatibility Command

Preset	0
Backwards Compatibility SCPI	`:CALCulate:MARKer[1]|2|…|4:X:POSition:STARt <integer>` `:CALCulate:MARKer[1]|2|…|4:X:POSition:STARt?`

Backwards Compatibility Notes	The legacy command,
	`:CALCulate:MARKer[n]:X:POSition:STARt <param>`
	was used to control the Reference marker in trace points (buckets) in Band Pair/Delta Pair mode. There is no new command for setting the start of a Band Function in trace points. So, when this command is received, the instrument first converts the specified span in trace points to the current X Axis Scale Units (for example, frequency or time) of the trace upon which the marker resides. Then, that value is sent to the
	`:CALC:MARKer[n]:FUNCtion:BAND:LEFT <param>`
	command to set the start of the marker’s Band Function
	The query form of the command will return the marker function LEFT value in trace points (buckets) by translating back based on the current X Axis Scale settings at the time the query is sent
	See "Band Function Backwards Compatibility" on page 343 for more information

Band Right

Sets the right edge frequency or time for the band of the selected marker. The left edge is unaffected

Remote Command	`:CALCulate:MARKer[1]|2|…|12:FUNCtion:BAND:RIGHt <freq>` `:CALCulate:MARKer[1]|2|…|12:FUNCtion:BAND:RIGHt?`

Example	Set the right edge of the band span of marker 12 to 20 GHz:
	`:CALC:MARK12:FUNC:BAND:RIGHt 20 GHz`
	Query the band span of Marker 1:
	`:CALC:MARK:FUNC:BAND:RIGHt?`

Notes	Units are those of the trace's domain, Hz for frequency domain, s for time domain. When the right edge is moved, the left edge stays anchored; thus, the marker's frequency will change Excess Active Function resolution may require up to 15 digits to allow sub-bucket resolution in narrow spans with many points. Our calculations indicate 15 digits plus decimal point may be required. This will not fit on the control; so, the control value can only display to 12 digits, but the value in the active function area should display to the full sub-bucket resolution Sending this command selects the subopcoded marker The unit of the parameter must match the current domain of the trace the selected marker is on, or an invalid suffix error is generated. If no unit is sent, the fundamental unit for the trace domain is used (Hz for freq domain traces, s for time domain traces) Note that all the values provided in this table are only valid for frequency domain traces. If the current domain of the trace is time domain, values and unit are different. In frequency domain, the Preset value is dependent on the frequency range of the instrument. The default value 1.3245 GHz is appropriate only if the instrument is a 26.5 GHz instrument (Option 526). In a 26.5 GHz Instrument, the default span is 26.49 GHz, so 5% of the span corresponds to 1.3245 GHz
Couplings	Changing **Band Right** necessarily changes **Band Span** and **Band Center** **Band Span** is set to 0 when the marker is turned off, which means **Band Right** is set to the center value at this time **Band Span** is set to 5% of span when any marker function is turned on if and only if it is zero at that time
Preset	If 0, **Band Span** is set to 5% of span, when a marker function is turned on, which affects **Band Right**
State Saved	Saved in instrument state
Min	0 Hz
Max	Infinity. Unlike legacy instruments, where the markers were forced to be on screen, X-Series marker values are not limited and do not clip

Backwards Compatibility Command

Preset	1000, the actual value is dependent on the selected number of sweep points
Backwards Compatibility SCPI	`:CALCulate:MARKer[1]|2|…|4:X:POSition:STOP <integer>` `:CALCulate:MARKer[1]|2|…|4:X:POSition:STOP?`

Backwards Compatibility Notes	The legacy command,
	`:CALCulate:MARKer[n]:X:POSition:STOP <param>`
	was used to control the Delta marker in trace points (buckets) in Band Pair/Delta Pair mode. There is no new command for setting the stop of a Band Function in trace points, so, when this command is received, the instrument first converts the specified span in trace points to the current X Axis Scale Units (for example, frequency or time) of the trace upon which the marker resides. Then, that value is sent to the
	`:CALC:MARKer[n]:FUNCtion:BAND:RIGHt <param>`
	command to set the stop of the marker's Band Function
	The query returns the marker function `RIGHt` value in trace points (buckets) by translating back based on the current X-Axis Scale settings at the time the query is sent
	See "Band Function Backwards Compatibility" on page 343 for more information

Band Span Auto/Man

Determines whether the Band Span for Marker Noise will track the instrument's Span.

When you choose any Band Function, and **Band Span Auto/Man** is in the **Auto** state, the **Band Span** is set to 5% of the screen width.

Adjusting the Band Span sets **Band Span Auto/Man** to **Man**.

This function only affects **Marker Noise**. While in **Marker Noise** and with **Band Span Auto/Man** in the **Auto** state, if the instrument **Span** is changed **Band Span** will stay at 5% of the new span.

If **Band Span Auto/Man** is in the **Man** state, the **Band Span** does not change when **Span** is changed. Also, if any Band Function but **Marker Noise** is in effect, the **Band Span** does not change when **Span** is changed.

The **Band Span** is set to 5% regardless of whether or not this would place part of the Band offscreen. The Marker Noise function is well able to function with part of the band offscreen.

Note that, if in **Zero Span**, "Span" should be replaced by "Sweep Time" in the discussion above.

Remote Command	`:CALCulate:MARKer[1]|2|…|12:FUNCtion:BAND:SPAN:AUTO ON | OFF` `:CALCulate:MARKer[1]|2|…|12:FUNCtion:BAND:SPAN:AUTO?`

Example	Set the band span of marker 12 to Auto:
	`:CALC:MARK12:FUNC:BAND:SPAN:AUTO ON`
	Query the auto band span state of Marker 1:
	`:CALC:MARK:FUNC:BAND:SPAN:AUTO?`

Dependencies	Only appears when the Marker Function for the selected marker is Marker Noise
Couplings	When **AutoBand Span** is turned ON, it immediately adjusts the band span to 5% of **Span**. If you select Marker Noise, and **AutoBand Span** is ON, the Band Span will immediately change to 5% of **Span** If **Band Span** is changed, either by the **Band Span** key, the **Band Left** key, or the **Band Righ**t key, or the equivalent commands, this function is set to **Man** This function is set to **Auto** when the Marker is turned **Off**, or by Preset, or by "Auto Couple" on page 1995 Sending this command selects the subopcoded marker
Preset	Auto
State Saved	Saved in instrument state
Backwards Compatibility Notes	In legacy instruments, the Noise Marker had a width that was always equal to 5% of the span. But in the X-Series it is possible for the user to change the span of the Marker Noise band using the Band Adjust function. To preserve the legacy behavior, the Band Span Auto/Man function is provided. When it is in Auto, which it is by default, the Maker Noise band is always held at 5% of Span, even if the Span

changes. When the user adjusts the Marker Noise Band Span, Band Span Auto/Man is set to Manual. So, the legacy behavior is preserved, but now you can set the Marker Noise Span as well, and that setting is preserved when Span is changed

N dB Points

Turns N dB points on or off, and allows you to set the N dB value. N dB uses the selected marker. If the selected marker is not on when N dB is turned on, the selected marker turns on, as a **Normal** marker, at center screen, and is used by N dB.

See:

– "N dB Points Results Queries" on page 354

– "More Information" on page 356

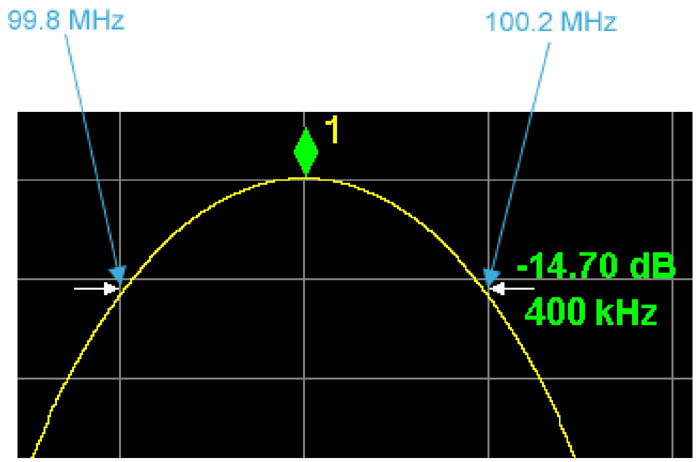
Remote Command	`:CALCulate:BWIDth|BANDwidth:NDB <rel_ampl>` `:CALCulate:BWIDth|BANDwidth:NDB?`
Notes	If the selected marker is turned **Off**, turns off N dB Points N DB Points is unaffected by "Auto Couple" on page 1995
Preset	–3.01dB Off, –3.01 dB
State Saved	The on/off status and the offset value are both saved in instrument state
Min	–140 dB
Max	–0.01 dB

Auto Function

Remote Command	`:CALCulate:BWIDth|BANDwidth[:STATe] OFF | ON | 0 | 1` `:CALCulate:BWIDth|BANDwidth[:STATe]?`
Preset	`OFF`

N dB Points Results Queries

You can query the width of the N dB band as well as the right and left edges of the band. For example, for the signal shown below, the marker is at 100 MHz and each graticule division represents 200 kHz. The N dB value is -14.7 dB, and this makes the width of the N dB band 400 kHz. The frequencies at the left and right edge of the N dB band are as shown, 99.8 MHz and 100.2 MHz:



The following queries return the following values:

`:CALC:BAND:RES? 400 kHz`

`:CALC:BAND:RLEF? 99.8 MHz`

`:CALC:BAND:RRIG? 100.2 MHz`

Remote Command	`:CALCulate:BWIDth|BANDwidth:RESult?`

Example	Set selected marker to 1:
	`:CALC:MARK:AOFF`
	Put marker 1 on peak:
	`:CALC:MARK:MAX`
	Turn on N dB for the selected marker (1):
	`:CALC:BWID ON`
	Set the offset to -3.01 dB:
	`:CALC:BWID:NDB-3.01`
	Query the result:
	`:CALC:BWID:RES?`

Notes	–100 returned if invalid reading

Remote Command	`:CALCulate:BWIDth|BANDwidth:RLEFt?`
Example	Return the leftmost X Axis value for the N dB band: `:CALC:BWID:RLEF?`
Notes	–100 returned if invalid reading

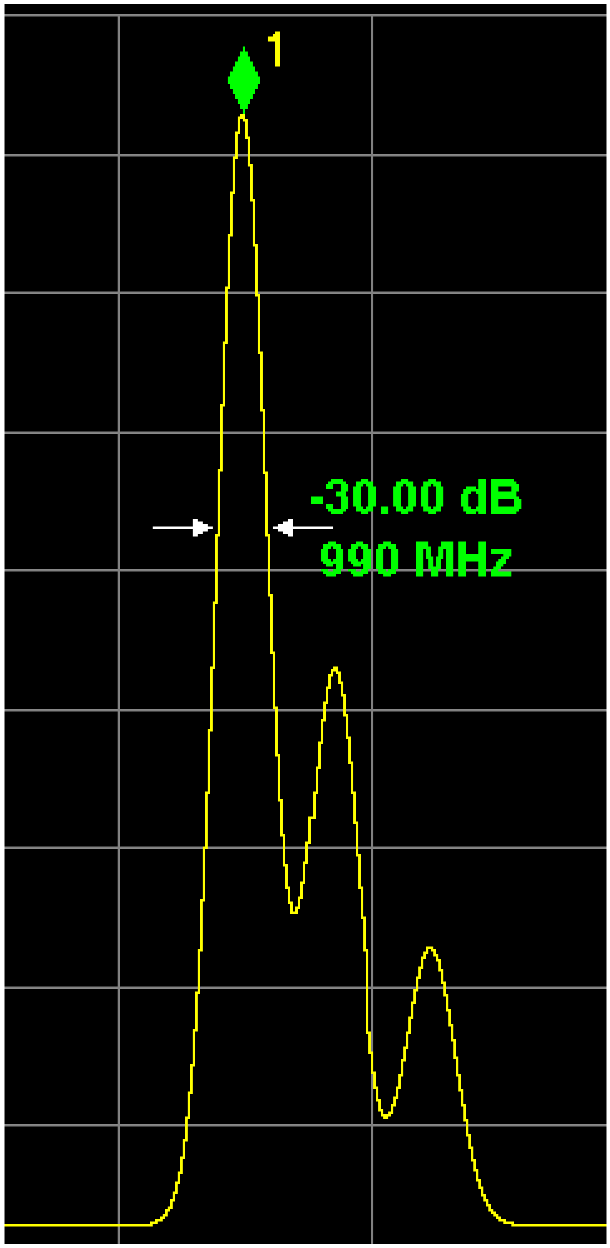
Remote	`:CALCulate:BWIDth|BANDwidth:RRIGht?`

Command	
Example	Return the rightmost X Axis value for the N dB band: `:CALC:BWID:RRIG?`
Notes	–100 returned if invalid reading

More Information

A marker should be placed on the peak of interest before turning on N dB points. The N dB points function looks for the two points on the marker's trace closest to the marker's X Axis value that are N dB below the marker's amplitude, one above and the other below the marker's X Axis value. (That is, one point is to the right, and one is to the left of the selected marker.) The selected N dB value is called the offset. The function reports the frequency difference (for frequency domain traces) or time difference (for time domain traces) between those two points.

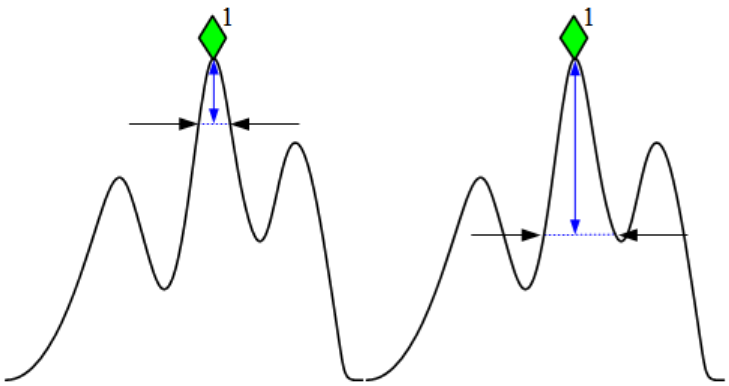
Each point is identified by a horizontal arrow pointing towards the marker, next to the trace. The arrows used by the N dB Points function is as shown in the figure below (where each square represents one pixel). They point in, horizontally, at the trace below a peak, on either side of its skirts.

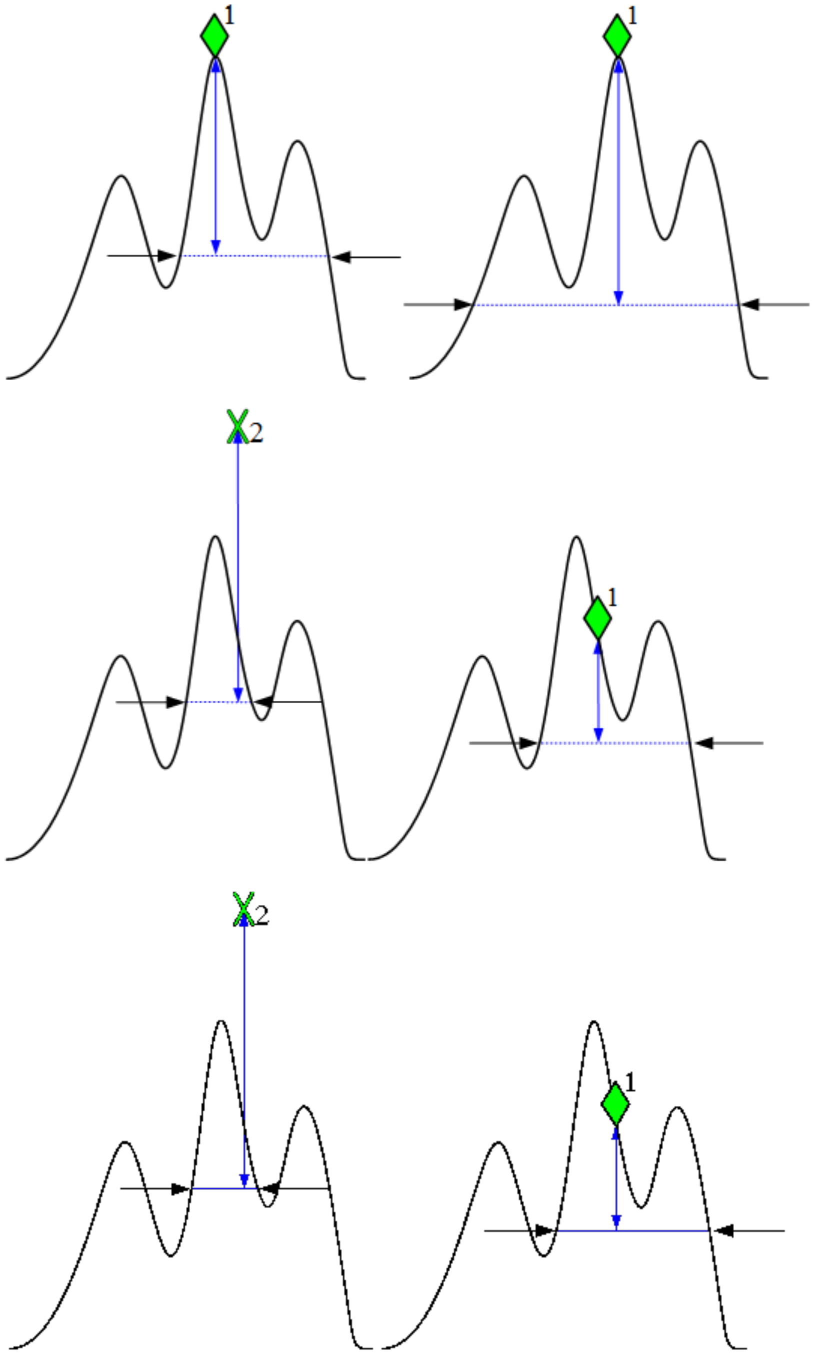


N dB Points can be used to measure the bandwidth of a signal; it is commonly used in conjunction with a tracking generator to measure filter bandwidths.

In one of the common use cases, the marker is placed on a peak, and the arrows are displayed N dB down the skirt from the marker on either side of the peak. The N dB value and the frequency difference between the two arrows is displayed around the arrow as shown in the figure above. Normally this displays on the right arrow, but if this would place any part of the text offscreen to the right then it displays on the left arrow. If the instrument is unable to find data that is N dB below the marker on either side of the marker, the arrows are displayed at the indicator point of the marker, no value (---) is displayed as the result and –100 Hz returned remotely (see figure below):

Some sample N dB scenarios are shown below to illustrate how the function works in various cases. In each case, the two-headed blue arrow represents N dB of amplitude.




1
1
2
1
2
1

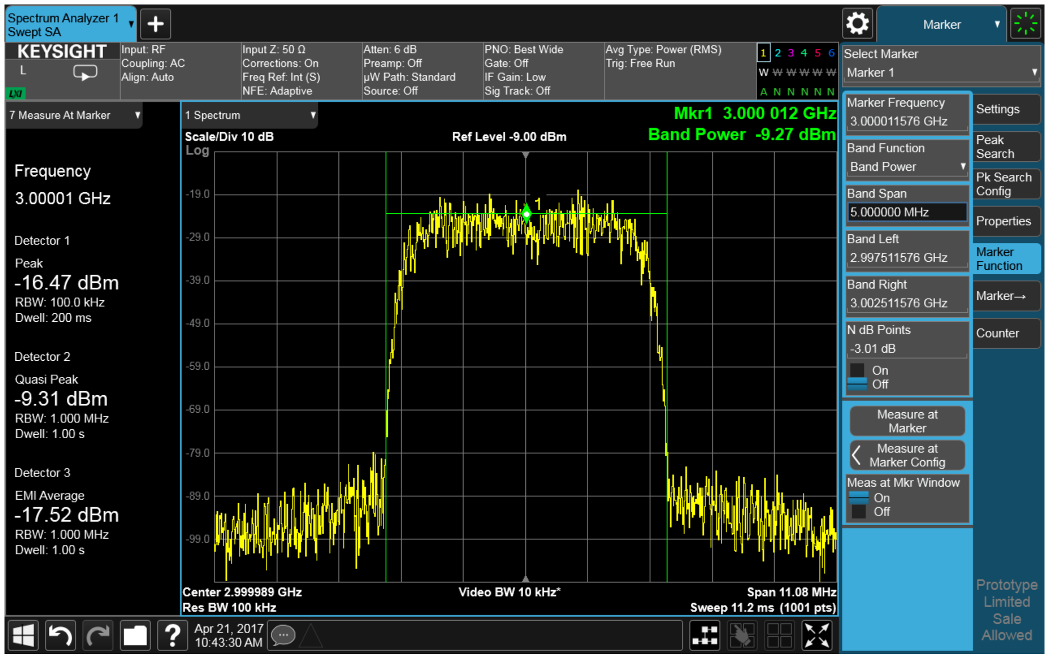
Measure at Marker

When this control is pressed, the instrument executes one **Measure at Marker** function and then returns. **Measure at Marker** goes to the frequency of the selected marker and takes a reading with each of the three detectors selected in the Detectors menu, using the dwell times specified there, then displays the readings in a window on the display, using the current Y-Axis Unit.

When the **Measure at Marker** is complete, the instrument restores all settings to their pre-**Measure-at-Marker** values and normal sweeps resume.

Remote Command	`:CALCulate:MARKer[1]|2|…|12:FUNCtion:MAMarker?`
Example	Perform a **Measure at Marker** function at Marker 2's current frequency and, when completed, return the results of the measure at marker window: `:CALC:MARK2:FUNC:MAM?`
Notes	Returns comma-separated values for the 3 specified detectors and the frequency value of the marker If a Detector is off, or if no measurement has yet completed, –999.0 is returned. This can happen, for example, if you are operating with too large a value of (span/sweep points) and the **Measure at Marker** function does not execute but instead displays the advisory message, "Span per point too large, narrow span or increase RBW or number of points" (see below) The size of the return data array is fixed at 4. The elements are: 1. Detector 1 value (if off, –999.0 for backwards compatibility) 2. Detector 2 value (if off, –999.0 for backwards compatibility) 3. Detector 3 value (if off, –999.0 for backwards compatibility) 4. Frequency of Marker If a sweep is in process when this function executes it aborts, and restarts after the function is complete
Dependencies	Only appears in the N/W6141A application or when Option EMC is installed and licensed If **BW & Avg Type** is in an Autocoupled state, the (up to three) measurements taken by **Measure at Marker** are taken with Auto Coupled settings for the functions in the **BW** menu, even if those functions are in manual
Couplings	If the specified Marker is not on, the instrument turns it on at the center of the screen and does a peak search before performing the function
Annunciation	In the status line messages indicate the progress of the function
Annotation	In the Measure at Marker Window
Status Bits/OPC dependencies	OPC goes true when the measurement is complete
Backwards Compatibility SCPI	`:MEASure:EMI:MARKer[1]|2|…|12?`
Backwards Compatibility Notes	Included for compatibility with the E7400 and PSA option 239. Performs a **Measure at Marker** function at the specified marker's current frequency and returns the results

Measure at Marker displays its information in a separate window that normally appears to the left of the measurement window.



The **Measure at Marker** box shows the detector name for the selected detectors and **Off** for those not selected. The marker frequency is shown in the **Frequency** field. The measured value is shown for all detectors except those that are "Off." For these, --- is displayed. The current Y-Axis unit is used, and the precision that is used for the detector value displays is exactly the same as for the Marker. The precision used for the Frequency display is six significant digits.

The sequence of steps in the measurement is as follows:

- Any sweep in progress is aborted
- If in **Zero Span**, the Center Frequency is used as the frequency at which to take the reading, since, in **Zero Span**, all markers are by definition at the Center Frequency
- If not in **Zero Span**:
- If the selected marker is **Off**, it is first turned on in the center of the screen and a peak search performed
- If the selected marker is on, but offscreen, it is first moved to the center of the screen and a peak search performed
- A frequency "zoom" function is performed to determine the frequency of the selected marker to the required precision. If you are operating with too large a

value of (span/sweep points) then the Measure at Marker window will not display, but instead an advisory message, “Span per point too large, narrow span or increase RBW or number of points”.This means you have chosen a combination of RBW, span and sweep points that makes each trace point much wider than the RBW, so that the trace point in which the signal appears is an inadequately precise measure of its frequency—for example, with a 30 MHz to 1000 MHz span, 601 trace points and 120 kHz RBW, each trace point is 13 times as wide as the RBW. In this case, a SCPI query of the results will yield –999 dBm for each detector

- If the zoom is successful, the instrument goes to zero span at this frequency.
- Each detector is then read in successive single-point zero span sweeps, using a sweep time equal to the specified dwell time. The value displayed by Measure at Marker represents the maximum value output by the detector during the dwell timeAutocoupled bandwidth and average type settings are used for each detector unless the **BW & Avg Type** control is set to **As Set**, in which case the current bandwidth and average type settings are used.
- Each result is then displayed in the measure at marker window as it becomes available
- The instrument returns to its pre-Measure at Marker span and settings after executing a Measure at Marker function, including Bandwidth, Avg Type, and EMC Std - regardless of the setting of **BW & Avg Type**
- Finally, if the sweep had to be aborted, the aborted sweep is restarted

Zooming

We want to make the "measure at marker" measurements with zero span data acquisition that is sometimes "zoomed." In this case, the definition of "zoomed" is "at a frequency within +/–0.5 bucket of the marker frequency, selected to optimize accuracy, based on the trace on which the marker is placed."

This definition of zoom is different from that used in counter zooming and preselector centering zooming and tune-and-listen zooming, all of which assume a reasonably stationary signal. With a stationary signal, zooming via repeatedly narrowing data acquisitions to find the signal with subbucket resolution is feasible; with EMC measurements, many signals (for example pulsed RF) are not stationary or not constant. Furthermore, the reason for zooming in EMC is because the user’s setup often represents a combination of RBW, span and sweep points that makes the bucket location of a signal an inadequately precise measure of its frequency (for example, if the user is looking at one or more full CISPR bands). A commonly used workaround for not zooming is to use more display points. However, with measure at marker, the peak detector is not going to do a good job in zero span unless the tuning is within about 5% of an RBW.

Instead, we can choose the frequency for the marker to higher resolution than the bucket resolution by interpolating from the trace data. This technique does not require another “zoom sweep” and thus will not misbehave with nonstationary signals like pulsed RF. Therefore, there should be no need to defeat the zoom function under user control.

In EMC measure-at-marker operations, we assume a CW signal, because fine-tuning the frequency of a CW signal can have a significant effect on accuracy. For other signal statistics, such as noise and pulsed-RF, fine-tuning is neither possible nor required. So, we can assume CW.

This algorithm will address two issues:

1. When to position the zero-span acquisition at a new frequency

2. What that new frequency is

To determine 1) we need to first perform the calculation in 2).

First we specify that the zoom will always be performed with the peak detector. The math is different (simpler but much different) with the sample detector and unreasonably complicated with other detectors, so it is not reasonable to assume anything other than a peak detector. The algorithm can still operate for other detectors, but it is not as accurate for those.

From the marker amplitude and the amplitudes at the adjacent buckets, we can compute the peak frequency for a CW signal. In fact, with the peak detector, we can compute that frequency from the marker bucket and the next lower bucket, and we can semiredundantly compute it symmetrically from the marker bucket and the next higher bucket. If these two agree, it means the signal is CW; if they disagree, it is not. If it is CW, we will change the frequency at which we acquire data for the measure at marker from the frequency of the marker; if the signal is not CW, we will not change the frequency (not zoom).

Step 1. Compute the frequency from the lower pair of buckets. Compute

fLowerCandidate = fCenterOfBucket – 0.5*BucketWidth + RBW3dB*sqrt(deltaA/(3dB))

fLowerCandidate = the estimated CW frequency computed from the lower bucket and marker bucket

fCenterOfBucket = the frequency at the center of the bucket. This is computed from fStart + BucketNumber * Span / (NumBuckets – 1). Of course, this expression in not computable if NumBuckets = 1, which is a nonsensical case, but the instrument should not crash when set up this way. When NumBuckets = 1, use 2 for NumBuckets.

BucketWidth = Span / (NumBuckets – 1)...as above, to protect against the one-bucket case, use 2 for NumBuckets when NumBuckets = 1.

RBW3dB = the 3 dB RBW, which is not normally the annotated RBW for EMC measurements, which are based on the 6 dB RBW.

deltaA = the amplitude at the marker, in dBm, minus the amplitude of the bucket one to the left of the marker, in dBm. Which reminds me...we need to protect against having the marker be the first or last bucket--we can't zoom in these cases.

If the marker is at a peak, as intended, deltaA must be positive. But the algorithm may be run when deltaA is not positive. In this case, we must "intercept" the computation to prevent a mathematics failure wherein the argument of the square root is negative. In this case, we should set fLowerCandidate to CenterOfBucket – 0.5*BucketWidth. This is equivalent to replacing deltaA with max(0,deltaA).

(3dB) is a constant, which reminds us that the units of deltaA are dB.

Step 2. Compute the frequency from the upper pair. Compute

fUpperCandidate = fCenterOfBucket + 0.5*BucketWidth - RBW3dB*sqrt(deltaA/(3dB))

All the terms are the same except:

deltaA = the amplitude at the marker, in dBm, minus the amplitude of the bucket one to the right of the marker, in dBm.

As in step 1:

If the marker is at a peak, as intended, deltaA must be positive. But the algorithm may be run when deltaA is not positive. In this case, we must "intercept" the computation to prevent a mathematics failure wherein the argument of the square root is negative. In this case, we should set fUpperCandidate to fCenterOfBucket + 0.5*BucketWidth. This is equivalent to replacing deltaA with max(0,deltaA)

Step 3. Compare fUpperCandidate with fLowerCandidate. If the absolute value of the difference is less than 0.1*RBW3dB, and deltaA (either one) is positive, then we conclude that the signal is CW and worth fine-tuning. Set the tuning to the mean value, which is (fUpperCandidate + fLowerCandidate)/2. Otherwise, use fMarker for the zero-span acquisition.

Measure at Marker Config

Opens a dialog that allows you to configure the **Measure at Marker** function.

The two most important settings are the detectors and the dwelltime associated with each. Any of the instrument’s detectors (up to three) can be used as the Measure at Marker detectors, or any of the three can be turned off. The dwell time for each detector is also settable.

When performing a Meas at Marker, the dwell time settings that you select will depend on the characteristics of the emission you are measuring. The default dwell time (200 ms) should work well for typical EUT emissions, but sometimes you will encounter emissions for which the defaults are not optimal. This is especially the case for emissions that vary slowly over time or have a slow repetition rate. By lengthening the dwell times, you can increase the likelihood of accurately measuring these low repetition rate signals.

When Measure at Marker is activated, the receiver makes a **Zero Span** measurement for each of the (up to) three detectors selected, using the Dwell Time set for each detector. If the signal's repetition period is greater than 200 ms (the default setting), the dwell time should be increased to capture at least two and preferably more repetitions of the signal. Additionally, if you do not need or do not wish to use a detector to make a measurement, that specific detector may be turned off.

If the **Measure at Marker** window is being displayed, and one of the detectors is changed, any value being displayed for that detector changes to “---“ until the next successful reading from that detector.

Dependencies	This control and the dialog it calls only appear in N6141, or when Option EMC is installed and licensed

Measure at Marker Window On/Off

Turns the **Measure at Marker Window** on or off. Turns `ON` automatically when **Measure at Marker** is initiated and turns `OFF` on Preset. If the Window is turned on without a Measure at Marker result, “---“ is displayed for each result for which the detector is not `OFF`.

Remote Command	`:DISPlay:WINDow:MAMarker[:STATe] ON | OFF | 1 | 0` `:DISPlay:WINDow:MAMarker[:STATe]?`
Example	`:DISP:WIND:MAM ON`
Couplings	The window turns `ON` automatically when **Measure at Marker** is initiated and turns `OFF` on Preset
Preset	`OFF`
State Saved	Saved in instrument state

BW & Avg Type

Controls the type of bandwidth and average type coupling used in **Measure at Marker**.

If set to **Autocoupled**, then the **Res BW** and **Average Type** are selected by the instrument during the **Measure at Marker** function, according to the normal Autocouple rules, regardless of whether **Res BW** and **Average Type** are currently in **Auto**. If set to **As Set**, then the current values for **Res BW** and **Average Type** are used (which could also be **Auto**).

Option	SCPI	Behavior
Autocoupled	`ON`	1. The **EMC Std** changes to CISPR if any of the CISPR detectors

Option	SCPI	Behavior
		(EMI Avg, RMS Avg, QPD) becomes selected; for all other detectors, the value of **EMC Std** that existed before Measure at Marker is used 2. **RBW** autocouples throughout Measure at Marker, even if **RBW** is set to **Manual.** The autocouple rules are based on whatever the instantaneous setting of EMC Std, Span, and Center Freq are
As Set	`OFF`	1. The **EMC Std** never changes; so if it is set to **None** it stays at **None** throughout, even if one of the CISPR detectors is selected 2. If **RBW** is set to **Auto**, then **RBW** autocouples throughout Measure at Marker. The autocouple rules are based on whatever the setting of EMC Std, Span, and Center Freq are 3. If **RBW** is set to **Manual**, the RBW never changes at all throughout Measure at Marker, it stays at the value to which it was set before Measure at Marker began

The instrument returns to its pre-**Measure at Marker** span and settings after executing a **Measure at Marker** function, including Bandwidth, Avg Type, and EMC Std.

It is important to note that, when **Res BW** is coupled to **Frequency**, as it is when **EMC Std** is anything but `NONE`, for all EMI measurements, the frequency it is coupled to for **Measure at Marker** is the *Marker* frequency, *not* the Center Frequency.

Remote Command	`:CALCulate:MAMarker:COUPling ON | OFF | 1 | 0` `:CALCulate:MAMarker:COUPling?`
Example	`:CALC:MAM:COUP ON`
Preset	Autocoupled (`ON`)
State Saved	Saved in instrument state

Center Presel On/Off

Controls the automatic centering of the preselector for the **Measure at Marker** function.

When **Center Presel** is `ON`, the first step in performing the **Measure at Marker** function is to perform a **Presel Center**. This is not performed if the microwave preselector is off, or the selected marker’s frequency is below Band 1. If the function is not performed, no message is generated.

Remote Command	`:CALCulate:MAMarker:PCENter ON | OFF | 1 | 0` `:CALCulate:MAMarker:PCENter?`

Example	:CALC:MAM:PCEN ON
Dependencies	Not shown in models that do not include a preselector, such as Option 503. If the SCPI is sent in these instruments, it is accepted without error, and the query always returns 0
Preset	ON
Backwards Compatibility SCPI	[:SENSe]:EMI:MEASure:PCENter[:STATe] OFF | ON | 0 | 1 [:SENSe]:EMI:MEASure:PCENter[:STATe]?
Backwards Compatibility Notes	Included for compatibility with E7400 and PSA Option 239

Detector 1, 2, 3

Lets you select the detector to be used for Detector 1, 2, or 3, or turn that Detector off. Press the cell containing the value of Detector 1|2|3 to see a dropdown that shows the list of detectors, including **Off**.

Remote Command	:CALCulate:MAMarker:DETector[1]|2|3 OFF | NORMal | AVERage | POSitive | SAMPle | NEGative | QPEak | EAVerage | RAVerage :CALCulate:MAMarker:DETector[1]|2|3?
Example	Set the detector for **Measure at Marker** Detector 1 to OFF: :CALC:MAM:DET OFF Set the detector for **Measure at Marker** Detector 2 to Quasi peak: :CALC:MAM:DET2 QPE
Preset	Detector 1, Peak Detector 2, Quasi Peak Detector 3, EMI Average
State Saved	Saved in instrument state

Detector 1, 2, 3 Dwell Time

Lets you select the dwell time (essentially, the measurement time) to be used while taking the measurement for Detector 1, 2 or 3. Press the cell containing the dwell time value of Detector 1|2|3 to enter the desired value for that Detector.

The minimum allowed dwell time is based on the current detector. If "**Off**" is selected for detector 1|2|3, this control is grayed-out and shows 200 ms.

Remote Command	:CALCulate:MAMarker:DETector[1]|2|3:DWELl <dwell time> :CALCulate:MAMarker:DETector[1]|2|3:DWELl?
Example	Set the detector for **Measure at Marker** Detector 1 to dwell for 500 ms: :CALC:MAM:DET:DWEL 500 ms

	Set the dwell time for Detector 3 to 400 ms: `:CALC:MAM:DET3:DWEL 400 ms`
Preset	200 ms
State Saved	Saved in instrument state
Min	1 ms
Max	60 s
Backwards Compatibility SCPI	`[:SENSe]:EMI:MEASure:DETector:DWELl <dwell time>`
Backwards Compatibility Notes	Included for compatibility with E7400 and PSA option 239. Sets all the detectors' dwell times to the specified amount

3.2.7.7 Marker To

The controls on this tab let you copy the current marker value into other instrument parameters (for example, **Center Frequency**). The currently selected marker is made the active function on entry to this menu (if the currently selected marker is not on when you press this front panel key, it is turned on at the center of the screen as a **Normal** marker, then made the active function).

The **Marker ->** (or **Marker To**) feature is used to quickly assign a marker's x- or y-axis value to another parameter. For example, if a marker's x-axis value is 500 MHz and y-axis value is –20 dBm, pressing **Mkr -> CF** assigns 500 MHz to **Center Frequency**, and pressing **Mkr - >Ref Lvl** assigns –20 dBm to **Ref Level**.

All **Marker To** functions executed from the front panel use the *selected* marker's values, while all **Marker To** remote commands specify in the command which marker's value to use.

Marker Frequency | Time

This is the fundamental control that you use to move a marker around on the trace. It is the same as "Marker Frequency | Time" on page 307 on the **Settings** tab.

Mkr->CF

Sets the instrument **Center Frequency** to the frequency of the selected marker. The marker stays at this frequency, so it moves to the center of the display. In delta marker mode, this function sets the center frequency to the x-axis value of the delta marker. When the frequency scale is in `LOG` mode, the center frequency is not at the center of the display.

If the currently selected marker is not on when this control is pressed, it is turned on at the center of the screen as a **Normal** marker.

Remote Command	`:CALCulate:MARKer[1]|2|…|12[:SET]:CENTer`
Example	Set the **Center Frequency** of the instrument to the value of Marker 2: `:CALC:MARK2:CENT`
Notes	Sending this command selects the subopcoded marker If specified marker is **Off**, this command will turn it on at the center of the screen as a **Normal** marker
Dependencies	Not available (control is grayed-out) when x-axis is the time domain
Couplings	All the usual couplings associated with setting **Center Frequency** apply

Mkr->CF Step

Sets the instrument Center Frequency (CF) Step size to the marker frequency, or in a **Delta** marker mode, to the frequency difference between the delta and reference markers.

If the currently selected marker is not on when this control is pressed, it is turned on at the center of the screen as a **Normal** marker.

Remote Command	`:CALCulate:MARKer[1]|2|…|12[:SET]:STEP`
Example	Set **CF Step** to the value (or delta value) of marker 1: `:CALC:MARK1:STEP`
Notes	Sending this command selects the subopcoded marker If specified marker is **Off**, this command turns it on at the center of the screen as a **Normal** marker
Dependencies	Not available (control is grayed-out) when x-axis is the time domain
Couplings	All the usual couplings associated with setting **CF Step** apply

Mkr->Start

Changes **Start Freq** to the frequency of the selected marker. The marker stays at this frequency, so it moves to the left edge of the display. In **Delta** marker mode, this function sets the start frequency to the x-axis value of the **Delta** marker.

If the currently selected marker is not on when this control is pressed, it is turned on at the center of the screen as a **Normal** marker.

Remote Command	`:CALCulate:MARKer[1]|2|…|12[:SET]:STARt`
Example	Set the start frequency to the value (or delta value) of Marker 1: `:CALC:MARK1:STAR`
Notes	Sending this command selects the subopcoded marker If specified marker is **Off**, this command turns it on at the center of the screen as a **Normal** marker

Dependencies	Not available (control is grayed-out) when x-axis is the time domain
Couplings	All the usual couplings associated with setting **Start Freq** apply

Mkr->Stop

Changes **Stop Freq** to the frequency of the selected marker. The marker stays at this frequency, so it moves to the right edge of the display. In **Delta** marker mode, this function sets the stop frequency to the x-axis value of the **Delta** marker.

If the currently selected marker is not on when this control is pressed, it is turned on at the center of the screen as a **Normal** marker.

Remote Command	`:CALCulate:MARKer[1]|2|…|12[:SET]:STOP`
Example	Set the stop frequency to the value (or delta value) of Marker 3: `:CALC:MARK3:STOP`
Notes	Sending this command selects the subopcoded marker If specified marker is **Off**, this command turns it on at the center of the screen as a **Normal** marker
Dependencies	Not available (control is grayed-out) when x-axis is the time domain
Couplings	All the usual couplings associated with setting **Stop Freq** apply

Mkr->Ref Lvl

Sets **Reference Level** to the amplitude value of the selected marker, moving the marked point to the reference level (top line of the graticule). The marker's mode (**Normal**, **Delta**, **Fixed**) does not matter in this case. For example, given a **Delta** marker, if the **Delta** marker is the selected marker, its amplitude is applied to the reference level. If the reference marker is selected, its amplitude is applied to the reference level.

If the currently selected marker is not on when this control is pressed, it is turned on at the center of the screen as a **Normal** marker, and its amplitude applied to the reference level.

Remote Command	`:CALCulate:MARKer[1]|2|…|12[:SET]:RLEVel`
Example	Set **Reference Level** of the instrument to the amplitude of Marker 2: `:CALC:MARK2:RLEV`
Notes	Sending this command selects the subopcoded marker If specified marker is **Off**, this command turns it on at the center of the screen as a **Normal** marker
Couplings	All the usual couplings associated with setting **Reference Level** apply
Backwards Compatibility	**Mkr-> Ref Lvl** behavior for a delta marker is slightly different from earlier models. ESA would calculate the delta amplitude (difference between reference marker and delta marker in dB) and assign that value

Notes	to the reference level (in dBm). PSA would just assign the delta marker's amplitude to the reference level, ignoring the reference marker altogether. X-Series products allow you to select either the reference or the delta marker individually. It is the selected marker's amplitude that is applied to **Reference Level**

MkrD->CF

Sets **Center Frequency** to the frequency difference between the selected marker and its reference marker. The marker is then changed to a **Normal** marker and placed at the center of span.

Remote Command	`:CALCulate:MARKer[1]|2|…|12[:SET]:DELTa:CENTer`
Example	Set instrument **Center Frequency** to the value of Marker 2: `:CALC:MARK2:CENT`
Notes	Sending this command selects the subopcoded marker
Dependencies	Only available when the selected marker is a **Delta** marker. Otherwise, the control is grayed-out Not available when x-axis is the time domain

MkrD->Span

Sets **Start Freq** and **Stop Freq** to the values of the **Delta** markers. That is, it moves the lower of the two marker frequencies to the start frequency and the higher of the two marker frequencies to the stop frequency. The marker mode is unchanged, and the two markers (delta and reference) end up on opposite edges of the display.

Remote Command	`:CALCulate:MARKer[1]|2|…|12[:SET]:DELTa:SPAN`
Example	Set **Start Freq** and **Stop Freq** to the values of Marker 2 and its reference marker: `:CALC:MARK2:DELT:SPAN`
Notes	Sending this command selects the subopcoded marker
Dependencies	Only available when the selected marker is a **Delta** marker. Otherwise, the control is grayed-out Not available when x-axis is the time domain
Couplings	All the usual couplings associated with setting **Span** apply (see also **Frequency**)
Backwards Compatibility SCPI	`:CALCulate:MARKer[1]|2|…|12[:SET]:SPAN`
Backwards Compatibility Notes	In earlier ESA and PSA products, **MkrD->Span** would adjust the span and change the **Delta** marker to a **Normal** marker, placing it at the center of screen. In all X-Series products, this is no longer true. The markers remain in **Delta** mode and the delta and reference marker end up on opposite edges of the display

Mkr -> Zoom Center

Only appears in the **Trace Zoom** View.

Moves the zoom region so that it is centered at the selected marker in the top window. **Zoom Span** is not changed, except as necessary to keep the entire Zoom Region between the top window start and stop frequencies. The center frequency of the lower window changes to reflect the new zoom center frequency.

If the marker frequency is entirely outside the current instrument (top window) start and stop frequencies, "Mkr->CF" on page 368 is first performed. (Note that if this **Mkr->CF** causes the Zoom Region to be outside the new start and stop frequencies, the Zoom Region is re-initialized to the new instrument **Center Frequency** with a span of 10% of the instrument **Span**). After the **Mkr->CF** is performed, **Mkr->Zoom Center** is performed.

Remote Command	`:CALCulate:MARKer[1]|2|…|12[:SET]:TZOom:CENTer`
Example	Set Zoom **Center Frequency** to the value of Marker 2: `:CALC:MARK2:TZO:CENT`
Notes	Sending this command selects the subopcoded marker If specified marker is **Off**, this command first turns it on at the center of the screen as a **Normal** marker. Then **Mkr->Zoom Center** is performed
Dependencies	Only appears in the **Trace Zoom** View of the Swept SA measurement. If the command is sent in other Views, generates an error

Mkr -> Zone Center

Only appears in the **Zone Span** View.

Moves the zone so that it is centered at the selected marker in the top window. The zone span is not changed. The center frequency of the lower window changes to reflect the new zone center frequency. The lower window will not be updated until it is made active.

Remote Command	`:CALCulate:MARKer[1]|2|…|12[:SET]:ZSPan:CENTer`
Example	Set Zone **Center Frequency** to the value of Marker 2: `:CALC:MARK2:ZSP:CENT`
Notes	Sending this command selects the subopcoded marker If specified marker is **Off**, this command first turns it on at the center of the screen as a **Normal** marker. Then **Mkr->Zone Center** is performed
Dependencies	Only appears in the **Zone Span** View of the Swept SA measurement. If the command is sent in other Views, gives an error Not available when the bottom window is in **Zero Span**

Move Display Trace -> Marker

Moves the **Display Trace** in the **Waterfall** window to the waterfall trace containing the currently selected marker.

Remote Command	`:CALCulate:MARKer[1]|2|…|12[:SET]:DTRAce`
Example	Move the **Display Trace** to Marker 2's trace in the **Waterfall** window: `:CALC:MARK2:DTRA`
Notes	Sending this command selects the subopcoded marker If the specified marker is **Off**, this command simply turns it on at the center of the screen, on the current **Display Trace** in the **Waterfall** window
Dependencies	Only appears when the **Waterfall** window is visible

Move Marker -> Display Trace

Moves the Marker in the **Waterfall** window to the current **Display Trace**.

Remote Command	`:CALCulate:MARKer[1]|2|…|12[:SET]:MTRAce`
Example	Move Marker 2 to the **Display Trace** in the **Waterfall** window: `:CALC:MARK2:MTRA`
Notes	Sending this command selects the subopcoded marker If the specified marker is **Off**, this command simply turns it on at the center of the screen, on the current **Display Trace** in the **Waterfall** window
Dependencies	Only appears when the **Waterfall** window is visible

3.2.7.8 Counter

Accesses Marker Counter controls. Does not appear in certain instruments, such as VXT.

Marker Count

Turns the marker frequency counter on or off. The selected marker is counted, and if the selected marker is a **Delta** marker and its reference marker is not **Fixed**, the reference marker is counted as well.

See:

– "Understanding the Marker Counter" on page 375

– "Query Count Value (Remote Query Only)" on page 375

Remote Command	`:CALCulate:MARKer[1]|2|…|12:FCOunt[:STATe] OFF | ON | 0 | 1` `:CALCulate:MARKer[1]|2|…|12:FCOunt[:STATe]?`

Example	`:CALC:MARK2:FCO ON`
	selects marker 2, turns it on, and turns on the counter
	`:CALC:MARK2:FCO:X?`

	returns the counted frequency
Notes	**Fixed** markers are not counted, but a **Fixed** marker will have a count stored in it if it is selected or is the reference marker for the selected marker. The count already in the marker is stored when the marker becomes fixed and if there is none or the marker moves (for example, **Peak Search**) it is counted and stored after the next sweep If a **Fixed** marker has a count stored in it, that count is displayed when the marker is selected, and used as the reference count when that marker is a reference marker If a **Fixed** marker has a count stored in it, that count is deleted if the **Marker X** is adjusted If a **Fixed** marker has a count stored in it, and a search function is performed using the **Fixed** marker while the counter is on, the count stored in the marker is updated If a **Fixed** marker has a count stored in it, and is a reference marker, and the reference is moved to a valid trace point by re-zeroing the delta (by pressing **Delta** again or sending the `DELTa` command) while the counter is on, the count stored in the marker is updated This command causes the specified marker to become selected
Dependencies	Marker Count is unavailable (grayed-out and `OFF`) if the **Gate** function is on
Couplings	If the selected marker is `OFF` when the counter is turned on, the selected marker is set to **Normal** and placed at center of screen on the trace determined by the Marker Trace rules If a marker that is `OFF` is selected while the counter is on, the counter remains on, but since the marker is `OFF`, the count is undefined. In this case the instrument returns Not A Number to a SCPI count query The counter is turned `OFF` when the selected marker is turned `OFF`
Preset	`OFF`
State Saved	The state of the counter (on/off) is saved in instrument state. In the case of Fixed markers, the count stored in the marker is saved in instrument state
Annotation	The absolute count is displayed for **Normal** markers. The difference between the count and the reference marker's count is displayed for **Delta** markers. A **Fixed** marker with no saved count, or a non-**Fixed** marker on a trace which is not updating, will show three dashes in the count block (---), and return not a number to a SCPI count query. This is true when the marker is selected or when it is a reference marker, and its Delta marker is selected Note that when the count is undefined, the Count value (result) itself will display as "---" but any text before or after the value is retained. Hence, an undefined count for Marker 1 (for example) would display as "Cnt1 --- Hz" as long as the value is undefined The format of the frequency counter display is: Cnt<n> <value> where n is the marker number, for example Cnt1 25 386 243 226.493 Hz If the marker is a delta marker then a leading delta symbol appears, as: ΔCnt1 –25 386 243 226.493 Hz The resolution of the frequency counter display is set by the following equation: LSDDisplayed = 10 ^ (floor (–4.7 - log (Gate_Time)) with the further restriction that the displayed resolution must always fall in the 1 Hz to .001 Hz range. Thus, for 2 ms (log 2 ms = –2.69897) and longer gate times, the counter resolution is 0.001 Hz The decimal point location is fixed, without trailing zero suppression. It displays in units of Hz. The

	digits to the left of the decimal have leading zero suppression. For understandability, with more than 4 digits to the left of the decimal point, the digits are grouped in threes, from the decimal point left, with spaces between those groups of three. For negative numbers there is no space between the minus and the number Examples: ΔCnt1 –2226.493 Hz ΔCnt1 –22 226.493 Hz
Backwards Compatibility Notes	In some legacy analyzers (for example, 8560 series) the FreqOffset value was applied to the Marker Count. In others (for example, ESA and PSA) it was not. X-Series follows the ESA/PSA model and does *not* apply Freq Offset to the Marker Count In ESA and PSA, the reference marker for **Delta** markers was always counted. In X-Series the marker is counted for **Normal** and **Delta** markers; but for the reference marker, if it is a **Fixed** marker, we use the count stored in the **Fixed** marker. This enhanced capability may require a change to some user code and/or test procedures

Query Count Value (Remote Query Only)

Queries the frequency count. Returns the absolute count, unless the specified marker is in **Delta** mode, in which case it returns the relative count. If the marker is **Off**, or the marker is on, but the counter is off, the instrument returns Not a Number to a SCPI count query. A marker with no stored count, or a non-**Fixed** marker on a stored trace, also returns Not a Number to a SCPI count query. This result may simply mean that the first sweep after the counter turned on has not yet completed.

Remote Command	`:CALCulate:MARKer[1]|2|…|12:FCOunt:X?`
Notes	Does *not* cause the specified marker to become selected

Understanding the Marker Counter

Using the internal counter we can count the frequency of a marker, but we cannot count while we are actually sweeping. So, once we are done with a sweep, we move to the selected marker frequency and count that frequency. Then, if the marker is a **Delta** marker, the count is also taken for its reference marker. The count is actually performed by moving the LO to the frequency (or frequencies in the case of a **Delta** marker) we wish to count. The count is executed on a marker-by-marker basis and no further count is taken until after the next sweep (even if the marker moves before another sweep has completed).

The **Marker Count** is taken by tuning the instrument to the frequency of the marker and counting the IF, with the instrument not sweeping. The count is adjusted for display by adding or subtracting it (as appropriate) from the LO frequency, so that you see a count that represents the signal frequency. This is true even if External

Mixing is ON. Since all this happens between sweeps, you never see the instrument retuning to do the counts.

If you wish to see the entered frequency of a counted marker it will appear in the active function area when that marker is selected (for Fixed markers, you must press **Marker**, **Fixed** to select Fixed markers, then press it a second time to view or adjust the x or y marker values).

Counting Off-screen Markers

If the selected marker is **Off**, the X-axis the instrument can still be tuned to the marker (unless it is outside the current range of the instrument), so the count can still be displayed. This means you can see a count for an off-screen marker, even though there may be no valid Y-value for the marker. If the marker frequency is outside the range of the instrument, the display shows three dashes in the count block (---), and Not a Number is returned to a SCPI count query.

Delta Marker

When a **Delta** Marker is selected while **Marker Count** is ON:

- If the reference marker is not a **Fixed** marker, the display shows the difference between the count of the selected marker and the count of the reference marker
- If the reference marker is a **Fixed** marker and there is a count stored in the marker (because **Marker Count** was ON when the marker became a **Fixed** marker), the display shows the difference between the count at the marker and the count stored in the reference marker

Marker Count works in **Zero Span** as well as in Swept SA. The instrument tunes to the frequency of the selected marker, which, for active zero span traces, is simply the center frequency of the instrument.

Fixed Markers

Fixed markers have a count stored in them that is generally kept fixed and not updated. If a **Fixed** marker is selected, or used as a reference, the signal at the marker frequency is not counted; rather the stored count is seen or used as the reference. The count is stored, if **Count** is ON, when the marker becomes **Fixed** or when, while **Fixed**, the marker is moved by re-zeroing the reference (if it is the reference marker) or via a peak search (since both of these, by definition, use valid trace data). The count stored in a **Fixed** marker is lost if the counter is turned off, if the marker is moved to an inactive trace, or if the marker is moved by adjusting its x-value.

More Information about Counter

When the counter is ON, the count (or the delta count) for the selected marker is displayed.

The invalid data indicator (*) turns on until the completion of the first count.

Marker Count frequency readings are corrected using the **Freq Offset** function (in some previous instruments, they were not). Note, however, that Marker delta readings are not corrected, as any offset would be applied to both.

In **Zero Span**, on active traces, the counter continues to function, counting any signal near the center frequency of the instrument.

NOTE	No signal farther from the marker frequency than the **Res BW** will be seen by the counter.

The above command turns on or off the frequency counter. If the specified marker number in the command is not the selected marker, it becomes the selected marker. If the specified marker number is not on, `:FCOunt ON` sets it to **Normal** and places it at center of screen on the trace determined by the Marker Trace rules. Once the marker count is on, it is on for any selected marker, not just for the one used in the command. The state query returns 1 only if marker count is on and the specified number is the selected marker. The invalid data indicator (*) turns on until the completion of the first count, but this does not prevent a value from being returned.

Counter Gate

Controls the length of time during which the frequency counter measures the signal frequency. Longer gate times allow for greater averaging of signals whose frequency is “noisy”, though the measurement takes longer. If the gate time is an integer multiple of the length of a power-line cycle (20 ms for 50 Hz power, 16.67 ms for 60 Hz power), the counter rejects incidental modulation at the power line rate. The shortest gate time that rejects both 50 and 60 Hz modulation is 100 ms, which is the value chosen in **Auto**, or on **Preset**, or when "Auto Couple" on page 1995 is pressed.

The start time of the Gate Time of the counter must be controlled by the same trigger parameters as controls the sweep. Thus, if **Trigger** is not **Free Run**, the counter gate must not start until after the trigger is received and delayed.

Remote Command	`:CALCulate:MARKer[1]|2|…|12:FCOunt:GATetime <time>` `:CALCulate:MARKer[1]|2|…|12:FCOunt:GATetime?`
Example	Set the gate time for Marker 2 to 10^{-2} s = 10 ms:

	:CALC:MARK2:FCO:GAT 1e-2
Notes	When **Auto Couple** is pressed, Gate Time is set to 100 ms This command causes the specified marker to become selected
Preset	100 ms
State Saved	Saved in instrument state
Min	1 us
Max	500 ms

Auto Function

Remote Command	:CALCulate:MARKer[1]|2|…|12:FCOunt:GATetime:AUTO OFF | ON | 0 | 1 :CALCulate:MARKer[1]|2|…|12:FCOunt:GATetime:AUTO?
Example	:CALC:MARK2:FCO:GAT:AUTO ON
Preset	ON

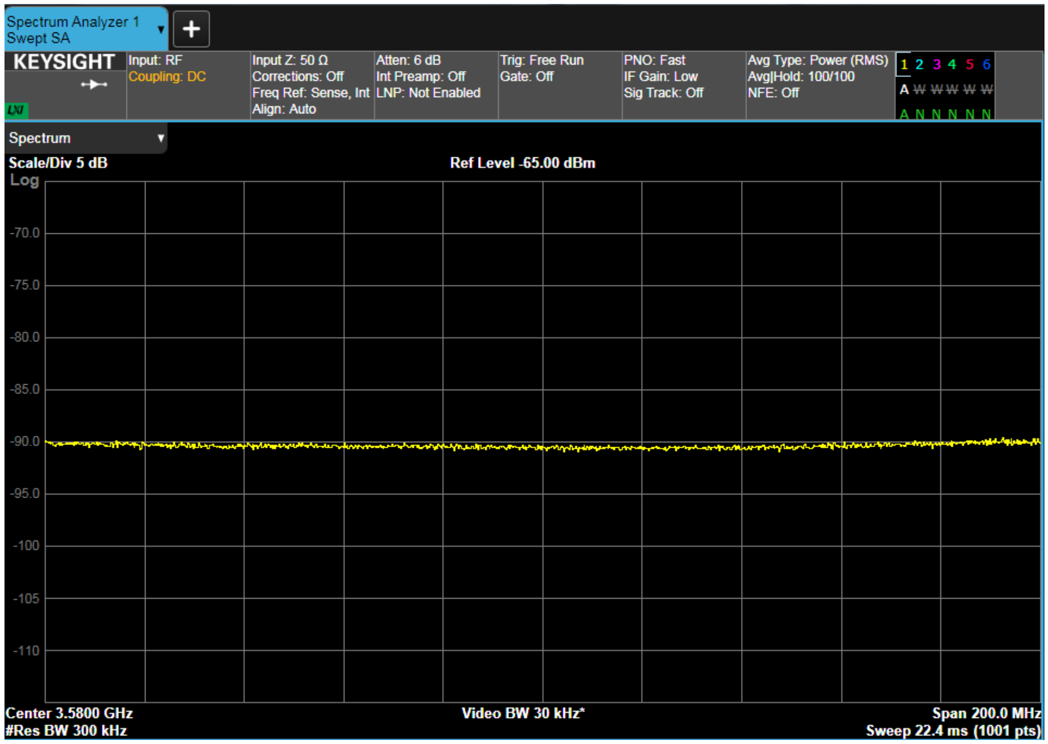
Backwards Compatibility Command

Notes	Provided for ESA compatibility, which allowed you to control the gate resolution, rather than the gate time :CALCulate:MARKer[1]|2|3|4:FCOunt:RESolution <freq> Sets the gate time to 1/freq :CALCulate:MARKer[1]|2|3|4:FCOunt:RESolution? Returns 1/gate_time :CALCulate:MARKer[1]|2|3|4:FCOunt:RESolution:AUTO OFF|ON|0|1 is accepted and ignored :CALCulate:MARKer[1]|2|3|4:FCOunt:RESolution:AUTO? Always returns 1 All these commands cause the marker to become selected
Preset	1Hz
Backwards Compatibility SCPI	:CALCulate:MARKer[1]|2|…|4:FCOunt:RESolution <freq> :CALCulate:MARKer[1]|2|…|4:FCOunt:RESolution?

Auto Function

Remote Command	:CALCulate:MARKer[1]|2|…|4:FCOunt:RESolution:AUTO ON | OFF | 1 | 0 :CALCulate:MARKer[1]|2|…|4:FCOunt:RESolution:AUTO?
Preset	ON

3.2.8 Meas Setup



Contains functions for setting up the measurement parameters and for setting up parameters global to all measurements in the Mode.

NOTE In the **Meas Setup** menu, you may configure Averaging, by setting the Average Number and the Average Type.

3.2.8.1 Settings

Contains frequently used **Meas Setup** functions to which you will want the fastest access.

Average/Hold Number

Sets the terminal count number N for **Average, Max Hold** and **Min Hold** trace types. This number is an integral part of how the average trace is calculated. Basically, increasing N results in a smoother average trace.

See:

– "More Information" on page 380

– "AVERage:CLEar command" on page 381

Remote Command	`[:SENSe]:AVERage:COUNt <integer>` `[:SENSe]:AVERage:COUNt?`
Notes	Note that the SCPI is under the (optional) `SENSe` node; for backwards compatibility
Couplings	Restarting any of these functions (**Average, Max Hold** or **Min Hold)** restarts all of them, as there is only one count
Preset	100
State Saved	Saved in instrument state
Min	1
Max	10000
Annotation	The current average/hold count K is displayed, up to the terminal count N, in the Meas Bar, as **Avg | Hold: K/N** when any active (updating) trace is in Average, Max Hold or Min Hold For example, Trace 2 in Average:, 10 of 100 counts so far: **Avg | Hold: 10/100** If in Continuous, and the Terminal count has been surpassed, the annotation shows as **Avg | Hold: >N/N** For example, Continuous sweep, Trace 2 in Average, Avg/Hold number is 100, but 150 averages have been taken so far: **Avg | Hold: >100/100** No count is displayed if no trace is in Average or Hold
Status Bits/OPC dependencies	See the **Sweep** key description for a discussion of the Sweeping, Measuring, Settling and OPC bits, and the Hi Sweep line. All are affected when a sequence is reset
Backwards Compatibility Notes	In older instruments, when changing the **Average Count** (now **Average/Hold Number**), you had to re-start the trace at the beginning of a sweep to ensure valid average data. Now, the system will ensure valid results when changing the count limit

More Information

When in **Single**, the sweep stops when N is reached. You can add more sweeps by increasing **Average/Hold Number**. For example, if you want to add one more average, or one more trace to Max Hold or Min Hold, simply increment this number by one, which you can do by pressing the **Up** key while **Average/Hold Number** is the active function.

In **Cont** (continuous), averaging and holding continues even after N is reached. Therefore, using doing trace holding in **Cont**, the value of N is irrelevant. But for averaging, each new sweep is exponentially averaged in with a weighting equal to N.

For details of how the average trace is calculated and how this depends on the **Average/Hold Number**, see "Average Type" on page 381, below. For details on how the various control functions in the instrument start and restart averaging, see "Average Type" on page 381.

Average/Hold Number is not affected by "Auto Couple" on page 1995.

AVERage:CLEar command

Resets the average/hold count and performs `:INIT:IMM`, which begins another set of sweeps when trigger conditions are satisfied. It only does this if an active trace is in Average or Hold type.

Remote Command	`[:SENSe]:AVERage:CLEar`

Example	`:AVER:COUN 100`
	`:AVER:CLE`
	sets the current count (k and K) to 1 and restarts the averaging process

Notes	When the instrument receives this command, it performs `:INIT:IMM`, if and only if there is an active trace in Max Hold, Min Hold, or Average type

Average Type

Lets you control the way averaging is done by choosing one of the following averaging scales:

Option	SCPI	Details
Log-Power (Video)	`LOG`	"Log-Pwr Avg (Video)" on page 383
Power (RMS)	`RMS`	"Pwr Avg (RMS)" on page 383
Voltage averaging	`SCALar`	"Voltage Avg" on page 384

Also lets you choose **Auto** (default); see "Auto" on page 382.

These are the averaging processes within the Swept SA measurement, all of which are affected by this setting:

1. Trace averaging (see **Trace** under **Trace Type**) averages signal amplitudes on a trace-to-trace basis. When performing Trace Averaging, the equation that is used to calculate the averaged trace depends on the average type. The average type applies to all traces in Trace Average (it is not set on a trace-by-trace basis)
2. Average detector (see **Trace** under **Detector**) averages signal amplitudes during the time or frequency interval represented by a particular measurement point

3. Noise Marker (see **Marker** under **Marker Function**) averages signal amplitudes across measurement points to reduce variations for noisy signals

4. VBW filtering (see **BW** under **VBW**) adds video filtering which is a form of averaging of the video signal

Remote Command	`[:SENSe]:AVERage:TYPE LOG | RMS | SCALar` `[:SENSe]:AVERage:TYPE?`
Preset	`LOG`
Range	Log-Power (Video) | Power (RMS) | Voltage
Annunciation	Log-Power | Power (RMS) | Voltage Found in the Meas Bar under **Avg Type** When not in Auto, label changes to **#Avg Type**
Backwards Compatibility Notes	The following legacy parameters to the `[:SENSe]:AVERage:TYPE` command are aliased as shown:

Legacy Param	Aliased To
`LINear`	`SCALar`
`VOLTage`	`SCALar`
`VIDeo`	`LOG`
`LPOWer`	`LOG`
`POWer`	`RMS`

Auto Function

Remote Command	`[:SENSe]:AVERage:TYPE:AUTO OFF | ON | 0 | 1` `[:SENSe]:AVERage:TYPE:AUTO?`
Preset	`ON`

Details of each averaging type appear below:

Auto

When **Auto** is selected, the instrument chooses the optimum type of averaging for the current instrument measurement settings. When one of the average types is selected manually, the instrument uses that type regardless of other instrument settings, and shows Man on the **Average Type** toggle.

Here are the auto-select rules for **Average Type:**

Auto selects **VoltageAveraging** if the Detector for any active trace is **EMI Average** or **QPD or RMS Average**; otherwise, it selects **Power (RMS)** Averaging if a **Marker Function** (**Marker Noise**, **Band/Intvl Power**) is on, or **Detector** is set to **Man** and **Average**; otherwise, if **Amplitude**, **Scale Type** is set to **Lin** it selects **Voltage**

Averaging; otherwise, if the EMC Standard is set to CISPR, it selects Voltage; otherwise **Auto** selects **Log-Power** Average.

Note that these rules are only applied to active traces. Traces which are not updating do not impact the auto-selection of Average Type. When you select log-power averaging, the measurement results are the average of the signal level in logarithmic units (decibels). When you select power average (RMS), all measured results are converted into power units before averaging and filtering operations, and converted back to decibels for displaying. Be aware that there can be significant differences between the average of the log of power and the log of the average power.

Log-Pwr Avg (Video)

Selects the logarithmic (decibel) scale for all filtering and averaging processes. This scale is sometimes called “Video” because it is the most common display and analysis scale for the video signal within a spectrum instrument. This scale is excellent for finding CW signals near noise, but its response to noise-like signals is 2.506 dB lower than the average power of those noise signals. This is compensated for in the **Marker Noise** function.

The equation for trace averaging on the log-pwr scale is shown below, where K is the number of averages accumulated. (In continuous sweep mode, once K has reached the **Average/Hold Number**, K stays at that value, providing a continuous running average.)

New avg = ((K−1)Old avg + New data)/K

This equation assumes all values in decibel scale.

Pwr Avg (RMS)

All filtering and averaging processes work on the power (the square of the magnitude) of the signal, instead of its log or envelope voltage. This scale is best for measuring the true time average power of complex signals. This scale is sometimes called RMS because the resulting voltage is proportional to the square root of the mean of the square of the voltage.

In the equation for averaging on this scale (below), K is the number of averages accumulated. (In continuous sweep mode, once K has reached the **Average/Hold Number**, K stays at that value, providing a running average.)

New avg = 10 log $((1/K)((K-1)(10^{\text{Old avg}/10})+10^{\text{New data}/10}))$

This equation assumes all values are in the decibel scale.

Voltage Avg

All filtering and averaging processes work on the voltage of the envelope of the signal. This scale is good for observing rise and fall behavior of AM or pulse-modulated signals such as radar and TDMA transmitters, but its response to noise-like signals is 1.049 dB lower than the average power of those noise signals. This is compensated for in the **Marker Noise** function.

In the equation for averaging on this scale (below), K is the number of averages accumulated. (In continuous sweep mode, once K has reached the **Average/Hold Number**, K stays at that value.)

New avg = 20 log ((1/K)((K−1)($10^{\text{Old avg}/20}$)+$10^{\text{New data}/20}$))

This equation assumes all values are in the decibel scale.

Meas Setup Summary Table

Lets you view and access many of the parameters in the **Meas Setup** menus on one screen.

Auto Couple

Immediately puts all **Auto/Man** functions into **Auto**. **Auto Couple** is confined to the current measurement only. It does not affect other measurements in the Mode.

In the **Auto** state, **Auto/Man** functions are said to be “coupled”, meaning their values change as you make changes to other values in the measurement. This helps ensure accurate measurements and optimum dynamic range. **Auto Couple** is an immediate action function, and when it is executed, all the **Auto/Man** controls for the current measurement are set to **Auto**, and all measurement settings coupled to the **Auto/Man** parameters are automatically set to their optimal values.

For further details of measurement-specific settings (if any), see "Measurement-Specific Details" on page 385 below.

Remote Command	`:COUPle ALL`
Example	`:COUP ALL`
Backwards Compatibility SCPI	`:COUPLE ALL | NONE`
Backwards Compatibility Notes	`:COUP:NONE` puts all Auto/Man parameters in manual mode, decoupling all the coupled instrument parameters. It is retained for backwards compatibility and is *not* recommended for making measurements or new designs

All **Auto/Man** parameter couplings in the measurement are set to **Auto**. This includes couplings that may be unavailable or grayed-out due to the current state. For example, in the Swept SA measurement, there is no **Auto/Man** coupling for **RBW** while in Zero Span. Nonetheless, if **Auto Couple** were executed while in Zero Span, it would set **RBW** to Auto "behind the scenes" so that, on exit from Zero Span, it would be in **Auto**.

Any **Auto/Man** selection specific (local) to the other measurements in the current Mode are not affected by **Auto Couple**. Any functions that are *not* coupled with other instrument parameters, such as ranging or leveling variables, such as **AutoRange** or **AutoScale**, are not affected.

Executing **Auto Couple** generates the informational message, "All Auto/Man functions have been set to Auto".

Each parameter, upon being set to **Auto**, selects and sets the appropriate auto-coupled value based on that parameter’s coupling rules. The Dependency Resolver orchestrates the couplings for parameters that depend on one or more other parameters. The coupling and dependency rules for each parameter are defined in the section describing that parameter.

Executing **Auto Couple***does not* affect markers, marker functions, trace or display attributes, or any other instrument setting other than those specifically mentioned above.

Measurement-Specific Details

TOI (SA Mode only)

Parameters affected by **Auto Couple** are:

- Center Frequency Step
- Resolution Bandwidth
- Span/RBW Ratio
- Sweep Time
- Video BANDwidth VBW/RBW ratio
- Upper and Lower Tone (set to Sense)
- Zero span measurement Resolution Bandwidth
- Zero span measurement Dwell Time

Harmonics (SA Mode only)

Parameters affected by **Auto Couple** are:

- Resolution Bandwidth
- Fundamental Frequency
- Dwell Time
- Range Table Resolution Bandwidths
- Range Table Dwell Times

Meas Preset

Resets the local measurement variables for the currently active measurement to their factory default values. The measurement settings that get reset are a subset of the ones that are reset during a **Mode Preset**. This function keeps the instrument in the current measurement and the current mode and does not affect the settings for other measurements, but does abort the currently running measurement and restarts it.

Remote Command	`:CONFigure:SANalyzer`
Example	`:CONF:SAN`
Notes	Clears the Measuring bit

3.2.8.2 Limits

Contains controls for the Limit Lines of the current measurement. Limits arrays can be user-entered, sent via SCPI, or loaded from a file.

Dependencies	Only appears if you have the proper option installed in your instrument
Preset	Limits are turned off by **Preset**, but the Limits arrays (data) are only reset (deleted) by **Restore Mode Defaults**. They survive shutdown and restarting of the instrument application, which means they will survive a power cycle

Select Limit

Specifies the *selected limit*. The term "selected limit" is used throughout this document to specify which limit is affected by the functions.

Notes	The selected limit is remembered even when not in the **Limits** menu
Preset	Limit 1, not affected by **Mode Preset**, preset by **Restore Mode Defaults**
State Saved	Saved in instrument state

Limit On/Off

Selects whether the limit and margin are displayed. If "Test Limits" on page 400 is ON, this also determines whether the "Test Trace" on page 394 is tested against the limit. If **Limit On/Off** is **On**, the following occurs:

- The limit line is displayed, in the same color as the limited trace, but paler. Portions of traces that fail the limits are displayed in red
- The margin line is displayed if "Margin" on page 388 is ON and the Margin Value is non-zero. The margin line is displayed in the same color as the limit line, but paler still and dashed. Portions of traces that pass the limits but fail the margin are displayed in amber
- The trace is tested for the purpose of the “Trace Pass/Fail” indication in the graticule if, in addition to **Limit On/Off** being **On,** the trace is displayed and "Test Limits" on page 400 is ON. If the trace is not tested, no report of the trace passing or failing is seen on the graticule. Note that the SCPI queries for Limit Pass/Fail are independent of these conditions; the test is always performed when queried via SCPI

The **PASS/FAIL** box in the corner of the **Meas Bar** is only displayed if there is at least one “Trace Pass/Fail” indication displayed in the graticule.

Note that the red and amber coloring of traces that fail the limits and/or margins only apply to traces whose X-axis corresponds to the current instrument X-axis. Traces that are not updating (in **View**, for example) do not change color if the instrument X-axis settings (for example, **Start Freq** and **Stop Freq**) do not match those of the trace, for example if they have been changed since the trace stopped updating. In this case, the Invalid Data indicator (*) appears in the upper right-hand corner.

When the limits are frequency limits, but the trace is a zero-span trace, the limit trace is drawn at the limit amplitude of the center frequency. When the limits are time limits, but the trace is a frequency domain trace, the limit trace is drawn according to the current time axis, with the left of the screen being 0 and the right being equal to sweep time.

Remote Command	`:CALCulate:LLINe[1]|2|…|6:DISPlay OFF | ON | 0 | 1` `:CALCulate:LLINe[1]|2|…|6:DISPlay?`
Example	Turn on the display for Limit Line 2: `:CALC:LLIN2:DISP ON`
Dependencies	Generates an “Option not available” error message unless you have the proper option installed in your instrument
Couplings	Limit display ON selects the limit Testing is done on all displayed limits if **Test Limits (All Limits)** is ON

	Entering the limit menu from the user interface turns on the selected limit
Preset	`OFF`
State Saved	Saved in instrument state
Backwards Compatibility SCPI	`:CALCulate:LLINe[1]|2:STATe OFF | ON | 0 | 1`

Margin

Selects a **Margin** for this limit, which causes a trace to Fail Margin when the trace is between the Limit Line and the Margin Line. Portions of the traces that pass the limit but fail the margin are displayed in amber.

A margin is always specified in dB relative to a limit – an upper limit always has a negative margin, and a lower limit always has a positive margin. If a value is entered with the incorrect sign, the system automatically takes the negative of the entered value.

If the limit type is switched from lower to upper while margin is present, the margin reverses sign.

When the Margin is selected, it may be turned off by pressing the **Margin** control until the toggle is next to **Off**. This may also be done by performing a preset. **Margin** is the default active function whenever the margin is on, and it is not the active function whenever the margin is off.

Margin lines are displayed in the same color as limit lines, but paler . If the limited trace is blanked then the limit line and the margin line are also blanked.

Remote Command	`:CALCulate:LLINe[1]|2|…|6:MARGin <rel_ampl>` `:CALCulate:LLINe[1]|2|…|6:MARGin?`

Example	Set Limit Line 1's margin to -2 dB (Limit Line 1 is by default an upper limit):
	`:CALC:LLIN1:MARG -2dB`
	Set Limit Line 2's margin to 1 dB (Limit Line 2 is by default a lower limit):
	`:CALC:LLIN2:MARG 1dB`

Notes	The queries "Limit Line Fail?" (`:CALCulate:LLINe[1]|2|3|4|5|6:FAIL?`) and "Trace Fail?" (`:CALCulate:TRACe[1]|2|3|4|5|6:FAIL?`) return 1 if the margin fails
Couplings	Affects `:CALC:LLIN3:FAIL` or `:CALC:TRAC2:FAIL?`
Preset	Not affected by **Mode Preset**, set to 0 dB for all Limits by **Restore Mode Defaults**
State Saved	Saved in instrument state
Min	–40 dB (Upper); 0 dB (Lower)
Max	0 dB (Upper); 40 dB (Lower);

Auto Function

Remote Command	`:CALCulate:LLINe[1]|2|…|6:MARGin:STATe OFF	ON	0	1` `:CALCulate:LLINe[1]|2|…|6:MARGin:STATe?`
Example	Turn off the margin for Limit Line 2 and remove any tests associated with that margin line: `:CALC:LLIN2:MARG:STAT OFF`
Preset	`OFF`
State Saved	Saved in instrument state

Type

Selects whether the limit you are editing is an upper or lower limit. An upper limit fails if the trace exceeds the limit. A lower limit fails if the trace falls below the limit.

Remote Command	`:CALCulate:LLINe[1]|2|…|6:TYPE UPPer	LOWer` `:CALCulate:LLINe[1]|2|…|6:TYPE?`
Example	Set Limit Line 2 to act as a lower limit: `:CALC:LLIN2:TYPE LOW`
Couplings	If a margin has already been set for this limit line, and this control is used to change the limit type, then the margin value reverses sign
Preset	Upper for Line 1, 3, and 5; Lower for Line 2, 4, 6 Not affected by **Mode Preset**, preset by **Restore Mode Defaults**
State Saved	Saved in instrument state

Edit Limit

Lets you edit the content and the properties of the Limit Line.

When entering the menu, the editor window (with the limit table) turns on, the selected Limit is turned **On**, and the amplitude scale is set to **Log**. The display of the trace to which the selected limit applies is turned on (thus, traces in **Blank** are set to **View** and traces in **Background** are set to **On**). Turning on the Limit means its display will be on, and its testing mode will be on as well. You should turn off any other limits that are on if they interfere with the editing of the selected limit.

NOTE **The table editor will only operate properly if the instrument is sweeping, because its updates are tied to the sweep system. Thus, you should not try to use the editor in single sweep, and it will be sluggish during compute-intensive operations like narrow-span FFT sweeps.**

Remote users can enter or access limit line data via the "Limit Line Data (Remote Command Only)" on page 402 command.

After exiting the editor, the Limit is still on and displayed, and the amplitude scale remains **Log**.

Limits are turned off by **Preset**, but the Limits arrays (data) are only reset (deleted) by **Restore Mode Defaults**. They survive shutdown and restarting of the instrument application, which means they will survive a power cycle.

When editing a limit, the editor remembers which limit and which element in the limit array you were editing, and returns you to that limit and that element when you return to the editor after leaving it.

Couplings	Turns the ΔLimit Peaks table off

Select Limit

Specifies the selected limit. The term “selected limit” is used throughout this document to specify which limit is affected by the functions.

Notes	The selected limit is remembered even when not in the Limit Menu
Preset	Limit 1, not affected by Mode Preset, preset by Restore Mode Defaults
State Saved	Saved in instrument state

Go To Row

Lets you move through the table to edit the desired point.

Min	1
Max	2000

Insert Row Below

Inserts a row below the current row. The new row is a copy of the current row and becomes the current row. The new row is not yet entered into the underlying table, and the data in the row is displayed in light gray. To enter the row into the table, press the **Enter** key, or tap either value then edit it.

Scale X Axis

Matches the X Axis to the selected Limit, as closely as possible.

For frequency limits and a frequency-domain X-axis, sets **Start Freq** and **Stop Freq** to contain the minimum and maximum Frequency of the selected Limit.

– For linear Frequency Scale, the range between **Start Freq** and **Stop Freq** is 12.5% above the range between the minimum and maximum frequency, so that span exceeds this range by one graticule division on either side (but never set **Start Freq** below 0 Hz nor **Stop Freq** above the maximum instrument frequency)

– For log Frequency Scale, **Start Freq** is set to the bottom of the decade in which the minimum frequency of the Limit appears, and **Stop Freq** is set to the top of the decade in which the maximum frequency of the Limit appears. In either case, if the frequency is at a decade boundary, we take that boundary as being the bottom/top of the decade in which the frequency appears. Example: Limit goes from 150 kHz to 1 GHz, set Start Freq to 100 kHz, Stop Freq to 1 GHz

For time limits and a time-domain X-axis, sets the sweep time to match the maximum Time of the selected Limit.

If the domain of the selected limit does not match the domain of the X Axis, no action is taken. Standard clipping rules apply, if the value in the table is outside the allowable range for the X axis.

Dependencies	If either the first or last point in the array is outside the frequency range of the current input, an error message is generated: "-221. Settings conflict; Start or Stop Freq out of range for current input settings"

X Offset

Offsets the limit trace by some specified frequency (for frequency-based limit lines) or a time (for time-based limit lines).

Remote Command	`:CALCulate:LLINe[1]|2|…|6:OFFSet:X <value>`
	`:CALCulate:LLINe[1]|2|…|6:OFFSet:X?`
	`<value>` = `<freq>` if Limit X-Axis Unit is Frequency
	`<value>` = `<time>` if Limit X-Axis Unit is Time

Example	Set the X axis offset to –50 MHz:
	`:CALC:LLIN:OFFS:X -50MHZ`
	Apply the X axis offset to all points in the limit line, then reset the X axis offset to zero:
	`:CALC:LLIN:OFFS:UPD`

Preset	0 Hz if Limit X-Axis Unit is Frequency 0 s if Limit X-Axis Unit is Time
State Saved	Saved in instrument state, survives Preset
Min	–500 GHz
Max	500 GHz
Annotation	When the offset is non-zero, the title of the limit table will include the words "[Offset Pending]"

Y Offset

Offsets all segments in the limit line by some specified amplitude.

Remote Command	`:CALCulate:LLINe[1]|2|…|6:OFFSet:Y <rel ampl>` `:CALCulate:LLINe[1]|2|…|6:OFFSet:Y?`

Example	Set the Y axis offset to –3 dB:
	`:CALC:LLIN:OFFS:Y -3 dB`
	Apply the Y axis offset to all points in the limit line, then reset the Y axis offset to zero:
	`:CALC:LLIN:OFFSet:UPD`

Preset	0 dB
State Saved	Saved in instrument state
Min/Max	–/+Infinity
Annotation	When the offset is non-zero, the title of the limit table includes the words “[Offset Pending]”

Apply Offsets to Limit Table

Adds the X and Y offsets to each point in the limit table, then resets the X and Y offset values to zero. This has no effect on the position of the limit trace.

For example, if the X offset is –10 MHz and the Y offset is 1 dB, the values in the limit table are updated as follows: 10 MHz is subtracted from each X value, 1 dB is added to each Y value. The offset values are then reset to zero. The limit trace is not moved, and the limit table is updated to accurately reflect the currently-displayed limit trace.

Remote Command	`:CALCulate:LLINe[1]|2|…|6:OFFSet:UPDate`
Example	Set updates the limit table to reflect the X and Y offsets, then reset the offsets to zero: `:CALC:LLIN:OFFS:UPD`
State Saved	No state

Delete Row

This is an immediate action key. It immediately deletes the currently-selected row, whether or not that row is being edited. The row following the currently-selected row (or the row preceding if there is none) is selected.

Delete Limit

Deletes the currently selected limit line. Pressing **Delete Limit** purges the data from the limit line tables.

Limit data – including secondary parameters such as description, margin value, etc. – is cleared and returned to factory preset settings.

When this control is pressed, a prompt is placed on the screen that says “Please press Enter or OK to delete limit. Press ESC or Cancel to close this dialog.” The deletion is *only* performed if you press **OK** or **Enter**. Following deletion, the informational message **Limit deleted** appears in the MSG line.

Remote Command	`:CALCulate:LLINe[1]|2|…|6:DELete`
Example	Delete all data for Limit Line 2: `:CALC:LLIN2:DEL`

Limit Table

Lets you configure the properties of the current row of the Limit Table.

Frequency

Lets you edit the frequency of the current row.

Min	0
Max	1 THz

Amplitude

Lets you edit the Amplitude of the current row.

Min	–1000 dBm
Max	1000 dBm

Limit Graph

Lets you edit the limit line visually. Each node in the limit line is represented by a gray circle. The current node has a blue outline in the table and a blue circle in the graph. Touch any circle and drag it where you want it to go.

Edit Limit Settings

Opens another menu page that lets you set certain properties of the selected Limit, such as Test Trace, Interpolation, Reference, Fixed/Relative, Description and Comment.

The facility to build a Limit from a Trace and to Copy Limits to other Limits is also found here.

Select Limit

Specifies the *selected limit*. The term “selected limit” is used throughout this document to specify which limit is affected by the functions.

Notes	The selected limit is remembered even when not in the Limit Menu
Preset	Limit 1, not affected by Mode Preset, preset by Restore Mode Defaults
State Saved	Saved in instrument state

Test Trace

Selects the trace you want the limit to test. A limit is applied to one and only one trace; each trace can have both an upper and a lower limit. When executing Limit Test, the limit is applied only to the specified trace.

A trace can have multiple limit lines simultaneously; in that case, only one upper and one lower limit line will affect the color of the trace. Other limit lines are displayed, and will affect the pass/fail status, but the trace will not turn red if it crosses a secondary limit line.

Remote Command	`:CALCulate:LLINe[1]|2|…|6:TRACe 1 | … | 6` `:CALCulate:LLINe[1]|2|…|6:TRACe?`
Example	Apply limit 3 to trace 2: `:CALC:LLIN3:TRAC 2`
Notes	When the trace display is off, the trace is not tested. The trace is tested only when the trace display is on and "Test Limits" on page 400 is ON
Couplings	This matters when testing a trace or limit line for failure, via `:CALC:LLIN3:FAIL?` or `:CALC:TRAC2:FAIL?`
Preset	Limits 1 and 2 preset to 1, Limits 3 and 4 preset to 2, Limits 5 and 6 preset to 3 Not affected by **Mode Preset**, preset by **Restore Mode Defaults**
State Saved	Saved in instrument state
Min	1
Max	6

Frequency Interpolation

This control is grayed-out if Time is the selected X Axis Unit.

Sets the interpolation between frequency points, allowing you to determine how limit trace values are computed between points in a limit table. The available interpolation modes are linear and logarithmic. If frequency interpolation is logarithmic (Log), frequency values between limit points are computed by first taking the logarithm of both the table values and the intermediate value. A linear interpolation is then performed in this logarithmic frequency space. An exactly analogous manipulation is done for logarithmic amplitude interpolation.

Note that the native representation of amplitude is in dB.

For linear amplitude interpolation and linear frequency interpolation, the interpolation is computed as:

$$y = 20\log\left(\frac{10^{\frac{y_{i+1}}{20}} - 10^{\frac{y_i}{20}}}{f_{i+1} - f_i}\left(f - f_i\right) + 10^{\frac{y_i}{20}}\right)$$

For linear amplitude interpolation and log frequency interpolation, the interpolation is computed as:

$$y = 20\log\left(\frac{10^{\frac{y_{i+1}}{20}} - 10^{\frac{y_i}{20}}}{\log f_{i+1} - \log f_i}\left(\log f - \log f_i\right) + 10^{\frac{y_i}{20}}\right)$$

For log amplitude interpolation and linear frequency interpolation, the interpolation is computed as:

$$y = \frac{y_{i+1} - y_i}{f_{i+1} - f_i}\left(f - f_i\right) + y_i$$

For log amplitude interpolation and log frequency interpolation, the interpolation is computed as:

$$y = \frac{y_{i+1} - y_i}{\log f_{i+1} - \log f_i}\left(\log f - \log f_i\right) + y_i$$

NOTE	Interpolation modes determine how limit values are computed between points in the limit table. The appearance of a limit trace is also affected by the amplitude scale, which may be linear or logarithmic.

Remote Command	`:CALCulate:LLINe[1]|2|…|6:CONTrol:INTerpolate:TYPE LOGarithmic	LINear` `:CALCulate:LLINe[1]|2|…|6:CONTrol:INTerpolate:TYPE?`
Example	Set Limit Line 1 frequency interpolation to linear: `:CALC:LLIN:CONT:INT:TYPE LIN`
Preset	`LINear` Not affected by **Mode Preset**, preset by **Restore Mode Defaults**
State Saved	Saved in instrument state

Freq Reference

Specifies whether the limit line frequency points are coupled to the instrument **Center Frequency**, and whether the frequency points are expressed as an offset from the instrument **Center Frequency**. If the limit lines are specified with time, this has no effect. The limit table must in this case support negative frequencies.

For example, assume you have a frequency limit line, and the instrument **Center Frequency** is 1 GHz. If Relative to CF is **Off**, entering a limit line segment with a frequency coordinate of 300 MHz displays the limit line segment at 300 MHz, and the limit line segment does not change frequency if **Center Frequency** changes. If Relative to CF is **On**, entering a limit line segment with a frequency coordinate of 300 MHz displays the limit line segment at CF + 300 MHz, or 1.3 GHz. Furthermore, if **Center Frequency** changes to 2 GHz, the limit line segment is displayed at CF + 300 MHz, or 2.3 GHz.

It is possible to change this setting after a limit line has been entered. When changing from **On** to **Off** or *vice versa*, the frequency values in the limit line table change so that the limit line remains in the same position for the current frequency settings of the instrument.

Pressing this button makes **Center Frequency** the active function.

Remote Command	`:CALCulate:LLINe[1]|2|…|6:FREQuency:CMODe:RELative ON	OFF	1	0` `:CALCulate:LLINe[1]|2|…|6:FREQuency:CMODe:RELative?`
Example	Make Limit Line 1 relative to **Center Frequency**: `:CALC:LLIN:FREQ:CMOD:REL ON`
Notes	If the Trace Domain is changed to Time (`:CALCulate:LLINe:CONTrol:DOMain TIME`), `:CALCulate:LLINe[1]|2|3|4|5|6:FREQuency:CMODe:RELative ON|OFF|1|0` has no effect
Couplings	Pressing this control makes **Center Frequency** the active function

Preset	`OFF` Not affected by **Mode Preset**, preset by **Restore Mode Defaults**
State Saved	Saved in instrument state

Amplitude Interpolation

Sets the interpolation to linear or logarithmic for the specified limiting points set, allowing you to determine how limit trace values are computed between points in a limit table. See Frequency Interpolation for the equations used to calculate limit values between points.

Remote Command	`:CALCulate:LLINe[1]|2|…|6:AMPLitude:INTerpolate:TYPE LOGarithmic | LINear` `:CALCulate:LLINe[1]|2|…|6:AMPLitude:INTerpolate:TYPE?`
Example	Set Limit Line 1 amplitude interpolation to linear: `:CALC:LLIN:AMPL:INT:TYPE LIN`
Preset	`LOGarithmic` Not affected by **Mode Preset**, preset by **Restore Mode Defaults**
State Saved	Saved in instrument state

Amptd Reference

Specifies whether the limit line amplitude points are coupled to the instrument reference level, and whether the amplitude points are expressed as an offset from the instrument reference level.

For example, assume you have a limit line, and the reference level at –10 dBm. If Relative to RL is **Off**, entering a limit line segment with an amplitude coordinate of –20 dB displays the limit line segment at –20 dBm, and the limit line segment will not change amplitude if the reference level amplitude changes. If Relative to RL is **On**, entering a limit line segment with an amplitude coordinate of –20 dB displays the limit line segment at RL – 20 dB, or –30 dBm. Furthermore, if the reference level amplitude changes to –30 dBm, the limit line segment is displayed at RL – 20 dB, or –50 dBm.

It is possible to change this setting after a limit line has been entered. When changing from **On** to **Off** or *vice versa*, the amplitude values in the limit line table change so that the limit line remains in the same position for the current reference level settings of the instrument.

Remote Command	`:CALCulate:LLINe[1]|2|…|6:AMPLitude:CMODe:RELative ON | OFF | 1 | 0` `:CALCulate:LLINe[1]|2|…|6:AMPLitude:CMODe:RELative?`
Example	Make Limit Line 1 relative to the reference level amplitude: `:CALC:LLIN:AMPL:CMOD:REL ON`

Couplings	Pressing this button makes **Reference Level** the active function
Preset	`OFF` Not affected by **Mode Preset**, preset by **Restore Mode Defaults**
State Saved	Saved in instrument state

Fixed / Relative Limit (Remote Command Only)

Sets both **Relative to CF** and **Relative to RL** simultaneously for all limits.

The query returns whether Limit Line 1 is set Relative to CF, and ignores all other fixed/relative data.

Example	Make all limit lines relative to center frequency and reference level: `:CALC:LLIN:CMOD REL`

Notes	Supported for Backwards Compatibility
	PSA offers only the following softkey, which is generic to all limit lines: Limits Fixed / Rel
	In X-Series A-Models, this functionality is provided by a softkey that is specific to each limit line, and which provides a sub-menu with 2 softkeys (Relative to CF / Relative to RL)
	In X-Series B-Models, this functionality is provided by two controls (**Freq Reference** and **Amptd Reference**) that are specific to each limit line)
	The legacy `:CALCulate:LLINe:CMODe?` query returns 1 if Limit Line 1 is set **Relative to CF**, and returns 0 otherwise, to be consistent with the implementation of the following X-Series commands:
	`:CALCulate:LLINe[1]|2|…|6:FREQuency:CMODe:RELative ON | OFF | 1 | 0`
	`:CALCulate:LLINe[1]|2|…|6:FREQuency:CMODe:RELative?`
	and
	`:CALCulate:LLINe[1]|2|…|6:AMPLitude:CMODe:RELative ON | OFF | 1 | 0`
	`:CALCulate:LLINe[1]|2|…|6:AMPLitude:CMODe:RELative?`

Preset	Fixed
Backwards Compatibility SCPI	`:CALCulate:LLINe:CMODe FIXed | RELative` `:CALCulate:LLINe:CMODe?`

Copy from Limit

Copies an existing limit into the specified limit, including all secondary parameters (Description, Associated Trace, Type, Margin, Interpolation, and Relative to CF/RL). The destination limit is specified as a subopcoded `LLINe` parameter and the source limit is specified as a numeric parameter.

Remote Command	`:CALCulate:LLINe[1]|2|…|6:COPY 1 | … | 6`

Example	Copy the data from line 1 into line 2: `:CALC:LLINE2:COPY 1`
Notes	The form is `:CALCulate:<destination>:COPY <source>`

Copy

Copies a Limit from the Limit specified in Copy From Limit

Build from Trace

Builds a limit using an existing trace. This command overwrites all data in the limit. Since a straight copy would typically have hundreds or thousands of segments, the data is approximated to better represent a limit line; small excursions whose width is less than 10 trace buckets are sometimes not captured. Secondary parameters that are not associated with traces (Description, Associated Trace, Type, Margin, Interpolation, Relative to CF/RL) are unchanged.

When taking a trace to build a limit, it often works well to take the trace with a resolution bandwidth wider than the expected measurement, a video bandwidth lower than the expected measurement, and with the detector set to Max Hold or Min Hold.

Note that an upper limit is built above the trace, while a lower limit is built below the trace. If the trace is constant, the limit should pass after being built.

Remote Command	`:CALCulate:LLINe[1]|2|…|6:BUILd TRACE1	…	TRACE6`
Example	Builds Limit Line 2 based on the data in trace 1. This overwrites the data in the table editor: `:CALC:LLIN2:BUIL TRACE1`

Build

Builds a Limit from the Trace specified in "Build from Trace" on page 399.

Description

Provides a description of up to 60 characters by which the operator can easily identify the limit. The value is stored in the exported file.

Remote Command	`:CALCulate:LLINe[1]|2|…|6:DESCription “Description”` `:CALCulate:LLINe[1]|2|…|6:DESCription?`
Example	`:CALC:LLIN:DESC “European Emissions”`

Dependencies	60 characters max
Preset	“” (null String), not affected by Mode Preset, preset by Restore Mode Defaults
State Saved	Saved in instrument state
Backwards Compatibility SCPI	`:CALCulate:LLINe[1]|2|…|6::TITLe:DATA “Description”` `:CALCulate:LLINe[1]|2|…|6::TITLe:DATA?`

Comment

Sets an ASCII-text comment field, which is stored in an exported file. Can be displayed in the active function area by selecting as the active function, if desired to be in a screen capture. The Limits CSV file supports this field.

Remote Command	`:CALCulate:LLINe[1]|2|…|6:COMMent "text"` `:CALCulate:LLINe[1]|2|…|6:COMMent?`
Example	`:CALC:LLIN1:COMM "this is a comment"`
Dependencies	60 characters max
Preset	“” (null String), not affected by Mode Preset, preset by Restore Mode Defaults
State Saved	Saved in instrument state
Annotation	When **Trace Annotation** under **Display** is ON, limit comment is displayed as part of the label next to the limit line on the graph

Test Limits

Selects whether displayed traces are tested against displayed limits (that is, those for which **Limit On/Off** is set to ON).

For each displayed trace for which a Limit is turned on, a message is displayed in the upper-left corner of the graticule to notify whether the trace passes or fails the limits.

If the trace is at or within the bounds of all applicable limits and margins, the text “Trace x Pass” is displayed in green, where x is the trace number. A separate line is used for each reported trace.

If the trace is at or within the bounds of all applicable limits, but outside the bounds of some applicable margin, the text “Trace x Fail Margin” is displayed in amber, where x is the trace number. A separate line is used for each reported trace. If the trace is outside the bounds of some applicable limits, the text “Trace x Fail” is displayed in red, where x is the trace number. A separate line is used for each reported trace. If the trace has no enabled limits, or the trace itself is not displayed, no message is displayed for that trace.

The **PASS/FAIL** box in the corner of the **Meas Bar** is only displayed if there is at least one “Trace Pass/Fail” indication displayed in the graticule.

If two amplitude values are entered for the same frequency, a single vertical line is the result. In this case, if an upper line is chosen, the lesser amplitude is tested. If a lower line is chosen, the greater amplitude is tested.

This command only affects the display, and has no impact on remote behavior. Limit queries over SCPI test the trace against the limit regardless of whether the trace or the limit is turned on (exception: `:CALCulate:TRACe[1]|2|3|4|5|6:FAIL?` tests only the limits that are turned on for that trace).

Remote Command	`:CALCulate:LLINe:TEST OFF | ON | 0 | 1` `:CALCulate:LLINe:TEST?`
Example	Turn on testing, and display the results in the upper left corner: `:CALC:LLIN:TEST ON`
Preset	`ON` Not affected by **Mode Preset**, preset by **Restore Mode Defaults**
State Saved	Saved in instrument state
Annotation	If this is on, the active limit window displays the information above regarding pass/fail for each displayed limit

X-Axis Unit

Selects how the limit-line segments are defined. Pressing **X-Axis Unit** selects whether the limit lines are entered using frequency (Freq) or sweep time (Time) to define the segments. They can be specified as a table of limit-line segments of amplitude versus frequency, or of amplitude versus time.. When the X-Axis Unit is set to Time, a time value of zero corresponds to the start of the sweep, which is at the left edge of the graticule, and the column and control in the Limit Table Editor reads Time instead of Frequency

Switching the limit-line definition between Freq and Time erases all the current limit lines. When you do this from the front panel, a warning dialog appears letting you know that you are about to erase all the limit lines, and prompting you to hit “OK” if you are sure:

Caution: Changing X-Axis Unit erases all your limit lines. Are you sure you want to do this? Press Enter or OK to proceed, or Cancel(Esc) to cancel

Remote Command	`:CALCulate:LLINe:CONTrol:DOMain FREQuency | TIME` `:CALCulate:LLINe:CONTrol:DOMain?`
Example	`:CALC:LLIN:CONT:DOM FREQ` deletes all currently existing limit lines, then sets all limit lines to be specified in terms of frequency
Couplings	Affects all limit lines simultaneously, and resets all limit line data except the `.wav` file and email

	address stored in the Actions
Preset	`FREQ` Not affected by **Mode Preset**, preset by **Restore Mode Defaults**
State Saved	Saved in instrument state

Delete All Limits

Deletes all limit lines. Pressing **Delete All Limits** purges the data from all limit line tables.

All limit data is cleared and returned to factory preset settings.

When this control is pressed a prompt is placed on the screen that says “Please press Enter or OK to delete all limits. Press **ESC** or **Cancel** to close this dialog.” The deletion is only performed if you press **OK** or **Enter**. Following deletion, the informational message “All Limits deleted” appears in the MSG line.

Remote Command	`:CALCulate:LLINe:ALL:DELete`
Example	`:CALC:LLIN:ALL:DEL` deletes all data for all limit lines

Limit Line Data (Remote Command Only)

Defines the limit line values, and destroys all existing data. Up to 200 points may be defined for each limit using the following parameters.

`<x>`	Frequency or time values as specified by `:CALCulate:LLINe:CONTrol:DOMain`. Units are not sent in the command but are taken to be fundamental units (Hz or seconds) Range: –30 Gs to +30 Gs for time limits, –3 kHz to +350 GHz for frequency limits
`<ampl>`	Amplitude units are not sent in the command but are taken to be the current Y Axis Unit. Up to two amplitude values can be provided for each x-axis value, by repeating <x-axis> in the data list Range: –1000 dBm to +1000 dBm
`<connect>`	connect values are either "0" or "1." A "1" means this point is connected to the previously defined point to define the limit line. A "0" means that it is a point of discontinuity and is not connected to the preceding point. The connect value is ignored for the first point

Example	`:CALC:LLIN3:DATA 1E9,-20,0,2E9,-20,1,2E9,-10,1,3E9,-10,1` describes a stair-stepped limit line
Preset	Limit line data is cleared by Restore Mode Defaults. However, it survives shutdown/restart of the instrument application (including power cycle)

State Saved	Saved in instrument state
Backwards Compatibility SCPI	`:CALCulate:LLINe[1]|2|…|6:DATA <x>,<ampl>,<connect>` `:CALCulate:LLINe[1]|2|…|6:DATA?`
Backwards Compatibility Notes	In the past it was possible to query the limit trace as though it were a normal trace. The query of the limit trace is not supported in the X-series

Merge Limit Line Data (Remote Command Only)

Adds the points with the specified values to the current limit line, allowing you to merge limit line data. Up to two amplitude values are allowed for each X value. If more than 200 points are entered to be merged, the first 200 points are merged, then an error message 'too many DATA entries' is reported.

`<x>`	Frequency or time values as specified by `:CALCulate:LLINe:CONTrol:DOMain`. Units are not sent in the command but are taken to be fundamental units (Hz or seconds) Range: –30 Gs to +30 Gs for time limits, –3 kHz to +350 GHz for frequency limits
`<ampl>`	Amplitude units are not sent in the command but are taken to be the current Y Axis Unit. Up to two amplitude values can be provided for each x-axis value, by repeating <x-axis> in the data list Range: –1000 dBm to +1000 dBm
`<connect>`	connect values are either "0" or "1." A "1" means this point is connected to the previously defined point to define the limit line. A "0" means that it is a point of discontinuity and is not connected to the preceding point. The connect value is ignored for the first point

Example	`:CALC:LLIN1:DATA:MERG 1000000000,-20,0,2000000000,-30,1` merges the 10 GHz segment and the 20 GHz segment into limit line 1. Note that the 20 GHz segment is connected to the next lower point, which may or may not be the 10 GHz point
Preset	Fixed
Backwards Compatibility SCPI	`:CALCulate:LLINe[1]|2|…|6:DATA:MERGe <x-axis>,<ampl>,<connect>`

Limit Test Current Results (Remote Command Only)

Queries the status of the current measurement limit testing. It returns a 0 if the measured results pass when compared with the current limits. It returns a 1 if the measured results fail any limit tests.

Remote Command	`:CALCulate:CLIMits:FAIL?`

Example	`:CALC:CLIM:FAIL?` queries the current measurement to see if it fails the defined limits Returns a 0 or 1: 0 it passes, 1 it fails

Limit Line Fail? (Remote Command Only)

Tests a limit line against its associated trace. Returns a 0 if the trace is within the limit and margin, a 1 if the trace exceeds either the limit or the margin.

Note that this command only tests one limit line – other limit lines are not tested when executing this command. To see whether a trace passed all limits, use `:CALCulate:TRACe:FAIL?`.

Note this command performs the test regardless of whether the trace or the limit is turned on the display.

Remote Command	`:CALCulate:LLINe[1]|2|…|6:FAIL?`
Example	`:CALC:LLIN:FAIL?` returns a zero if limit line 1's associated trace has no failure, 1 if there is a margin or limit failure

Limit Line Control (Remote Commands Only)

Defines a list of limit line control (frequency or time) values for a given limit line. Up to 2000 points may be defined for each limit using the following parameters.

`<x>`	Frequency or time values as specified by `:CALCulate:LLINe:CONTrol:DOMain`. Units default to Hz (for frequency) and seconds (for time) Range: –30 Gs to +30 Gs for time limits, –3 kHz to +1200 GHz for frequency limits

Note that X values may be repeated if a vertical step in the limit line is desired.

The points query returns the number of points in the control. It should match the number of points in the amplitude, that is, the number of values for the CONTrol axis and for the corresponding UPPer and/or LOWer limit lines must be identical. If one array is larger than the other, the limit trace is built using only as much data as is contained in the smaller array.

An empty array returns not a number (9.91e+37 to a data query), 0 to a `POINts` query.

Remote Command	`:CALCulate:LIMit[1]|2|…|6:CONTrol[:DATA] <x>, <x>, …` `:CALCulate:LIMit[1]|2|…|6:CONTrol[:DATA]?`
Example	`:CALC:LIM:CONT 1GHz,2GHz,2GHz,3GHz` describes the X values of a stair-stepped limit line

Preset	Limit line data is cleared by Restore Mode Defaults
State Saved	Saved in instrument state

Remote Command	`:CALCulate:LIMit[1]|2|…|6:CONTrol:POINts?`
Example	`:CALC:LIM:CONT:POIN?` returns the number of points in the limit line
Preset	Limit line data is cleared by Restore Mode Defaults
State Saved	Yes

Limit Line Upper / Lower (Remote Commands Only)

Defines a list of amplitude values for a given limit line. Changing the number of elements in the list spectrum will automatically turn the limit line off. Using the “UPP” syntax defines an upper limit line, using the “LOW” syntax defines a lower limit line. Note that a line may not be simultaneously both upper and lower; the type of the limit line will automatically be changed as appropriate. Up to 200 points may be defined for each limit using the following parameters.

`<ampl>`	Amplitude units are not sent in the command but are taken to be the current Y Axis Unit Range: –200 dBm to +100 dBm

The points query returns the number of points in the amplitude list. It should match the number of points in the control, that is, the number of values for the `CONTrol` axis and for the corresponding UPPer and/or LOWer limit lines must be identical. If one array is larger than the other, the limit trace is built using only as much data as is contained in the smaller array.

An empty array returns the system error message “list is empty” to a data query, 0 to a `POINts` query.

Remote Command	`:CALCulate:LIMit[1]|2|…|6:UPPer[:DATA] <ampl>, <ampl>, …` `:CALCulate:LIMit[1]|2|…|6:UPPer[:DATA]?`
Example	`:CALC:LIM:UPP -10, -10, -20, -20` describes the amplitude values of an upper limit line
Preset	Limit line data is cleared by Restore Mode Defaults
State Saved	Saved in instrument state

Remote Command	`:CALCulate:LIMit[1]|2|…|6:UPPer:POINts?`
Example	`:CALC:LIM:UPP:POIN?` returns the number of points in the upper limit line
Preset	Upper Limit line data/points is cleared by Restore Mode Defaults
State Saved	Saved in instrument state

Remote Command	`:CALCulate:LIMit[1]|2|…|6:LOWer[:DATA] <ampl>, …` `:CALCulate:LIMit[1]|2|…|6:LOWer[:DATA]?`
Example	`:CALC:LIM:LOW -10, -10, -20, -20` describes the amplitude values of a lower limit line
Preset	Limit line data is cleared by Restore Mode Defaults
State Saved	Saved in instrument state

Remote Command	`:CALCulate:LIMit[1]|2|…|6:LOWer:POINts?`
Example	`:CALC:LIM:UPP:POIN?` returns the number of points in the lower limit line
Preset	Limit line data/points is cleared by Restore Mode Defaults
State Saved	Saved in instrument state

Limit Fail? (Remote Query Only)

Tests a limit line against its associated trace. Returns a 0 if the trace is within the limit and margin, a 1 if the trace exceeds either the limit or the margin. This query is identical to `:CALC:LLIN:FAIL?`

Note that this query only tests one limit line – other limit lines are not tested when executing this command. To see whether a trace passed all limits, use `:CALCulate:TRACe:FAIL?`.

Note this query performs the test regardless of whether the trace or the limit is turned on the display.

Remote Command	`:CALCulate:LIMit[1]|2|…|6:FAIL?`
Example	`:CALC:LIM:FAIL?` returns a zero if limit line 1's associated trace has no failure, 1 if there is a margin or limit failure
Couplings	This query is identical to `:CALC:LLIN:FAIL?`

Limit Clear (Remote Command Only)

Clears a limit line, and all associated data. Identical to `:CALC:LLIN:DEL`

Remote Command	`:CALCulate:LIMit[1]|2|…|6:CLEar`
Example	`:CALC:LIM2:CLE` deletes all data for limit line 2
Couplings	Identical to `:CALC:LLIN:DEL`

Trace Fail (Remote Query Only)

Tests a trace against all associated limit lines. Returns 0 if the trace is within all limits and margins, 1 if the trace exceeds either the limit or the margin. If no limits apply to the selected trace, automatically returns 0.

Only applies to limits that are turned on, if a Limit is off it will not be tested. If a Trace is not displaying, it will still be tested, and if **Test Limits (All Limits)** is off the Trace will still be tested.

This command ignores limit lines that are assigned to other traces.

Remote Command	`:CALCulate:TRACe[1]|2|…|6:FAIL?`
Example	`:CALC:TRAC3:FAIL?` returns zero if there is no failure, 1 if the trace exceeds either the limit or the margin

3.2.8.3 Meas Standard

Includes controls for setting the Radio Standard for PowerSuite measurements, as well as controls for setting the EMC Standard and CISPR Preset to which the current measurement will be made.

The EMC Standard and CISPR Preset controls only appear with Option EMC or the N6141A application or the W6141A application installed and licensed.

Dependencies	Only appears if you have the proper option installed in your instrument

Radio Standard Presets

Lets you specify the Radio Standard to be used. Spectrum Analyzer Mode supports many Radio Standards. You can select the desired Radio Standard using the **Radio Std Presets** dialog, which is a cascading list of standards. When you have the selected the desired Standard, press **OK** and the measurement settings will change to reflect that standard.

Remote Command	`[:SENSe]:RADio:STANdard[:SELect] NONE | JSTD | IS95a | IS97D | IS98D | GSM | W3GPP | C2000MC1 | C20001X | NADC | PDC | BLUEtooth | TETRa | WL802DOT11A | WL802DOT11B | WL802DOT11G | HIPERLAN2 | DVBTLSN | DVBTGPN | DVBTIPN | FCC15 | SDMBSE | UWBINDOOR | LTEB1M4 | LTEB3M | LTEB5M | LTEB10M | LTEB15M | LTEB20M | WL11N20M | WL11N40M | WL11AC20M | WL11AC40M | WL11AC80M | WL11AC160M | WL11AX20M | WL11AX40M | WL11AX80M | WL11AX160M | WL11BE20M | WL11BE40M | WL11BE80M | WL11BE160M | WL11BE320M | WL11AD2G | WL11AY2G16 | WL11AY4G32 | WL11AY6G48 | WL11AY8G64 | NR5GFR1B100M` `[:SENSe]:RADio:STANdard[:SELect]?`

Example	`:RAD:STAN NONE` `:RAD:STAN?`
Dependencies	Some selections appear only when support license is valid
Couplings	By changing the radio standard, the measurement parameters will be automatically set to an appropriate default value
State Saved	Saved in instrument state

The **Radio** column in the table lets you specify the device to be used. It is a global setting that affects the Device selection, between Mobile (MS) and Base Station (BTS) settings, for all relevant PowerSuite measurements. The Device SCPI command has the same effect as a selection in the **Radio** column:

Remote Command	`[:SENSe]:RADio:STANdard:DEVice BTS | MS` `[:SENSe]:RADio:STANdard:DEVice?`
Example	`:RAD:STAN:DEV MS` `:RAD:STAN:DEV?`
Preset	`BTS`
State Saved	Saved in instrument state
Range	`BTS|MS`

Chart for Standard and Available Measurements

Note that not every measurement in Spectrum Analyzer Mode is available for every standard. The chart below describes which measurements are available for each Radio Standard.

For TOI or Harmonics measurements, *no* Radio Standards are available.

	Swept SA	CHP	OBW	ACP	CCDF	Burst Power	Spurious Emission	SEM	List Sweep
None	X	X	X	X	X	X	X	X	(X)
3GPP 5G NR	(X)	X	X	X	X			X	(X)
3GPP LTE	(X)	X	X	X	X			X	(X)
3GPP W-CDMA	(X)	X	X	X	X	X		X	(X)
GSM/EDGE	(X)				X	X			(X)
cdma2000 1x	(X)	X	X	X	X	X			(X)
IS-95A	(X)	X	X	X	X	X			(X)
J-STD-008	(X)	X	X	X	X	X			(X)
IS-97D/98D	(X)	X	X	X	X				(X)
NADC	(X)	X	X	X	X	X			(X)
PDC	(X)	X	X	X	X	X			(X)

	Swept SA	CHP	OBW	ACP	CCDF	Burst Power	Spurious Emission	SEM	List Sweep
Bluetooth	(X)				X	X			(X)
W-LAN 802.11a	(X)							X	(X)
W-LAN 802.11b	(X)							X	(X)
W-LAN 802.11g	(X)							X	(X)
W-LAN 802.11n	(X)	X	X		X			X	(X)
W-LAN 802.11ac	(X)	X	X		X			X	(X)
W-LAN 802.11ax	(X)	X	X		X			X	(X)
W-LAN 802.11be	(X)	X	X		X			X	(X)
W-LAN 802.11ad	(X)	X	X		X			X	(X)
W-LAN 802.11ay	(X)	X	X		X			X	(X)
W-LAN HiperLAN/2	(X)							X	(X)
TETRA	(X)	X		X					(X)
DVB-T L/SECAM/NICAM	(X)	X			X				(X)
FCC Part 15 Subpart F	(X)	X			X				(X)
DVBT-T G/PAL/NICAM	(X)	X			X				(X)
DVB-T I/PAL/NICAM	(X)						X		(X)
S-DMB System E	(X)	X	X	X					(X)
UWB Indoor	(X)						X		(X)

General Radio Standards

The table below lists the settings and provides an example for each general Radio Standard.

None	Command Example	:RAD:STAN NONE
	IBW	2 MHz
	Span	3 MHz
	RBW	Auto rules
	VBW	Auto rules
TETRA	Command Example	:RAD:STAN TETR
	IBW	18 kHz
	Span	27 kHz
	RBW	1.2 kHz
	VBW	Auto rules
	RRC Filter	On
	RRC Filter Alpha	0.35
FCC Part15 Subpart F	Command Example	:RAD:STAN FCC15

Video Radio Standards

The table below lists the settings and provides an example for each video Radio Standard.

DVB-T L/SECAM/NICAM	Command Example	:RAD:STAN DVBTLSN
	IBW	7.61 MHz
	Span	24 MHz
	RBW	3.9 kHz
	VBW	Auto rules
	Sweep Points	8001
DVB-T G/PAL/NICAM	Command Example	:RAD:STAN DVBTGPN
	IBW	7.61 MHz
	Span	24 MHz
	RBW	3.9 kHz
	VBW	Auto rules
	Sweep Points	8001
DVB-T I/PAL/NICAM	Command Example	:RAD:STAN DVBTIPN
	IBW	7.61 MHz
	Span	24 MHz
	RBW	3.9 kHz
	VBW	Auto rules
	Sweep Points	8001

S-DMB System E	Command Example	:RAD:STAN SDMBSE
	IBW	25 MHz
	Span	37.5 MHz
	RBW	360 kHz
	VBW	Auto rules
	RRC Filter	Off
	RRC Filter Alpha	0.22

Cellular Radio Standards

The table below lists the CHP settings and provides an example for each cellular Radio Standard.

GSM/EDGE	Command Example	:RAD:STAN GSM
3GPP 5G NR	Command Example	:RAD:STAN NR5GFR1B100M
	IBW	100 MHz
	Span	150 MHz
	RBW	Auto rules
	VBW	Auto rules
3GPP W-CDMA	Command Example	:RAD:STAN W3GPP
	IBW	5 MHz
	Span	7.5 MHz
	RBW	240 kHz
	VBW	Auto rules
	RRC Filter	Off
	RRC Filter Alpha	0.22
3GPP LTE 1.4 MHz	Command Example	:RAD:STAN LTEB1M4
	IBW	1.4 MHz
	Span	2.1 MHz
	RBW	Auto rules
	VBW	Auto rules
3GPP LTE 3 MHz	Command Example	:RAD:STAN LTEB3M
	IBW	3 MHz
	Span	4.5 MHz
	RBW	Auto rules
	VBW	Auto rules

3GPP LTE 5 MHz	Command Example	:RAD:STAN LTEB5M
	IBW	5 MHz
	Span	7.5 MHz
	RBW	Auto rules
	VBW	Auto rules
3GPP LTE 10 MHz	Command Example	:RAD:STAN LTEB10M
	IBW	10 MHz
	Span	15 MHz
	RBW	Auto rules
	VBW	Auto rules
3GPP LTE 15 MHz	Command Example	:RAD:STAN LTEB15M
	IBW	15 MHz
	Span	22.5 MHz
	RBW	Auto rules
	VBW	Auto rules
3GPP LTE 20 MHz	Command Example	:RAD:STAN LTEB20M
	IBW	20 MHz
	Span	30 MHz
	RBW	Auto rules
	VBW	Auto rules
cdma2000	Command Example	:RAD:STAN C20001X :RAD:STAN C2000MC1 :RAD:STAN? (Query always returns C20001X)
	IBW	1.23 MHz
	Span	1.845 MHz
	RBW	24 kHz
	VBW	Auto rules
IS-95A	Command Example	:RAD:STAN IS95
	IBW	1.23 MHz
	Span	1.845 MHz
	RBW	24 kHz
	VBW	Auto rules

J-STD-008	Command Example	:RAD:STAN JSTD
	IBW	1.23 MHz
	Span	1.845 MHz
	RBW	24 kHz
	VBW	Auto rules
NADC	Command Example	:RAD:STAN NADC
	IBW	32.8 kHz
	Span	49.2 kHz
	RBW	1.2 kHz
	VBW	Auto rules
PDC	Command Example	:RAD:STAN PDC
	IBW	21 kHz
	Span	31.5 kHz
	RBW	6.2 kHz
	VBW	Auto rules
IS-97D/98D	Command Example	:RAD:STAN IS97D :RAD:STAN IS98D :RAD:STAN IS95C :RAD:STAN? Query always returns `IS97D`
	IBW	1.23 MHz
	Span	1.845 MHz
	RBW	24kHz
	VBW	Auto rules

Band Class (IS-97D/98D only)

The following function is only available when you have selected the standard: IS-97D/98D. It lets you select the band class.

Remote Command	`[:SENSe]:RADio:STANdard:BAND:CLASs BC0 | BC1` `[:SENSe]:RADio:STANdard:BAND:CLASs?`
Example	`:RAD:STAN:BAND:CLAS BC0` `:RAD:STAN:BAND:CLAS?`
Preset	`BC0`
State Saved	Saved in instrument state
Range	0 (800 MHz Band)|1 (1900 MHz Band)

Wireless Radio Standards

The table below lists the CHP settings and provides an example for each wireless Radio Standard.

WLAN 802.11a	Command Example	:RAD:STAN WL802DOT11A
	IBW	20 MHz
	Span	30 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11g	Command Example	:RAD:STAN WL802DOT11G
	IBW	20 MHz
	Span	30 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11b	Command Example	:RAD:STAN WL802DOT11B
	IBW	25 MHz
	Span	37.5 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11n 20 MHz	Command Example	:RAD:STAN WL11N20M
	IBW	20 MHz
	Span	30 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11n 40 MHz	Command Example	:RAD:STAN WL11N40M
	IBW	40 MHz
	Span	60 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11ac 20 MHz	Command Example	:RAD:STAN WL11AC20M
	IBW	20 MHz
	Span	30 MHz
	RBW	100 kHz
	VBW	Auto rules

WLAN 802.11ac 40 MHz	Command Example	:RAD:STAN WL11AC40M
	IBW	40 MHz
	Span	60 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11ac 80 MHz	Command Example	:RAD:STAN WL11AC80M
	IBW	80 MHz
	Span	120 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11ac 160 MHz	Command Example	:RAD:STAN WL11AC160M
	IBW	160 MHz
	Span	240 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11ax 20 MHz	Command Example	:RAD:STAN WL11AX20M
	IBW	20 MHz
	Span	30 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11ax 40 MHz	Command Example	:RAD:STAN WL11AX40M
	IBW	40 MHz
	Span	60 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11ax 80 MHz	Command Example	:RAD:STAN WL11AX80M
	IBW	80 MHz
	Span	120 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11ax 160 MHz	Command Example	:RAD:STAN WL11AX160M
	IBW	160 MHz
	Span	240 MHz
	RBW	100 kHz
	VBW	Auto rules

WLAN 802.11be 20 MHz	Command Example	:RAD:STAN WL11BE20M
	IBW	20 MHz
	Span	30 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11be 40 MHz	Command Example	:RAD:STAN WL11BE40M
	IBW	40 MHz
	Span	60 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11be 80 MHz	Command Example	:RAD:STAN WL11BE80M
	IBW	80 MHz
	Span	120 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11be 160 MHz	Command Example	:RAD:STAN WL11BE160M
	IBW	160 MHz
	Span	240 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11be 320 MHz	Command Example	:RAD:STAN WL11BE320M
	IBW	320 MHz
	Span	480 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11ad 2 GHz	Command Example	:RAD:STAN WL11AD2G
	IBW	2.16 GHz
	Span	3.24 GHz
	RBW	1 MHz
	VBW	Auto rules
WLAN 802.11ay 2.16 GHz	Command Example	:RAD:STAN WL11AY2G16
	IBW	2.16 GHz
	Span	3.24 GHz
	RBW	1 MHz
	VBW	Auto rules

WLAN 802.11ay 4.32 GHz	Command Example	:RAD:STAN WL11AY4G32
	IBW	4.32 GHz
	Span	6.48 GHz
	RBW	1 MHz
	VBW	Auto rules
WLAN 802.11ay 6.48 GHz	Command Example	:RAD:STAN WL11AY6G48
	IBW	6.48 GHz
	Span	9.72 GHz
	RBW	1 MHz
	VBW	Auto rules
WLAN 802.11ay 8.64 GHz	Command Example	:RAD:STAN WL11AY8G64
	IBW	8.64 GHz
	Span	12.96 GHz
	RBW	1 MHz
	VBW	Auto rules
3GPP 5G NR 5G NR FR1 100MHz	Command Example	:RAD:STAN NR5GFR1B100M
	IBW	100 MHz
	Span	150 MHz
	RBW	Auto rules
	VBW	Auto rules

WLAN HiperLAN/2	Command Example	:RAD:STAN HIPERLAN2
	UWB Indoor	Command Example RAD:STAN UWBINDOOR
	Bluetooth	Command Example RAD:STAN BLUE

Packet Type (Bluetooth only)

The command below sets the packet type for the Bluetooth measurement

Remote Command	[:SENSe]:RADio:STANdard:PACKet DH1 | DH3 | DH5 [:SENSe]:RADio:STANdard:PACKet?
Example	:RAD:STAN:PACK DH1 :RAD:STAN:PACK?
Notes	The packet length is: DH1 366 µs

	DH3	1622 µs
	DH5	2870 µs
Preset	DH1	
State Saved	Saved in instrument state	
Range	DH1 | DH3 | DH5	

Radio Standard Presets Hierarchy

General	None	
	TETRA	BTS
		MS
	FCC Part 15 Subpart F	
	APCO-25	
	DMR	
	dPMR	
Video	DVB-T	L/SECAM/NICAM
		G/PAL/NICAM
		I/PAL/NICAM
	S-DMB System E	

Cellular	3GPP 5G NR	BTS	FR1 100 MHz
		MS	FR1 100 MHz
	3GPP LTE	BTS	1.4 MHz (6 RB)
			3 MHz (15 RB)
			5 MHz (25 RB)
			10 MHz (50 RB)
			15 MHz (75 RB)
			20 MHz (100 RB)
		MS	1.4 MHz (6 RB)
			3 MHz (15 RB)
			5 MHz (25 RB)
			10 MHz (50 RB)
			15 MHz (75 RB)
			20 MHz (100 RB)
	3GPP W-CDMA	BTS	
		MS	
	GSM/EDGE	BTS	
		MS	
	cdma2000 1x	BTS	
		MS	
	IS-95A	BTS	
		MS	
	J-STD-008	BTS	
		MS	
	IS-97D/98D	BTS	Band Class 0
			Band Class 1
		MS	Band Class 0
			Band Class 1
	NADC	BTS	
		MS	
	PDC	BTS	
		MS	

Wireless	W-LAN	802.11a	
		802.11b	
		802.11g	
		802.11n	20 MHz
			40 MHz
		802.11ac	20 MHz
			40 MHz
			80 MHz
			160 MHz
		802.11ax	20 MHz
			40 MHz
			80 MHz
			160 MHz
		802.11be	20 MHz
			40 MHz
			80 MHz
			160 MHz
			320 MHz
		802.11ad	
		802.11ay	2.16 GHz
			4.32 GHz
			6.48 GHz
			8.64 GHz
		HiperLAN/2	
	Bluetooth	DH1	
		DH3	
		DH5	
	UWB Indoor		

Each Radio Standard has the preset parameter set for the measurement.

When a standard is selected, the default value of the measurement parameters are overwritten by those preset values.

When the standard is NONE, or the standard does not specify the firm RBW requirement, then the table displays “auto”, and the following definition is used to compute the proper RBW setting:

1. Compute the guard-band = [Offset Freq A] - 0.5*([Chan Integ BW] + [Ref BW])
2. Divide by 4.5. Call the result GuardbandGoalRBW

3. Compute the greater of the Reference and Offset A integration bandwidths. Divide that result by 100 and call it the ChannelWidthGoalRBW
4. Find the smallest integration bandwidth of any of the offsets; divide it by two and call the result IntegBWGoalRBW
5. Compute AutoRBWGoal = min(IntegBWGoal, max(GuardbandGoalRBW, ChannelWidthGoalRBW))
6. Compute the RBW to be selected to be the largest available RBW that is smaller than AutoRBWGoal

Measurements that are unavailable for a particular Radio Standard are grayed-out. Radio Standards that are unavailable for the current active measurement are also grayed-out.

However, remote operations, such as `:CONF` allow the measurement to be active even if it is not a supported format. In this case, the measurement configuration should be set to `NONE`.

Enable Non-Std Meas

Lets you specify whether all measurements and radio standards are enabled or not.

By default, **Enable Non-Std Measurements** is set to `NO`, so you can select only valid combinations of preset available standards and measurements. Combinations of measurement and standard that would have no valid preset value are grayed-out.

When **Enable Non-Std Measurements** is set to `YES`, all measurements and standard selections are enabled, so you can select any combination.

NOTE **If you select an unavailable measurement or unavailable radio standard using the Enable Non-Std Meas control, the measurement results may not conform to the selected standard.**

Remote Command	`[:SENSe]:RADio:STANdard:EAMeas YES | NO` `[:SENSe]:RADio:STANdard:EAMeas?`
Example	`:RAD:STAN:EAM YES` `:RAD:STAN:EAM?`
Preset	`NO`
State Saved	Saved in instrument state
Range	`YES|NO`

EMC Standard

Lets you select NONE (no EMI standard), CISPr (CISPR 16-1-1), or MIL (MIL-461A). Each standard has a unique way of determining the couplings between detectors and RBWs, as well as its own set of available RBWs.

Note that "Auto Couple" on page 1995 has no effect on the EMC Standard setting.

Remote Command	`[:SENSe]:EMC:STANdard[:SELect] NONE | CISPr | MIL` `[:SENSe]:EMC:STANdard[:SELect]?`
Example	`:EMC:STAN CISP`
Dependencies	When the **EMC Standard** changes to **CISPR** or **MIL**, the **RBW Filter Type** and **RBW BW** controls are grayed-out. The **Filter Type** is then always Gaussian; the **Filter BW** is chosen as appropriate for the filter and the standard. See the **BW** key description When the EMC Standard changes to **None**, the **Filter Type** is set to Gaussian and the Filter BW is set to -3 dB Only appears with Option EMC installed and licensed. If not, the command generates a message
Couplings	The auto rules for detector select Peak for any trace in Auto when the EMI Standard is CISPR or MIL Choosing a CISPR detector or CISPR presets automatically picks the CISPR Standard, however switching from a CISPR detector has no impact on EMC Standard
State Saved	Saved in instrument state

Backwards Compatibility Command

Notes	This command is mapped to `:EMC:STANdard` with the following mappings: EMI=>CISPr, SAN =>None, and if the legacy command comes in with the OFF parameter, it sets EMC Standard to None and Res BW to Manual . The query returns "OFF" if Res BW in Manual, otherwise "EMI" if EMC Standard is CISPR or MIL, and "SAN" if EMC Standard is None
Dependencies	Only appears in N/W6141A applications or with Option EMC installed and licensed. If not, the command generates a message
Preset	`SAN`
Backwards Compatibility SCPI	`[:SENSe]:BANDwidth|BWIDth[:RESolution]:MODE EMI | SAN | OFF` `[:SENSe]:BANDwidth|BWIDth[:RESolution]:MODE?`

CISPR Presets

This group of controls lets you easily set up the instrument for CISPR measurements.

This topic contains the following sections:

- "Controls in the CISPR Group" on page 424
- "Band Setup" on page 424
- "Sweep Points in Band E" on page 425

Remote Command	`[:SENSe]:FREQuency:CISPr:BAND A | B | C | CD | D | E`
Example	`:FREQ:CISPR:BAND A` activates the CISPR preset for Band A
Couplings	Selecting a CISPR preset sets the EMI Standard to CISPR, performs an autocouple all, and sets the Y Axis Unit to dBµV (unless dBuV is grayed-out, in which case it will leave the Y Axis Unit unaffected)

Controls in the CISPR Group

This group contains controls to set the following Presets:

- CISPR A 9 kHz – 150 kHz
- CISPR B 150 kHz – 30 MHz
- CISPR C 30 MHz – 300 MHz
- CISPR C/D 30 MHz – 1 GHz
- CISPR D 300 MHz – 1 GHz
- CISPR E 1 GHz – 18 GHz

Band Setup

The number of sweep points for each band is roughly calculated by the formula 2*(Stop Frequency-Start Frequency)/RBW, so that you get two points for every RBW width. This number is increased as necessary to make it an odd integer, so that you always end up with an odd number of sweep points. This is desirable so that you always have a sweep point at the Center Freq.

Band Setup	Band A	Band B	Band C	Band D	Band C&D	Band E
Start Frequency	9 kHz	150 kHz	30 MHz	300 MHz	30 MHz	1 GHz
Stop Frequency	150 kHz	30 MHz	300 MHz	1 GHz	1 GHz	Max freq of instrument or 18 GHz, whichever is lower
Sweep Points	1411	6635	4501	11667	16167	See below

The table above is based on the fact that the Res BW autocouples to the center frequency when in the CISPR EMC standard as follows:

Center Frequency	RBW
<150 kHz	200 Hz
150 kHz to 30 MHz	9 kHz
>30 MHz to 1 GHz	120 kHz
>1 GHz	1 MHz

Sweep Points in Band E

Note that the Res BW is 1 MHz in band E. The number of sweep points for band E is dependent on the maximum frequency of the instrument. The formula above gives the following values for Band E:

Option	Max Instrument Freq (nominal)	Width of Band E	Number of Points
503 (3.0 GHz models)	3.0 GHz	2.0 GHz	4001
503 (3.6 GHz models	3.6 GHz	2.6 GHz	5201
507 (7 GHz models)	7.0 GHz	6.0 GHz	12001
507 (7.5 GHz models)	7.5 GHz	6.5 GHz	13001
508	8.4 GHz	7.4 GHz	14801
513	13.2 GHz	12.2 GHz	24401
526	26.5 GHz	17 GHz	34001
544 (and above)	44 GHz	43 GHz	40001 (max)

3.2.8.4 Legacy Compat (Compatibility)

Contains controls for setting the Legacy Compatibility functions, which let you modify certain behaviors to exactly match our legacy products.

Certain behaviors in the X-Series instruments were changed from legacy HP/Agilent analyzers, in order to give you access to new, more powerful functionality. Keysight recognizes that from time to time, it is necessary to *exactly* match legacy behaviors, which is what the controls on this tab accomplish.

Average/Hold

In X-Series instruments, Max Hold and Min Hold traces were added to the trace types that were controlled by the Average Number (which became the Average/Hold Number). In other words, setting an Average/Hold number of 100 and then performing a Max Hold in Single sweep takes 100 traces and then stops, and pressing Restart restarts the Max Hold Sequence. This allows the user to exactly control how the number of Max Hold traces taken; however, many users need a way of stopping and then resuming a Max/Min Hold without clearing the accumulated result.

In the past you could stop and start Max Hold by going back and forth between **Single** and **Continuous**. Currently, neither X-Series nor legacy instruments like ESA and PSA clear the Max or Min Hold when going from **Cont** to **Single** and *vice versa*; so, you can go to **Single** to stop temporarily and then resume the Max or Min Hold by going back to **Cont**. However, in X-Series, because Max and Min Hold obey the **Average/Hold Number**, this is not an effective method for stopping a sweep, until you have reached the terminal count. Also, **Restart** is sometimes used as part of this method and in the X-Series, **Restart** clears the accumulated Max/Min Hold, whereas in the PSA (for example) it does not.

The **Average/Hold** switch in the **Legacy Compatibility** menu solves this problem. When this switch is **On**, the following is true for traces in Max Hold or Min Hold:

– They pay no attention to the Average/Hold number; “Single” for Max Hold and Min Hold causes one sweep only, so going to **Single** stops after the current sweep, and going to **Cont** starts you going again without clearing the accumulated result

– They do not clear the Max or Min Hold on **Restart** or **Single**, or `:INIT:IMM` (changing a measurement parameter like frequency or bandwidth, etc. would still restart the max/min hold)

Note that whenever any trace is in Average, the **Single/Cont** controls *do* tie in to the **Avg/Hold Number**, and pressing **Single***does* cause a set of sweeps (100 by default). This is also true in PSA.

Remote Command	`:CONTrol:COMPatible:TRACe ON | OFF | 1 | 0` `:CONTrol:COMPatible:TRACe?`
Example	`:CONT:COMP:TRAC ON` `ON` means exhibit legacy average/hold behavior
Preset	Unaffected by **Mode Preset**. Set to `OFF` by **Restore Mode Defaults**
State Saved	Saved in State

Detector

In the HP/Agilent ESA Spectrum Analyzer, the default detector is **Peak**. In later instruments, **Normal** (which does alternate peak and pit detection) is the default, but ESA did not have this detector. For ESA compatibility, the **Detector** switch in the **Legacy Compatibility** menu causes the Detector Auto Rules to select the **Peak** detector instead of the **Normal** detector for the conditions under which the **Normal** detector would otherwise be chosen.

This means that when you have this switch on, performing **Mode Preset** causes the **Peak** detector to be chosen, rather than the **Normal** detector, just like ESA.

Remote Command	`:CONTrol:COMPatible:DETector ON | OFF | 1 | 0` `:CONTrol:COMPatible:DETector?`
Example	`:CONT:COMP:DET ON` `ON` means exhibit ESA detector behavior
Preset	Unaffected by **Mode Preset**. Set to `OFF` by **Restore Mode Defaults**
State Saved	Saved in State

*RST

In older HP/Agilent/Keysight Spectrum Analyzers, sending `*RST` (to preset the analyzer) puts the analyzer in **Continuous** sweep mode. To be compliant with the IEEE-488.2 specification, X-Series instruments put the instrument into **Single** sweep mode on `*RST`.

For backwards compatibility, when the `*RST` switch in the **Legacy Compatibility** menu is `ON`, the `*RST` command puts the instrument into **Continuous** sweep mode.

Remote Command	`:CONTrol:COMPatible:RST ON | OFF | 1 | 0` `:CONTrol:COMPatible:RST?`
Example	`:CONT:COMP:RST ON` `ON` means exhibit pre-X-series `*RST` behavior
Preset	Unaffected by **Mode Preset**. Set to `OFF` by **Restore Mode Defaults**
State Saved	Saved in State

3.2.8.5 Tune & Listen

Contains controls to turn the demod function on and off and select modulation type and configure the demod bandwidth. This tab only appears if N9063C Analog Demod Mode, N6141C Mode, or Option EMC is installed and licensed.

Does not appear in instruments that do not contain a speaker, such as VXT, EXM, UXM and CXA-m.

When the function is `ON` (set to AM, FM, or ΦM), the demodulated signal is fed to the instrument's speaker. Muting and volume control functions are done through the standard Windows speaker volume control interface.

Demod Type

Sets the type of Demod to be performed for the Tune & Listen function.

Remote Command	`[:SENSe]:DEMod AM | FM | PM | OFF` `[:SENSe]:DEMod?`
Example	`:DEM AM` turns amplitude demodulation function ON
Dependencies	When **Tune & Listen** is ON, all active traces are forced to use the same detector CISPR detectors (QPD, EMI Avg, RMS Avg) and Tune & Listen are mutually exclusive. No sound output is heard if one of these detectors is selected
Preset	OFF
State Saved	Saved in instrument state
Backwards Compatibility SCPI	`[:SENSe]:DEMod:STATe ON | 1 | OFF | 0` `[:SENSe]:DEMod:STATe?`
Backwards Compatibility Notes	Sending `DEM:STAT ON` has the same effect as sending `DEM:AM,` turning AM Demod ON Sending `DEM:STAT OFF` has the same effect as sending `DEM:OFF,` turning Demod OFF The query returns the state of the Analog Demod Tune and Listen function. The response to the query is determined by the current setting of `[:SENSE]:DEMod AM|FM|PM|OFF`. The response is 1 if `AM, FM, PM` are selected, or 0 if `OFF` is selected. In ESA, the command [:SENSe]:`DEMod AM|FM` would select the demodulation type but would not activate it (turn it on). In X-Series this command both selects and activates demodulation The X-Series implementation of Demod Tune and Listen does not include Squelch Control as was supported in ESA The speaker control for Tune and Listen for X-Series is done with the volume up/down and mute hardkeys in the System Settings dialog and is handled by the Windows operating system. There is no software speaker on/off control as was supported in ESA

Demod Time

Sets the amount of time the instrument demodulates the signal after each sweep for the Tune & Listen function. The demodulated signal can be heard through the speaker during demodulation. In zero span, demodulation can be performed continuously, making this parameter not applicable, hence it is grayed-out in zero span.

Remote Command	`[:SENSe]:DEMod:TIME <time>` `[:SENSe]:DEMod:TIME?`
Example	`:DEM:TIME 500 ms` `:DEM:TIME?`
Notes	Grayed-out in **Zero Span**
Dependencies	Unavailable in **Zero Span**
Preset	500 ms
State Saved	Saved in instrument state

Min	2 ms
Max	100 s

AM Channel BW

Sets the RBW setting used by the hardware during the demodulation period in nonzero spans for the Tune & Listen function. Note that this is a separate parameter only for the demodulation function and does not affect the RBW setting in the BW menu which is used during the normal sweep. The flat top filter type must be used during the demodulation period. A 5 kHz Video Bandwidth filter is used.

In Zero Span, the instrument's RBW & VBW filters are used for the demodulation; thus, the Channel BW (and RBW filter type) will match those of the instrument. This allows gap-free listening. The Channel BW control is grayed-out and the value displayed on the control matches the current RBW of the instrument. Upon leaving zero span, the non-zero-span setting of Channel BW is restored as well as the flattop filter type.

Remote Command	`[:SENSe]:DEMod:AM:BANDwidth:CHANnel <freq>` `[:SENSe]:DEMod:AM:BANDwidth:CHANnel?`
Example	`:DEM:AM:BAND:CHAN 200 kHz`
Notes	Grayed-out in **Zero Span**
Dependencies	Unavailable in **Zero Span**
Couplings	In **Zero Span** only, the value is set equal to the instrument's current RBW value and it displays that value on the control, but the control is grayed-out
Preset	30 kHz
State Saved	Saved in instrument state
Min	390 Hz
Max	8 MHz

FM Channel BW

Sets the **Res BW** setting used by the hardware during the demodulation period in nonzero spans for the **Tune & Listen** function. Note that this is a separate parameter only for the demodulation function and does not affect the RBW setting in the BW menu which is used during the normal sweep. The flat top filter type must be used during the demodulation period. A 5 kHz Video Bandwidth filter is used.

In **Zero Span**, the instrument's RBW & VBW filters are used for the demodulation; thus, the Channel BW (and RBW filter type) will match those of the instrument. This allows gap-free listening. The Channel BW control is grayed-out and the value displayed on the control matches the current RBW of the instrument. Upon leaving zero span, the previous setting of Channel BW and the flattop filter type are restored.

Remote Command	`[:SENSe]:DEMod:FM:BANDwidth:CHANnel <freq>` `[:SENSe]:DEMod:FM:BANDwidth:CHANnel?`
Example	`:DEM:FM:BAND:CHAN 200 MHz`
Notes	Grayed-out in **Zero Span**
Dependencies	Unavailable in **Zero Span**
Couplings	In **Zero Span** only, the value is set equal to the instrument's current RBW value and it displays that value on the control, but the control is grayed-out
Preset	150 kHz
State Saved	Saved in instrument state
Min	390 Hz
Max	8 MHz

PM Channel BW

Sets the RBW setting used by the hardware during the demodulation period in nonzero spans for the Tune & Listen function. Note that this is a separate parameter only for the demodulation function and does not affect the RBW setting in the BW menu which is used during the normal sweep. The flat top filter type must be used during the demodulation period. A 5 kHz Video Bandwidth filter is used.

In **Zero Span**, the instrument's RBW & VBW filters are used for the demodulation; thus, the Channel BW (and RBW filter type) will match those of the instrument. This allows gap-free listening. The Channel BW control is grayed-out and the value displayed on the control matches the current RBW of the instrument. Upon leaving zero span, the previous setting of Channel BW and the flattop filter type are restored.

Remote Command	`[:SENSe]:DEMod:PM:BANDwidth:CHANnel <freq>` `[:SENSe]:DEMod:PM:BANDwidth:CHANnel?`
Example	`:DEM:PM:BAND:CHAN 200 MHz`
Notes	Grayed-out in **Zero Span**
Dependencies	Unavailable in **Zero Span**
Couplings	In **Zero Span** only, the value is set equal to the instrument's current RBW value and it displays that value on the control, but the control is grayed-out
Preset	100 kHz
State Saved	Saved in instrument state
Min	390 Hz
Max	8 MHz

FM Demod De-emphasis

Controls a single-pole filter (6 dB/octave roll off) for the **Tune & Listen** function, usually to counter intentional pre-emphasis in the transmitter. When De-emphasis state is `OFF`, the hardware digital filter is bypassed, otherwise the setting is applied.

The choices are Off, 25 µs, 50 µs, 75 µs, and 750 µs.

Only available when FM is the demod selected. Grayed-out for AM and PM.

Remote Command	`[:SENSe]:DEMod:FM:DEEMphasis OFF | US25 | US50 | US75 | US750` `[:SENSe]:DEMod:FM:DEEMphasis?`
Example	`:DEM:FM:DEEM US75` Sets the de-emphasis for FM demod to 75 µs
Dependencies	Only available in FM. Grayed-out for AM and PM
Preset	`US75` recommended for US commercial FM 75 µs pre-emphasis
State Saved	Saved in instrument state

3.2.8.6 Advanced

Contains controls for setting advanced functions of the instrument.

Does not appear in instruments that do not contain **Advanced** functions. Most of the modular instruments (including VXT models M9410A/11A) fall into this category, as does UXM.

Phase Noise Optimization

Selects the LO (local oscillator) phase noise behavior for various desired operating conditions.

For full details, see "Parameter Options, Installed Options, Auto Rules & Ranges" on page 432 below.

Remote Command	`[:SENSe]:FREQuency:SYNThesis[:STATe] 1 | … | 5` `[:SENSe]:FREQuency:SYNThesis[:STATe]?`
Example	`:FREQ:SYNT 2` selects optimization for best wide offset phase noise
Dependencies	Does not appear in all models. The control is not displayed in those models, but the command is accepted for compatibility (although no action is taken)
Preset	Because this function is in Auto after preset, and because **Span** after preset > 314.16 kHz (see Auto

	rules, next section) the state of this function after Preset will be 2
Range	See "Ranges" on page 436 below
Annotation	Found in the Meas Bar under **PNO** When not in Auto, label changes to **#PNO**

Auto Function

Remote Command	`[:SENSe]:FREQuency:SYNThesis:AUTO[:STATe] OFF | ON | 0 | 1` `[:SENSe]:FREQuency:SYNThesis:AUTO[:STATe]?`
Example	`:FREQ:SYNT:AUTO ON`
Preset	`ON`

Parameter Options, Installed Options, Auto Rules & Ranges

The Phase Noise Optimization control lets you optimize the setup and behavior of the Local Oscillator (LO) depending on your specific measurement conditions. You may wish to trade off noise and speed, for example, to make a measurement faster without regard to noise or with optimum noise characteristics without regard to speed.

Parameter Values Summary

Option	#	Description
"Balanced" on page 433	1	– In instruments with EP0, balances close-in phase noise with spur avoidance – In instruments without EP0 optimizes phase noise for small frequency offsets from the carrier
"Best Wide-offset" on page 434	2	Optimizes phase noise for wide frequency offsets from the carrier
"Fast Tuning" on page 434	3	Optimizes LO for tuning speed
"Best Close-in" on page 433	4 or 1*	– In instruments with EP0, emphasizes close-in phase noise performance without regard to spur avoidance – In instruments without EP0, this setting is accepted but no action is taken
"Best Spurs" on page 433	5	– In instruments with EP0, emphasizes spur avoidance over close-in phase noise performance – In instruments without EP0, this setting is accepted but no action taken
Auto	-	Automatically selects LO (local oscillator) phase noise behavior to optimize dynamic range and speed for various instrument operating conditions

*Dependent on Option EP0 installation. See "Best Close-in" on page 433 below.

The actual behavior varies somewhat depending on model number and option; for example, you always get Fast Tuning by choosing Option #3, but in some models, "Fast Tuning" on page 434 is identical in effect to "Best Close-in" on page 433.

Best Close-in

Without option EP0

`:FREQ:SYNT 1`

The LO phase noise is optimized for smaller offsets from the carrier, at the expense of phase noise farther out.

The actual frequency offset within which noise is optimized is shown with in square brackets, as this can vary depending on the hardware set in use. For example, in some instruments this annotation appears as [offset <20 kHz]

With option EP0

`:FREQ:SYNT 4`

In instruments with Option EP0, the LO is configured for the best possible close-in phase noise (offsets up to 600 kHz from the carrier), regardless of spurious products that occur with some center frequencies. Because this is generally less desirable for close-in measurements than the "Balanced" on page 433 setting, parameter 1 selects "Balanced" on page 433 in EP0 instruments, in the interests of optimizing code compatibility across the family. Parameter 4 selects "Best Close-in" on page 433, which is usually not as good a choice as "Balanced" on page 433.

Balanced

`:FREQ:SYNT 1`

In instruments with EP0, the LO is configured for the best possible phase noise at offsets up to 600 kHz from the carrier whenever there are no significant spurs within the span observed with an on-screen carrier. When there will be such a spur, the LO is reconfigured in a way that allows the phase noise to increase by 7 dB mostly within ±1 octave around 400 kHz offset. The spurs will always be below –70 dBc.

Best Spurs

`:FREQ:SYNT 5`

In instruments with EP0, the LO is configured for better phase noise than the "Best Wide-offset" on page 434 case close to the carrier, but the configuration has 11 dB worse phase noise than the "Best Close-in" on page 433 case mostly within ±1 octave around 300 kHz offset. Spurs are even lower than in the "Balanced" on page 433 case at better than –90 dBc, whether or not the carrier is on-screen.

This setting is never selected when Phase Noise Optimization is in Auto, you must select it manually.

Best Wide-offset

`:FREQ:SYNT 2`

The LO phase noise is optimized for wider offsets from the carrier. Optimization is especially improved for offsets from 70 kHz to 300 kHz. Closer offsets are compromised and the throughput of measurements (especially remote measurements where the center frequency is changing rapidly), is reduced.

The actual frequency offset beyond which noise is optimized is shown with in square brackets, as this can vary depending on the hardware set in use. For example, in some instruments this annotation appears as [offset >30 kHz]

In instruments with Option EP0, the LO is configured for the best possible phase noise at offsets up to 600 kHz from the carrier whenever there are no significant spurs within the span observed with an on-screen carrier. When there will be such a spur, the LO is reconfigured in a way that allows the phase noise to increase by 7 dB mostly within ±1 octave around 400 kHz offset. The spurs will always be below –70 dBc.

Fast Tuning

`:FREQ:SYNT 3`

In this mode, the LO behavior compromises phase noise at many offsets from the carrier in order to allow rapid measurement throughput when changing the center frequency or span. The term "Fast Tuning" on page 434 refers to the time it takes to move the local oscillator to the start frequency and begin a sweep; this setting does not impact the actual sweep time in any way.

In instruments with EP1, the LO behavior compromises phase noise at offsets below 4 MHz in order to improve measurement throughput. The throughput is especially affected when moving the LO more than 2.5 MHz and up to 10 MHz from the stop frequency to the next start frequency.

In instruments with Option EP0, this is the same configuration as "Best Spurs" on page 433. It is available with the "Fast Tuning" on page 434 label for convenience, and to make the user interface more consistent with other X-Series instrument family members.

(In models whose hardware does not provide for a "Fast Tuning" on page 434 option, the settings for "Best Close-in" on page 433 are used if "Fast Tuning" on page 434 is selected. This gives the fastest possible tuning for that hardware set.)

Auto

`:FREQ:SYNT:AUTO ON`

Selects the LO (local oscillator) phase noise behavior to optimize dynamic range and speed for various instrument operating conditions. The selection rules are as follows.

Auto Optimization Rules

X-Series instruments have several grades of LO, offering different configurations when in the Auto Mode. The rules for Auto selection are as follows:

Models with Option	Conditions	Selection
EP0 Models with option EP0 have a two stage local oscillator, which switches to a single loop for fast tuning (available in UXA)	Center frequency is < 699.9 kHz	"Balanced" on page 433
	Span > 114.1 MHz, *or* RBW > 800 kHz	"Fast Tuning" on page 434
	RBW > 290 kHz, *or* Span > 4.2 MHz	"Best Wide-offset" on page 434
	Other conditions	"Balanced" on page 433
EP1 Models with option EP1 have a two-loop local oscillator, which switches to a single loop for fast tuning (available in PXA)	Span > 44.44 MHz, *or* RBW > 1.9 MHz, *or* Source Mode is set to “Tracking”	"Fast Tuning" on page 434
	Center frequency is < 195 kHz, *or* CF >= 1 MHz *and* Span <= 1.3 MHz *and* RBW <= 75 kHz	"Best Close-in" on page 433
	All other conditions	"Best Wide-offset" on page 434
EP2 Models with option EP2 use a different loop bandwidth for the fast-tuning choice, which is a compromise between tuning speed and phase noise, giving good tuning speed at all offsets. Although not as good as for "Best Close-in" on page 433; this is useful when you have to look across a wide range of spans (available, for example, in MXA for excellent phase noise)	CF < 130 kHz , *or* CF > 12 MHz *and* Span < 495 kHz *and* RBW < 40 kHz	"Best Close-in" on page 433
	Span > 22 MHz, *or* RBW > 400 kHz, *or* CF ≤ 12 MHz *and* Span < 495 kHz *and* RBW < 23 kHz	"Fast Tuning" on page 434
	All other conditions	"Best Wide-offset" on page 434
EP4 (available in CXA for improved phase noise)	Span > 101 MHz *or* RBW > 1.15 MHz *or* Source Mode is set to “Tracking”	"Fast Tuning" on page 434
	CF is < 109 kHz *or* CF >= 4.95 MHz *and* Span <= 666 kHz *and* RBW < 28 kHz	"Best Close-in" on page 433

Models with Option	Conditions	Selection
	All other conditions	"Best Wide-offset" on page 434
All Other Models Note that in these models, the hardware does not actually provide for an extra-fast tuning option, so the settings for "Fast Tuning" on page 434 are actually the same as "Best Close-in" on page 433, but the rules are implemented this way so that the user who doesn't care about phase noise but does care about tuning speed doesn't have to remember which of the other two settings gives faster tuning	Span > 12.34 MHz, *or* RBW > 250 kHz, *or* Source Mode is set to "Tracking"	"Fast Tuning" on page 434
	Center frequency is < 25 kHz, *or* CF >= 1 MHz *and* Span <= 141.4 kHz *and* RBW <= 5 kHz	"Best Close-in" on page 433
	All other conditions	"Best Wide-offset" on page 434

In all the above cases:

– The RBW to be used in the calculations is the equivalent –3 dB bandwidth of the current RBW filter

– The rules apply whether in swept spans, zero span, or FFT spans

Ranges

Option	Option #	Phase Noise Option	Range
No EPx Option	1	Best Close-in	[offset < 20 kHz]
	2	Best Wide-offset	[offset > 30 kHz]
	3	Fast Tuning	[same as Best Close-In]
EP0	4	Best Close-in	[offset < 600 kHz]
	1	Balanced	[offset < 600 kHz]
	5	Best Spurs	[offset < 600 kHz]
	2	Best Wide-offset	[offset > 800 kHz]
	3	Fast Tuning	[same as Best Close-In]
EP1	1	Best Close-in	[offset < 140 kHz]
	2	Best Wide-offset	[offset > 160 kHz]
	3	Fast Tuning	[single loop]

Option	Option #	Phase Noise Option	Range
EP2, EP3, EP5	1	Best Close-in	[offset < 70 kHz]
	2	Best Wide-offset	[offset > 100 kHz]
	3	Fast Tuning	[medium loop bw]
EP4	1	Best Close-in	[offset < 90 kHz]
	2	Best Wide-offset	[offset > 130 kHz]
	3	Fast Tuning	[same as Best Close-In]

ADC Dither

Controls the **ADC Dither** function, which enhances linearity for low level signals at the expense of reduced clipping-to-noise ratio. The reduced clipping-to-noise ratio results in higher noise, because we work to ensure that the clipping level of the ADC relative to the front terminals remains unchanged with the introduction of dither, and this results in reduced ADC dynamic range. So, making measurements with ADC dither gives you better amplitude linearity, but turning ADC dither off gives you a lower noise floor (better sensitivity).

With dither on, the third-order distortions are usually invisible for mixer levels below –35 dBm. With dither off, these distortions can be visible, with typical power levels of –110 dBm referred to the mixer. Detection nonlinearity can reach 1 dB for dither off at mixer levels around –70 dBm and lower, while the specified nonlinearity is many times smaller with dither on.

When **ADC Dither** is on, the linearity of low-level signals is improved. The enhanced linearity is mostly improved scale fidelity. The linearity improvements of dither are most significant for RBWs of 3.9 kHz and less in swept mode, and FFT widths of 4 kHz and less in FFT mode.

The increased noise due to turning dither on is most significant in low band (0 to 3.6 GHz) with **IF Gain** set to Low, where it can be about 0.2 dB.

Remote Command	`[:SENSe]:ADC:DITHer[:STATe] OFF | ON | HIGH`
	For options, see "Option Details" on page 438
	`[:SENSe]:ADC:DITHer[:STATe]?`

Example	`:ADC:DITH HIGH`
	`:ADC:DITH ON`
	Specifying option `ON` sets Medium dither. In older instruments, the **Medium** key was labeled **On**, and the SCPI for this setting has *not* changed

Dependencies	In some models, the `HIGH` parameter is not available. In some instruments, the `HIGH` parameter is accepted, and the `HIGH` state is set and returned to a query, but the Medium (`ON`) dither level is actually used
Preset	AUTO

Range	OFF|ON|HIGH
Backwards Compatibility SCPI	[:SENSe]:ADC:DITHer AUTO
Backwards Compatibility Notes	The command: [:SENSe]:ADC:DITHer AUTO is aliased to: [:SENSe]:ADC:DITHer:AUTO[:STATe] ON Because of this, the [:SENSe]:ADC:DITHer function cannot be a true Boolean, so the query, [:SENSe]:ADC:DITHer? returns OFF or ON (not 1 or 0 like a true Boolean)

Auto Function

Remote Command	[:SENSe]:ADC:DITHer:AUTO[:STATe] OFF | ON | 0 | 1 [:SENSe]:ADC:DITHer:AUTO[:STATe]?
Example	:ADC:DITH:AUTO ON
Preset	ON

Option Details

Detail on the settings follows:

Auto

Sets the ADC dither to automatic. The instrument then chooses the dither level according to which is most likely to be the best selection, based on other settings within the digital IF.

When in Auto, the instrument sets the dither to Medium whenever the effective IF Gain is Low by this definition of IF Gain = Low:

- When Sweep Type = Swept, IF Gain = Low whenever Swept IF Gain is set to Low Gain, whether by autocoupling or manual selection
- When Sweep Type = FFT, IF Gain = Low whenever FFT IF Gain is set to "Low Gain," which cannot happen by autocoupling

Whenever the IF Gain is not Low by this definition, Auto sets the dither to Off.

Example	:ADC:DITH:AUTO ON

High (Best Log Accy)

When ADC Dither is set to High, the scale fidelity is especially good, most notably the relative scale fidelity. The tradeoff is that there is a modest loss of noise floor performance, up to about a decibel.

Example	`:ADC:DITH:HIGH`

Medium (Log Accy)

The Medium setting of ADC Dither (known as “On” in earlier versions of the instrument software) improves the linearity of low-level signals at the expense of some noise degradation.

Example	`:ADC:DITH:ON`

Off (Best Noise)

When ADC Dither is Off, the instrument noise floor is improved, because without the need to make room for the dither, you get a lower noise floor and better sensitivity.

Example	`:ADC:DITH:OFF`

Swept IF Gain

To take full advantage of the RF dynamic range of the instrument, there is an added switched IF amplifier with approximately 10 dB of gain. When you can turn it on without overloading the instrument, the dynamic range is always better with it on than off. The **Swept IF Gain** control can be used to set **IF Gain** to Auto, to **High** Gain (the extra 10 dB), or to **Low** Gain. These settings affect sensitivity and IF overloads.

This function is only active when in Swept sweeps. In FFT sweeps, the FFT IF Gain function is used instead.

Option	SCPI	Details
Auto	AUTO = ON	"Auto" on page 440
Low	OFF	"Low Gain (Best for Large Signals)" on page 440
High	ON	"High Gain (Best Noise Level)" on page 440

Remote Command	`[:SENSe]:IF:GAIN:SWEPt[:STATe] OFF | ON | 0 | 1` `[:SENSe]:IF:GAIN:SWEPt[:STATe]?`
Example	`:IF:GAIN:SWEP ON`
Dependencies	The IF Gain keys (FFT IF Gain and Swept IF Gain) have no effect when the U7227A USB Preamplifier is connected. This is not annotated or reflected on any control; there are no keys grayed-out nor any SCPI locked out. The instrument simply behaves as though both FFT IF Gain and Swept IF Gain are set to Low regardless of the setting on the keys
Couplings	The ‘auto’ rules for Swept IF Gain depend on attenuation, preamp state, start and stop frequency and the setting of FFT IF Gain. Set the Swept IF Gain to High (On) when the total input attenuation is 0 dB, the preamp is off, the start frequency is 10 MHz or more, and the FFT IF Gain is autocoupled, or manually set to Autorange, or manually set to High. Also set the Swept IF Gain to High (On) when the

	total input attenuation is 2 dB or less, the preamp is on, the start frequency is 10 MHz or more, and the stop frequency is 3.6 GHz or less and the FFT IF Gain is autocoupled, or manually set to Autorange, or manually set to High. Under all other circumstances, set the Swept IF Gain to Low (Off) If the sweep type is Swept, the start frequency of the instrument is less than 10 MHz, and you put Swept IF Gain in Manual On, a warning condition is generated and remains in effect as long as this condition exists. The warning message is about a possible IF overload As with most parameters with an AUTO state, "Auto Couple" on page 1995 sets it to Auto, and setting any specific value (for example on or off) will set the AUTO state to false
Preset	Auto after a Preset, which yields Off unless the Preamp is on Auto and Off after Meas Preset
State Saved	Saved in instrument state
Range	Low Gain | High Gain
Annunciation	Low | High Found in the Meas Bar under **IF Gain** when in Swept sweep type When not in Auto, label changes to **#IF Gain**

Auto Function

Remote Command	`[:SENSe]:IF:GAIN:SWEPt:AUTO[:STATe] OFF | ON | 0 | 1` `[:SENSe]:IF:GAIN:SWEPt:AUTO[:STATe]?`
Example	`:IF:GAIN:SWEP:AUTO ON`
Preset	`ON`

Auto

Activates the auto rules for Swept IF Gain.

Low Gain (Best for Large Signals)

Forces Swept IF Gain to be off.

Example	`:IF:GAIN:SWEP OFF`

High Gain (Best Noise Level)

Example	`:IF:GAIN:SWEP ON`
Dependencies	The High setting for **Swept IF Gain** is grayed-out when **FFT IF Gain** is manually set to Low (not when Low is chosen by the auto-rules)

FFT IF Gain

Accesses the keys to set the ranging in the digital IF when doing FFT sweeps. When in Autorange mode, the IF checks its range once for every FFT chunk, to provide the best signal to noise ratio. You can specify the range for the best FFT speed, and optimize for noise or for large signals.

When the sweep type is FFT and this function is in **Autorange**, the IF Gain is set `ON` initially for each chunk of data. The data is then acquired. If the IF overloads, then the IF Gain is set `OFF` and the data is re-acquired. Because of this operation, the Auto setting uses more measurement time as the instrument checks/resets its range. You can get faster measurement speed by forcing the range to either the high or low gain setting. But you must know that your measurement conditions will not overload the IF (in the high gain range) and that your signals are well above the noise floor (for the low gain range), and that the signals are not changing.

Option	SCPI	Details
Auto	AUTO = ON	"Auto" on page 442
Autorange	`AUTOrange`	"Autorange (Slower: Follows Signals)" on page 442
Low	`LOW`	"Low Gain (Best for Large Signals)" on page 442
High	`HIGH`	"High Gain (Best Noise Level)" on page 442

Remote Command	`[:SENSe]:IF:GAIN:FFT[:STATe] AUTOrange | LOW | HIGH` `[:SENSe]:IF:GAIN:FFT[:STATe]?`
Example	`:IF:GAIN:FFT ON`
Dependencies	The IF Gain keys (FFT IF Gain and Swept IF Gain) have no effect when the U7227A USB Preamplifier is connected. This is not annotated or reflected on any control; there are no keys grayed-out nor any SCPI locked out. The instrument simply behaves as though both FFT IF Gain and Swept IF Gain are set to Low regardless of the setting on the keys
Couplings	As with most parameters with an `AUTO` state, "Auto Couple" on page 1995 sets it to Auto, which then picks `AUTOrange`, and setting any specific value (`AUTOrange`, `LOW` or `HIGH`) will set the `AUTO` state to false
Preset	`AUTOrange`
State Saved	Saved in instrument state
Range	`AUTOrange|LOW|HIGH`
Annunciation	Autorange | Low | High Found in the Meas Bar under **IF Gain** when in FFT sweep type When not in Auto, label changes to **#IF Gain**
Backwards Compatibility SCPI	`:DISPlay:WINDow[1]:TRACe:Y[:SCALe]:LOG:RANGe:AUTO` `[:SENSe]:ADC:RANGe AUTO | NONE`
Backwards Compatibility Notes	The first form is included for ESA compatibility The second form is included for PSA compatibility. The command and query are accepted without error but ignored

Auto Function

Remote Command	`[:SENSe]:IF:GAIN:FFT:AUTO[:STATe] OFF | ON | 0 | 1` `[:SENSe]:IF:GAIN:FFT:AUTO[:STATe]?`

Example	`:IF:GAIN:FFT:AUTO ON`
Preset	`ON`

Auto

Allows the instrument to pick the FFT IF Gain method as appropriate. When in Auto, the FFT IF Gain is set as follows:

- When the Sweep Type Rules are set to “Best Speed,” the instrument selects `LOW` Gain as the auto choice
- When the Sweep Type Rules are set to “Best Dynamic Range”, the instrument selects `AUTOrange` as the auto choice

Auto is selected when "Auto Couple" on page 1995 is pressed.

Autorange (Slower: Follows Signals)

Turns the ADC ranging to automatic, which provides the best signal to noise ratio. `AUTOrange` is usually preferred over the manual range choices.

NOTE: In N9041B, when the **Software Preselection** switch in the **Amplitude**, **Signal Path** menu is `ON`, and RF Input 2 is selected, **Autorange** always selects high gain. This provides the best signal-to-noise ratio, at the risk of overloading in the presence of stronger signals. If you experience overloads with **Software Preselection** set to `ON`, set **FFT IF Gain** to **Low** manually.

Example	`:IF:GAIN:FFT AUTOrange`

Low Gain (Best for Large Signals)

Forces FFT IF Gain to be `LOW`.

Example	`:IF:GAIN:FFT LOW`

High Gain (Best Noise Level)

Forces FFT IF Gain to be `HIGH`.

Example	`:IF:GAIN:FFT HIGH`

Noise Floor Extension

Lets you configure Noise Floor Extension (NFE). All Modes that support NFE let you set it on or off. Additionally, some Modes support *two* “on” states for NFE, Full and Adaptive, as described below.

Adaptive Option Support

At present (Release: X-Apps 2024), support for **Adaptive** NFE is as follows:

Mode	Measurements	Supports Adaptive NFE?
BT	ACP, IBEM, IBSP	No
CQM	MON	Yes
EDGEGSM	EORF, ETSP, MON	No
EMI	APD, DAN, FSC, MON, RTSC, SCH	Yes
LTEAFDD	PVT	No
LTEATDD	PVT	No
MSR	ACP, CHP, MON, OBW, SEM, SPUR	Yes
NR5G	PVT	No
PNOISE	LPL, MON, SFR	No
SA	SAN	Yes
SRCOMMS	ACP, CHP, MON, OBW, SEM, SPUR	Yes
VMA	ACP, CHP, OBW, SEM, SPUR	Yes
WCDMA	ACP, CHP, MON, OBW, SEM, SPUR	Yes
WLAN	CHP, MON, OBW, SEM, SPUR	Yes

The menus and command options are as follows:

NFE State	Modes with Adaptive NFE	Modes without Adaptive NFE	SCPI
Off	**Off**	**Off**	See "NFE On/Off Command" on page 445
On	**Full**	**On**	
Adaptive	**Adaptive**	n/a	See "Adaptive NFE Command" on page 445

As shown in the table above, the **On** state (in Modes that do not support **Adaptive** NFE) matches the **Full** state in Modes that *do* support **Adaptive** NFE.

To maintain SCPI backwards compatibility, the existing command to turn NFE on or off is retained, and a new command is added to set the state to turn **Adaptive**`ON` or `OFF`:

- `[:SENSe]:CORRection:NOISe:FLOor ON|OFF|1|0` is retained, with the default changed to `ON` for Modes that support **Adaptive** NFE
- `[:SENSe]:CORRection:NOISe:FLOor:ADAPtive ON|OFF|1|0` is added (for certain Modes), default = `ON`

When NFE is **On** or **Full**, the expected noise power of the instrument (derived from a factory calibration) is subtracted from the trace data. This will usually reduce the apparent noise level by about 10 dB in low band, and 8 dB in high band (>~3.6 GHz).

NFE works with any RBW, VBW, detector, any setting of **Average Type**, any amount of trace averaging, and any signal type. It is ineffective when the trace is not smoothed (smoothing processes include narrow VBWs, trace averaging, and long sweep times with the detector set to **Average** or **Peak**). It works best with extreme amounts of smoothing, and with the average detector, with the **Average Type** set to **Power**.

In those cases where the cancellation is ineffective, it nonetheless has no undesirable side-effects. There is no significant speed impact to having **Noise Floor Extension** on.

The best accuracy is achieved when substantial smoothing occurs in each point before trace averaging. Thus, when using the **Average** detector, results are better with long sweep times and fewer trace averages. When using the **Sample** detector, the VBW filter should be set narrow with less trace averaging, instead of a wide VBW filter with more trace averaging.

NOTE **Noise Floor Extension has no effect unless the RF Input is selected, so when External Mixing is selected, it does nothing.**

For more details, see "Optimal Detector & Averaging Selections" on page 446 and "Recalibration of Noise Floor" on page 447.

Pros & Cons of Adaptive NFE

Adaptive NFE provides an alternative to fully-on or fully-off NFE. Fully-on NFE can, notably in cases with little or no averaging of the spectrum, result in a display that is distractingly unfamiliar in the variability in response to low level signals. Fully-off NFE fails to achieve the potential improvement in dynamic range and associated accuracy of measurement of low-level signals. **Adaptive** NFE controls the degree of potential improvement in the noise floor to give more improvement for those instrument settings that can make good use of the potential improvement—those settings with high degrees of variance reduction through some variant of averaging. When the potential improvement is small, the display acts like the fully-off case, and when it is high, it acts like the fully-on case, and in-between, application is a compromise between attractiveness and effectiveness.

In **Adaptive** NFE, there is not the same dramatic visual impact on the noise floor as there is in **Full** NFE. **Adaptive** NFE controls the amount of correction that is applied based on other instrument settings like RBW, averaging and sweep time. **Adaptive** NFE controls the degree of potential improvement in the noise floor to give more improvement for those instrument settings that can make good use of the potential improvement, such as settings that provide more averaging. The result is that when not much averaging is being performed, the signal displays more like the fully-off case; and when lots of averaging is being performed, the signal displays more like the **Full** NFE case.

Adaptive NFE is recommended for general-purpose use. For fully-ATE (automatic test equipment) applications, where possible distraction of the instrument user is not a risk, **Full** NFE is recommended.

NFE On/Off Command

Remote Command	`[:SENSe]:CORRection:NOISe:FLOor ON | OFF | 1 | 0` `[:SENSe]:CORRection:NOISe:FLOor?`
Example	`:CORR:NOIS:FLO ON`
Dependencies	Only appears in instruments with the NFE or NF2 license installed. In all others, the control does not appear. In those cases, the SCPI command is accepted without error, but has no effect
Couplings	When NFE is enabled in any Mode manually, a prompt is displayed reminding you to perform the **Characterize Noise Floor** operation if it is needed When NFE is enabled through SCPI, and a **Characterize Noise Floor** operation is needed, an error is entered in the system error queue
Preset	Unaffected by **Mode Preset**. Turned `ON` at startup and by **Restore Mode Defaults** in Modes that support **Adaptive**. Turned `OFF` at startup and by **Restore Mode Defaults** in Modes that do *not* support **Adaptive** In Modes that support **Adaptive** NFE, the default (preset) state of NFE is **Adaptive**. In Modes that do not support **Adaptive** NFE, the default state of NFE is **Off**
State Saved	No

Adaptive NFE Command

Only effective in instruments with the NFE or NF2 license installed, and in Modes that support **Adaptive** NFE. For coverage, see "Adaptive Option Support" on page 443 above.

For all other cases, the SCPI command below is accepted without error, but has no effect.

Remote Command	`[:SENSe]:CORRection:NOISe:FLOor:ADAptive ON | OFF | 1 | 0` `[:SENSe]:CORRection:NOISe:FLOor:ADAptive?`

Example	First turn NFE on, this is **Full** mode
	`:CORR:NOIS:FLO ON`
	Then set it to **Adaptive**
	`:CORR:NOIS:FLO:ADAP ON`

Couplings	To maintain backwards compatibility, sending :`CORR:NOIS:FLO ON` turns NFE **Adaptive**`OFF`. To turn

	Adaptive on, you must issue the commands in the proper order, as shown in the example above
Preset	Not affected by **Mode Preset**, but set to `ON` at startup and by **Restore Mode Defaults**
State Saved	No

Optimal Detector & Averaging Selections

Note that some measurements do not allow you to switch the **Detector** type (which is set by default to **Average**), so the discussion of detector types here is irrelevant for those measurements. Similarly, some measurements do not allow you to set **Average Type** (set by default to `LOG`), so that discussion here is irrelevant in those cases.

The instrument is characterized in the factory (or during a field calibration) with a model of the noise, referred to the input mixer, versus frequency in each band and path combination. Bands are 0 (low band) and 1 through 4 (high band) in a 26.5 GHz instrument, for example. Paths include normal paths, preamp paths, the electronic attenuator, etc.

In most band/path combinations, the noise can be well characterized based on just two parameters and the instrument frequency response before compensation for frequency-dependent losses.

After the noise density at the input mixer is estimated, the effects of the input attenuator, RBW, detector, etc. are computed to obtain the estimated input-port-referred noise level.

In the simplest case, the measured power (signal plus analyzer noise) in each display point (bucket) is compensated by subtracting the estimated noise power, leaving just the signal power. This is the operation when **Detector** is **Average** and **Average Type** is set to **Power** (`RMS`).

For best operation, **AverageDetector** (default) and **Average Type**. = **Power** are recommended, as already stated. In other cases, operation is often not quite as good but still highly effective. Other **Detector** options, when available, behave as follows:

Positive Peak	The noise floor is estimated based on the RBW and the duration of the bucket using the same equations used in the noise marker function. The voltage of the noise is subtracted from the voltage of the observed signal-plus-noise measurement to compute the estimated signal voltage **Positive Peak** is one example of processing that varies with detector to give good estimates of the signal level without the analyzer noise For pulsed-RF, **Positive Peak** can still give excellent effectiveness FFT analysis does not work well, and does not perform NFE well, with pulsed-RF signals, so this combination is *not* recommended
Negative Peak	Not very useful

Sample	Works well, but never better than **Average** , because it does not smooth as well
Normal	A combination of peak and negative peak behaviors, and works about as well as these

For best operation, extreme smoothing is desirable, as already stated. Using narrow VBWs works well, but using very long bucket durations and the average detector works best. Reducing the number of trace points makes the buckets longer.

For best operation, **Average Type** = **Power** (`RMS`) is optimal (when this option is available). When making CW measurements in the presence of noise without NFE, averaging on the decibel scale has the advantage of reducing the effect of noise. Using NFE with **Average Type** = **Log-Power** (`LOG`) is not synergistic, though; NFE with **Average Type** = **Power** (`RMS`) works a little better than NFE with `LOG`.

The results from NFE with internal preamp can often be lower than the theoretical noise in a signal source at room temperature, a noise density of -174 dBm/Hz. This is expected and useful behavior, because NFE is designed to report the amount of input signal that exceeds the thermal noise, not the amount that includes the thermal noise. This can be a useful behavior because thermal noise often interferes with what you want to measure, instead of being part of what you want to measure. Note that NFE is not adequately accurate to always be able to read below kTB.

Recalibration of Noise Floor

In instruments with the NF2 license installed, the calibrated noise floor used by **Noise Floor Extension** should be refreshed periodically. Keysight recommends that the **Characterize Noise Floor** operation be performed after the first 500 hours of operation, *and* once every calendar year. To do this, use "Characterize Noise Floor" on page 2128, under **System**, **Alignments**, **Advanced**. If you have not done this yourself at the recommended interval, then when you turn on **Noise Floor Extension**, the instrument will prompt you to do so with a dialog stating:

This action will take several minutes to perform. Please disconnect all cables from the RF input and press Enter to proceed. Press ESC to cancel, or Postpone to postpone for a week

If you cancel, you will be prompted again the next time you turn NFE on. If you postpone, you will be prompted again after a week passes and you then turn NFE on.

Noise Source

Lets you turn the noise source power on or off and select the type of Noise Source to be used when making manual noise figure measurements.

See "More Information" on page 448.

Remote	`:SOURce:NOISe:TYPE NORMal | SNS`

Command	`:SOURce:NOISe:TYPE?`
Example	`:SOUR:NOIS:TYPE NORM`
Couplings	If no SNS is connected, this parameter is set to `NORMal` When Type is set to `SNS` and the SNS is disconnected, this parameter changes to `NORMal` When an SNS is not connected, the `SNS` option is grayed-out (disabled)
Preset	`NORMal`
State Saved	Saved in instrument state
Range	`NORMal | SNS`
Backwards Compatibility Notes	In previous Noise Figure analysis applications, this command could optionally be preceded with the `:SENSe` keyword. The optional `:SENSe` keyword is no longer supported

Auto Function

Remote Command	`:SOURce:NOISe[:STATe] ON | OFF | 1 | 0` `:SOURce:NOISe[:STATe]?`
Example	`:SOUR:NOIS OFF`
Couplings	If an SNS is connected, and the Type is set to `SNS`, this parameter turns the SNS on or off When an SNS is not connected, this parameter turns the BNC 28V output on or off When the SA mode is first entered, this parameter is set to `OFF`, and the 28v drive is `OFF` When the SA mode is exited, this parameter is set to `OFF` and the 28v drive is turned `OFF`
Preset	`OFF`

More Information

There are several types of noise source:

- 346/7 Series
- N4000 series Smart Noise Source (SNS)
- USB Noise Source (connects via USB rather than via the Noise Source connector on the rear panel)

This menu allows you to control any of these.

When an SNS is connected, you can select it from the **Type** dropdown, allowing the **State** parameter to then control the SNS. The `NORMal` source is controlled by a BNC connector that supplies 28V. If SNS is *not* connected, then the “state” parameter controls the `NORMal` noise source 28V BNC port. If both are connected, the **Type** parameter determines which source the **State** parameter controls. Two sources can never be controlled together. The query "SNS Attached (Remote Query Only)" on page 449 can be used remotely to determine whether an SNS is connected. SNS functionality is limited to turning on or off only. The SNS ENR data and temperature cannot be queried, unless Noise Figure Mode is installed. The SNS ENR data is issued in printed form when an SNS is purchased, or can be read using the instrument's Noise Figure Mode if installed, or other Keysight noise figure instruments that support the SNS.

Only one SNS is supported at a time. To switch to a different SNS (a USB SNS or an N4000 series SNS), disconnect the one that is no longer being used prior to connecting a new one.

When you switch to the Swept SA measurement, the **State** is `OFF` and the 28v BNC drive and SNS is turned off to ensure the two are in sync. When you exit the Swept SA measurement, **State** is set to `OFF`, and the 28v BNC and SNS drive are turned off.

For making manual noise figure measurements, the following setup is recommended:

- Set **Span** to Zero
- Set **Attenuation** to 0 dB
- Set the PRE-AMP `ON`
- Set **Res BW** to 4 MHz
- Set **Detector** to `AVERage`
- Set **Sweep Time** to 16 ms - sets the variance correctly for good results.
- Set a **Band/Interval Power Marker** function, and set the interval over the full width of trace; that is, **Left** = 0s and **Right** = 16 ms

SNS Attached (Remote Query Only)

If a Smart Noise Source (SNS) is present, returns 1, otherwise 0.

Remote Command	`:SOURce:NOISe:SNS:ATTached?`
Example	`:SOUR:NOIS:SNS:ATT?`
Preset	`OFF`
State Saved	No
Backwards Compatibility Notes	In previous Noise Figure analysis applications, this command could optionally be preceded with the `:SENSe` keyword. The optional `:SENSe` keyword is no longer supported

ACP Enhanced Dynamic Range On/Off

Causes a 300 kHz SAW filter (also called the **ACP Filter**) to be switched into the signal path to allow third-order critical measurements, such as ACP measurements, to be made with improved dynamic range when the spectrum is substantially wider than 300 kHz. When **ACP Enhanced Dynamic Range** is ON:

- When **Res BW** ≤ 300 kHz, the **ACP Filter** is switched in. This means that the **Res BW** shape is affected, but not excessively
- When **Res BW** > 300 kHz, ACP Enhanced Dynamic Range causes no changes in the signal path

NOTE **This function should be used only under specific measurement scenarios, such as ratio measurements of intermodulation, to avoid adding other measurement inaccuracies, such as Frequency Readout Accuracy, Res BW amplitude accuracy, power bandwidth accuracy and absolute amplitude accuracy.**

Remote Command	`[:SENSe]:IF:EDRange ON | OFF | 1 | 0` `[:SENSe]:IF:EDRange?`
Example	`:IF:EDR ON`
Preset	`OFF`
State Saved	Saved in instrument state

3.2.8.7 Global

The controls in this menu apply to all Modes in the instrument.

Some controls (for example, "Global Center Freq" on page 2013) allow you to switch certain Meas Global parameters to a Mode Global state. These switches apply to all Modes that support global settings. For example, no matter what Mode you are in when you set **Global Center Freq** to ON, it applies to all Modes that support Global settings.

Other controls (for example, **Extend Low Band**) are actually set in this menu, but apply to all Modes.

Global Center Freq

The software maintains a Mode Global value called **Global Center Freq**.

When **Global Center Freq** is switched ON, the current Mode’s center frequency is copied into the **Global Center Frequency**, and from then on all Modes that support global settings use the **Global Center Frequency**, so you can switch between any of these Modes and the **Center Frequency** remains unchanged.

Adjusting the **Center Frequency** of any Mode that supports Global Settings, while **Global Center Freq** is ON, modifies the **Global Center Freq**.

When **Global Center Freq** is switched OFF, the **Center Frequency** of the current Mode is unchanged, but now the **Center Frequency** of each Mode is once again independent.

When **Mode Preset** is pressed while **Global Center Freq** is ON, the **Global Center Freq** is preset to the preset **Center Frequency** of the current Mode.

This function resets to OFF when "Restore Defaults" on page 2016 is pressed, or when **System**, **Restore Defaults**, **All Modes** is pressed.

Remote Command	`:INSTrument:COUPle:FREQuency:CENTer ALL | NONE` `:INSTrument:COUPle:FREQuency:CENTer?`
Example	`:INST:COUP:FREQ:CENT ALL` `:INST:COUP:FREQ:CENT?`
Preset	Set to OFF on **Global** Settings, **Restore Defaults** and **System, Restore Defaults, All Modes**
Range	ALL|NONE

Preset	OFF
Backwards Compatibility SCPI	`:GLOBal:FREQuency:CENTer[:STATe] 1 | 0 | ON | OFF` `:GLOBal:FREQuency:CENTer[:STATe]?`

Global EMC Std

When this control is switched ON, the current Mode's EMC Std is copied into the **Global EMC Std**, and from then on all Modes that support global settings use the **Global EMC Std**, so you can switch between any of these Modes and the EMC Std remains unchanged.

Adjusting the EMC Std of any Mode that supports Global settings, while **Global EMC Std** is ON modifies the **Global EMC Std**.

When **Global EMC Std** is switched OFF, the EMC Std of the current Mode remains unchanged, but now the EMC Std of each Mode is once again independent. When **Mode Preset** is pressed while **Global EMC Std** is ON, **Global EMC Std** is preset to the preset EMC Std of the current Mode.

This function resets to OFF when "Restore Defaults" on page 2016 is pressed, or when **System, Restore Defaults, All Modes** is pressed.

Remote Command	`:INSTrument:COUPle:EMC:STANdard ALL | NONE` `:INSTrument:COUPle:EMC:STANdard?`

Example	`:INST:COUP:EMC:STAN ALL` `:INST:COUP:EMC:STAN?`
Dependencies	Only available if Option EMC is installed
Preset	Set to `OFF` on **Global** Settings, **Restore Defaults** and **System, Restore Defaults, All Modes**
Range	`ALL | NONE`

Global Limit Lines (Freq and Amptd)

When this control is set to `ALL`, the current Mode's Limit Line is copied into the **Global Limit Lines**, and from there to all Modes that support Global settings and use **Global Limit Lines**, so you can switch between any of these Modes and the Limit Lines remain unchanged.

Adjusting the Limit Lines of any Mode that supports **Global** Settings, while **Global Limit Lines** is `ALL`, modifies the **Global Limit Lines**.

When **Global Limit Lines** is set to `NONE`, the Limit Lines of the current Mode are unchanged, but now the Limit Lines of each Mode are once again independent. When **Mode Preset** is pressed while **Global Limit Lines** is `ALL`, **Global Limit Lines** is preset to the preset Limit Lines of the current Mode.

This function is reset to `NONE` when "Restore Defaults" on page 2016 is pressed, or when **System**, **Restore Defaults**, **All Modes** is pressed.

Remote Command	`:INSTrument:COUPle:LLINe ALL | NONE` `:INSTrument:COUPle:LLINe?`
Example	`:INST:COUP:LLIN ALL | NONE` `:INST:COUP:LLIN?`
Preset	Set to `OFF` on **Global** Settings, **Restore Defaults** and **System, Restore Defaults, All Modes**
Range	`ALL | NONE`

Extend Low Band

The software maintains a Mode Global value called **Extend Low Band**.

Under the current sweep configuration crossing over two bands, when **Extend Low Band** is turned `ON`, the instrument checks whether one band can cover the whole sweep frequency range or not. If it can, then the instrument locks the band; otherwise, it does nothing (the band crossover occurs).

This function does *not* work when **Band Lock** under **System > Service > Lock Functions** is not -1 (no Band Lock). In that case, **Band Lock** takes priority over **Extend Low Band**.

This function resets to `OFF` when "Restore Defaults" on page 2016 is pressed, or when **System**, **Restore Defaults**, **All Modes** is pressed.

Remote Command	`:INSTrument:COUPle:FREQuency:BAND:EXTend 0 | 1 | ON | OFF` `:INSTrument:COUPle:FREQuency:BAND:EXTend?`
Example	`:INST:COUP:FREQ:BAND:EXT 1` `:INST:COUP:FREQ:BAND:EXT?`
Preset	Set to `OFF` by **Global** Settings > **Restore Defaults** and **System** > **Restore Defaults** > **All Modes**
Range	`ON|OFF`

Restore Defaults

Resets all functions in the **Global** settings menu to `OFF`. Pressing **System**, **Restore Defaults**, **All Modes** has the same effect.

Remote Command	`:INSTrument:COUPle:DEFault`
Example	`:INST:COUP:DEF`
Backwards Compatibility SCPI	`:GLOBal:DEFault`

3.2.8.8 Source

Accesses menus for controlling a Tracking Source in Tracking Source mode.

Does not appear in instruments that do not support Tracking Source functions, such as most of the modular instruments (including VXT), and UXM.

Some instruments (such as VXT) contain an Independent Source, which is controlled using the **RF Source** tab in the **Input/Output** menu.

Dependencies	Only appears in the Swept SA measurement of Spectrum Analyzer Mode Operation with a tracking source requires a license, such as ESC or TG3. If the proper license is not installed, the **Source** tab does not appear, and sending any SCPI command in the `:SOURce` subsystem generates a message, "Settings conflict; option not installed"

NOTE **Option T03 or T06 is required for the Tracking Generator function in CXA.**

Option T03, T07, T13 or T26 is required for the Tracking Generator function in CXA-m.

CXA-m TG Uncalibrated Amplitude Range

When using the CXA-m Tracking Generator, if the Source Frequency is in any of the frequency ranges in the table below, and the Source Amplitude is in the corresponding amplitude range of the below table, a warning status message is generated, +313 “Source Uncal”. This is also true if **Power Sweep** is ON and any amplitude in the Power Sweep (as calculated by Amplitude, Power Sweep, and Amptd Offset) is in that range.

Frequency Range	Amplitude Range
2 MHz ≤ frequency < 10 GHz	-40 dBm ≤ amplitude < -35 dBm
10 GHz ≤ frequency < 20 GHz	-40 dBm ≤ amplitude < -35 dBm or -5 dBm < amplitude ≤ 0 dBm
20 GHz ≤ frequency ≤ 26.55 GHz	-12 dBm < amplitude ≤ 0 dBm

RF Output

Turns source RF Power on or off.

NOTE As stated below, when the RF Output is ON, "Source Mode" on page 456 is set to **Tracking**. See the **Source Mode** control description for special considerations concerning how to configure an N5172B or N5182B source for use with External Source Control.

Remote Command	`:OUTPut[:EXTernal] [:STATe] ON | OFF | 1 | 0` `:OUTPut[:EXTernal] [:STATe]?`
Example	`:OUTP ON` `:OUTP?`
Dependencies	Grayed-out in measurements that do not support a source. If you switch to such a measurement, the output is forced to OFF Grayed-out if there is no valid source selection. In this case, go to the **Select Source** menu to choose, configure and/or verify your source When there is no available Source Mode (other than OFF), due to other couplings, then **RF Ouput** is grayed-out
Couplings	When **RF Output** is turned ON, **Source Mode** is set to **Tracking** When **Source Mode** is turned OFF, **RF Output** is turned OFF When **Source Mode** is turned OFF (or forced to OFF by another coupling), **RF Output** is turned OFF Turning **RF Output**OFF does not affect **Source Mode** or other settings
Preset	OFF On either **Mode Preset**, **Source Preset**, or **Restore Input/Output Defaults**

State Saved	Part of the **Input/Output** system, which means it is loaded and saved with state
Range	ON|OFF
Annunciation	The Source annotation in the Meas Bar shows Off if Source Mode is Off, “Trk, RF off” if Source Mode is Tracking but RF is off, and “Trk, RF on” if Source Mode is Tracking and the RF output is on 

Source Amplitude

Adjusts the power level of the selected source. Note that the actual amplitude is also affected by Amplitude Offset and Power Sweep.

Remote Command	:SOURce[:EXTernal]:POWer[:LEVel][:IMMediate][:AMPLitude] <ampl> :SOURce[:EXTernal]:POWer[:LEVel][:IMMediate][:AMPLitude]?
Example	:OUTP ON :SOUR:POW -10dBm
Dependencies	If the requested setting of Source Amplitude causes the calculated external source start or stop Amplitude to exceed the external source capability, a warning status message is generated, “Data out of Range; clipped to source max/min” The “Show Source Capabilities and Settings” menu can then be examined to check the source capabilities This parameter test and clip is also performed at source acquisition See also "CXA-m TG Uncalibrated Amplitude Range" on page 454
Preset	-10.00 dBm (On Source Preset and Restore Input/Output Defaults) Not affected by Mode Preset
State Saved	Part of the Input/Output system, which means it is Loaded and Saved with state
Min/Max	The range of the amplitude parameter is dependent on the amplitude range of the source that is selected, and the settings of Amplitude Offset and Power Sweep
Backwards Compatibility SCPI	:SOURce:POWer:STARt <ampl> :SOURce:POWer:STARt?
Backwards Compatibility Notes	This alias is for the ESA tracking generator. It specifies the source output power level at the start of the power sweep, just as does :SOURce:POWer

Tracking Peak

Activates a routine that adjusts the delay of the instrument’s tuned frequency with respect to the tracking generator output in order to guarantee that the measurement is peaked in amplitude. This delay is automatically determined by the instrument, in order to accommodate the delay of the DUT and its cables. The resulting delay from this adjustment is displayed on the Manual Track Delay control and may then be further adjusted by the user.

This delay is most critical when the sweep rates are very high, over 108 Hz/s. The adjustment routine works best at these high sweep rates. Once set, this delay will usually not need to be adjusted again unless the DUT or cable lengths are changed.

When the signal to noise ratio is not good enough for the instrument to determine a valid delay time, an error message is returned.

If the sweep time is larger than 30 seconds, the tracking peak function would occupy an unacceptably large amount of time, since it has to take a sweep to function, so it does not execute. In this case when you press the Tracking Peak key, the instrument will not execute the tracking peak function, but instead retain the old track delay value and give you a message.

Remote Command	`:SOURce:POWer:TRCKing:PEAK`
Example	`:SOUR:POW:TRCK:PEAK` Peak the Tracking Generator
Dependencies	If the currently selected source does not support this capability (for example, an external tracking source), this control does not display This control does not appear unless you are in Tracking Source mode

Source Mode

Lets you select Tracking mode for the Source, and allows you to set **Source Mode** to `OFF`

Source Mode can be set to `TRACking` without the user setting it directly. There are several couplings that cause **Source Mode** to be automatically set to `TRACking` (detailed in the table below). One important coupling is that **Source Mode** is forced to `TRACking` when the RF Output is turned on if the measurement supports Tracking. Since **Source Mode** is set to `OFF` by **Mode Preset**, this means that you will rarely need to change the **Source Mode** setting directly.

NOTE: When **Source Mode** is set to `TRACking`, the instrument acquires control of the source. When this happens, the source is told to save its state and then perform a preset. Usually both of these operations take very little time; however, on an N5172B or an N5182B, if many Source real-time apps are in use, both save and preset can take many seconds. If it takes longer than the instrument expects to acquire control, you will see an error: “Source connection lost, check interface connection”. If you see this error, and you are using an N5172B or an N5182B, you can shorten the acquire time by presetting your MXG before attempting to use External Source Control.

Remote Command	`:INSTrument:SOURce[:SELect] TRACking | OFF`

	`:INSTrument:SOURce[:SELect]?`
Example	`:INST:SOUR TRAC`
Dependencies	Grayed-out if no Source is selected. In this case go to the Select Source menu to select, configure and/or verify your source Grayed-out and forced to Off if either BBIQ or External Mixing are selected Grayed-out in Measurements that do not support a source **Tracking** is grayed-out when Manual FFT is selected **Tracking** is grayed-out when the RF Preselector is on (in models which support the RF Preselector)
Couplings	When RF Output is turned On, **Source Mode** is set to `TRACking`. When **Source Mode** is turned `OFF`, RF Output is turned Off Whenever you switch to a Mode in which the **Source Mode** was previously set to `TRACking`, it is again set to `TRACking`. That is, the last setting of the **Source Mode** is remembered when you leave a Mode and restored when you return **Source Mode** is forced to `TRACking` when the RF Output is turned on, if the measurement supports Tracking If **Source Mode** is set to `TRACking`, then it is forced to `OFF` when you select a measurement that does not support Tracking If TRACking is set to `TRACking`, then it is forced to `OFF` when you turn on the RF Preselector (in models which support the RF Preselector) Whenever **Source Mode** is set to `TRACking`, the instrument acquires the Source. Similarly, the Source is released whenever **Source Mode** is set to `OFF`. This is true whether **Source Mode** was set directly by you, was set indirectly through a coupling, if you switched to a Mode that had previously been set to `TRACking`, or if you switched to a Mode in which **Source Mode** is not set to `TRACking` For an external source, “acquiring the source” involves contacting the external instrument over the remote interface (which puts it into Remote) and taking control of it When you set **Source Mode** to `OFF`, it releases the Source (and puts it into Local). For an external source, this means you are now free to operate the source for other purposes When the Source is acquired, its previous state is saved, and when it is released, that state is restored, so that you can acquire and then release the source and it will return to the state it was in before you acquired it
Preset	`OFF`
State Saved	Saved in instrument state
Annunciation	If the Source Mode is off, the settings panel at the top of the screen shows:  See the RF Output control for the case where the Source Mode is Tracking

When the instrument acquires the Source, the following things happen:

1. The instrument attempts to verify communication with the selected source. If the communication somehow fails, the Source Mode is set to Off, and the instrument will report a message “System Error; source connection lost, check interface

connection”. This will also happen if at any time, during normal operation, the source connection fails after having been successfully acquired Note that even if this happens the current Source is not removed from the list of available sources

2. If the communication succeeds, the source goes to Remote. The instrument then commands the external source to save its current state in one of its own internal state registers (Seq 0, state 99)
3. The instrument examines its current Source State and if the settings for the sweep exceed the capabilities of the configured source it clips the settings and displays an informational message, “Some source settings changed to match source limits.” The sweep setting is forced to a setting that allows the source to sweep. The user can then reconfigure the sweep settings one at a time to see which is in conflict. The menu: Show Source Capabilities and Settings... can be used to show potential settings conflicts with the source capabilities
4. The following clip is performed to ensure that the instrument’s current settings of max and/or min frequency do not exceed the capabilities of the source:

   Instrument start frequency = max\{instrument current frequency, source minimum frequency\}

   Instrument stop frequency = min\{instrument current frequency, source maximum frequency\}

In other words, if the instrument’s current state contains a frequency that is outside the frequency range of the Source, the instrument State is clipped to conform to the capabilities of the source. If this happens, an informational message is displayed, “Some analyzer settings changed to match source limits.”

1. Once the Source is acquired, other Auto coupled instrument sweep parameters are changed to perform the Stimulus/Response measurement
2. Additionally, once the Source is acquired, some Source State variables will need to be Preset if they cannot be supported by the current source. These include Multiplier Numerator , Multiplier Denominator, Reverse Sweep, and Source Freq Offset
3. The instrument writes its current (updated) Source State to the source

After this has been done, the source and instrument will operate together in “tracking” mode, which, for an external source, includes a software or hardware handshake for synchronization

If any subsequent setting change of the instrument causes a conflict regarding the calculated source settings (for example, frequency/amplitude/trace point beyond the source ranges), the instrument will clip to the source max/min and generate a warning message, -221 “Data out of Range; clipped to source max/min”.

When the Source is released, the instrument commands the external source to recall its state from its own internal state register (Seq 0, state 99) thus leaving the source in its pre-acquisition state, and the instrument measurement couplings and dependencies are removed, allowing the measurement to return to its normal, non-tracking state. It also puts the Source in Local.

Source Setup Table

Accesses various setup parameters for the Source. In addition, the results of the source control sweep algorithms can be viewed. This gives information of the source range required for a given instrument sweep range. This can be used dynamically as a way of configuring the sweep settings.

Point Trigger: Lets you set up how you want to trigger the source as it steps from frequency to frequency. For more on triggering in Tracking Mode, see "Tracking Setup Details" on page 461.

Amplitude parameters: Power Sweep, Amplitude Offset, Amplitude Step. The resolution of the Source amplitude parameters is coupled to match the minimum resolution of the source when the source is acquired. When the source is released, the amplitude parameter resolution reverts to default values.

Frequency parameters: Multiplier (Numerator and Denominator), Reverse Sweep, Freq Offset. These controls give you added flexibility when using a stepped tracking source for stimulus/response measurements.

- Because with a stepped source, the source frequency does not need to track 1:1 with the instrument LO frequency, it is possible to measure scalar harmonic and subharmonic responses of devices. For example, the second harmonic response is measured by stepping the instrument and source so that the instrument is always at twice the source frequency.
- In addition, the frequency offset capability allows the measurement of frequency conversion devices (like mixers).
- In tracking mode, the source frequency tracks the instrument frequency according to the source frequency equation:

Source Frequency = (Analyzer Frequency *Multiplier Numerator / Multiplier Denominator) + Source Frequency Offset

NOTE **In the above equation, Analyzer Frequency is the frequency to which the instrument is set, which is the instrument's displayed frequency, offset by any Freq Offset set under the Frequency hardkey. Source Frequency Offset is the value set under Source, Frequency, Freq Offset.**

For some Stimulus/Response measurements you may wish to bypass the Microwave Preselector. For information on bypassing the Microwave Preselector, see "Use of the YTF (Microwave or mm Preselector) with External Source Control" on page 460

Example calculations:

Source Frequency = (Analyzer Frequency * Multiplier Numerator / Multiplier Denominator) + Offset Frequency				
Analyzer Start Freq (Hz)	**Analyzer Stop Freq (Hz)**	**Multiplier (Num/Den)**	**Offset Freq (Hz)**	**Source Freq (Hz)**
1.0e6	2.0e6	1/1	0.0	1.0e6 – 2.0e6
2.0e6	4.0e6	1/1	100.0e6	102.0e6 – 104.0e6
2.0e6	4.0e6	-1/1	100.0e6	98.0e6 – 96.0e6
102.0e6	104.0e6	1/1	-100.0e6	2.0e6 – 4.0e6
98.0	96.0e6	-1/1	100.0e6	2.0e6 – 4.0e6
3.0e6	4.0e6	3/1	0.0	9.0e6 – 12.0e6
4.0e6	6.0e6	5/1	100.0e6	120.0e6 – 130.0e6
4.0e6	6.0e6	-5/1	100.0e6	80.0e6 – 70.0e6

Use of the YTF (Microwave or mm Preselector) with External Source Control

In most stimulus/response measurements that utilize External Source Control, the source exactly tracks the tuned analyzer frequency. Consequently, preselection is not needed, and you can achieve greatly superior amplitude accuracy and repeatability by bypassing the YTF (Preselector) using the Microwave Preselector Bypass control in the Amplitude, uW Path Control menu (note: this control is only available if option MPB is installed).

There are rare but important cases, however, where the source is tuned to a different frequency than the analyzer, using the Multiplier and Reverse controls in the Source, Frequency menu. For example, you might be tuning the source to ½ of the analyzer frequency when looking at second harmonic distortion in a DUT. In these cases, it would be commonplace for there to be an undesired signal at the analyzer input that is at an image frequency that you will want to reject with the YTF.

Understanding these cases is important for proper operation of the Microwave Preselector with External Source Control, so that you only bypass it when it will improve accuracy but not hinder the measurement.

Point Trigger

Shows point trigger type selected and navigates to the **Point Trigger** menu, which lists all instrument point trigger types.

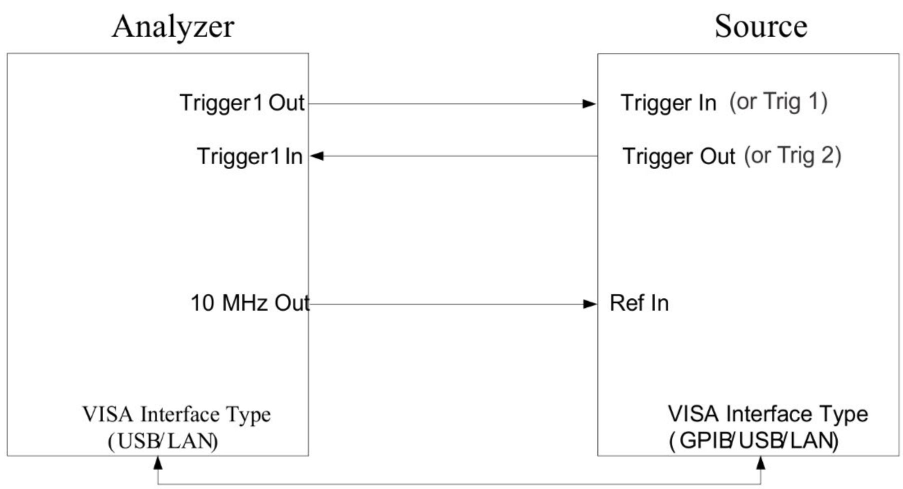
The instrument and source point trigger synchronization can be done using SCPI bus commands or by using external trigger output and input lines.

NOTE **For X-Series software versions earlier than A.10.01, hardware triggering was unavailable in stepped tracking at frequencies above 3.6 GHz, so above 3.6 GHz, software triggering was always used. This is no longer the case.**

Remote Command	`:SOURce:TRIGger:TYPE BUS | EXTernal[1] | EXTernal2` `:SOURce:TRIGger:TYPE?`
Example	`:SOUR:TRIG:TYPE EXT1` Selects instrument external trigger 1 in and out for point trigger synchronization with selected source
Dependencies	If an internal Tracking Generator is selected, then this menu is unavailable, Additionally, the External 1 and External 2 Trigger keys on the Spectrum Analyzer are released from any grayout that may have been forced on them by the external source Point Trigger selection In some models, there is no second External input. In these models, the External 2 selection does not appear and the EXTernal2 parameter will generate a “Hardware missing; Not available for this model number” message
Couplings	The source control point trigger selection can select external trigger 1 or 2 in for synchronized point triggering. This can conflict with the selection under the **Trigger** hardkey, if it has **External 1** or **2** selected. If there is a conflict when the selection is made under the **Point Trigger** menu, the **Trigger** selection under the **Trigger** hardkey changes to **Free Run**
Preset	Unaffected by **Mode Preset** but set to `EXTernal1` by **Source Preset** or **Restore Input/Output Defaults**
State Saved	Part of the Input/Output system, which means it is Loaded and Saved with state

Tracking Setup Details

When an external source is operating in Tracking Mode, operation can be greatly enhanced by using hardware triggers. Below is a typical connection diagram showing a hardware handshake using Trigger 1 inputs and outputs on the instrument (trigger 2 in and out is also a valid connection).



Typical Analyzer-Source connection

Analyzer Trigger 1 Out: Triggers the external source to step to next point in the frequency step/list.

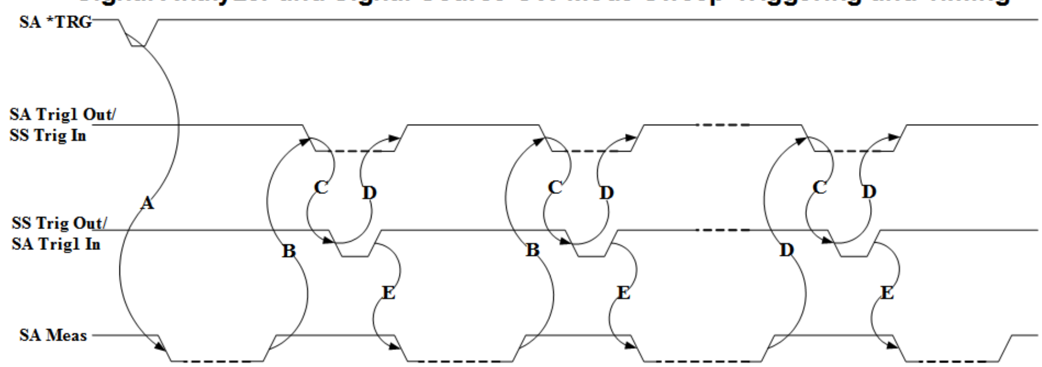
Analyzer Trigger 1 In: Triggers the analyzer to make a measurement on this point

Source Trigger In (or “Trig 1” at default setting for N5181B/82B, N5183B MXG or N5171B/72B, N5173B EXG):
Triggers the source to step to the next point.

Source Trigger Out (or “Trig 2” at default setting for N5181B/82B, N5183B MXG or N5171B/72B, N5173B EXG): Indicates that the source has settled.

IO interface Connection: instrument can connect to sources with its GPIB, USB or LAN interface.

Signal Analyzer and Signal Source CW Mode Sweep Triggering and Timing



A- Test system triggers SA sweep programmatically (*TRG). First point measurement started
B - SA finishes measurement and triggers SS to move to next sweep point by pulling SA Trigger 1 Out low
C - SS pulls SS Trigger Out line low and steps to next sweep point
D - SA releases SA Trigger 1 Out line (timing not crucial; OK to release on SS Trig Out line high or after meas)
E - SS source settles and releases SS Trig Out line, triggering SA to start next point measurement

Notes:

- Trigger sync connections are optional – synchronization can be done via remote commands if Bus Trigger is enabled in the Source Setup menu.
- Connection from the SA external frequency reference output to the source frequency reference input (10 MHz Out to Ref In) is not required, but may improve the measurement accuracy.

SW Trigger

Analyzer and source point trigger synchronization is setup using the SCPI commands. Source is stepped via SCPI commands. Analyzer waits for source to settle by polling source.

SCPI example: `:SOUR:TRIG:TYPE BUS`

Ext Trigger 1

SCPI example: `:SOUR:TRIG:TYPE EXT1`

Analyzer and source point trigger synchronization is setup using the analyzer Trigger 1 Output and Trigger 1 Input. The Source is stepped via Trigger 1 Output. The Analyzer waits for source to settle via Trigger 1 Input.

With an acquired source, selecting this point trigger mode overrides existing external trigger 1 output level, slope, and delay, and external trigger 1 type and polarity.

External trigger 1 input level = 1.20 V

External trigger 1 input slope = Positive

External trigger 1 input delay = Off

External trigger 1 output type = Source Point Trigger

External trigger 1 output polarity = Positive

When this selection is made:

- The **External 1** selection in the **Trigger** menu (under the **Trigger** hardkey) does not appear and, if **External 1** was previously selected, it changes to **Free Run**
- **Trig 1 Out** selected under **Output Config** in the **Input/Output** menu changes to **Source Point Trigger**

If you subsequently go into the **Trig 1 Out** menu and select a different Trigger Output, the **Point Trigger** reverts to SW Trigger.

Ext Trigger 2

Analyzer and source point trigger synchronization is setup using the analyzer Trigger 2 Output and Trigger 2 Input. The Source is stepped via Trigger 2 Output. The instrument waits for source to settle via Trigger 2 Input.

SCPI example: `:SOUR:TRIG:TYPE EXT2`

With an acquired source, selecting this point trigger mode overrides existing external trigger 2 output level, slope, and delay, and external trigger 2 type and polarity.

External trigger 2 input level = 1.20 V

External trigger 2 input slope = Positive

External trigger 2 input delay = Off

External trigger 2 output type = Source Point Trigger

External trigger 2 output polarity = Positive

When this selection is made:

- The **External 2** selection in the **Trigger** menu (under the **Trigger** hardkey) does not appear and, if **External 2** was previously selected, it changes to **Free Run**
- **Trig 2 Out** selected under **Output Config** in the **Input/Output** menu changes to **Source Point Trigger**

If you subsequently go into the **Trig 2 Out** menu and select a different Trigger Output, the **Point Trigger** reverts to SW Trigger.

Manual Track Delay

Lets you manually adjust the delay of the tracking generator oscillator using the step keys, knob, or numeric keypad. The tracking delay should be tuned to maximize the amplitude of the trace. Generally, you should only need to perform this adjustment if the characteristics of your setup make it difficult for the instrument to accurately determine the correct delay with the Tracking Peak function (for example, your DUT may not be passing enough signal at the desired frequency for Tracking Peak to work properly). Any time you change the DUT, it is a good practice to set the Manual Track Delay to 0.

Remote Command	`:SOURce:POWer:TRCKing <integer>` `:SOURce:POWer:TRCKing?`
Example	`:SOUR:POW:TRCK 120` Set Man Track Adjust to 120
Dependencies	If the currently selected source does not support this capability (for example, an external tracking source), this key does not appear This key does not appear unless you are in Tracking Source mode
Preset	Unaffected by Preset. Set to 0 by **Restore Input/Output Defaults**
State Saved	Part of the **Input/Output** system, which means it is loaded and saved with state
Min	0
Max	10 us

Save/Restore Source State

Lets you disable the ability of the External Source to return to the state it was in before it was acquired.

Normally, when the instrument acquires the Source, the Source saves its state in an internal register. Then, when the instrument releases the Source, it restores its previous state from that register.

You may wish to defeat this feature, to save time when acquiring/releasing the Source. If so, turn this function Off. The default state is On. Once set to On, it stays On until you turn it Off, shutdown the instrument or perform a Restore Mode Defaults.

Remote Command	`:SOURce:STATe:RESTore ON | OFF | 0 | 1` `:SOURce:STATe:RESTore?`
Example	`:SOUR:STAT:REST OFF` `:SOUR:STAT:REST?`
Notes	You must be in Spectrum Analyzer Mode to use this command. Use `:INSTrument:SELect` to set

	the Mode
Dependencies	If the currently selected source does not support this capability (for example, an internal Tracking Generator which must track the LO), this control is forced to its Preset value and grayed-out
Preset	Unaffected by Mode Preset but is set to ON by Restore Mode Defaults
Range	ON|OFF

Power Sweep

Sets up a Power Sweep. **Power Sweep** is useful for measuring saturation behavior in a test device, such as a power amplifier.

The source will sweep the power between the start power defined by the Amplitude function and the stop power = start power + power sweep value:

Source (start) amplitude = Amplitude – Amplitude Offset

Source (stop) amplitude = Amplitude – Amplitude Offset + Power Sweep

In Stepped Tracking, such as is used with an external source or the CXA-m TG, the instrument controls the source with step sweep mode, which provides a linear progression from one selected frequency, amplitude, or both, to another, pausing at linearly spaced points (steps) along the sweep. The instrument continues to sweep the specified frequency range when power sweep is on, although generally Power Sweep is performed in Zero Span.

With CXA options T03, T06 , the hardware is capable of continuous power sweeps. This makes it possible to use the swept sweep time rules and should be employed for faster sweeps. Care should be taken to limit the sweep time you use as there are no sweep time couplings to Power Sweep settings. The recommended minimum sweep time depends on the RBW and power-sweep range. Start by computing (1.28/RBW)* (abs(startPower – stopPower)/(5 dB)). The recommended minimum sweep time is the larger of this value and 50 ms.

Some external Sources have mechanical attenuators, which are not used in Power Sweep in order to save wear on the attenuators. To allow an acceptable range of Power Sweep without changing the mechanical attenuation, the Sources are put in a mode that allows the Source to handle a wide amplitude range without switching the attenuators. When the Power Sweep settings put the Source in an amplitude range that requires the mechanical attenuators, the instrument displays a condition warning message:

Settings Alert; Src pwr ramp>ALC range

Remote Command	`:SOURce:POWer:SWEep <rel_ampl>` `:SOURce:POWer:SWEep?`
Example	`:SOUR:POW -5` `:SOUR:POW:SWE:STAT ON`

	`:SOUR:POW:SWE 10`
	Set source start power to - 5 dBm and stop power + 5dBm (-5 + 10)
	`:SOUR:POW:SWE:STAT ON`

Dependencies	If the requested setting of **Power Sweep** causes the calculated external source start or stop Amplitude to exceed the external source capability, a warning status message is generated, "Data out of Range; clipped to source max/min". The Show Source Capabilities and Settings menu can then be examined to check the source capabilities This parameter test and clip is also performed at source acquisition See also "CXA-m TG Uncalibrated Amplitude Range" on page 454
Preset	This is unaffected by "Mode Preset" but is set to 0dB on a "Source Preset" or "Restore Input/Output Defaults"
State Saved	Part of the Input/Output system, which means it is Loaded and Saved with state
Min/Max	–/+500 dB
Backwards Compatibility SCPI	`:SOURce[:EXTernal][:SWEep]:POWer:SPAN <rel_ampl>` `:SOURce[:EXTernal][:SWEep]:POWer:SPAN?`
Backwards Compatibility Notes	This alias is for the ESA tracking generator and PSA option 215. It specifies the range of power levels through which the source output will sweep just as does `:SOURce:POWer:SWEep`

Auto Function

Remote Command	`:SOURce:POWer:SWEep:STATe ON | OFF | 1 | 0` `:SOURce:POWer:SWEep:STATe?`
Preset	Unaffected by **Mode Preset** but set to `OFF` by **Source Preset** or **Restore Input/Output Defaults**

Backwards Compatibility Command

Notes	The ESA tracking generator and the PSA option 215 support this SCPI command. It sets the source output to be at a single amplitude (fixed) or to sweep through a range of power levels
	`:SOURce:POWer:MODE FIXed`
	is equivalent to `:SOURce:POWer:SWEep:STATe OFF`
	`:SOURce:POWer:MODE SWEep`
	is equivalent to `:SOURce:POWer:SWEep:STATe ON`

Preset	Unaffected by **Mode Preset** but set to `FIXed` by **Source Preset** or **Restore Input/Output Defaults**
Backwards Compatibility SCPI	`:SOURce[:EXTernal]:POWer:MODE FIXed | SWEep` `:SOURce[:EXTernal]:POWer:MODE?`

Amptd Offset

Offsets the displayed power of the source in the Amplitude parameter. Using the amplitude offset allows you to take into account any system losses or gains (for example, due to cable loss), thereby displaying the actual power delivered to the device under test. See the equations under **Source**, **Amplitude**, "Power Sweep" on page 466.

Remote Command	`:SOURce:CORRection:OFFSet <rel_ampl>` `:SOURce:CORRection:OFFSet?`
Example	`:SOUR:CORR:OFFS 5` Sets the displayed source offset power to 5 dB
Dependencies	If the requested setting of Amptd Offset causes the calculated external source start or stop Amplitude to exceed the external source capability, a warning status message is generated, “Data out of Range; clipped to source max/min”. The Show Source Capabilities and Settings menu can then be examined to check the source capabilities This parameter test and clip is also performed at source acquisition
Preset	Unaffected by Mode Preset but is set to 0.00dBm on a Source Preset or Restore Input/Output Defaults
State Saved	Part of the **Input/Output** system, which means it is loaded and saved with state
Min/Max	–/+1000 dB

Amptd Step

Sets the step size associated with the Source Amplitude key. When auto-coupled, the step size is the current "Scale/Div" on page 202 setting under the **Amplitude** hardkey (note that this is true even if the instrument is currently in Linear amplitude scale).

Once a step size has been selected and the Source Amplitude function is active, the step keys (and the `UP|DOWN` parameters for Source Amplitude from remote commands) change the Source Amplitude by the step-size value.

You may change the step size manually by pressing Amptd Step and entering a value. The function (and the step size) will return to **Auto** when **Mode Preset** or "Auto Couple" on page 1995 is performed.

Remote Command	`:SOURce:POWer:STEP[:INCRement] <ampl>` `:SOURce:POWer:STEP[:INCRement]?`
Example	`:SOUR:POW:STEP 0.1` Set amplitude step to 0.1 dB
Couplings	In **Auto**, coupled to the size of one logarithmic vertical graticule division
Preset	Auto
State Saved	Part of the **Input/Output** system, which means it is loaded and saved with state
Min	0.1 dB
Max	20 dB

Auto Function

Remote Command	`:SOURce:POWer:STEP:AUTO OFF | ON | 0 | 1` `:SOURce:POWer:STEP:AUTO?`
Example	`:SOUR:POW:STEP:AUTO ON`
Preset	`ON`
State Saved	In Input/Output state

Multiplier Numerator

This parameter offsets the source frequency from the instrument frequency. The source frequency tracks the SA frequency according to the source frequency equation shown at the bottom of the Source Setup Table.

Remote Command	`:SOURce:FREQuency[:MULTiplier]:NUMerator <integer>` `:SOURce:FREQuency[:MULTiplier]:NUMerator?`
Example	`:SOUR:FREQ:NUM 3` Sets the source frequency multiplier numerator to 3
Dependencies	If the currently selected source does not support this capability (for example, an internal Tracking Generator which must track the LO), this control is forced to its Preset value and grayed-out
Preset	Unaffected by Mode Preset but is set to 1 on Source Preset or Restore Input/Output Defaults
State Saved	Part of the **Input/Output** system, which means it is loaded and saved with state
Min	1
Max	1000

Multiplier Denominator

This parameter offsets the source frequency from the instrument frequency. The source frequency tracks the SA frequency according to the source frequency equation shown at the bottom of the Source Setup Table.

Remote Command	`:SOURce:FREQuency[:MULTiplier]:DENominator <integer>` `:SOURce:FREQuency[:MULTiplier]:DENominator?`
Example	`:SOUR:FREQ:DEN 3` Sets the source frequency multiplier denominator to 3
Dependencies	If the currently selected source does not support this capability (for example, an internal Tracking Generator which must track the LO), this control is forced to its Preset value and grayed-out
Preset	Unaffected by Mode Preset but is set to 1 on Source Preset or Restore Input/Output Defaults
State Saved	Part of the **Input/Output** system, which means it is loaded and saved with state
Min	1
Max	1000

Source Sweep Reverse

Lets you reverse the source sweep direction

Normally, the source will sweep from a lower frequency to a higher frequency. However, there are test scenarios in which the source sweep needs to be “reversed”. In this case, it sweeps from a higher frequency to a lower frequency. For example, when the DUT is a frequency converter and a measurement of the Lower Side Band characteristics is desired, a reverse sweep is employed. Reverse sweeps are supported for such scenarios, but two cautions are in order:

1. Reverse Sweep only reverses the direction of the source’s sweep, not the instrument’s sweep. Unless you are actually using a device like a frequency converter and looking at the lower sideband, thus effectively reversing the direction of the source’s sweep, the source will be sweeping in the opposite direction from the instrument, and it will not be possible track the desired device output frequency

2. Any time you are using a frequency converter, care must be taken in setting up all of the sweep parameters, including instrument start/stop frequency and source multiplier, to make sure that the instrument’s sweep tracks the output of the converter device

Remote Command	`:SOURce:FREQuency:SSReverse ON | OFF | 0 | 1` `:SOURce:FREQuency:SSReverse?`
Example	`:SOUR:FREQ:SSR OFF` `:SOUR:FREQ:SSR?`
Notes	You must be in Spectrum Analyzer Mode to use this command. Use `:INSTrument:SELect` to set the Mode
Dependencies	If the currently selected source does not support this capability (for example, an internal Tracking Generator which must track the LO), this control is forced to its Preset value and grayed-out
Preset	Unaffected by Mode Preset but is set to `OFF` on Source Preset or Restore Input/Output Defaults
State Saved	Part of the **Input/Output** system, which means it is loaded and saved with state
Range	`ON|OFF`

Freq Offset

This parameter offsets the source frequency from the instrument frequency. The source frequency tracks the SA frequency according to the equations at the bottom of the Source Setup Table.

Remote Command	`:SOURce:FREQuency:OFFSet <freq>` `:SOURce:FREQuency:OFFSet?`

Example	`:SOUR:FREQ:OFFS 10MHz` Sets the source frequency offset to 10 MHz
Dependencies	If the currently selected source does not support this capability (for example, an internal Tracking Generator which must track the LO), this control is forced to its Preset value and grayed-out
Preset	Unaffected by Mode Preset but is set to 0.00Hz on Source Preset or Restore Input/Output Defaults
State Saved	Part of the **Input/Output** system, which means it is loaded and saved with state
Min	-500 GHz
Max	500 GHz
Backwards Compatibility SCPI	`:SOURce:EXTernal:SWEep:OFFSet:FREQuency <freq>` `:SOURce:EXTernal:SWEep:OFFSet:FREQuency?`
Backwards Compatibility Notes	PSA option 215 supports this command, which is equivalent to `:SOURce:FREQuency:OFFSet`

Auto Function

Remote Command	`:SOURce:FREQuency:OFFSet:STATe ON | OFF | 1 | 0` `:SOURce:FREQuency:OFFSet:STATe?`
Preset	This is unaffected by Mode Preset but is set to `OFF` on Source Preset or Restore Input/Output Defaults
Backwards Compatibility SCPI	`:SOURce:EXTernal:SWEep:OFFSet:STATe ON | OFF | 1 | 0` `:SOURce:EXTernal:SWEep:OFFSet:STATe?`
Backwards Compatibility Notes	PSA Option 215 supports this SCPI command. It is equivalent to `:SOURce:FREQuency:OFFSet:STATe`

Select Source

Allows you to maintain a list of available external and internal Sources, and choose the Source that you want to use from the list. The controls for adding sources to the list are shown at the top of the screen, the list of available sources in the middle of the screen, and the currently selected source at the bottom of the screen.

The sources in the Available Source List are as follows:

– Any internal sources that are installed and licensed

NOTE **Only one internal source can be installed, displayed at address “INTERNAL”**

– Any external sources that you have previously configured, whether or not they are currently connected, displayed with their VISA address

The list of available sources includes any sources that you have previously used (unless you have deleted them) and any found using the “Add Source to List” controls.

Double-tap the source you want to use, or use the up and down arrows to move to the source that you want and press Select Highlighted Source” or “Enter”. The source you have selected shows up at the bottom of the screen as the “Selected Source”. Press “Verify Connection” to make sure that the interface connection to the Source is functional.

At any time, you may use the “Add Source to List” controls to find new sources or “Delete Highlighted Source” to remove a source from the list of available sources.

Note that only external sources that are supported by the Tracking Source Mode are displayed in the Available Source List. Here are the Keysight/Agilent sources currently supported:

Source	UXA	PXA	MXA	EXA	CXA	MXE (Presel off)
MXG N5161A	X	X	X	X	X	X
MXG N5162A	X	X	X	X	X	X
EXG N5171B	X	X	X	X	X	X
EXG N5172B	X	X	X	X	X	X
EXG N5173B	X	X	X	X	X	X
MXG N5181A	X	X	X	X	X	X
MXG N5182A	X	X	X	X	X	X
MXG N5183A	X	X	X	X		X
MXG N5181B	X	X	X	X	X	X
MXG N5182B	X	X	X	X	X	X
MXG N5183B	X	X	X	X	X	X
PSG E8257C	X	X	X	X		
PSG E8257D	X	X	X	X		
PSG E8257N	X	X	X	X		
PSG E8267C	X	X	X	X		
PSG E8267D	X	X	X	X		

Add Installed USB Source

Sources on USB (once installed) can be added to the list by pressing **Add Installed USB Sources**. Any supported source found is added to the list.

Press this control to add USB sources to the Available Source List. Note that this function will *only* find sources that have previously been installed onto the USB. For information on how to install a USB source, see "Installing a USB source" on page 473

Notes	If no installed USB device is found which is a supported source, an error message is generated

Installing a USB source

USB is the only interface that requires no runtime action by the user in the Select Source menu, but does require “installation” when a source is plugged in.

You start by connecting the USB source to the instrument. You will see a series of messages indicating that the instrument is installing required device software.

When the installation is complete, you will see a message to that effect. You can then use **Add Installed USB Sources** (above) to add the source to the list of sources in the Available Source List.

GPIB Address

Lets you enter the GPIB address of a GPIB source. After you enter the address press **Add Specified GPIB Address** to add the source at that address to the Available Source List.

NOTE **For the GPIB interface to work properly when controlling a Source, it must be configured as a Controller. You can find this setting in the System menu under System, I/O Config, GPIB. Set the GPIB Controller function to Enabled.**

Preset	Unaffected by Mode Preset but set to 19 by **Restore Input/Output Defaults**
State Saved	No
Min	0
Max	30

Add Specified GPIB Address

Add the source at the entered GPIB address to the Available Source List. If a supported source is found at that address, it is added to the list.

Notes	If GPIB controller mode is not enabled, an error message is generated If no supported source is found at the specified address, an error message is generated

Scan & Add GPIB Source

Sources on GPIB can be added by pressing **Scan & Add GPIB Source**. Any supported source found is added to the Available Source List.

NOTE	This will cause any older, non-SCPI compatible devices on your GPIB to generate error messages.

Notes	If the GPIB controller mode is not enabled, an error message is generated If no GPIB device is found which is a supported source, an error message is generated

IP Address

Lets you enter the IP address of a source om the LAN. After you enter the address, press **Add** to add the source at that address to the Available Source List.

Preset	Unaffected by Mode Preset but set to 0.0.0.0 by **Restore Input/Output Defaults**
State Saved	No

Add Specified IP Address

Adds the source at the entered IP address to the Available Source List. If a supported source is found at that address, it is added to the list.

Notes	If no supported source is found at the specified address, an error message is generated

Run Connection Expert...

The LAN cannot be scanned directly from the instrument software, but if you want to discover sources on the LAN, you can open Keysight Connection Expert by pressing **Run Connection Expert...**. You can import the list of currently configured devices from Keysight Connection Expert by pressing **Add From Connection Expert**.

The Connection Expert list depends on which instruments have been discovered by the Keysight Connection Expert application. Any connected, supported sources in that list is added.

Add From Connection Expert

You can import the list of currently configured devices from Keysight Connection Expert by pressing **Add From Connection Expert**. The Connection Expert list depends on which instruments have already been discovered by the Keysight Connection Expert application. Any connected, supported sources in that list is added.

Notes	If no supported source is found in the Connection Expert list, an error message is generated

Select Highlighted Source

You can navigate up and down in the list with the up and down arrow keys, and select any entry by pressing **Select Highlighted Source** (or by double-tapping on the entry in the table). The highlighted source becomes the Current Source and is prominently displayed at the bottom of the screen.

At any given time, there is only one selected Source for the entire system; once a Source is selected, it becomes the Current Source and will be used by all applications that support Source Control.

For example, if no Source has yet been selected, the statement at the bottom of the screen would say

`Selected Source`

`None`

If an N5182A connected via USB were the Current Source, the statement at the bottom of the screen might say:

`Selected Source`

`Keysight N5182A US00000258 at USB0::2931::7937::US00000258::0::INSTR`

The command defined below allows the programmatic user to directly define the VISA address via a string parameter. The parameter is checked for proper syntax, the connection to the instrument is verified, and the source is added to the Available Source List if it verifies. If it does not verify or no source is found at that address, an error message is generated.

Normally the source selection activities should be performed only when the user changes the hardware connection configuration or activates/deactivates a source option license; shutdown and startup of the application will not cause source re-selection.

The Keysight IO Libraries Suite provides a “Keysight VISA Help” document that has a section that shows the proper syntax for valid VISA address strings, in the `ViOpen` function definition.

Remote Command	`:SYSTem:COMMunicate:SOURce[1]:ADDRess <address string>` `:SYSTem:COMMunicate:SOURce[1]:ADDRess?`

Example	Different examples for setting external source address
	`:SYST:COMM:SOUR:ADDR “TCPIP0::MyHostName::INSTR”`
	`:SYST:COMM:SOUR:ADDR “TCPIP0::123.121.100.210::INSTR”`

	`:SYST:COMM:SOUR:ADDR “USB0::12212::32145::US1234567A::INSTR”` `:SYST:COMM:SOUR:ADDR “GPIB1::19::INSTR”`
Notes	Empty string is allowed and means no source is defined or selected The address string is the VISA address for external sources and “`INTERNAL`” for an internal source
Dependencies	Operation with a source requires a license. If the proper license is not installed, the command generates an error message, “Settings conflict; option not installed” If no supported source, or no source at all, is found at the specified address, the command generates an error message
Preset	The current source selection is unaffected by Mode Preset and Source Preset but reverts to [None] on Restore Input/Output Defaults If an internal Tracking Generator is installed, then instead of None, the default selection is `INTERNAL`
State Saved	Selected Source is saved Power On Persistent (survives power cycle) Part of the Input/Output system, which means it is Loaded and Saved with state
Backwards Compatibility SCPI	`:SYSTem:COMMunicate:LAN:SOURce[:EXTernal]:IP <address string>` `:SYSTem:COMMunicate:LAN:SOURce[:EXTernal]:IP?`

Backwards Compatibility Notes	Provided for compatibility with PSA Option 215. The address string is reformatted for the X-Series. For example, if the user sends
	`:SYSTem:COMMunicate:LAN:SOURce:EXTernal:IP 146.208.172.111`
	The instrument turns this into
	`:SYSTem:COMMunicate:SOURce:ADDRess “TCPIP0::146.208.172.111::INSTR"`

Delete Highlighted Source

Deletes the highlighted source from the list of available sources. You are prompted with a dialog box to make sure you *really* want to do this. The prompt says:

“The highlighted source will be permanently deleted from the list. Are you sure you want to do this? Press Enter to proceed, or Cancel (ESC) to cancel”

Verify Connection

This control verifies the interface connection to the Current Source (it does *not* verify any signal connections!)

Until the selected source is verified, a statement appears at the bottom of the screen which says (in red):

This Source has not been verified. Press “Verify Source” to check the interface connection.

When you press this key, the connection is checked to the selected source. If all is well, the statement is changed to (in green):

This connection to this source has been verified.

If the verification fails, the statement at the bottom will change to (in red):

Verification of this source failed. Check the interface connection

The selected source is also verified whenever it is acquired. If a Source's connection has been verified by any means, then that Source is considered to have been verified until either the instrument software is shut down or if, in attempting to use the Source, communication with it fails.

Show Source

Shows the capabilities of the currently selected Source. The menu is useful for displaying source capabilities such as frequency and amplitude ranges.

Dependencies	If no source is selected this control is grayed-out

Source Preset

Forces all the settings in the instrument's Source State to their preset condition.

The Source State is the set of Source settings that is maintained and remembered by the instrument for use in the Tracking Source Mode. The Source State variables are controlled and set in the menus under the Source front panel key. These settings include:

- RF Output Off
- Amplitude = – 10 dBm
- Amplitude Step = Auto
- Power Sweep = 0 dB
- Amplitude Offset = 0 dB
- Source Sweep Reverse = Off
- Multiplier Numerator = 1
- Multiplier Denominator = 1
- Freq Offset = 0 Hz
- Point trigger is set to "Ext1"

The Source State is saved along with the state of the current Mode when you save a State, and is recalled when that Mode State is recalled. When the instrument first starts up, a Source Preset is performed. In the Input/Output menu, Restore Input/Output Defaults will also perform a Source Preset.

A Mode Preset, from modes that support the External Source, will turn the RF Off but will *not* perform a Source Preset. By the same token, Source Preset does *not* perform a Mode Preset.

Source Preset does *not* change the Source Mode nor the selection of which physical source is being used, nor does it release the current source (the source remains under the control of the instrument) nor exit the Source menu.

Remote Command	`:SOURce:PRESet`
Example	`:SOUR:PRES`
Preset	Initiates a Source Preset
State Saved	No

Source Setting Query (Remote Query Only)

This query returns certain settings from the Source when the Source Mode is set to Tracking. The returned values are all in ASCII text format.

Remote Command	`:SOURce:SETtings?`
Example	`:SOUR:SET?`
Notes	Returns a set of comma-separated values as follows (no spaces): `source max frequency,source min frequency,source frequency resolution,source max amplitude,source min amplitude,source amplitude resolution,source sweep max point,source start frequency,source stop frequency,source start amplitude,source stop amplitude`

3.2.9 Sweep

Accesses controls to configure and control the acquisition of data, and the X-axis parameters of the instrument.

Depending on the selected mode and measurement, these controls might include: **Sweep Time**, **Continuous/Single**, **Pause/Resume**, **X Scale** and **Number of Points**.

3.2.9.1 Sweep/Control

Accesses controls that let you operate the sweep and control functions of the instrument, such as **Sweep Time** and **Continuous/Single**.

Sweep Time

Controls the time the instrument takes to sweep the current frequency span when "Sweep Type" on page 490 is `SWEpt`, displays the sweep time in swept measurements, and displays the equivalent sweep time when **Sweep Type** is `FFT`.

NOTE **In instruments without sweeping hardware, such as some modular instruments, this control may be labelled "Acquisition Time"**

When **Sweep Time** is Auto, the instrument computes a time that will give accurate measurements based on other settings of the instrument, such as RBW and VBW.

You can choose a shorter sweep time to improve the measurement throughput (with some potential unspecified accuracy reduction), but the Meas Uncal indicator will come on if the sweep time you set is less than the calculated Auto Sweep time. You can also select a longer sweep time, which can be useful (for example) for obtaining accurate insertion loss measurements on very narrowband filters. The number of measurement points can also be reduced to speed the measurement (at the expense of frequency resolution).

You might need to specify a specific sweep speed to accommodate a specific condition in your transmitter. For example, you may have a burst signal and need to measure an exact portion of the burst.

When in Zero Span, there is no "Auto Sweep Time", so the Auto/Man toggle on this control disappears.

When Sweep Type is `FFT`, you cannot control the sweep time, it is simply reported by the instrument to give you an idea of how long the measurement is taking. The Auto/Man toggle therefore disappears when in an `FFT` sweep. In this case the **Sweep Time** function is grayed-out.

NOTE In VXT Models M9410A/11A/15A, **Sweep Type** is *always* set to `FFT`, as these models do not have sweeping hardware. Therefore, in VXT Models M9410A/11A/15A, the **Sweep Time** control is *always* grayed-out unless you are in Zero Span. The value reported on the control is the approximate time that will be taken to acquire the trace data for one measurement cycle. This is basically the acquisition time for each frequency segment ("chunk") multiplied by the number of segments. The "chunk" time is determined by other parameters, such as RBW and VBW. The value displayed represents, as close as can be estimated, the time to "take one sweep".

When the control is grayed-out, sending the **Sweep Time** SCPI command generates an error.

If you need a longer total acquisition time than that represented by the **Sweep Time** readout in VXT Models M9410A/11A/15A, use the "Minimum Acquisition Time" on page 482 control.

Note that although some overhead time is required by the instrument to complete a sweep cycle, the sweep time reported when Sweep Type is `SWEpt` does not include the overhead time, just the time to sweep the LO over the current Span. When Sweep Type is `FFT`, however, the reported Sweep Time takes into account both the data acquisition time and the processing time, in order to report an equivalent Sweep Time for a meaningful comparison to the Swept case.

NOTE	Significantly faster sweep times are available for the Swept SA measurement with Option FS1.

NOTE	The Meas Uncal (measurement uncalibrated) warning is displayed in the Status Bar at the bottom of the screen when the manual **Sweep Time** entered is faster than the time computed by the instrument's Sweep time equations, that is, the Auto Sweep Time. The instrument's computed Sweep time will give accurate measurements; if you sweep faster than this your measurements may be inaccurate. A Meas Uncal condition may be corrected by returning **Sweep Time** to Auto; by entering a longer **Sweep Time**; or by choosing a wider RBW and/or VBW. On occasion, other factors such as the Tracking Generator's maximum sweep rate, the YTF sweep rate (in high band) or the LO's capability (in low band) can cause a Meas Uncal condition. The most reliable way to correct this is to return **Sweep Time** to Auto. If the instrument calculates that the Auto Sweep Time would be greater than 4000s (which is beyond its range), the warning message "Settings Alert; Sweep Rate Unavailable" is displayed. In this case increase the RBW or reduce the span. If the instrument's estimated sweep time in an `FFT` sweep is greater than 4000s, the warning message "Settings Alert; Span : RBW Ratio too big" is displayed. In this case reduce the span or increase the RBW and/or FFT Width.

NOTE	When using a Tracking Source (**Source**, **Source Mode** set to "**Tracking**"), the sweep time shown includes an estimate of the source's settling time. This estimate may contain inaccuracies, particularly when software triggering is used for the source. This can result in the reported sweep time being shorter than the actual sweep time.

Remote Command	`[:SENSe]:SWEep:TIME <time>`

	`[:SENSe]:SWEep:TIME?`
Example	`:SWE:TIME 500 ms` `:SWE:TIME?`
Notes	The values shown in this table reflect the "swept spans" conditions, which are the default settings after a preset. See "Couplings" for values in the zero-span domain
Dependencies	The Auto/Man toggle disappears in Zero Span. Sending `:SWEep:TIME:AUTO ON` in Zero Span generates an error message In `FFT` sweeps, the Sweep Time control is grayed-out. Pressing the control or sending the SCPI for sweep time while the instrument is in FFT sweep generates a -221, "Settings Conflict;" error In certain instruments without sweeping hardware, such as VXT and UXM, the Auto/Man toggle disappears, and the **Sweep Time** control is grayed-out Sending `:SWEep:TIME:AUTO ON` in `FFT` sweeps generates an error Grayed-out while in Gate View, to avoid confusion with GATE VIEW Sweep Time Grayed-out in Measurements that do not support `SWEpt` mode Not displayed in Modes that do not support `SWEpt` mode Set to **Auto** when "Auto Couple" on page 1995 is pressed or sent remotely
Couplings	Coupled to RBW when in a non-zero span. If **Sweep Time** is set to Auto, then the sweep time is changed as the RBW changes, to maintain amplitude calibration Also coupled to Video Bandwidth (VBW). As the VBW is changed, the sweep time (when set to Auto) is changed to maintain amplitude calibration. This occurs because of common hardware between the two circuits Although the VBW filter is not "in-circuit" when using the average detector and the EMI detectors, the Video BW control can have an effect on (Auto) sweep time in these cases, and is not disabled. Because the purpose of the average detector and the VBW filter are the same, either can be used to reduce the variance of the result. In this case, reducing the VBW setting increases the sweep time, which increases the averaging time, producing a lower-variance trace Span, Center Frequency, and the number of sweep points also can have an effect, so changing these parameters may change the Sweep Time The Sweep Time used upon entry to Zero Span is the same as the Sweep Time that was in effect before entering Zero Span. The Sweep Time can be changed while in Zero Span. Upon leaving Zero Span, the Auto/Man state of Sweep Time that existed before entering Zero Span is restored If **Sweep Time** was in **Auto** before entering Zero Span, or if it is set to **Auto** while in **Zero Span** (which can happen via remote command or if "Auto Couple" on page 1995 is pressed) it returns to **Auto** and recouples when returning to non-zero spans If **Sweep Time** was in **Man** before entering **Zero Span**, it returns to **Man** when returning to non-zero spans, and any changes to Sweep Time that were made while in **Zero Span** are retained in the non-zero span (except where constrained by minimum limits, which are different in and out of zero span)
Preset	Auto
State Saved	Saved in instrument state
Min	In zero span: 1 ms In swept spans: 1 ms In Stepped Tracking (as with option ESC): same as auto sweep time

	In Swept Tracking, with Tracking Generator option T03 or T06, the minimum sweep time is 1 ms, but the Meas Uncal indicator is turned on for sweep times faster than 50 ms
Max	Zero span: 6000 s Swept spans: 4000 s In VXT: depends on current settings in Swept spans
Annotation	The sweep time is displayed in the lower-right corner of the screen. The number of points is displayed parenthetically, as: Sweep 13.3 ms (1001 points) If in an FFT sweep, the word (FFT) is added in parentheses and a ~ is used to indicate “approximate”, as Sweep (FFT) ~13 ms (1001 points) A “#” mark appears before “Sweep” in the annotation when it is switched from Auto to Manual coupling. Note that this # does NOT appear when in zero span, as there is neither an autocoupled nor a manual state in zero span; there is no coupling at all
Status Bits/OPC dependencies	Meas Uncal is Bit 0 in the register `STATus:QUEStionable:INTegrity:UNCalibrated`

Auto Function

Remote Command	`[:SENSe]:SWEep:TIME:AUTO OFF | ON | 0 | 1` `[:SENSe]:SWEep:TIME:AUTO?`
Example	`:SWE:TIME:AUTO OFF` `:SWE:TIME:AUTO?`
Preset	`ON`

Minimum Acquisition Time

Sets the minimum time to be used to acquire each frequency segment (“chunk”) in an FFT sweep. In Auto, it simply uses the value driven by "Sweep Time" on page 479. You can use this control to increase the total acquisition time to the value you need in order to acquire all of the data for your particular measurement.

This control is provided in VXT Models M9410A/11A/15A to give you control over the acquisition time, because **Sweep Time** is not available in these models, as they always use FFT sweeps.

In manual, if set to a value greater than Sweep Time/number of chunks, the instrument acquires more than the minimum amount of data and averages multiple FFTs.

Note that if set to manual, the acquisition time may *exceed* the minimum in order to do an integral number of FFTs.

Remote Command	`[:SENSe]:SWEep:ACQuisition:TIME <time>`

	[:SENSe]:SWEep:ACQuisition:TIME?
Example	:SWE:ACQ:TIME 500 ms :SWE:ACQ:TIME?
Dependencies	Only available in certain modular instruments such as VXT Models M9410A/11A Grayed-out in Zero Span. Grayout error: "-121, Settings conflict; Zero Span, Min Acq Time unavailable"
Preset	Auto
State Saved	Saved in instrument state

Auto Function

Remote Command	[:SENSe]:SWEep:ACQuisition:TIME:AUTO OFF | ON | 0 | 1 [:SENSe]:SWEep:ACQuisition:TIME:AUTO?
Example	:SWE:ACQ:TIME:AUTO OFF
Preset	ON

Sweep/Measure

Lets you toggle between **Continuous** and **Single** sweep or measurement operation. The single/continuous state is Meas Global, so the setting affects all measurements.

The front-panel key **Single/Cont** performs exactly the same function

See "More Information" on page 484

Remote Command	:INITiate:CONTinuous OFF | ON | 0 | 1 :INITiate:CONTinuous?
Example	Put instrument into **Single** measurement operation: :INIT:CONT 0 :INIT:CONT OFF Put instrument into **Continuous** measurement operation: :INIT:CONT 1 :INIT:CONT ON
Preset	ON Note that :SYST:PRES sets :INIT:CONT to ON, but *RST sets :INIT:CONT to OFF
State Saved	Saved in instrument state
Annunciation	The **Single/Continuous** icon in the Meas Bar changes depending on the setting: – A line with an arrow is **Single** – A loop with an arrow is **Continuous**
Backwards	X-Series A-models had **Single** and **Cont** hardkeys in place of the **SweepSingleCont** softkey. In the X-

Compatibility Notes	Series A-models, if in single measurement, the **Cont** hardkey (and `INIT:CONT ON`) switched to continuous measurement, but never restarted a measurement and never reset a sweep X-Series B-models have a **Cont/Single** toggle control instead of **Single** and **Cont** hardkeys, but it is still true that, if in single measurement, the **Cont/Single** toggle control never restarts a measurement and never resets a sweep

More Information

Continuous Mode	The instrument takes repetitive sweeps, averages, measurements, etc., when in continuous mode. If in average or Max/Min Hold, and the average/hold count reaches the **Average/Hold Num**, the count stops incrementing, but the instrument keeps sweeping See the **Trace** key description under **Trace Average** for the averaging formula used both before and after the **Average/Hold Num** is reached. The trigger condition must be met prior to each sweep The type of trace processing for multiple sweeps is set under the **Trace** key, with choices of **Trace Average**, **Max Hold**, or **Min Hold**
Single Mode	The instrument takes a single sweep when in **Single** mode, or if in average or Max/Min Hold, or if there is a **Waterfall** window displayed, it takes multiple sweeps until the average/hold count reaches the **Average/Hold Num**, then the count stops incrementing, and the instrument stops sweeping See the **Trace** key description under **Trace Average** for the averaging formula used. The trigger condition must be met prior to the sweep The type of trace processing for multiple sweeps is set under the **Trace** key, with choices of **Trace Average**, **Max Hold**, or **Min Hold**

If the instrument is in **Single** measurement mode, pressing the **Cont/Single** toggle control does not zero the count and does not cause the sweep to be reset; the only action is to put the instrument into Continuous measurement operation.

If the instrument is already in **Continuous** sweep:

- `:INIT:CONT 1` has no effect
- `:INIT:CONT 0` places the instrument in Single Sweep but has no effect on the current sequence until k = N, at which point the current sequence will stop and the instrument will go to the idle state

See "Restart" on page 2018 for details of `:INIT:IMMediate`.

If the instrument is already in **Single** sweep, `:INIT:CONT OFF` has no effect.

If the instrument is already in **Single** sweep, then pressing **Cont/Single** in the middle of a sweep does not restart the sweep or sequence. Similarly, pressing **Cont/Single** does not restart the sweep or sequence if the sweep is not in the idle state (for example, if you are taking a very slow sweep, or the instrument is waiting for a trigger). Even though pressing **Cont/Single** in the middle of a sweep does not restart the sweep, sending `:INIT:IMM` *does* reset it.

If the instrument is in **Single** sweep, and *not* Averaging/Holding, and you want to take one more sweep, press **Restart**.

If the instrument is in **Single** sweep, *and* Averaging/Holding, and you want to take one more sweep without resetting the Average trace or count, go to **Meas Setup** and increment the average count by 1 by pressing the **Step-Up** key while **Average/Hold Num** is the active function. You can also do this by sending `:CALC:AVER:TCON UP`.

Sweep Time Annotation

Lets you specify whether you want to see, for Sweep Time, an estimate of the total time the instrument is taking to make a sweep, or 1/(Sweep Rate) as has traditionally been the case.

In previous instruments, Sweep Time has always been displayed, when taking a sweep by the swept method (as opposed to the FFT method), as 1/(Sweep Rate), even though that may be shorter than the time it actually takes to perform a sweep. This value of 1/(Sweep Rate) is an excellent indication of how fast the local oscillator is moving, and the experienced user can infer much from this quantity about the optimal value of other settings, like Res BW.

However, 1/(Sweep Rate) can be much less than the total time it takes the instrument to do a multi-band sweep over a wide frequency range, due to band switching and settling times that may add to the total sweep time.

Because of this, you are now given the option of which value the instrument will display. The Sweep Time Annotation gives you two choices, `NORMal` and `ESTimated`. If you prefer the traditional method (that is, always display 1(sweep rate)), choose Normal (1/Sweep Rate). If instead you choose “Estimated”, the estimated actual sweep time is displayed, which is the time from start to finish of a sweep, as well as it can be estimated. This is displayed in the Sweep Time annotation area and is still called “Sweep Time”, as always. To show you that this is the estimated actual sweep time instead of 1/(Sweep Rate), it is preceded by a tilde (~), so it will look like this (for example):

Sweep ~5.3 s (1001 pts)

instead of

Sweep 440 ms (1001 pts)

Note that this value does *not* include the time *between* sweeps, so it not a measure of “cycle time”.

Note also that Estimated Sweep Time only applies when Sweep Type=Swept; when Sweep Type=FFT, the behavior remains as it always has for FFT sweeps, the display is (for example):

Sweep (FFT) ~1.2 s (1001 pts)

Sweep Time Annotation is an Auto/Man control. In Auto (the default state), Normal is chosen unless when unless there is a band crossing or software preselection is being performed, in which case Estimated is chosen.

The Sweep Time command and Sweep Time query set and return the traditional values; but if you want to query the estimated sweep time via SCPI, there is a new query that returns the estimated sweep time:

`[:SENSe]:SWEep:ETIMe?`

Remote Command	`[:SENSe]:SWEep:TIME:ANNotation NORMal:ESTimated` `[:SENSe]:SWEep:TIME:ANNotation?`
Example	`:SWE:TIME:ANN NORM` `:SWE:TIME:ANN?`
Couplings	If you manually choose a value, the Auto/Man selection will change to Manual. You can set it back to auto by tapping the Auto/Man switch
Preset	Auto
State Saved	Saved in instrument state
Annotation	If Estimated, Sweep Time displays as: Sweep ~5.3 s (1001 pts)

Auto Function

Remote Command	`[:SENSe]:SWEep:TIME:ANNotation:AUTO ON | OFF | 1 | 0` `[:SENSe]:SWEep:TIME:ANNotation:AUTO?`
Example	`:SWE:TIME:AUTO:ANN OFF`
Preset	`ON`

Zoom Sweep Time

Controls the sweep time in the bottom window of the Trace Zoom View (the Zoomed Trace window).

Zoom Sweep Time works very much the way Sweep Time works, but it only affects the sweep time of the Zoomed Trace window, whereas Sweep Time affects the Sweep Time of the Spectrum (top) window in Trace Zoom. Because the ratio of the Zoom Sweep Time to the Sweep Time affects the width of the blue bar in the Spectrum window, adjusting Zoom Sweep Time changes the width of the blue bar.

Adjusting the Zoom Sweep Time has no impact on Sweep Time; hence it has no impact on any parameter that might be coupled to Sweep Time and no impact on the measurement. It only affects the portion of the upper trace which is visible in the bottom window.

Remote Command	`[:SENSe]:SWEep:TZOom:TIME <time>` `[:SENSe]:SWEep:TZO:TIME?`

Example	`:SWE:TZO:TIME 500 ms`
Dependencies	Only appears if the Zoomed Trace window is present
Preset	10% of Sweep Time
State Saved	Saved in instrument state
Min	10% of minimum Sweep Time
Max	Maximum Sweep Time
Annotation	The zoom sweep time is displayed in the lower-right corner of the bottom window. The number of points is displayed parenthetically, as Zoom Sweep 13.3 ms (101 points) If in an FFT sweep, the word (FFT) is added in parentheses and a ~ is used to indicate “approximate”, as Zoom Sweep (FFT) ~13 ms (101 points) A “#” mark appears before “Zoom Sweep” in the annotation when Sweep Time is switched from Auto to Manual coupling. Note that this # does *not* appear when in zero span, as there is neither an autocoupled nor a manual state in zero span; there is no coupling at all

Zoom Center

Allows you to change the center of the zoom region, and hence of the lower window, without changing the Zoom Span, when you are in Zero Span.

The **Zoom Center** value is displayed in the lower left corner of the zoom window (below the graticule).

Remote Command	`[:SENSe]:FREQuency:TZOom:TIME:CENTer <time>` `[:SENSe]:FREQuency:TZOom:TIME:CENTer?`
Example	`:FREQ:TZO:TIME:CENT 500 ms`
Dependencies	Only appears if the Zoomed Trace window is present Grayed-out unless in Zero Span. If the command is sent when not in Zero Span, an error is reported
Couplings	The center of the lower window is limited by the Sweep Time in the upper window. You cannot move the zoom region out of the upper window, nor does changing the Zoom Center ever change the Zoom Sweep Time. When Zoom Center increases or decreases to a value that causes the zoom region to touch an edge of the top window, the Zoom Center is clipped at that value
Preset	50% of Sweep Time
State Saved	Saved in instrument state
Min	50% of Zoom Sweep Time
Max	Sweep Time - 50% of Zoom Sweep Time
Annotation	Lower left corner of the Zoomed Trace window

Restart

Restarts the current sweep, or measurement, or set of averaged/held sweeps or measurements. If you are Paused, pressing **Restart** performs a Resume.

The front-panel key **Restart** performs exactly the same function.

The **Restart** function is accessed in several ways:

– Pressing the **Restart** key

– Sending `:INIT:IMM`

– Sending `:INIT:REST`

See "More Information" on page 488

Remote Command	`:INITiate[:IMMediate]` `:INITiate:RESTart`
Example	`:INIT:IMM` `:INIT:REST`
Notes	`:INIT:REST` and `:INIT:IMM` perform exactly the same function
Couplings	Resets average/hold count k. For the first sweep overwrites all active (update = on) traces with new current data. For application modes, it resets other parameters as required by the measurement
Status Bits/OPC dependencies	This is an Overlapped command The `STATus:OPERation` register bits 0 through 8 are cleared , *except* bit 6 (Waiting for Periodic Sync). Initiating a measurement and Waiting for Periodic Sync could be asynchronous The `STATus:QUEStionable` register bit 9 (`INTegrity` sum) is cleared The `SWEEPING` bit is set The `MEASURING` bit is set
Backwards Compatibility Notes	For Spectrum Analysis Mode in ESA and PSA, the **Restart** hardkey and the `:INIT:REST` command restarted trace averages (displayed average count reset to 1) for a trace in **Clear Write**, but did not restart **Max Hold** and **Min Hold** In X-Series, the **Restart** hardkey and the `:INIT:REST` command restart not only **Trace Average**, but **MaxHold** and **MinHold** traces as well

More Information

The **Restart** function first aborts the current sweep or measurement as quickly as possible. It then resets the sweep and trigger systems, sets up the measurement and initiates a new data measurement sequence with a new data acquisition (sweep) taken once the trigger condition is met.

If the instrument is in the process of aligning when a **Restart** is executed, the alignment finishes before the restart function is performed.

Even when set for **Single** operation, multiple sweeps may be taken when **Restart** is pressed (for example, when averaging/holding is on). Thus, when we say that **Restart** "restarts a measurement", depending on the current settings, we may mean that it:

- Restarts the current sweep
- Restarts the current measurement
- Restarts the current set of sweeps if any trace is in Trace Average, Max Hold or Min Hold
- Restarts the current set of measurements if Averaging, or Max Hold, or Min Hold is on for the measurement

If there is no Average or Max/Min Hold function (no trace in Trace Average or Hold, or **Average/Hold Num** set to 1), and no **Waterfall** window is being displayed, a single sweep is equivalent to a single measurement. A single sweep is taken after the trigger condition is met; and the instrument stops sweeping once that sweep has completed. However, with **Average/Hold Num** >1, and at least one trace set to Trace Average, Max Hold, or Min Hold, or a **Waterfall** window being displayed, multiple sweeps/data acquisitions are taken for a single measurement. The trigger condition must be met prior to each sweep. The sweep is stopped when the average count k equals the number N set for **Average/Hold Num**.

Once the full set of sweeps has been taken, the instrument goes to the idle state. To take one more sweep without resetting the average count, increment the average count by 1, by pressing the **Step-Up** key while **Average/Hold Number** is the active function, or by sending the remote command `:CALC:AVER:TCON UP`.

Trace Update

The numeric results are not blanked at any time during the restart cycle.

For slow sweeps (see **Trace Update** section in **Trace/Detector**), the traces are updated real-time during the sweep. There may be a special circumstance in application mode measurements where an exception is made and the traces and/or results need to be blanked before displaying the new results.

To summarize, the following list shows what happens to the trace data on various events:

Event	Trace Effect
Clear/Write pressed (even if already in Clear/Write)	Set to mintracevalue
Max Hold pressed (even if already in Max Hold)	Set to mintracevalue

Event	Trace Effect
Min Hold pressed (even if already in Min Hold)	Set to maxtracevalue
Trace Average pressed (even if already in Trace Average)	Trace data unaffected but start new sweep/avg/hold
Restart pressed	Trace data unaffected but start new sweep/avg/hold
Parameter requiring restart changed (e.g., RBW)	Trace data unaffected but start new sweep/avg/hold

Sweep and Trigger Reset

Resetting the sweep system resets the average/hold count k to 0. It also resets the set point counter to 0. Resetting the trigger system resets the internal auto trig timer to the value set by the **Auto Trig** control.

Averaging

The weighting factor used for averaging is `k`. This `k` is also the average/hold count for how many valid sweeps (data acquisitions) have been done. This `k` is used for comparisons with N, as those comparisons always needs to be based on valid completed sweeps.

The displayed average/hold, `K`, shows the count for the sweep (data acquisition) in progress. `K` = `k` + 1, with a limit of N. The displayed value `K` changes from its previous value to 1 as soon as the trigger condition for the first data acquisition (sweep) is met.

3.2.9.2 Sweep Config

Accesses controls that enable you to configure the Sweep and Control functions of the instrument, such as Sweep Rules.

Sweep Type

Selects `FFT` or `SWEpt` types.

Sweep Type refers to whether or not the instrument is in **Swept** or **FFT** analysis. When in **Auto**, the selection of **Sweep Type** is governed by two different sets of rules, depending on whether you want to optimize for dynamic range or for speed.

FFT “sweeps” should not be used when making EMI measurements; therefore, when a CISPR detector (Quasi Peak, EMI Average, RMS Average) is selected for any active trace (one for which **Update** is on), the **FFT** option in the **Sweep Type** menu is grayed-out, and the Auto Rules only select **Swept**. If **Sweep Type** is manually selected as **FFT**, the CISPR detectors are all grayed-out.

FFT sweeps are never auto-selected when Screen Video, Log Video or Linear Video are the selected Analog Output.

Value	SCPI	Notes
Auto	AUTO = ON	When in **Auto**, the selection of sweep type is governed by two different sets of rules, depending on whether you want to optimize for dynamic range or for speed. See "Sweep Type Rules" on page 492
FFT	`FFT`	Manually selects FFT analysis, so it cannot change automatically to **Swept**
Swept	`SWEep`	Manually selects swept analysis, so it cannot change automatically to **FFT** Selected automatically if any of the CISPR detectors is specified for any active trace, in which case the **FFT** Sweep Type selection is also grayed-out

Remote Command	`[:SENSe]:SWEep:TYPE FFT | SWEep` `[:SENSe]:SWEep:TYPE?`
Example	`:SWE:TYPE FFT` `:SWE:TYPE?`
Dependencies	Grayed-out in **Zero Span**, but the setting can be changed remotely with no error indication Does not appear in certain instruments without sweeping hardware, such as VXT Grayed-out or not displayed in measurements that do not support swept mode When Gate is ON, Gate Method selection affects **Sweep Type** availability: – When Gate Method is FFT, **Swept** grayed-out and rules choose FFT – When Gate Method is Video or LO, **FFT** grayed-out and rules choose Swept **Swept** is grayed-out while in Gated FFT (meaning Gate is ON and Gate Method is FFT) When a CISPR detector (Quasi Peak, EMI Average, RMS Average) is selected for any active trace, the **FFT** selection is grayed-out When the RF Preselector is on, the **FFT** selection is grayed-out When **Source Mode** is set to **Tracking**, the **FFT** selection is grayed-out When **Signal ID** is on, Manual **FFT** is grayed-out While in Gated LO (meaning Gate is ON and Gate Method is LO), the **FFT** selection is grayed-out While in Gated Video (meaning Gate is ON and Gate Method is Video), the **FFT** selection is grayed-out
Preset	AUTO = ON
Annotation	The indication of sweep time includes a #Swp to indicate manual selection, as: Sweep (#Swp) 13.33 ms (1001 points) The indication of sweep time includes parenthetical notes to indicate sweep type unless in Auto, Swept, as: Auto, Swept — Sweep 13.33 ms (1001 points)

	<table><tr><td>Manual, Swept</td><td>Sweep (#Swp) 13.33 ms (1001 points)</td></tr><tr><td>Auto, FFT</td><td>Sweep (FFT) ~13 ms (1001 points)</td></tr><tr><td>Manual, FFT</td><td>Sweep (#FFT) ~13 ms (1001 points)</td></tr></table> The indication of (FFT) includes a # to indicate manual selection, as: Sweep (#FFT) ~13 ms (1001 points)

Backwards Compatibility Notes	Two additional parameters, `AUTO` and `SWP`, are supported for backwards compatibility only and should not be used for new designs
	`[:SENSe]:SWEep:TYPE AUTO`
	sets sweep type Auto to `ON` but the query returns either `FFT` or `SWE` depending on the auto setting
	`[:SENSe]:SWEep:TYPE SWP`
	selects sweep type Swept but returns `SWE` to a query

Auto Function

Remote Command	`[:SENSe]:SWEep:TYPE:AUTO OFF | ON | 0 | 1` `[:SENSe]:SWEep:TYPE:AUTO?`
Example	`:SWE:TYPE:AUTO ON` `:SWE:TYPE:AUTO?`
Couplings	Pressing "Auto Couple" on page 1995 always sets **Sweep Type** to **Auto** **Swept** is always selected whenever any form of **Signal ID** is on, or **Source Mode** is set to **Tracking**, or any EMI detector is selected, or the RF Preselector is `ON`
Preset	`ON`

Sweep Type Rules

Specifies which set of rules to use for automatically selecting **Sweep Type** when "Sweep Type" on page 490 is in **Auto**.

Value	SCPI	Notes
Auto	`AUTO` = `ON`	When in **Auto**, **Sweep Type Rules** are set to `DRANge`
Best Dynamic Range	`DRANge`	Choose between **Swept** and **FFT** analysis with the primary goal of optimizing dynamic range. If the dynamic range is very close between **Swept** and **FFT**, then choose the faster one. This auto selection also depends on RBW Type
Best Speed	`SPEed`	Choose between **FFT** or **Swept** analysis based on the fastest instrument speed

Remote Command	`[:SENSe]:SWEep:TYPE:AUTO:RULes SPEed | DRANge` `[:SENSe]:SWEep:TYPE:AUTO:RULes?`
Example	`:SWE:TYPE:AUTO:RUL SPE` `:SWE:TYPE:AUTO:RUL?`
Dependencies	Grayed-out in **Zero Span**, however, the setting can be changed remotely with no error indication

	Does not appear in certain instruments without sweeping hardware, such as VXT
Preset	DRANge
State Saved	Saved in instrument state

Auto Function

Remote Command	[:SENSe]:SWEep:TYPE:AUTO:RULes:AUTO[:STATe] OFF | ON | 0 | 1 [:SENSe]:SWEep:TYPE:AUTO:RULes:AUTO[:STATe]?
Example	:SWE:TYPE:AUTO:RUL:AUTO ON :SWE:TYPE:AUTO:RUL:AUTO?
Couplings	Pressing "Auto Couple" on page 1995 always sets **Sweep Type Rules** to **Auto**
Preset	ON

In determining the **Swept** or **FFT** setting, the auto rules use the following approach:

- If the RBW Filter Type is Gaussian, use the RBW for the Normal Filter BW and if that RBW > 210 Hz, use **Swept**; for RBW <= 210 Hz, use **FFT**
- If the RBW Filter Type is Flat Top, use the same algorithm, but use 420 Hz instead of 210 Hz for the transition point between **Swept** and **FFT**
- If any of the CISPR detectors is selected for any active trace, always use **Swept**

Sweep Time Rules

Allows you to select one of three sets of sweep time rules. These rules are used to set the sweep time when **Sweep Time** is in **Auto** mode. Note that these rules only apply when "Sweep Type" on page 490 is **Swept** (either manually or automatically chosen) and not when in **FFT** sweeps.

If any selection is manually chosen, the **Auto/Man** toggle is set to **Man**.

Remote Command	[:SENSe]:SWEep:TIME:AUTO:RULes NORMal | ACCuracy | SRESponse For options, see "Option Details" on page 494 [:SENSe]:SWEep:TIME:AUTO:RULes?
Example	:SWE:TIME:AUTO:RUL ACC :SWE:TIME:AUTO:RUL?
Dependencies	SA - Normal and SA – Accuracy are not available (grayed-out) when Source Mode=Tracking Grayed-out in **Zero Span**, however, the setting can be changed remotely with no error indication Grayed-out in **FFT** sweeps. Pressing this selection while the instrument is in **FFT** sweep generates an advisory message. The SCPI is acted upon if sent, but has no effect other than to change the readout on the control, as long as the instrument is in an **FFT** sweep Does not appear in certain instruments without sweeping hardware, such as VXT
Couplings	Set to **Auto** by "Auto Couple" on page 1995

	Stimulus / Response is automatically selected when the Source is on (**Source Mode** not set to OFF)
Preset	AUTO
State Saved	Saved in instrument state
Backwards Compatibility SCPI	:SWEep:TIME:AUTO:MODE SRESponse | SANalyzer :SWEep:TIME:AUTO:MODE?
Backwards Compatibility Notes	:SWEep:TIME:AUTO:MODE SANalyzer is aliased to :SWEep:TIME:AUTO:RULes NORMal :SWEep:TIME:AUTO:MODE SRESponse is aliased to :SWEep:TIME:AUTO:RULes SRESponse The query is aliased to :SWEep:TIME:RULes?, so it matches for SRESponse but not for SANalyzer The old Auto Sweep Time command was the same: [:SENSe]:SWEep:TIME:AUTO:RULes NORMal | ACCuracy so, it still works although it now has a third parameter (SRESponse)

Auto Function

Remote Command	[:SENSe]:SWEep:TIME:AUTO:RULes:AUTO[:STATe] ON | OFF | 1 | 0 [:SENSe]:SWEep:TIME:AUTO:RULes:AUTO[:STATe]?
Example	:SWE:TIME:AUTO:RUL:AUTO ON :SWE:TIME:AUTO:RUL:AUTO?
Couplings	Set on Preset or by "Auto Couple" on page 1995
Preset	ON

Option Details

Value	SCPI	Notes
Auto	AUTO = ON	When in **Auto**, the Sweep Time Rules are set to SA-Normal
SA - Normal	NORMal	This selection selects auto rules for optimal speed and generally sufficient accuracy
SA - Accuracy	ACCuracy	This selection selects auto rules for specified absolute amplitude accuracy
Stimulus / Response	SRESponse	This selection selects auto rules for the case where the instrument is sweeping in concert with a source Automatically selected when the Source is on (Source Mode not set to OFF)

Sweep Time Rules is set to **SA-Normal** on a **Preset** or **Auto Couple**. These rules give optimal sweep times at a loss of accuracy. Note that this means that in the Preset or Auto Coupled state, instrument amplitude accuracy specifications do not apply.

Setting **Sweep Time Rules** to **SA-Accuracy** results in slower sweep times than **SA-Normal**, usually about three times as long, but with better amplitude accuracy for

CW signals. The instrument absolute amplitude accuracy specifications only apply when **Sweep Time** is set to **Auto**, and **Sweep Time Rules** are set to **SA-Accuracy**. Additional amplitude errors, which occur when **Sweep Time Rules** are set to **SA-Normal**, are usually well under 0.1 dB with non-EMI detectors (though this is not guaranteed). With EMI detectors (Quasi Peak, EMI Average and RMS Average), the errors are usually well under 0.5 dB. For best accuracy when using EMI detectors, zero span is the preferred measurement technique; for the EMI detectors, zero span measurements will not fully agree with swept measurements except at extremely slow sweep rates (note that the meters in the N6141A are zero span measurements and therefore this statement also applies to the meters).

Because of the faster sweep times and still low errors, **SA-Normal** is the preferred setting of **Sweep Time Rules**.

The third set of rules, **Stimulus/Response**, is automatically selected when an integrated source is turned on, such as a Tracking Generator or a synchronized external source.

Note that there are two types of source-synchronized sweeping, one where the source sweeps (as with a built-in tracking generator) and one where the source steps. The former is usually much faster than even general-purpose sweeps because when sweeping along with a swept source the RBW and VBW filters do not directly interact with **Span**. However, sweeping in concert with a stepped source usually slows the sweep down because it is necessary to wait for the stepped source and the instrument to settle at each point. The instrument chooses one of these methods based on what kind of a source is connected or installed; it picks the former if there is no source in use, which means that by selecting **Stimulus/Response** rules manually when there is no source in use, you can achieve faster sweep times than **SA – Normal**.

Stimulus/Response auto-coupled sweep times are typically valid in stimulus-response measurements when the system's frequency span is less than 20 times the bandwidth of the device under test. As noted above you can select these rules manually (even if not making Stimulus-Response measurements), which will allow you to sweep faster before the "Meas Uncal" warning comes on, but you are then not protected from the over-sweep condition and may end up with uncalibrated results. However, it is commonplace in measuring non-CW signals such as noise to be able to get excellent measurement accuracy at sweep rates higher than those required for CW signal accuracy, so this is a valid measurement technique.

As always, when the X-series instrument is in **AutoSweep Time**, the sweep time is estimated and displayed in the **Sweep/Control** menu as well as in the annotation at the bottom of the displayed measurement. Since this can depend on variables outside the instrument's control, the actual sweep time may vary slightly from this estimate.

FFT Width

Displays and controls the width of the FFTs performed while in FFT mode. The **FFT Width** is the range of frequencies being looked at by the FFT, sometimes referred to as the "chunk width" – it is *not* the resolution bandwidth used when performing the FFT.

It is important to understand that this function does not directly set the FFT width, it sets the limit on the FFT Width. The actual FFT width used is determined by several other factors including the **Span** you have set. Usually, the instrument picks the optimal **FFT Width** based on the current setup; but on occasion you may wish to limit **FFT Width** to be narrower than that which the instrument would have set.

NOTE: This function does not allow you to widen **FFT Width** beyond that which the instrument might have set; it only allows you to narrow it. You might do this to improve the dynamic range of the measurement or eliminate nearby spurs from your measurement.

Note that the **FFT Width** setting has no effect unless in an **FFT** sweep.

See "More Information" on page 497

Remote Command	`[:SENSe]:SWEep:FFT:WIDTh <real>` `[:SENSe]:SWEep:FFT:WIDTh?`
Example	`:SWE:FFT:WIDT 167 kHz` sets this function to "<167.4 kHz"
Notes	The parameter is in units of frequency For values sent via SCPI, the instrument chooses the smallest value that is at least as great as the requested value Examples: – Parameter 3.99 kHz is sent via SCPI. Analyzer chooses ≤4.01 kHz – Parameter 4.02 kHz is sent via SCPI. Analyzer chooses ≤28.81 kHz – Parameter 8 MHz is sent via SCPI. Analyzer chooses 10 MHz
Dependencies	Does not appear in VXT models M9421A/10A/11A/15A In some models, the analog prefilters are not provided. In these models the **FFT Width** function is always in **Auto**. The **FFT Width** control is not displayed in these models, and the SCPI commands are accepted without error but have no effect Grayed-out in **Zero Span**, however, the setting can be changed remotely with no error indication
Couplings	**FFT Width** affects **ADC Dither**, "Meas Setup" on page 379 and the point at which the instrument switches from **Swept** to **FFT** acquisition
Preset	The Preset is **Auto**, but **Preset** will also pick **Best Dynamic Range** and this function is set to ~Maximum

State Saved	Saved in instrument state
Min	4.01 kHz
Max	Depends on the IF Bandwidth option. The maxim available width is: Standard, 10 MHz Option B25, 25 MHz Option B40, 40 MHz Option B2X, 255 MHz
Backwards Compatibility SCPI	`[:SENSe]:SWEep:FFT:SPAN:RATio <integer>` `[:SENSe]:SWEep:FFT:SPAN:RATio?`

Auto Function

Remote Command	`[:SENSe]:SWEep:FFT:WIDTh:AUTO OFF | ON | 0 | 1` `[:SENSe]:SWEep:FFT:WIDTh:AUTO?`
Example	`:SWE:FFT:WIDT:AUTO ON` `:SWE:FFT:WIDT:AUTO?`
Couplings	Pressing "Auto Couple" on page 1995 always sets **FFT Width** to **Auto**
Preset	ON

More Information

An FFT measurement can only be performed over a limited span known as the “FFT segment”. Several segments may need to be combined to measure the entire span. For advanced FFT control in X-Series, you have direct control over the segment width using the **FFT Width** control. Generally, in automatic operation, X-Series sets the segment width to be as wide as possible, as this results in the fastest measurements.

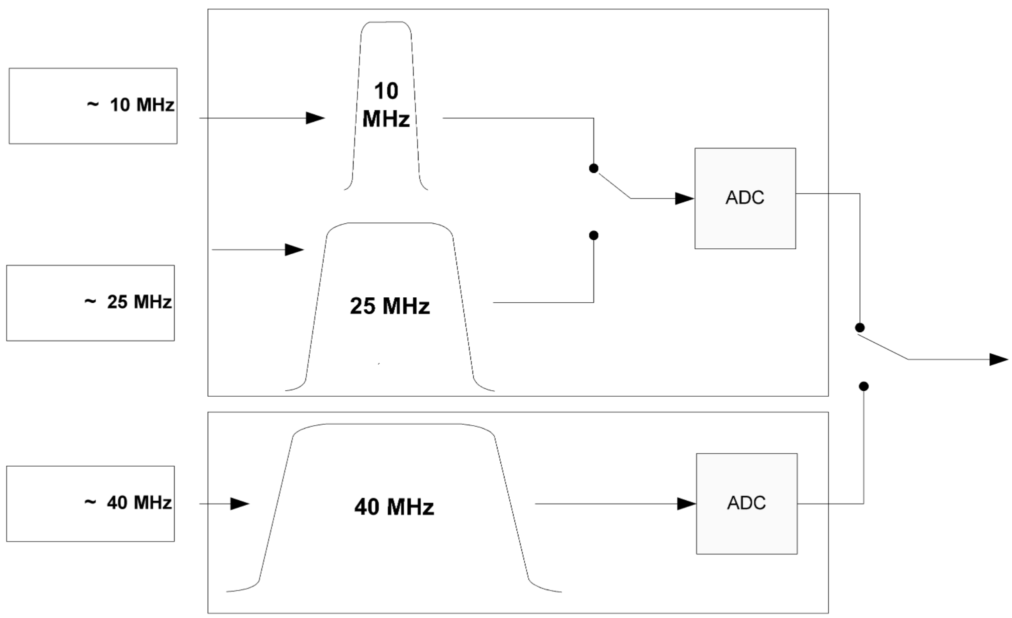
However, to increase the dynamic range, most X-series models provide a set of analog prefilters that precede the ADC. Unlike swept measurements, which pass the signal through a bandpass before the ADC, FFT measurements present the full signal bandwidth to the ADC, making them more susceptible to overload, and requiring a lower signal level. The prefilters act to alleviate this phenomenon - they allow the signal level at the ADC to be higher while still avoiding an ADC overload, by eliminating signal power outside the bandwidth of interest, which in turn improves dynamic range.

Although narrowing the segment width can allow higher dynamic ranges in some cases, this comes at the expense of losing some of the speed advantages of the FFT, because narrower segments require more acquisitions and proportionately more processing overhead.

However, the advantages of narrow segments can be significant. For example, in pulsed-RF measurements such as radar, it is often possible to make high dynamic range measurements with signal levels approaching the compression threshold of the instrument in swept spans (well over 0 dBm), while resolving the spectral components to levels below the maximum IF drive level (about –8 dBm at the input mixer). But FFT processing experiences overloads at the maximum IF drive level even if the RBW is small enough that no single spectral component exceeds the maximum IF drive level. If you reduce the width of an FFT, an analog filter is placed before the ADC that is about 1.3 times as wide as the FFT segment width. This spreads out the pulsed RF in time and reduces the maximum signal level seen by the ADC. Therefore, the input attenuation can be reduced, and the dynamic range increased without overloading the ADC.

Further improvement in dynamic range is possible by changing the **FFT IF Gain** (in the **Meas Setup** menu of many measurements). If the segments are reduced in width, **FFT IF Gain** can be set to **High**, improving dynamic range.

Depending on what IF Bandwidth option you have specified, there can be up to three different IF paths available in FFT sweeps, as seen in the diagram below:



The 10 MHz path is always used for **Swept** sweeps. It is always used for **FFT** sweeps as well, unless you specify ~25 MHz in which case the 25 MHz path is used for **FFT** sweeps, or ~40 MHz, in which case the 40 MHz path is used for **FFT** sweeps. Note that, although each of these control s picks the specified path, the instrument may choose an FFT width less than the full IF width to optimize speed, trading off acquisition time versus processing time.

If the 255 MHz IF (Option B2X) is installed, it may also be used for **FFT** sweeps, but only if you specify ~255 MHz for FFT Width.

Points

Sets the number of points taken per sweep, and displayed in the traces. The current value of points is displayed parenthetically, next to the sweep time in the lower-right corner of the display. Using more points provides greater resolution. Using fewer points compacts the data and decreases the time required to access a trace over the remote interface.

Increasing the number of points does not increase the sweep time. However, it can slightly impact the trace processing time and therefore the overall measurement speed. Decreasing the number of points does not decrease the sweep time, but it may speed up the measurement, depending on the other sweep settings (for example, in **FFT** sweeps). Fewer points will always speed up the I/O.

Due to minimum sweep rate limitations of the hardware, the minimum sweep time available to the user will increase above its normal value of 1 ms as the number of sweep points increases above 15001.

Changing the number of sweep points has several effects on the instrument. Since markers are read at the point location, the marker reading may change. The sweep time resolution will change. Trace data for all the traces is cleared and, if Sweep is in Cont, a new trace taken. If any trace is in average or hold, the averaging starts over. If Limit Lines are ON, the limit lines are updated.

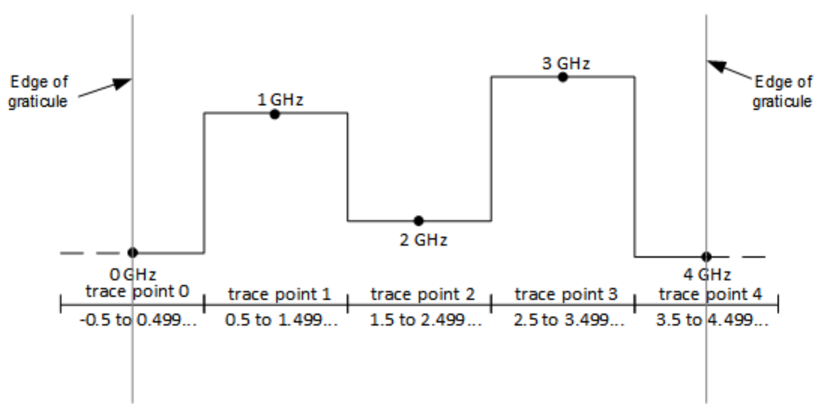
When in a split-screen display, each window may have its own value for points.

When sweep points is changed, an informational message is displayed, "Sweep points changed, all traces cleared."

Remote Command	`[:SENSe]:SWEep:POINts <integer>` `[:SENSe]:SWEep:POINts?`
Example	`:SWE:POIN 5001` `:SWE:POIN?`
Dependencies	Not available when **Signal ID** is ON in External Mixing Neither the knob nor the step keys can be used to change this value. If it is attempted, a warning is given Clipped to 1001 whenever you are in the **Spectrogram** View in all models except MXE, clipped to 20001 whenever you are in the **Spectrogram** View in MXE Grayed-out in measurements that do not support swept Not displayed in modes that do not support **Swept** Grayed-out if **Normalize** is ON; you cannot change the number of sweep points with **Normalize** on, as it will erase the reference trace
Couplings	When **Source Mode** is **Tracking**, and Stepped Tracking is used (as with Option ESC), 201 source steps are used to achieve optimal speed. The number of sweep points in the instrument is then set to match the number of steps in the source. When **Source Mode** is **Off**, the previous number of points (the value

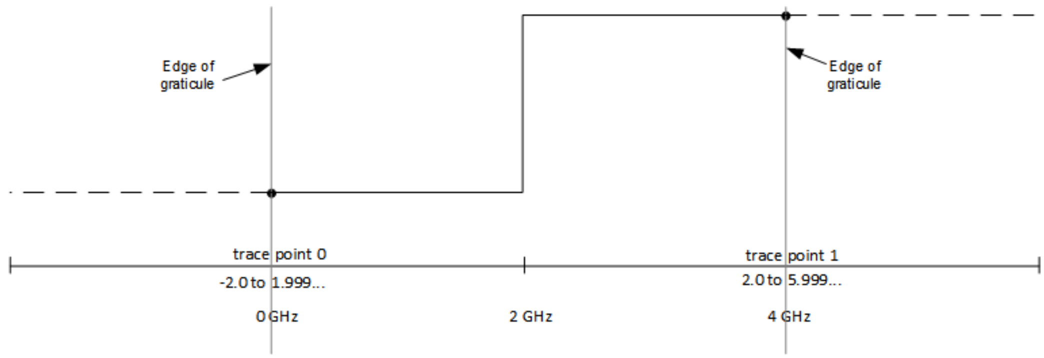
	that existed when **Source Mode** was **Off** previously) is restored, even if you have changed the **Points** value while **Source Mode** was set to **Tracking** Whenever the number of sweep points change: – All trace data is erased – Any traces with **Update** Off will also go to **Display** Off (like going from View to Blank in the older instruments) – Sweep time is re-quantized – Any Limit Lines that are on are updated – If averaging/hold is on, averaging/hold starts over The resolution of setting the sweep time depends on the number of points selected
Preset	1001
State Saved	Saved in instrument state
Min	Normally the minimum is 1, but in **TrackingSource Mode**, the minimum value of **Points** is 101. If you go into **TrackingSource Mode** with fewer points than 101, it sets **Points** to 101
Max	20001 all measurements unless noted below 100,001 when not in **Tracking Source Mode** In **Tracking Source Mode**: – in Stepped Tracking (for example, External Source), 1601 or the maximum number of points supported by the source, whichever is less – in Swept Tracking with the CXA TG, 10000 – in Stepped Tracking with the CXA-m TG, 16000
Annotation	On second line of annotations, in lower right corner in parenthesis behind the sweep annotation

Traces are drawn by connecting the trace points, so below is what a 5-point trace with start frequency of 0 and stop frequency of 4 GHz would look like. Note that the black dots at the bucket centers are not actually drawn, but are for illustrative purposes only.



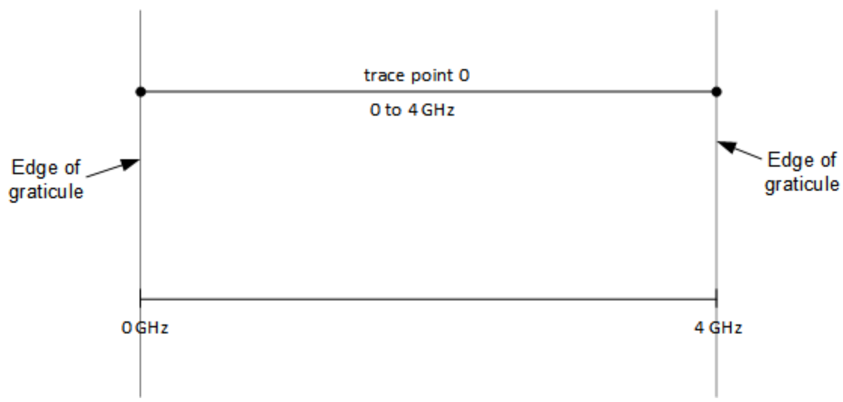
The first bucket (for measurement purposes) actually begins at start – (span/2 (sweep_points – 1)), and the last bucket extends to stop + (span/2(sweep_points – 1)). However, the first bucket is drawn starting at start, so only half the bucket is drawn, and the last bucket is drawn ending at stop, so only half of the last bucket is drawn.

The limiting case for which this applies is the two-bucket trace, which looks like this:



The one-bucket trace is a special case. The one-bucket trace extends from start to stop and is drawn from start to stop as shown below.

Note that the black dots at the bucket ends are not actually drawn, but are for illustrative purposes only.



Zoom Points

In the **Trace Zoom** View, the **Points** control changes to **Zoom Points** whenever the focus (thick blue border) is on the bottom window. **Zoom Points** controls how many points are displayed in the Zoom Window and hence indirectly controls the Zoom Span.

Remote Command	`[:SENSe]:SWEep:TZOom:POINts <integer>` `[:SENSe]:SWEep:TZOom:POINts?`

Example	`:SWE:TZO:POIN 5001` `:SWE:TZO:POIN?`
Dependencies	Only appears in the **Trace Zoom** View of the Swept SA measurement. If the command is sent in other Views, gives an error
Couplings	Coupled to **Zoom Span** and **Sweep Points**; if **Zoom Span** changes, **Zoom Points** changes but **Sweep Points** does not. If **Sweep Points** changes, **Zoom Points** changes but **Zoom Span** does not **Zoom Span** is directly coupled to **Zoom Points**. If **Zoom Points** changes, **Zoom Span** changes but **Sweep Points** does not
Preset	On entry to **Trace Zoom**, 10% of the number of points in the upper window
State Saved	Saved in instrument state
Min	1
Max	Number of points in top window
Annotation	On second line of annotations, in bottom window, in lower right corner in parenthesis behind the sweep annotation

IF Dithering

Lets you turn IF Dithering on or off. This is a technique used in unpreselected instruments (such as Keysight's modular instruments) to enhance the rejection of images and internally-generated spurious signals.

Remote Command	`[:SENSe]:SWEep:IF:DITHer OFF | ON | 0 | 1` `[:SENSe]:SWEep:IF:DITHer?`
Dependencies	Only appears in Spectrum Analyzer Mode in VXT models
Preset	`OFF`
State Saved	Saved in instrument state

Image Protection

Lets you turn IF Protection on or off. This is a technique used in unpreselected instruments (such as Keysight's modular instruments) to detect and suppress images and spurs that may be present in non-preselected hardware.

IF Protection takes two sweeps and by correlating the data between them, provides a single, correct power-versus-frequency trace.

Remote Command	`[:SENSe]:SWEep:IMAGeprot OFF | ON | 0 | 1` `[:SENSe]:SWEep:IMAGeprot?`
Dependencies	Only appears in Spectrum Analyzer Mode in VXT models
Preset	`ON`
State Saved	Saved in instrument state

Abort (Remote Command Only)

Stops the current measurement. Aborts the current measurement as quickly as possible, resets the sweep and trigger systems, and puts the measurement into an "idle" state. If the instrument is in the process of aligning when `:ABORt` is sent, the alignment finishes *before* the abort function is performed, so `:ABORt` does not abort an alignment.

If the instrument is set for **Continuous** measurement, it sets up the measurement and initiates a new data measurement sequence with a new data acquisition (sweep) taken once the trigger condition is met.

If the instrument is set for **Single** measurement, it remains in the "idle" state until an `:INIT:IMM` command is received.

Remote Command	`:ABORt`
Example	`:ABOR`
Notes	If :`INIT:CONT` is `ON`, then a new continuous measurement will start immediately, with sweep (data acquisition) occurring once the trigger condition has been met If :`INIT:CONT` is `OFF`, then `:INIT:IMM` is used to start a single measurement, with sweep (data acquisition) occurring once the trigger condition has been met
Dependencies	For continuous measurement, `:ABORt` is equivalent to the **Restart** key Not all measurements support this command
Status Bits/OPC dependencies	The `STATus:OPERation` register bits 0 through 8 are cleared , *except* bit 6 (Waiting for Periodic Sync). Initiating a measurement and Waiting for Periodic Sync could be asynchronous The `STATus:QUEStionable` register bit 9 (`INTegrity` sum) is cleared Since all the bits that feed into OPC are cleared by `:ABORt`, the Abort command will cause the `*OPC` query to return true

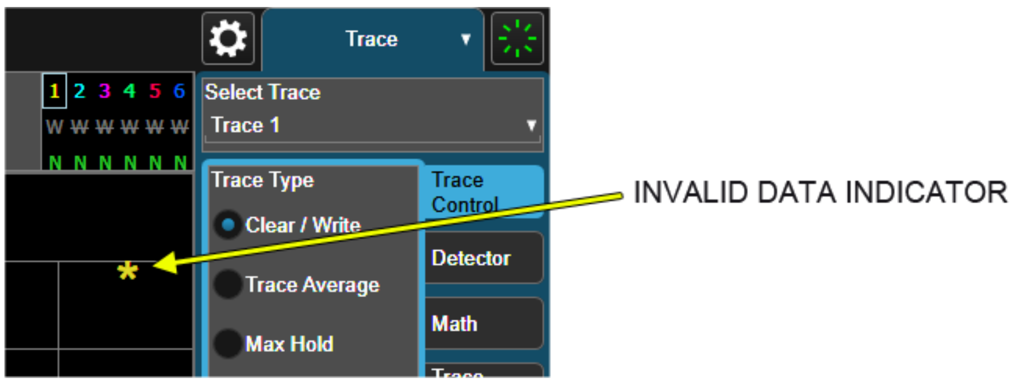
3.2.10 Trace

This menu lets you control the acquisition, display, storage, detection and manipulation of trace data for the available traces. The Trace Control tab of this menu contains radio-button selections for the trace type (**Clear/Write, Trace Average, Max Hold, Min Hold**) and **View/Blank** setting for the selected trace.

A trace is a series of data points, each having an x and a y value. The x value is frequency (or time, in zero span) and the y value is amplitude. Each data point is referred to as a trace point. In any given trace, trace point 0 is the first point, and trace point (sweep_points – 1) is the last. For example, in a 1001-point trace, the first point is 0 and the last is 1000. Another term sometimes used to describe traces is bucket. A bucket is the frequency span of a trace point, equal to the point spacing. For swept analysis, the y value in each bucket is measured while the instrument is sweeping across the bucket. How it is measured depends on which detector is selected.

When in **Single** Mode, Measurements and their Views save the trace data from the last acquisition. This is true on multiple screens. The marker and trace data are present whenever the measurement is brought back into focus. The measurement switches for these measurements do not clear the traces, so the data is present until the next acquisition is completed.

Invalid Data Indicator



The invalid data indicator is displayed whenever the data on the display does not match the settings of the instrument. The most common example of this is when instrument settings have changed in the time since the data in the traces on the display was taken. This means that the screen annotation cannot be guaranteed to match the trace data. For example, if you change Center Frequency, the invalid data indicator will display until the trace has been retaken.

If any Trace is in View mode (displaying but not updating) and instrument settings are changed, the invalid data indicator will display as long as that trace remains in View. Traces that are blanked do not turn on the invalid data indicator.

Not all instrument settings require display of the invalid data indicator when they change; only changes that require a new acquisition will cause it to display. For example, changing the Y-Axis scale of the instrument does not cause the invalid data indicator to display, unless the attenuation changes.

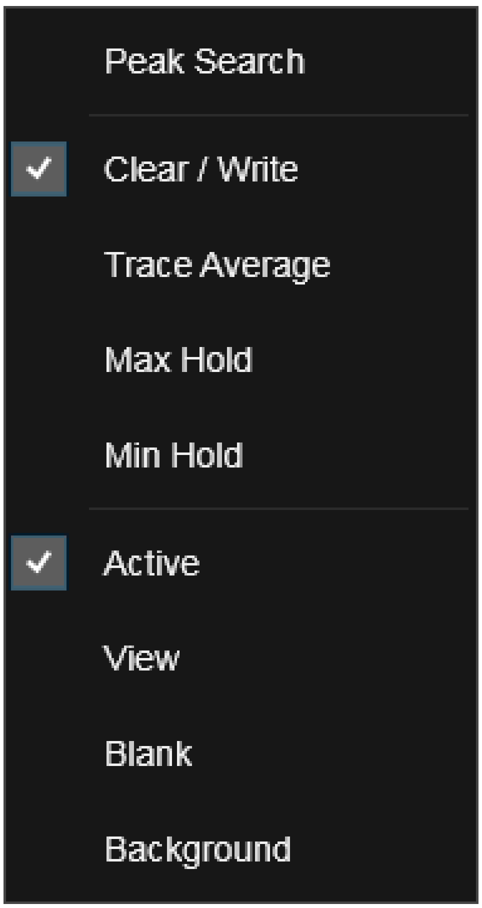
The invalid data indicator is also turned on:

- When the counter is turned on, until the completion of the first count
- When a trace is imported from mass storage and the trace’s parameters do not match the current instrument settings
- When a trace is sent to the instrument from a remote interface (since there is no way to know if its settings match)

NOTE	The Invalid Data Indicator has an associated status bit that can be checked at any time to see if the indicator is on.

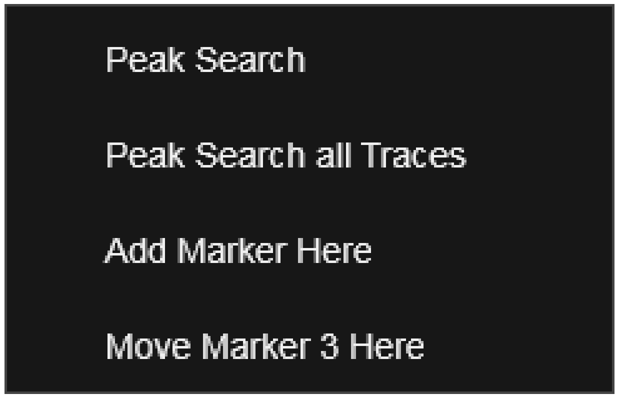
Trace right-click menu

If you right-click on a trace (or touch and hold a trace and wait for the circle to close), the **Trace Right-Click** menu appears:



If you now tap or click on one of the items in this menu, it performs the corresponding function. **Peak Search** finds the highest peak on the selected Trace (see "Peak Search" on page 318). **Clear/Write**, **Trace Average**, **Max Hold** and **Min Hold** set the "Trace Type" on page 1905. **Active**, **View**, **Blank**, and **Background** set the "View/Blank" on page 1721 type.

If you right-click on the trace (or touch and hold the trace and wait for the circle to close) in the **Waterfall** window (for example, in the **Spectrogram** View), the **Waterfall Trace Right-Click** menu appears:



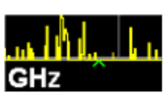
Peak Search works as above. **Peak Search all Traces** finds the highest peak in the **Waterfall** window (see "Peak Search All Traces" on page 319). **Add Marker Here** takes the lowest-numbered marker that is currently **Off** and turns it on as a **Normal** marker in the **Waterfall** window at the point where you right-clicked (or touched-and-held). **Move Marker n Here** moves the currently selected marker to the point in the **Waterfall** window where you right-clicked (or touched-and-held).

Trace Update Indicator

Trace updates can take one of two forms:

1. The trace is updated in a single operation that affects all the points in the trace at once. This happens, for example, in the case of very fast (< 200 ms) sweeps, single-chunk FFTs, and the initial math operation after a math function is set for a trace
2. The trace is updated in a series of discrete steps, with measurement data being gathered between each step. This is the case for slow sweeps, multi-chunk FFTs, gated sweeps, etc.

In the first case, no update indicator is required. In the second case, however, a visual indicator exists on the trace where the new data is being written, a green "caret" (^) , which moves across the bottom of the graticule showing the current trace point.



Trace Annunciator Panel

The trace annunciator panel appears on the right-hand side of the Meas Bar. Here is an explanation of the fields in this panel:

On the top line each trace number is shown, in the trace color. A blue box is drawn around the currently selected trace.

Below each trace number, is a letter signifying the trace type for that trace number, where

W	Clear/Write
A	Trace Average
M	Max Hold
m	Min Hold

If the letter is white, it means the trace is being updated (**Update** = **On**); if the letter is dimmed , it means the trace is not being updated (**Update** = **Off**). A strikethrough (for example, W) indicates that the trace is blanked (**Display** = **Off**). Note that it is possible for a trace to be updating and blanked, which is useful if the trace is a trace math component.

The third line shows the detector type for each trace, or, if trace math is on for that trace, it shows f (for "Math Function"). It is not always possible to have a unique detector for each trace, but the instrument hardware provides the maximum flexibility of detector selection to maintain the highest accuracy.

The letters used for this readout are

N	Normal
A	Average
P	Peak
p	Negative Peak
S	Sample
Q	Quasi Peak
E	EMI Average
R	RMS Average
f	Math Function

If the DET letter is green, it means the detector is in **Auto**; if it is white, it means the detector has been manually selected.

So, in the example above, the panel shows the following:

Trace 1	Visible, being updated, in **Clear/Write**, with **Normal** detector auto selected
Trace 2	Visible, being updated, in **Clear/Write**, being written to with a math function
Trace 3	Visible, not updating, data was taken in **Max Hold**, with **Peak** detector auto selected
Trace 4	Blanked, not updating, data was taken with **Averaging** turned on, **Sample** detector manually selected
Trace 5	Visible, not updating, data was taken in **Min Hold** with **Negative Peak** detector auto selected
Trace 6	Blanked, not updating, in **Clear/Write**, with **Normal** detector manually selected

Trace Annotation

When "Trace Annotation" on page 1981 (see **Display** menu) is **On**, each non-blanked trace is labeled on the trace with the detector used to take it, unless a trace math function is on for that trace, in which case it is labeled with the math function.

The detector labels are:

`NORM`	Normal
`PEAK`	Peak
`SAMP`	Sample
`NPEAK`	Negative Peak
`RMS`	Average detector with Power Average (RMS)
`LG AVG`	Average detector with Log-Pwr Average
`VAVG`	Average detector with Voltage Average
`QPEAK`	Quasi Peak
`EMI AVG`	EMI Average
`RMS AVG`	RMS Average

The trace math labels are:

`PDIF`	Power Difference
`PSUM`	Power Sum
`LOFF`	Log Offset
`LDIF`	Log Difference

3.2.10.1 Select Trace

Specifies the *selected trace*, which is the trace that will be affected when you change trace settings.

Select Trace appears above the menu panel, indicating that it applies to *all* controls in the menu panel. **Select Trace** is blanked if you select a tab whose controls do *not* depend on the selected trace (for example, **Trace Function**).

Notes	The selected trace is remembered even when not in the **Trace** menu
Dependencies	For the Swept SA measurement: – In Image Suppress mode, when you select a trace it becomes the active trace, and the formerly active trace goes into View – When you turn on Image Suppress, Update turns off for all traces except the selected trace For the ACP measurement, when **Meas Method** is `RBW`, `FAST` or `FPOWer`, **Select Trace** is disabled
Preset	Trace 1
State Saved	Yes

3.2.10.2 Trace Control

The controls on this tab allow you to set the "Trace Type" on page 1905 and its update mode.

There are four Trace Types:

– Clear/Write

– Trace Average

– Max Hold

– Min Hold

Each type handles data in a different way.

Each trace also has two values that determine whether it is being written or not, and whether it is being displayed or not. These values, **Update** and **Display,** are described fully in the "View/Blank" on page 1721 control description. Essentially, when **Update** is `ON`, a trace is updating, and when **Update** is `OFF` it is not. When **Display** is `ON`, it is visible and when **Display** is `OFF` it is not. These terms are used throughout the descriptions in this section.

Trace Type

There are four trace Types:

Option	Parameter	SCPI Example	Details
Clear/Write	`WRITe`	`:TRAC2:TYPE WRIT`	See: "Clear/Write" on page 512
Trace Average	`AVERage`	`:TRAC2:TYPE AVER`	See: "Trace Average" on page 513

Option	Parameter	SCPI Example	Details
Maximum Hold	`MAXHold`	`:TRAC3:TYPE MAXH`	See: "Max Hold" on page 514
Minimum Hold	`MINHold`	`:TRAC5:TYPE MINH`	See: "Min Hold" on page 514

Full descriptions of each type are provided below. You may select one of these types for each trace. Re-selecting the current **Trace Type** initiates the same action that selecting it the first time did, even though it is already selected. For example, selecting **Clear/Write** while **Clear/Write** is already selected will nonetheless clear the trace and begin rewriting it.

Besides the **Trace Type**, the "View/Blank" on page 1721 state must be set to **Active** (**Update**: `ON`, **Display**: `ON`) for a trace to be updating and visible. Selecting any **Trace Type** automatically makes the trace **Active**.

See also: "Trace Mode Backwards Compatibility Commands" on page 510

Remote Command	For Swept SA Measurement (in SA Mode): `:TRACe[1]|2|…|6:TYPE WRITe	AVERage	MAXHold	MINHold` `:TRACe[1]|2|…|6:TYPE?` For all other measurements: `:TRACe[1]|2|3:<meas>:TYPE WRITe	AVERage	MAXHold	MINHold` `:TRACe[1]|2|3:<meas>:TYPE?` where `<meas>` is the identifier for the current measurement
Example	`:TRAC:TYPE WRIT` `:TRAC:TYPE?`
Couplings	Selecting a **Trace Type** (by pressing any of the Trace Type selections or sending `:TRAC:TYPE`) sets the Trace to **Active** (**Update**: `ON`, **Display**: `OFF`), even if the same trace type was already selected When Detector setting is "Auto" (`[:SENSe]:<meas>:DETector:AUTO?)`, Detector `([:SENSe]:<meas>:DETector[:FUNCtion]?`) switches aligning with the switch of this parameter: "`NORMal`" with `WRITe` (Clear Write), "`AVERage`" with `AVERage`, "`POSitive` (peak)" with `MAXHold`, and "`NEGative` (peak)" with `MINHold`
Preset	Swept SA and Monitor Spectrum: `WRITe` All other measurements: `AVERage` Following **Preset**, all traces are cleared (all trace points set to mintracevalue)
State Saved	The type of each trace is saved in instrument state
Annunciation	The type for each trace is indicated in the Trace annunciator panel on the Measurement Bar

Trace Mode Backwards Compatibility Commands

In earlier instruments, the "Trace Modes" were: Clear/Write, Max Hold, Min Hold, View and Blank. Averaging was global to all traces and was controlled under the **BW/Avg** menu.

In X-Series, trace averaging can be done on a per-trace basis. The Trace Modes (now called Trace Types) are Clear/Write, Trace Average, Max Hold and Min Hold. View and Blank are set separately under "View/Blank" on page 1721.

While this provides more flexibility, it also gives rise to potential backwards compatibility problems. To mitigate these, the old Trace Mode command has been retained and a new Trace Type command has been added. The :`TRACe:MODE` command is retained for backwards compatibility, and the :`TRACe:TYPE`, :`TRACe:UPDate` and :`TRACe:DISPlay` commands introduced for ongoing use. The old Trace Modes are selected using `:TRAC:MODE`, whose parameters are mapped into calls to `:TRACe:TYPE`, `:TRACe:UPDate` and `:TRACe:DISPlay`, and the old global Averaging command `[:SENSe]:AVERage[:STATe]` is provided for backwards compatibility. See the individual command descriptions for details.

When **Average/Hold** in the **Meas Setup**, **Legacy Compatibility** menu is `ON`, the following is true for traces in Max Hold and Min Hold:

- They ignore the **Average/Hold** number; **Single** for Max Hold causes one sweep only, so switching to **Single** stops after the current sweep, and switching to **Cont** starts again without clearing the accumulated result
- Max Hold is not cleared on a **Restart**, **Single** or `:INIT:IMM`, but changing a measurement parameter, like frequency or bandwidth etc., still restarts the Max Hold

Preset	`WRITe`
State Saved	The trace mode is an alias only
Backwards Compatibility SCPI	`:TRACe[1]|2|…|6:MODE WRITe | MAXHold | MINHold | VIEW | BLANk` `:TRACe[1]|2|…|6:MODE?`
Backwards Compatibility Notes	The legacy `:TRACe:MODE` command is retained for backwards compatibility. In conjunction with the legacy `:AVErage` command, it works as follows: – `:AVErage ON|OFF` sets/clears a variable that we will call average for the sake of this discussion. This variable is maintained by the instrument solely for backwards compatibility. See the `[:SENSe]:AVERage[:STATe]` command description below – `:TRACe:MODE WRITe` sets `:TRACe:TYPE WRITe` (Clear/Write) unless average is true, in which case it sets it to `:TRACe:TYPE AVErage`. It also sets `:TRACe:UPDate ON`, `:TRACe:DISPlay ON`, for the selected trace – `:TRACe:MODE MAXHold` sets `:TRACe:TYPE MAXHold` (Max Hold). It also sets `:TRACe:UPDate ON`, `:TRACe:DISPlay ON`, for the selected trace – `:TRACe:MODE MINHold` sets `:TRACe:TYPE MINHold` (Min Hold). It also sets `:TRACe:UPDate ON`, `:TRACe:DISPlay ON`, for the selected trace – `:TRACe:MODE VIEW` sets `:TRACe:UPDate OFF`, `:TRACe:DISPlay ON`, for the selected trace

	– `:TRACe:MODE BLANk` sets `:TRACe:UPDate OFF`, `:TRACe:DISPlay OFF`, for the selected trace The query returns the same value as `:TRACe:TYPE?`, meaning that if you set `:TRACe:MODE:VIEW` or `:TRACe:MODE:BLANk`, the query response will not be what you sent `:TRACe[n]:MODE` was formerly used to set the type or "writing mode" of the trace. At that time, View and Blank were writing modes. The new `:TRACe:TYPE` command should be used in the future, but `:TRACe:MODE` is retained to provide backwards compatibility In X-Series, unlike earlier instruments, Max Hold and Min Hold now obey the Average Number and counts up to a terminal value as Average always has As the **Average/Hold Number** now affects **Min Hold** and **Max Hold**, the operations that restart Averaging (for example, the **Restart** key) now also restart **Min Hold** and **Max Hold** As a result of these changes, legacy code that restarts averaging while retaining a running Max Hold will need to be rewritten, because the Max Hold will now restart when the Average does Also, previous to X-Series: – Pressing **Max Hold** while already in **Max Hold** (or doing so remotely) had no effect. Now it will clear the trace and restart the sweep and the Max Hold sequence – Changing the vertical scale (Log/Lin or dB/div) of the display restarted **Max Hold** and **Min Hold**. This is no longer the case
Preset	`OFF`
State Saved	The state of Average is saved in Instrument State for ghosting purposes
Backwards Compatibility SCPI	`[:SENSe]:AVERage[:STATe] ON | OFF | 1 | 0` `[:SENSe]:AVERage[:STATe]?`
Backwards Compatibility Notes	Previous to X-Series, Averaging (also sometimes known as trace averaging) was global to all traces, that is, it was either on or off for all active traces. The legacy command `[:SENSe]:AVERage [:STATe] ON|OFF|1|0` was used to turn Averaging on or off In X-Series, Averaging is turned on or off on a per-trace basis, so it can be on for one trace and off for another For backwards compatibility, the old global Average State variable is retained solely as a legacy variable, turned on and off and queried by the legacy command `[:SENSe]:AVERage[:STATe] OFF|ON|0|1.` When Average is turned on, any trace in Clear/Write will get put into Average. While Average is on, any trace put into Clear/Write by the old `:TRAC:MODE` command will instead get put into Average. When Average is turned off, any trace in Average will get put into Clear/Write

Trace Type Details

Clear/Write

Each trace update replaces the old data in the trace with new data.

Pressing **Clear/Write** for the selected trace, or sending `:TRAC:TYPE WRIT` for the specified trace, sets the trace type to **Clear/Write** and clears the trace, even if you are already in **Clear/Write**. Then a new sweep is initiated. Trigger conditions must be met before the sweep actually starts, and if in **Single** the sweep won't start until **Restart** is pressed.

Pressing **Clear/Write** stops the current sweep and initiates a new one, so **Trace Average, Max Hold** and **Min Hold** data may be interrupted in mid-sweep when **Clear/Write** is pressed, and therefore may not accurately reflect the displayed count. Therefore, when **Clear/Write** is pressed for one trace, **Trace Average, Max Hold** and **Min Hold** must restart for all traces.

When in **Clear/Write**, if a measurement-related instrument setting is changed (that is, one which requires new data to be taken, like **Center Frequency** or **Attenuation**), a new sweep is initiated but the trace is not cleared.

Trace Average

The instrument maintains and displays an average trace, which represents the cumulative average on a point-by-point basis of the new trace data and previous averaged trace data.

Pressing **Trace Average** (for the selected trace), or sending `:TRAC:TYPE AVER` (for the specified trace), sets the trace type to **Trace Average**, clears the trace, initiates a new sweep, and restarts the Average sequence.

Details of the count limiting behavior and the averaging calculations may be found under **Avg|Hold Number** and **Average Type** under **Meas Setup.**

When in **Trace Average**, if a measurement-related instrument setting is changed (that is, one which requires new data to be taken, like Center Frequency or Attenuation), the average restarts and a new sweep is initiated but the trace is not cleared.

Restarting the average means:

- The average/hold count k is set to 1, so that the next time the average trace is displayed it simply represents one trace of new data
- A new sweep is initiated
- Once the new sweep starts, the trace is overwritten with current trace data as the first trace of the new average

Remember that restarting averaging also restarts **Max Hold** and **Min Hold**, as there is only one count for Trace Average and Hold.

Max Hold

The instrument maintains and displays a max hold trace, which represents the maximum data value on a point-by-point basis of the new trace data and previous trace data. Details of the count limiting behavior may be found under **Avg|Hold Number** under **Meas Setup.**

Pressing **Max Hold** for the selected trace, or sending `:TRAC:TYPE MAXH` for the specified trace, sets the Trace Type to **Max Hold,** clears the trace , initiates a new sweep, and restarts the hold sequence, even if you are already in **Max Hold**.

When in **Max Hold**, if a measurement-related instrument setting is changed(that is, one which requires new data to be taken, like **Center Frequency** or **Attenuation**), the **Max Hold** sequence restarts and a new sweep is initiated but the trace is not cleared.

Restarting the **Max Hold** sequence means:

- The average/hold count k is set to 1, so that the next time the max hold trace is displayed it simply represents one trace of new data
- A new sweep is initiated.

Remember that restarting **Max Hold** also restarts averaging and **Min Hold**, as there is only one count for Trace Average and Hold.

Min Hold

The instrument maintains and displays a min hold trace, which represents the minimum data value on a point-point basis of the new trace data and previous trace data. Details of the count limiting behavior may be found under **Avg|Hold Number** under the **Meas Setup** functions.

Pressing **Min Hold** for the selected trace, or sending `:TRAC:TYPE MINH` for the specified trace, sets the Trace Type to **Min Hold,** clears the trace, initiates a new sweep, and restarts the hold sequence, even if you are already in **Min Hold**.

When in **Min Hold**, if a measurement-related instrument setting is changed(that is, one which requires new data to be taken, like **Center Frequency** or **Attenuation**), the **Min Hold** sequence restarts and a new sweep is initiated but the trace is not cleared.

Restarting the **Min Hold** sequence means:

- The average/hold count k is set to 1, so that the next time the min hold trace is displayed it simply represents one trace of new data
- A new sweep is initiated

Remember that restarting **Min Hold** also restarts **Max Hold** and averaging, because there is only one count for Trace Average and Hold.

Clear and Write | Restart Averaging | Restart Max/Min Hold

Starts the trace writing, as though the "Trace Type" on page 1905 had just been selected. The effect is exactly the same as reselecting the current **Trace Type** again – the control is provided because it may not be obvious that reselecting the same selection from a radio button menu will take any action.

This control displays different labels, depending on the selected Trace Type:

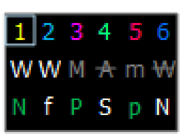
- **Clear/Write**: Clear and Write
- **Trace Average**: Restart Averaging
- **Max Hold**: Restart Max Hold
- **Min Hold**: Restart Min Hold

View/Blank

Lets you set the state of the two trace variables: **Update** and **Display**. The choices available in this dropdown menu are:

Active	Update and Display both ON
View	Update OFF; Display ON
Blank	Update OFF; Display OFF
Background	Update ON, Display OFF Allows a trace to be blanked *and* continue to update “in the background”, which was not possible in the past

In the Swept SA measurement, a trace with **Display**OFF is indicated by a strikethrough of the type letter in the trace annotation panel in the Measurement Bar. A trace with **Update**OFF is indicated by dimming the type letter in the trace annotation panel in the Measurement Bar. In the example below, Traces 3, 4, 5 and 6 have **Update**OFF, and Traces 4 and 6 have **Display**OFF.



See: "More Information" on page 517

Notes	For the commands to control the two variables, Update and Display, see "Trace Update State On/Off" on page 516 and "Trace Display State On/Off" on page 516 below
Dependencies	When Signal ID is on, this key is grayed-out

Couplings	Selecting a Trace Type for a trace (pressing the key or sending the equivalent command) puts the trace in **Active** (Update ON and Display ON), even if that trace type was already selected Selecting a detector for a trace (pressing the key or sending `[:SENS]:DET:TRAC`) puts the trace in **Active** (**Update**ON and **Display**ON**)**, even if that detector was already selected Selecting a "Math Function" on page 1724 other than `OFF` for a trace (pressing the key or sending the equivalent command) puts the trace in **Active** (**Update**ON and **Display**ON**)**, even if that Math Mode was already selected Loading a trace from a file puts that trace in **View** regardless of the state it was in when it was saved; as does being the target of a **Copy** or a participant in an **Exchange**

Trace Update State On/Off

Remote Command	For Swept SA Measurement (in SA Mode):
	`:TRACe[1]|2|…|6:UPDate[:STATe] ON | OFF | 1 | 0`
	`:TRACe[1]|2|…|6:UPDate[:STATe]?`
	For all other measurements:
	`:TRACe[1]|2|3:<meas>:UPDate[:STATe] ON | OFF | 1 | 0`
	`:TRACe[1]|2|3:<meas>:UPDate[:STATe]?`
	where <meas> is the identifier for the current measurement

Example	Make trace 2 inactive (stop updating): `:TRAC2:UPD 0`
Couplings	Whenever you set **Update** to ON for any trace**,** the **Display** is set to ON for that trace

Preset	For Swept SA Measurement (in SA Mode):
	`1|0|0|0|0|0`
	ON for Trace 1; `OFF` for 2–6
	For all other measurements:
	`1|0|0`
	ON for Trace 1; `OFF` for 2 &3

State Saved	Saved in instrument state

Trace Display State On/Off

Remote Command	For Swept SA Measurement (in SA Mode):
	`:TRACe[1]|2|…|6:DISPlay[:STATe] ON | OFF | 1 | 0`
	`:TRACe[1]|2|…|6:DISPlay[:STATe]?`
	For all other measurements:
	`:TRACe[1]|2|3:<meas>:DISPlay[:STATe] ON | OFF | 1 | 0`
	`:TRACe[1]|2|3:<meas>:DISPlay[:STATe]?`
	where <meas> is the identifier for the current measurement

Example	Make trace 1 visible:
	`:TRAC2:DISP 1`
	Blank trace 3:
	`:TRAC3:DISP 3`

Couplings	Whenever you set **Update** to `ON` for any trace**,** the **Display** is set to `ON` for that trace

Preset	For Swept SA Measurement (in SA Mode):
	`1|0|0|0|0|0`
	`ON` for Trace 1; `OFF` for 2–6
	For all other measurements:
	`1|0|0`
	`ON` for Trace 1; `OFF` for 2 &3

State Saved	Saved in instrument state

More Information

When a trace becomes inactive, any update from the `:SENSe` system (detectors) immediately stops, without waiting for the end of the sweep. The trace data remains unchanged, but stops updating. If the trace is blanked, this still does not affect the data in the trace. Traces that are blanked (**Display**=`OFF`) do not display nor appear on printouts, but their data stays intact, they may be queried, and markers may be placed on them

In most cases, inactive traces are static and unchanging; however, there are cases when an inactive trace will update, specifically:

- if data is written to that trace from remote
- if trace data is loaded from mass storage
- if the trace is the target of a **Copy** or participant in an **Exchange**
- if the trace is cleared using **Clear Trace**

Inactive traces that are also being displayed (traces in **View**) are displayed at half intensity. Traces in **View** display across the entire X-Axis of the instrument. Their horizontal placement does not change, even if X-Axis settings subsequently are changed, although Y-Axis settings do affect the vertical placement of data.

When a trace becomes active (**Update**=`ON`), the trace is cleared, the average count is reset, and a new sweep is initiated.

Note that putting a trace into **Display**=`OFF` and/or **Update**=`OFF` does *not* restart the sweep and does *not* restart Averaging or Hold functions for any traces.

Trace Settings Table

Lets you configure the Trace system using a visual utility.

Clear All Traces

Clears all traces. Does not affect the state of any function or variable in the instrument. Loads `mintracevalue` into all of the points for all traces, except traces in **Min Hold**, in which case it loads `maxtracevalue`, even if **Update** = `OFF`.

Remote Command	`:TRACe[:<meas>]:CLEar:ALL`
Example	`:TRAC:CLE:ALL`
Dependencies	When Signal ID is on, this key is grayed-out

3.2.10.3 Detector

Lets you choose and configure detectors for the selected trace.

Detector

Selects a specific detector for the current measurement. The detector selected is then applied to the selected trace.

The instrument is in Auto detection by default, and normally Auto detection will choose the best detector for you automatically. If you choose a detector manually, this will turn Auto detection off for the selected trace.

For the SCPI UI, two commands are provided. One is a legacy command, which affects all traces. There is also a command which is new for the X-Series, which uses a subopcode to specify to which trace the specified detector is to be applied.

The three detectors at the end of the Detector menu, Quasi Peak, EMI Average, and RMS Average, are referred to collectively as the “CISPR detectors” because their behaviors are specified by the CISPR 16–1–1 specification. These detectors appear only if the N6141A or W6141A application or Option EMC installed and licensed.

NOTE **The instrument can typically provide 3 different detectors simultaneously. Occasionally the instrument can only provide 2 simultaneous detectors, typically when the Average detector is selected. When one of the CISPR detectors is selected, it is only possible to have that one detector, so all active traces change to that detector. It is never possible to have more than 3 simultaneous detectors.**

– "Detector Basics" on page 522
– "Detector Notes" on page 522
– "CISPR Detector Notes" on page 524
– "Multiple Detectors" on page 525

Remote Command	`[:SENSe]:DETector:TRACe[1]|2|…|6 AVERage | NEGative | NORMal | POSitive | SAMPle | QPEak | EAVerage | RAVerage`
	For options, see "Option Details" on page 521
	`[:SENSe]:DETector:TRACe[1]|2|…|6?`

Example	`:DET:TRAC AVER`
	Sets trace 1's detector to average
	`:DET:TRAC1 AVER`
	Sets trace 1's detector to average
	`:DET:TRAC2 SAMP`
	Sets trace 2's detector to sample

Notes	The query returns a name that corresponds to the detector type as shown below, and indicates the setting for Trace 1:

String Returned	Definition
NORM	Normal
AVER	Average / RMS
POS	Positive peak
SAMP	Sample
NEG	Negative peak
QPE	Quasi Peak
EAV	EMI Average
RAV	RMS Average

Dependencies	When Tune & Listen is on, or Demod Audio is the selected Analog Output, all active traces are forced to use the same detector CISPR detectors are grayed-out when you have manually selected FFT sweep. Conversely, if any CISPR detector is selected on an active trace, the auto rules for sweep type will never select FFT, and manual FFT selection is grayed-out When Signal ID is on, the **Detector** key is grayed-out for Traces 2-6 in Image Suppress mode and for Traces 3-6 in Image Shift Mode The VBW filter is not used for the Average detector or any of the CISPR detectors (Quasi Peak, EMI Average, RMS Average), as indicated by a * after the VBW value on the graph if any of these detectors is selected for any updating trace It is never possible to have more than 3 simultaneous detectors, and sometimes fewer than three. If the instrument has to enforce this limit a message is generated, "Detector n changed due to physical

	constraints" where "n" is the detector number
Couplings	Selecting a detector for a trace (pressing the key or sending `[:SENS]:DET:TRAC`) puts **Update On and Display On** for that trace, even if that detector was already selected. Note that the legacy command `[:SENS]:DET[:FUNC]` does *not* exhibit this behavior The auto detector rules depend upon marker type, averaging state and type, trace state writing mode, and trace active state Selecting a detector, whether by pressing the control or sending the equivalent command, turns trace math to Off for the selected/specified trace Use of the Average detector affects the VBW setting because of its effect on the VBW/RBW coupling. See the BW key description Selecting any CISPR detector on any active trace sets the EMC Standard to CISPR. If any trace with a CISPR detector becomes active, the EMC Standard is set to CISPR If the Avg Type is in Auto, and any of the CISPR detectors is selected on any active trace, the Voltage Averaging type is auto-selected
Preset	Preset returns all traces to "auto", which will result in Normal (Rosenfell) detection for all traces
State Saved	Saved in instrument state
Annunciation	The detectors currently selected are annunciated in the Trace Panel on the right side of the Meas Bar
Annotation	The four-letter mnemonic for the detector appears in the trace window next to the trace it applies to if Trace Annotation is on
Backwards Compatibility Notes	In the X-Series, the detector selected is applied to the selected trace. This differs from previous instruments, where the selected detector was applied to all traces, and you could only have one detector

Backwards Compatibility Command

Example	`:DET AVER`
	Sets detector to average for all traces
	`:DET:FUNC?`
	Returns trace 1's detector setting

Notes	This is a SCPI-only legacy command to preserve the classic functionality wherein all traces are affected when a detector is selected (in the X-Series, the detector is set on a per-trace basis) The query returns a name that corresponds to the detector type as shown below, and indicates the setting for Trace 1 The `RMS` selection sets the detector type to `AVERage` and the Average Type to `RMS`. Therefore, if RMS has been selected, the query will return `AVER` The `EPOS` selection sets the detector type to Peak and the EMC Standard to CISPR. A query then returns `POS` The `MPOS` selection sets the detector type to Peak and the EMC Standard to MIL Impulse. A query then returns `POS` The `RAV` parameter is not included in the command because this is not a legacy detector; nonetheless, if it happens to be the detector on Trace 1 then `RAV` is returned

	String Returned	**Definition**
	NORM	Normal
	AVER	Average / RMS
	POS	Positive peak
	SAMP	Sample
	NEG	Negative peak
	QPE	Quasi Peak
	EAV	EMI Average
	RAV	RMS Average
Preset	NORMal	
State Saved	Saved in instrument state	
Backwards Compatibility SCPI	[:SENSe]:DETector[:FUNCtion] NORMal | AVERage | POSitive | SAMPle | NEGative | QPEak | EAVerage | EPOSitive | MPOSitive | RMS [:SENSe]:DETector[:FUNCtion]?	
Backwards Compatibility Notes	In ESA and E7400, selecting QPD or EMI Average sets the Amplitude Scale Type to Linear and performs an auto-ranging function resulting in the Reference Level being adjusted such that the highest level of the trace is near (but below) the Reference Level. Subsequent selection of Peak, Negative Peak, Sample, or Average (the 'non-EMI Detectors') will return the Reference Level and Amplitude Scale Type to their pre-EMI Detector values. The X-Series does not perform this scale and reference level change because the digital IF makes it unnecessary The commands that select the CISPR detectors are not generally compatible with pre-PSA instruments, because the CISPR detectors are now part of the overall detector set, rather than a separate set. However, the basic behavior of coupling the resolution bandwidth to the selected detector is similar to the behavior of previous EMI instruments, like the E4400B series The following ESA/E7400 detector commands are no longer accepted: [:SENSe]:DETector[:FUNCtion]:EMI QPD | AVERage | OFF [:SENSe]:POWer:QPGain[:STATe] [:SENSe]:ARDT	

Option Details

Value	SCPI	Notes
Normal	NORMal	Determines the peak of CW-like signals, and yields alternating maximums and minimums of noise-like signals. This is also referred to as Rosenfell detection
Average	AVERage	Determines the average of the signal within the bucket. The averaging method depends upon Average Type selection (voltage, power or log scales) and delivers: RMS detection when Avg Type = Power Video detection when Avg Type = Log-Pwr Scalar detection when Avg Type = Voltage
Peak	POSitive	Determines the highest signal within the bucket

Value	SCPI	Notes
Sample	`SAMPle`	Determines the instantaneous level of the signal at the center of the bucket
Negative Peak	`NEGative`	Determines the minimum of the signal within the bucket
Quasi Peak	`QPEak`	EMI – CISPR detector Only appears with the N6141A or W6141A application or Option EMC installed and licensed A fast-rise, slow-fall detector used in making CISPR compliant EMI measurements, compliant with the latest CISPR 16-1-1 standard
EMI Average	`EAVerage`	EMI – CISPR detector Only appears with the N6141A or W6141A application or Option EMC installed and licensed Provides a standard means to “smooth” the signal while still providing compliance to CISPR pulse response standards. It displays the average value of the amplitude envelope, rather than the average value of sample-detected amplitude, and uses an advanced algorithm to realize a lowpass filter that conforms to the latest CISPR 16-1-1standard
RMS Average	`RAVerage`	EMI – CISPR detector Not to be confused with the RMS mode of the regular Average detector, this is a special frequency-dependent EMI filter which only appears when the N6141A or W6141A application or Option EMC is installed and licensed This filter conforms to the latest revision of the CISPR 16–1–1 standard

Detector Basics

To understand detectors, you must understand the concept of trace buckets. For every trace point in swept and zero span analysis, there is a finite time during which the data for that point is collected. The instrument has the ability to look at all of the data collected during that time and present a single point of trace data based on the detector type. We call the interval during which the data is being collected the “bucket.” Often the term “trace point” is used to mean the same thing.

However, it is important to understand that a trace is more than a series of single points. The data is sampled rapidly enough within each “bucket” and processed so that the detector results are equivalent to those that would be achieved with a continuous time (non-sampled) system.

Detector Notes

– The VBW filter is not used for the Average detector or any of the CISPR detectors (Quasi Peak, EMI Average, RMS Average), so varying the VBW will have no effect for any traces for which this detector is selected (other than to slow down the sweep, because of the coupling to Sweep Time of VBW). If any traces for which

VBW does not apply are in Update On state (traces with Average, EMI Average, RMS Average or Quasi Peak detectors selected), then an * displays after the VBW annotation on the front panel.

- Rosenfell (Normal) detection: when the signal is CW-like, it displays the peak-detected level in the interval (bucket) being displayed. If the signal is noise-like (within a bucket the signal both rose and fell), it alternates displaying the max/min values. That is, an even bucket shows the peak (maximum) within a two-bucket wide interval centered on the even bucket. And an odd bucket will show the negative peak (minimum) within a two-bucket wide interval. For example, for an even bucket the two-bucket wide interval is a combination of one-half bucket to the left of the even bucket, the even bucket itself, and one-half bucket to the right of the even bucket, so the peak found is displayed in the correct relative location on screen. The odd buckets are similar.
- The Average Detector result depends on the Average Type. To explicitly set the averaging method, use the **Meas Setup**, **Average Type** key.
- Because they may not find a spectral component's true peak, neither average nor sample detectors measure amplitudes of CW signals as accurately as peak or normal, but they do measure noise without the biases of peak detection.
- Peak detection is used for CW measurements and some pulsed-RF measurements. For FFT analysis, the highest amplitude across the frequency width of a bucket is displayed, even if that peak amplitude falls between samples of the spectrum computed in the FFT process.
- Sample detection is good for displaying noise or noise-like signals but is not the best choice for making amplitude measurements of CW-like signals. This is because:
- the peak response to a signal can occur between samples. So, unless the Span to RBW ratio is lower than usual, then the highest sample can be well below the peak signal amplitude.
- for the high sweep rates normally used, the peak response of the RBW filters is up to –0.5 dB. This sweeping error is compensated when using the peak and normal detectors by changing the overall gain. But the gain is not changed when in the sample detector, because doing so would cause errors in the response to noise. Instead, the auto-couple rules for sweep time are modified to give slower sweeps.
- When the **Detector** choice is **Auto**, the detector selected depends on marker functions, trace functions, average type, and the trace averaging function.
- When you manually select a detector (instead of selecting **Auto**), that detector is used regardless of other instrument settings.

CISPR Detector Notes

Quasi Peak

This is a fast-rise, slow-fall detector used in making CISPR compliant EMI measurements and defined by CISPR Publication 16–1–1. Quasi-peak detection displays a weighted, sample-detected amplitude using specific, charge, discharge, and meter time constants derived from the legacy behaviors of analog detectors and meters. It is used for EMI measurements to provide a specific and consistent response to EMI-like signals.

In the past, Quasi Peak and EMI Average measurements were often made on a linear display scale (and CISPR standard operation calls for this), because those detectors only worked properly with signals on a linear (voltage) scale. The X-series instruments are capable of making Quasi Peak and EMI Average detected measurements correctly on a log scale, due to the digital IF. This latter capability means that the user can observe detected EMI levels on a log scale, allowing a large visible dynamic range. You can manually set the Average Type to Log-Power or Power, but the results will no longer be CISPR compliant.

Also, in the past, EMI analysis equipment would need to perform a ranging operation to set the reference level when one of these detectors was turned on, but the X-series instruments do not - because of its digital IF, there is no need to set the reference level (range) to improve the accuracy nor to allow visibility of the detected level.

EMI Average

The EMI Average detector in Agilent's X-Series instruments is so called to distinguish it from the Average detector, although EMI users typically refer to it simply as the “Average detector”. The intent of this detector is to provide a standard means to “smooth” the signal while still providing compliance to CISPR pulse response standards.

Unlike the regular Average detector, which averages on a bucket-by-bucket basis using either a power, log-power or voltage scale (a bucket is the same as a trace point), the EMI Average detector displays the average value, on the voltage scale, of the overall amplitude envelope, independent of the trace bucket width. It is defined for EMI measurements by the CISPR 16–1–1 standard and, in the X-series, uses a sophisticated algorithm to implement a lowpass filter that conforms to the latest CISPR standard.

Note that CISPR standard operation is to perform the envelope averaging on the voltage scale. You can manually set the Average Type to Log-Power or Power, but the results will no longer be CISPR compliant. See note under Quasi-Peak.

RMS Average

Not to be confused with the RMS mode of the regular Average detector, this is a special filter for making EMI measurements. It is a frequency dependent

RMS/Averaging filter, used in making CISPR compliant EMI measurements. This filter conforms to the 2007 revision of the CISPR 16–1–1 standard. This detector does one averaging process (in the VBW hardware) on the "power" (a.k.a. RMS) scale and another process on the voltage scale using a "meter movement simulator" similar to the one used in the QPD filter.

Note that CISPR standard operation is to perform the envelope averaging on the voltage scale. You can manually set the Average Type to Log-Power or Power, but the results will no longer be CISPR compliant. See note under Quasi-Peak.

Multiple Detectors

The instrument always provides the requested detector on the specified trace. Depending on the detectors requested the instrument can provide up to three different detectors simultaneously within the constraints of its digital processing algorithms. Some detectors utilize more resources; the Quasi-Peak detector, for example, utilizes most of the digital IF's resources, and the hardware in some instruments is incapable of providing another detector when Quasi-Peak is on. If the limit of system resources is exceeded, detectors on some existing traces may be forced to change. When this happens, they change to match the detector just requested, and a message is generated: “Detector <X> changed due to physical constraints”, where X might contain multiple values.

Example: User has traces 1, 2, and 3 with Peak, Average, and Negative Peak. User specifies QPD for trace 1. Traces 2 and 3 also change to QPD and we generate the message “Detector 2,3 changed due to physical constraints”. Now all three traces have the QPD.

Detector Select Auto/Man

Sets the Detector mode to Auto or Manual. In Auto, the proper detector is chosen based on rules that take into account the measurement settings and other instrument settings.

When you select any detector explicitly, this toggles automatically to Man (manual).

Remote Command	`[:SENSe]:DETector:TRACe[1]|2|…|6:AUTO ON | OFF | 1 | 0` `[:SENSe]:DETector:TRACe[1]|2|…|6:AUTO?`
Example	`:DET:TRACE2:AUTO ON` Sets trace 2 detection to automatic
Dependencies	The auto detector rules depend upon marker type, averaging state and type, trace state writing mode, and trace active state When operating a source in Tracking Source mode, Auto selection is the Average detector. All other detector selections are allowed, but in most cases you will want to stick with Average, which gives optimal sensitivity

Couplings	Selecting **Auto**, whether by pressing the control or sending the equivalent command, turns trace math `OFF` for the selected/specified trace
Preset	Auto (On) for all detectors
State Saved	Saved in instrument state

Backwards Compatibility Command

Example	`:DET:AUTO ON`
Notes	SCPI only. Turns AUTO on or off for *all* detectors. This is a legacy command to preserve the classic functionality wherein all traces are affected when a detector is addressed The query returns the Auto state of Trace 1
Backwards Compatibility SCPI	`[:SENSe]:DETector:AUTO ON | OFF | 1 | 0` `[:SENSe]:DETector:AUTO?`

Detector Auto All Traces

Returns the selected set of detectors to the “preset” state, which is auto-selected.

Dependencies	When Signal ID is on, this control is grayed-out
Couplings	Sets all traces’ Detector Auto to true

Detector Average Preset

Used to make a measurement of the average power and the signal envelope. This is a one-time setting of a commonly used detector set. It is quicker than making many individual changes and the detectors are free to change afterward. The effect is identical to just setting the traces’ detectors individually.

Dependencies	When Signal ID is on, this control is grayed-out
Couplings	Trace 1: Set to peak detection, and Clear-Write Trace 2: Set to average detection, and Clear-Write Trace 3: Set to negative peak detection, and Clear-Write

Detector Sample Preset

Used to make a measurement that displays a power sample and the signal envelope. This is not a “mode”, but a one-time setting of a commonly used detector set; it is quicker than making many individual changes, but the detectors are free to change afterward, the effect is identical to just setting the traces’ detectors individually.

Dependencies	When Signal ID is on, this control is grayed-out

Couplings	Trace 1: Set to peak detection, and Clear-Write Trace 2: Set to sample detection, and Clear-Write Trace 3: Set to negative peak detection, and Clear-Write

3.2.10.4 Math

Lets you turn on and configure Trace Math functions.

Math Function

Trace Math functions perform mathematical operations between traces and, in some cases, user-specified offsets. When in a Trace Math function, the indicated function is performed during the sweep with the math function used in place of a detector. The trace operands for the math function are set using the "Operand 1 / Operand 2" on page 1730 controls.

– See "How trace math is processed" on page 531

Remote Command	For option details, see "Trace Math Options" on page 529
	For Swept SA Measurement (in SA Mode):
	`:CALCulate:MATH <trace_num>, PDIFference | PSUM | LOFFset | LDIFference | OFF, <trace_num>, <trace_num>, <real>,<real>`
	`:CALCulate:MATH? <trace_num>`
	where `<trace_num>` is any one of:
	`TRACE1|…|TRACE6`
	For all other measurements:
	`:CALCulate:<meas>:MATH <trace_num>, PDIFference | PSUM | LOFFset | LDIFference | OFF, <trace_num>, <trace_num>, <real>,<real>`
	`:CALCulate[:<meas>]:MATH? <trace_num>`
	where:
	`<meas>` is the identifier for the current measurement, and
	`<trace_num>` is any one of:
	`TRACe1|TRACe2|TRACe3`
	Note that the format of the `TRACe<n>` parameter differs from that for the Swept SA Measurement

Example	`:CALC:MATH TRACE3,PDIF,TRACE1,TRACE2,0,0`
	Sets Trace 3 to Power Diff trace math function, and sets the First Trace operand (for Trace 3) to Trace 1 and the Second Trace operand (for Trace 3) to Trace 2
	`:CALC:MATH TRACE3,PSUM,TRACE1,TRACE2,0,0`
	Sets Trace 3 to Power Sum trace math function and sets the First Trace operand (for Trace 3) to Trace 1 and the Second Trace operand (for Trace 3) to Trace 2
	`:CALC:MATH TRACE3,LOFF,TRACE1,TRACE2,-6.00,0`

	Sets Trace 3 to Log Offset trace math function, sets the First Trace operand (for Trace 3) to Trace 1, leaves the Second Trace operand (for Trace 3) unchanged (it is irrelevant for this function) and sets the Log Offset (for Trace 3) to -6 dB
	`:CALC:MATH TRACE3,LDIF,TRACE1,TRACE2,0,-6.00`
	Sets Trace 3 to Log Diff trace math function, sets the First Trace operand (for Trace 3) to Trace 1, sets the Second Trace operand (for Trace 3) to Trace 2, and sets the Log Difference reference (for Trace 3) to -6 dBm
	`:CALC:MATH TRACE1,OFF,TRACE2,TRACE3,0,0`
	Turns off trace math for trace 1

Notes	The Trace Math Function command has 6 main set of parameters:
	- Set 1 defines the "result trace":
	`TRACE1|…|TRACE6`
	-Set 2 defines the "function":
	`PDIFference|PSUM|LOFFset|LDIFference|OFF`
	- Set 3 is a "trace operand" (1):
	`TRACE1|…|TRACE6`
	- Set 4 is a "trace operand" (2):
	`TRACE1|…|TRACE6`
	- Set 5 defines the "Log Offset" (in dB)
	- Set 6 defines the "Log Difference Reference" (in dBm)
	Note that the trace math mode is an enumeration; that is, when a math function is set for a trace, it turns off any math function that is on for that trace, then sets the new math function
	The parameters sent in the command are reflected in the values in the control menu. There is no default for any parameter; all 6 parameters must be sent to satisfy the parser. Failure to specify a parameter will result in a missing parameter message
	The query returns the math mode, the operand traces, the offset and the reference for the specified trace, all separated by commas

Dependencies	Trace Math is not available if **Normalize** is on Trace Math is not available if Signal ID is on None of the trace operands can be the destination trace. If any of the three trace math commands is sent with a destination trace number matching one of the operands, a warning is generated and the function does not turn on
Couplings	When a math function is changed for a trace, that trace is set to Display = ON; and Update = ON

Preset	For Swept SA Measurement (in SA Mode):
	`OFF,TRACE5,TRACE6,0,0 | OFF,TRACE6,TRACE1,0,0 | OFF,TRACE1,TRACE2,0,0 | OFF,TRACE2,TRACE3,0,0 | OFF,TRACE3,TRACE4,0,0 | OFF,TRACE4,TRACE5,0,0`
	For all other measurements:
	`OFF,TRACE2,TRACE3,0,0 | OFF,TRACE3,TRACE1,0,0 | OFF,TRACE1,TRACE2,0,0`

State Saved	The trace math function for each trace is saved in instrument state
Annunciation	An "f" is shown on the trace annunciation panel in the Measurement Bar when a math function is on;

	and the function is annotated on the trace if Trace Annotation is on
Status Bits/OPC dependencies	*OPC can be used to detect the completion of a sweep, which will also correspond to the completion of the math operation, since all math takes place during the sweep

Trace Math Options

IMPORTANT To generate a trace math result, *you must take a sweep*. The trace math engine, described below, operates in concert with the sweep engine in the instrument. Until a sweep has been taken, even if the constituent traces are not in Update mode, no result is generated.

Note that certain events can affect the trace in ways that affects all points at once. This can happen in any number of ways, including:

- A trace clear taking place
- A trace being loaded from the file system
- Trace data being sent in from the remote interface
- A copy or exchange of trace data

You should try to avoid these occurrences during a sweep, as they will tend to invalidate the math result being accumulated.

The Trace Math functions are:

Power Diff (Op1 - Op2)

Calculates a power difference between the `First Trace` operand and the `Second Trace` operand and puts the result in the destination trace.

During the sweep, the following formula is executed for each point in the trace operands, and the corresponding point is generated for the destination trace:

```
DestinationTrace = 10 log(10(1/10)(FirstTrace) – 10(1/10)(SecondTrace))
```

The values of the trace points are assumed to be in a decibel scale, as they are internally stored.

If a point in `FirstTrace` is equal to `maxtracevalue`, the resultant point is also `maxtracevalue`.

Otherwise, if the result of the subtraction is less than or equal to 0, the resultant point is `mintracevalue`.

Power Sum (Op1 + Op2)

Calculates a power sum between the `First Trace` operand and the `Second Trace` operand and puts the result in the destination trace.

During the sweep, the following formula is executed for each point in the trace operands, and the corresponding point is generated for the destination trace.

```
DestinationTrace = 10 log(10(1/10)(FirstTrace) + 10(1/10)(SecondTrace))
```

The values of the trace points are assumed to be in a decibel scale, as they are internally stored.

If a point in either trace operand is equal to `maxtracevalue`, the resultant point is also `maxtracevalue`.

Log Offset (Op1 + Offset)

Calculates a log offset from the `First Trace` operand and puts the result in the destination trace. This is like the B-DL function in some older instruments. The offset is entered on the `Offset` control, which only appears when this math function is in force for the selected trace. Each destination trace has its own offset.

During the sweep, the following formula is executed for each point in the trace operand, and the corresponding point is generated for the destination trace.

```
DestinationTrace = FirstTrace + Offset
```

The values of the trace points are assumed to be in dBm (as they are internally stored) and the offset is in dB.

If a point in the trace operand is equal to `maxtracevalue`, the resultant point is also `maxtracevalue`.

If a point in the trace operand is equal to `mintracevalue`, the resultant point is also `mintracevalue`.

Example: If offset is 25 dB, then our destination trace will be higher than the operand trace by 25 dB.

Note that the `Second Trace` operand is not used for this function.

Log Diff (Op1 - Op2 + Ref)

Offsets the difference between the `First Trace` operand and the `Second Trace` operand by a reference and puts the result in the destination trace. This is like the A-B+DL function in some older instruments. The Reference is entered on the **Reference** control, which only appears when this math function is in force for the selected trace. Each destination trace has its own reference.

Offsets the difference between the `First Trace` operand and the `Second Trace` operand by a reference and puts the result in the destination trace. This is like the A-

B+DL function in some older instruments. The Reference is entered on the **Reference** control, which only appears when this math function is in force for the selected trace. Each destination trace has its own reference.

During the sweep, the following formula is executed for each point in the trace operands, and the corresponding point is generated for the destination trace.

```
DestinationTrace = (FirstTrace - SecondTrace) + Reference
```

The values of the operand trace points are assumed to be in decibel units (as they are internally stored) and the reference is in dBm so the result is in dBm.

Example: If the first operand trace 1 is at 5 dBm, the second operand trace 2 is at –5 dBm, and the reference is –25 dBm, then the destination trace will be –15 dBm.

Example: If the first operand trace1 is at 60 dBuV, the second operand trace 2 is at 50 dBuV, and the reference is 35 dBuV, then the destination trace will be 45 dBuV.

If a point in `FirstTrace` is equal to `maxtracevalue`, the resultant point is also `maxtracevalue`.

If a point in `FirstTrace` is equal to `mintracevalue`, the resultant point is also `mintracevalue`.

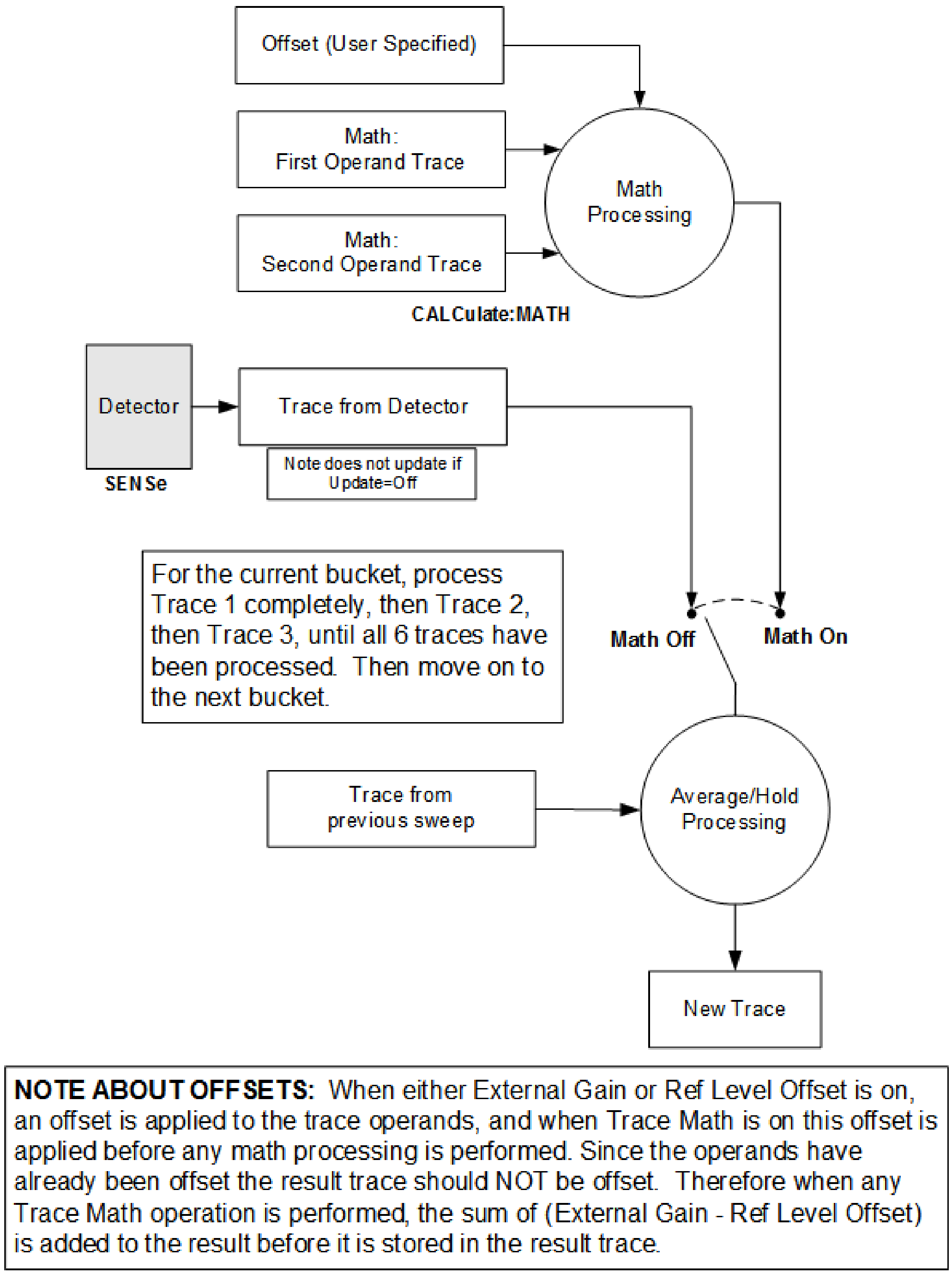
If neither of the above is true for a given point, then:

- If that point in `SecondTrace` is equal to `maxtracevalue`, the resultant point is `mintracevalue`.
- If that point in `SecondTrace` is equal to `mintracevalue`, the resultant point is `maxtracevalue`.

How trace math is processed

Whenever a trace math function is turned on, or the parameters and/or operands of an existing trace math function are changed, the destination trace is cleared. After the trace is cleared, all x-axis values in the trace, and the domain of the trace, are set to match the X-Axis settings of the first trace operand. When this is complete, a new sweep is initiated.

The process of acquiring data, processing it using the math and Average/Hold functions, and presenting it as trace data, consists of several functional blocks, as shown below:



For each active trace, the current trace point is processed for `Trace 1`, then `Trace 2`, then `Trace 3`, etc. Trace data is taken from either the detector for that trace, or

from the mathematical result of up to two other traces and an offset, depending on whether trace math is on or not. The resultant data is then fed to the Average/Hold processing block, where (if the trace type is **Average**, **Max Hold**, or **Min Hold**) it is processed with previous trace data. The new trace data resulting from this process is then available for display, storage or remote output.

When the processing is complete for `Trace 1`, `Trace 2` is processed, and so on until all six traces have been processed. This allows a downstream trace to use as one of its math components a fully processed upstream trace. In other words, if math is `ON` for `Trace 4`, and its operand traces are `Trace 2` and `Trace 3`, then all detector, math, average and hold processing for Traces 2 and 3 is completed before the math is performed for `Trace 4`. When the current trace point is completed for all traces, the instrument moves on to the next trace point.

This allows very flexible and powerful math functions to be configured. For example, `Trace 1` can be an average trace, which can be fed with an offset to `Trace 2`, which can also be in **Max Hold**, allowing you to obtain the **Max Hold** of an Average trace.

Note that none of this processing is performed on inactive traces.

Note also that for any active trace with math `ON`, the Operand traces should have *lower* numbers than the trace (for example, using `Trace 4` as an operand for `Trace 1` will cause the data coming from `Trace 4` to be delayed by one sweep).

Operand 1 / Operand 2

These two controls select the first and second trace operands to be used for the trace math functions for the destination trace. The operands are common to all math functions for a given trace. The most recently sent `:CALCulate:MATH` command for a given trace sets the operands for that trace. Those settings are displayed on the trace operand controls for that trace.

Example	The following examples are for the Swept SA measurement
	Set Trace 3 to Power Diff trace math function. Set the First Trace operand (for Trace 3) to Trace 1 and the Second Trace operand (for Trace 3) to Trace 2:
	`:CALC:MATH TRACE3,PDIF,TRACE1,TRACE2,0,0`
	Set Trace 3 to Log Offset trace math function. Set the First Trace operand (for Trace 3) to Trace 1, leave the Second Trace operand (for Trace 3) unchanged (it is irrelevant for this function) and set the Log Offset (for Trace 3) to -6 dB:
	`:CALC:MATH TRACE3,LOFF,TRACE1,TRACE2,-6.00,0`

Notes	See "Math Function" on page 1724 for how to specify Operands 1 and 2 using `:CALCulate:MATH`
Dependencies	The destination trace cannot be an operand. The destination trace number is grayed-out on the dropdown
Preset	Operand 1: Trace number minus 2 (wraps at 1). For example, for Trace 1, Operand 1 presets to Trace

	5; for Trace 6, it presets to Trace 4 Operand 2: Trace number minus 1 (wraps at 1). For example, for Trace 1, Operand 2 presets to Trace 6; for Trace 6, it presets to Trace 5
State Saved	Operands 1 and 2 for each trace are stored in instrument state

Offset

Used by the Log Offset math function.

Example	The following example is for the Swept SA measurement Set Trace 3 to Log Offset trace math function, set the First Trace operand (for Trace 3) to Trace 1, leave the Second Trace operand (for Trace 3) unchanged (it is irrelevant for this function) and set the Log Offset (for Trace 3) to -6 dB: `:CALC:MATH TRACE3,LOFF,TRACE1,TRACE2,-6.00,0`
State Saved	The Log Offset value for each trace is saved in Instrument State
Min	–100 dB
Max	100 dB

Reference

Used by the Log Diff math function.

Example	The following example is for the Swept SA measurement Set Trace 3 to Log Diff trace math function, set the First Trace operand (for Trace 3) to Trace 1, set the Second Trace operand (for Trace 3) to Trace 2, and set the Log Difference reference (for Trace 3) to -6 dBm: `:CALC:MATH TRACE3,LDIF,TRACE1,TRACE2,0,-6.00`
State Saved	The Log Difference reference value for each trace is saved in instrument state
Min/Max	Same as reference level

3.2.10.5 Trace Function

Contains controls to:

- Copy and Exchange traces
- Preset or Clear all traces

From Trace

Selects the trace to be copied to or exchanged with the "To Trace" on page 1732 when a "Copy" on page 1732 or "Exchange" on page 1733 is performed

Preset	1

To Trace

Selects the trace to be copied from or exchanged with the "From Trace" on page 1732 when a "Copy" on page 1732 or "Exchange" on page 1733 is performed

Preset	2

Copy

Executes a Trace Copy based on the "From Trace" on page 1732 and "To Trace" on page 1732 parameters. The copy operation is from the **From Trace** to the **To Trace**. The action is performed once.

The X-Axis settings and domain of a trace are also copied.

Remote Command	For Swept SA Measurement (in SA Mode):
	`:TRACe:COPY TRACE1 | … | TRACE6, TRACE1 | … | TRACE6`
	For all other measurements:
	`:TRACe:<meas>:COPY TRACe1 | TRACe2 | TRACe3, TRACe1 | TRACe2 | TRACe3`
	where `<meas>` is the identifier for the current measurement
	Note that the format of the `TRACe<n>` parameter differs from that for the Swept SA Measurement

Example	Copy Trace 1 to Trace 3 and put Trace 3 in Update=Off, Display=On `:TRAC:COPY TRACE1,TRACE3`
Notes	The command is of the form: `:TRACe:COPY <source_trace>,<dest_trace>`
Dependencies	When Signal ID is on, this key is grayed-out
Couplings	The destination trace is put in **View** (Update = Off, Display = On) after the copy

Preset	For Swept SA Measurement (in SA Mode):
	`TRACE1, TRACE2`
	For all other measurements:
	`TRACe1, TRACe2`

Exchange

Executes a Trace Exchange based on the "From Trace" on page 1732 and "To Trace" on page 1732 parameters. The **From Trace** and **To Trace** values are exchanged with each other. The action is performed once.

The X-Axis settings and domain of a trace are also copied when it is exchanged with another trace.

Remote Command	For Swept SA Measurement (in SA Mode):
	`:TRACe:EXCHange TRACE1 | … | TRACE6, TRACE1 | … | TRACE6`
	For all other measurements:
	`:TRACe:<meas>:EXCHange TRACe1 | TRACe2 | TRACe3, TRACe1 | TRACe2 | TRACe3`
	where `<meas>` is the identifier for the current measurement
	Note that the format of the `:TRACe<n>` parameter differs from that for the Swept SA Measurement

Example	Exchange Trace 1 and Trace 2 and put both traces in Update=`OFF`, Display=`ON`: `:TRAC:EXCH TRACE1,TRACE2`
Notes	The command is of the form: `:TRACe:EXCHange <trace_1>,<trace_2>`
Couplings	Both traces are put in **View** (Update=Off, Display=On) after the exchange

Preset All Traces

Turns on Trace 1 and blanks all other traces. This is useful when you have many traces on and you want to return to having only Trace 1 on the display. Does not affect the trace type, detector or any other aspect of the trace system.

Remote Command	`:TRACe[:<meas>]:PRESet:ALL`
Example	`:TRAC:PRES:ALL`
Dependencies	When Signal ID is on, this key is grayed-out

Clear All Traces

Clears all traces. Does not affect the state of any function or variable in the instrument. Loads `mintracevalue` into all of the points for all traces, except traces in **Min Hold**, in which case it loads `maxtracevalue`, even if **Update** = `OFF`.

Remote Command	`:TRACe[:<meas>]:CLEar:ALL`
Example	`:TRAC:CLE:ALL`
Dependencies	When Signal ID is on, this key is grayed-out

3.2.10.6 Normalize

Lets you configure and execute functions to display one trace relative to a reference trace.

Normalize On/Off

Switches **Normalize** on or off. When ON, on each sweep, the normalized trace (Trace 3) is subtracted from Trace 1 and the result is added to the normalized reference level. This arithmetic assumes all values are in decibel units, so we are actually taking a ratio.

The steps to perform **Normalize** are:

– Store the current Trace 1 into the reference trace, which is Trace 3

– Turn on **Normalize**

If you try to turn on **Normalize** without first storing a reference trace, you will see an error.

When **Normalize** is ON, Y-Axis Unit (in the Amplitude menu) is grayed-out and forced to **dBm**, and Transducer Unit (in the Limit Editor) is grayed-out and forced to **None**.

See:

– "More Information" on page 538

– "Normalize Block Diagram" on page 539

Remote Command	`:CALCulate:NTData[:STATe] OFF | ON | 0 | 1` `:CALCulate:NTData[:STATe]?`
Example	`:CALC:NTD ON` `:CALC:NTD?`
Dependencies	If Normalize (On) is pressed before Store Ref (1→ 3), an error message is generated Normalize remains OFF in this case Normalize is not available (grayed-out) if any Trace Math function is on Normalize is not available if Amplitude, Scale Type is set to 'Lin"
Couplings	When **Normalize** is ON, Trace 1 is placed in **Clear/Write** with **Update** = ON and **Display** = ON
Preset	OFF
State Saved	Saved in instrument state

More Information

Normalize is most useful for applying correction data to a trace while making a stimulus-response measurement with a tracking generator (or synchronized source). For example, connect the cables and a through line, in place of the device to be measured, between the tracking generator and the instrument input. Notice that the frequency response is not perfectly flat, showing the response of the cables, as well as the flatness of both the tracking generator and the instrument. Now press **Store Ref (1→ 3)**, **NormalizeOn**. Notice that the displayed trace is now flat, or normalized. The position of the normalized trace can now be moved to a different position on the display by changing the normalized reference position. This may be useful if the device to be tested has positive gain, such as an amplifier. Now replace the through line with the device under test, and an accurate measurement of the gain or loss can be made.

Normalize can also be used to perform a scalar reflection measurement (return loss). In this case a directional coupler or bridge is used to extract the reflected signal. In the simplest reflection measurement, a Short is placed at the end of the cable and the result is stored to trace 3 (as before). When **Normalize** is turned on, the result is the calibrated return loss in dB. For a more accurate calibration, an Open and Short can be used. To do the Open/Short calibration, the Open/Short key at the bottom of the Normalize menu is pressed. This will initiate a guided calibration procedure which captures the reference trace. This is then stored to Trace 3, as before. When **Normalize** is turned on the corrected return loss is displayed.

Measurement Details

First the following calculation is performed:

Trace 1 = (Trace 1D – Normalized Trace)

Where:

- Trace 1D is the measured value of trace 1, as it comes from the SENSe subsystem
- Normalized Trace is Trace 3, in which you have previously stored a reference trace
- All values are in decibel units

This Trace 1 contains the values that will be returned from a trace query, or if the marker is placed on the trace.

For example, let's say bucket 1 on Trace 1 is at 0 dBm, and bucket 1 on Trace 3 is at 10 dBm. The resultant bucket is at 0 dBm – 10 dBm = –10 dB (just like with a delta marker).

You are also given the ability to define what (dB) value to use for Ref Level, and to define where on the screen the Ref Lvl line will appear using Normalized Reference Position. This flexibility in displaying the result allows a wide range of devices, including amplifiers, to be tested using Normalize.

In the example above, bucket 1 has the value of –10 dB. Let us assume you have set Norm Ref Lvl to 5 dB. Thus bucket 1 will display 1.5 divisions below the Reference Level line (assuming 10 dB per division).

The Reference Level line is normally the top line of the graticule. If Norm Ref Position is set to 10, this is the case. If it is set to 9, it is the next line down. If it is set to 5, it is the middle line of the graticule. If set to 0 it is the bottom line.

So, in the example above, if Norm Ref Position is set to 9, then bucket 1 will display 2.5 divisions below the top line of the graticule.

None of the manipulations of Norm Ref Position and Norm Ref Lvl affect the data in the trace.

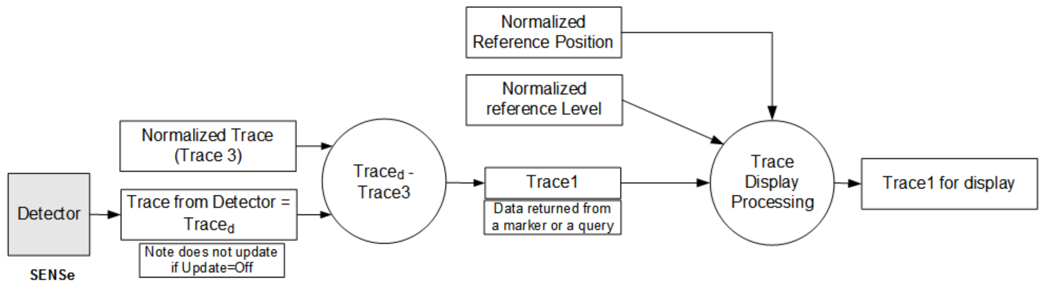
As **Normalize** displays a ratio between two traces (a difference, in dB) the Y-Axis Unit while in Normalize is dB in Log Amplitude and dimensionless in Linear. The Y Axis Unit chosen in the Y Axis Unit menu is unaffected by Normalize. When you leave Normalize the Y Axis Unit returns to the value set in the Y Axis Unit menu. While in Normalize, all amplitude functions, such as Marker Y and the values in other traces, should be always in dB unit, and so should the returned trace query results. In other words, both trace query result and marker Y become independent of the Y Axis Unit chosen in the Y Axis Unit menu when normalize is on.

(In Linear, the equivalent calculation is performed but it yields a dimensionless ratio, so the normalized ref level is unitless, presetting to 1, just as in Log it presets to 0 dB. Linear normalization is not currently available in the X-Series).

Y Axis annotation is blanked while in Normalize. Any other traces on the display are plotted in dB, where the dB value used is equivalent to the dBm value of the trace. For example, if bucket 1 in trace 2 is at –40 dBm, that bucket is plotted at –40 dB. All traces use Norm Ref Lvl and Norm Ref Position for positioning on the display. When Normalize exits, the normal Ref Lvl is restored. This normal Ref Level is unaffected by Normalize.

Normalize Block Diagram

This block diagram shows how Normalize works:



Store Reference (Trace1 -> Trace3)

Copies trace 1 into trace 3. Store Ref (1→ 3) must be pressed before pressing Normalize (On). Note that this puts Trace 3 in Update=OFF (not updating) and Display=ON (visible).

Notes	There is no remote command for this function, but the trace copy command can be used for this purpose
Dependencies	If Normalize (On) is pressed before Store Ref (1→ 3), an error message is generated. Normalize remains OFF in this case

Show Reference (Trace 3)

Views or blanks the reference trace on the display. The reference trace is trace 3, so this is the same as setting Trace 3's "Display" attribute.

Example	`:TRAC3:DISP 1` Shows the reference trace
Notes	Use the `:TRAC3:DISP` command to show or blank the reference trace Trace 3 is always the reference trace by definition
State Saved	Saved in instrument state

Norm Ref Lvl

Sets the level (in dB) of the normalized reference. This is the Level of the line specified by Norm Ref Position.

Remote Command	`:DISPlay:WINDow[1]:TRACe:Y[:SCALe]:NRLevel <rel_ampl>` `:DISPlay:WINDow[1]:TRACe:Y[:SCALe]:NRLevel?`
Example	`:DISP:WIND:TRAC:Y:NRL .10 dB` `:DISP:WIND:TRAC:Y:NRL?`
Preset	0 dB

State Saved	Saved in instrument state
Min	–327.6 dB
Max	327.6 dB

Norm Ref Position

Sets the graticule line that represents the Norm Ref Lvl. 10 is the top line and 0 is the bottom line. The normalized reference position is indicated with a white right arrow on the left side of the display and a white left arrow on the right side of the display, just inside the graticule.

This function may be used to offset the displayed trace without affecting the instrument gain or attenuation settings. This allows the displayed trace to be moved off the top of the screen so that it may be completely seen, but without decreasing measurement accuracy.

Remote Command	`:DISPlay:WINDow[1]:TRACe:Y[:SCALe]:NRPosition <integer>` `:DISPlay:WINDow[1]:TRACe:Y[:SCALe]:NRPosition?`
Example	`:DISP:WIND:TRAC:Y:NRP 5` `:DISP:WIND:TRAC:Y:NRP?`
Notes	The top and bottom graticule lines correspond to 10 and 0, respectively
Preset	10
State Saved	Saved in instrument state
Min	0
Max	10

Open/Short Cal

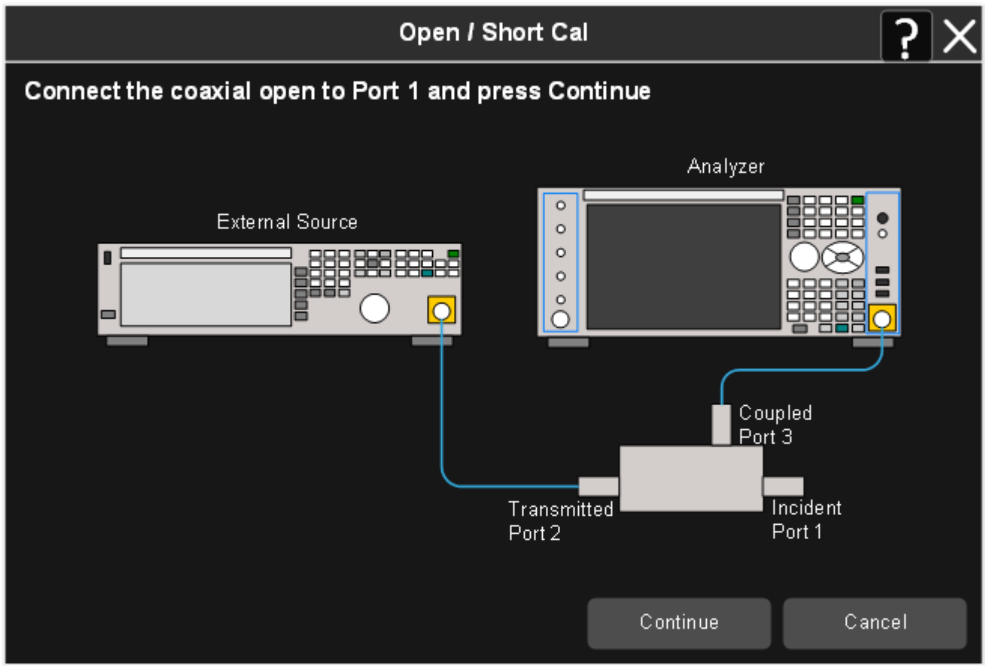
Performs a guided Open/Short Calibration, providing step-by-step instructions. This is the most accurate way to make the return loss measurement on the X-series instruments. You are directed through a 1-Port coaxial open calibration, and a 1-Port coaxial short calibration. The result can then be saved to Trace 3. It is used to perform calibrated scalar reflection measurements (return loss), using **Normalize**.

See "Open/Short Guided Cal" on page 541

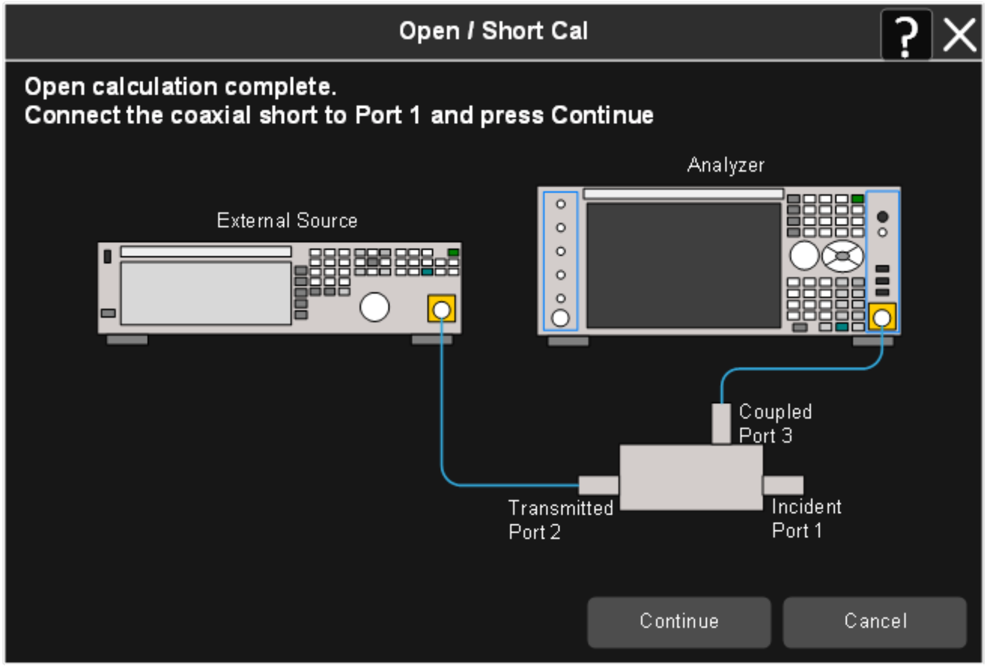
Notes	Does not auto return

Open/Short Guided Cal

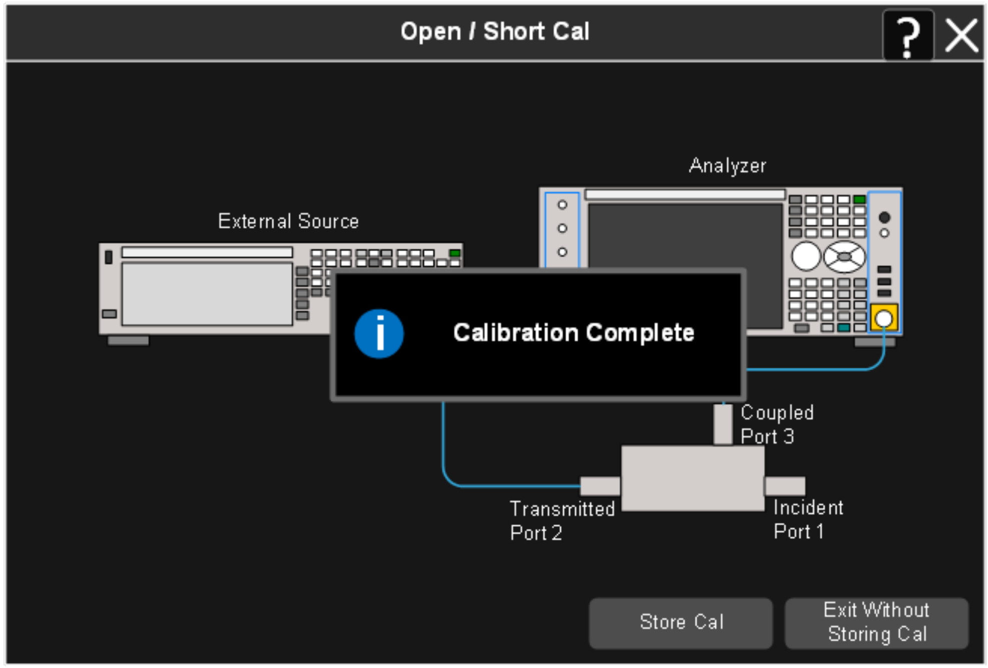
On pressing the **Open/Short Cal** control in the **Normalize** menu, the Open Calibration Form is displayed. The form shows a diagrammatic representation of how to connect the external source to the spectrum instrument to perform the calibration. When the **Continue** button is pressed, the Open calibration sweep is taken and stored in internal memory, for use later in this cal process. If the Cancel button is pressed, the Open/Short Cal is cancelled and the Normalize menu is returned.



On completion of the Open Calibration, the Short Calibration Form is displayed. This form shows a diagrammatic representation of how to connect the external source to the spectrum analyzer to perform the Short calibration. When the Continue button is pressed, the Short calibration sweep is taken and stored in internal memory, for use later in this cal process. If the Cancel button is pressed, the Open/Short Cal is cancelled and the Normalize menu is returned.



On completion of the Short Calibration, the Open and Short calibration measurements are averaged (power). The picture with prompt is taken off the screen and a menu with “Store Cal” and “Exit Without Storing Cal” is displayed. When you press “Store Cal” the resulting trace is stored to Trace 3. If the “Exit Without Storing Cal” button is pressed, the Open/Short Cal is cancelled. In either case you return to the Normalize menu.



The Open Short calibration is applied by taking the average of the Open and the Short trace. The average is a linear average point-by-point. You can further configure averaging on the traces (Open, Short, and final measurement). In this case, the value of the averaged Open and Short trace are linear averaged (by performing a point-by-point average of the two traces). Both the Open and the Short terminations should have approximately unity reflection. Taking the average gives the best estimate of a perfect reflector for a scalar return loss measurement. You should store the result in reference trace 3, for later application with the Normalize function.

3.3 Channel Power Measurement

This measurement is used to find the total power present in a specified bandwidth. Power Spectral Density (signal power normalized to 1 Hz) is also reported.

When in WLAN Mode, or when WLAN radio standard is selected in SA Mode, the peak Power Spectral Density for 1 MHz is reported.

Measurement Commands

The general functionality of "CONFigure" on page 2732, "INITiate" on page 2733, "FETCh" on page 2733, "MEASure" on page 2735, and "READ" on page 2734 are described in the section **SCPI Operation and Results Query** in the topic **Programming the Instrument**.

Note that, in general, `:CONF:<Measurement>` resets the specified measurement settings to their defaults. X-Series permits the addition of the `NDEFault` node to the command, which prevents a measurement preset after a measurement switch.

The tables below list setup commands for this measurement and queries to retrieve results.

Command	Function
`:INITiate:CHPower`	Initiates a trigger cycle for the CHP measurement, but does not return any data. You must then use `:FETC:CHP[n]?` to retrieve data Does not change any measurement settings
`:CONFigure?`	Returns the long form name of current measurement, in this case, `CHPower`
`:CONFigure:CHPower`	Selects CHP measurement with **Meas Setup** settings in preset state – same as "Meas Preset" on page 643
`:CONFigure:CHPower:NDEFault`	Selects CHP measurement *without* affecting settings

The following queries are used to retrieve data. The type of data returned depends on the value of n.

Query	Function
`:FETCh:CHPower[n]?`	Retrieves the data defined by n
`:MEASure:CHPower[n]?`	Switches to CHP measurement, restores default values, starts the measurement, then retrieves the data defined by n
`:READ:CHPower[n]?`	Starts the measurement, then retrieves the data defined by n

Backwards Compatibility Queries

Query	Return Value
`:FETCh:CHPower:CHPower?`	Returns the Channel Power (dBm)

Query	Return Value
:MEASure:CHPower:CHPower?	
:READ:CHPower:CHPower?	
:FETCh:CHPower:DENSity?	Returns the Power Spectral Density (dBm/Hz)
:MEASure:CHPower:DENSity?	
:READ:CHPower:DENSity?	

The results returned by the queries depend on the currently-selected Mode and the value of n (where required). The sections below provide mode-specific details for each Mode.

SA Mode Measurement Results

n	Results Returned		
1 or not specified	Returns scalar results:		
	1	Channel Power	A floating-point number representing the total channel power in the specified integration bandwidth
	2	PSD (Power Spectral Density)	The power in the specified unit bandwidth. The unit bandwidth is selected by "PSD Unit" on page 639; either dBm/Hz or dBm/MHz
2	Returns floating point numbers that are the captured trace data of the power (in dBm/resolution BW) of the signal for Trace 1. The frequency span of the captured trace data is specified by "Span" on page 624		
3	n/a		
4	n/a		
5	Returns floating point numbers that are the captured trace data of the power (in dBm/resolution BW) of the signal for Trace 2. The frequency span of the captured trace data is specified by **Span**		
6	Returns floating point numbers that are the captured trace data of the power (in dBm/resolution BW) of the signal for Trace 3. The frequency span of the captured trace data is specified by **Span**		

MSR Mode Measurement Results

n	Results Returned		
1 or not specified	Returns scalar results:		
	1	Channel Power	A floating-point number representing the total channel power in the specified integration bandwidth
	2	PSD (Power Spectral Density)	The power in the specified unit bandwidth. The unit bandwidth is selected by "PSD Unit" on page 639; either dBm/Hz or dBm/MHz
2	Returns floating point numbers that are the captured trace data of the power (in dBm/resolution BW) of the signal for Trace 1. The frequency span of the captured trace data is specified by "Span" on page 624		
3	Returns [Carriers] comma-separated scalar results, in the following order		

n	Results Returned
	<table><tr><th>#</th><th>Item</th><th>Unit</th></tr><tr><td>1</td><td>Total Power of Carrier 1</td><td>dBm</td></tr><tr><td>2</td><td>Total Power of Carrier 2</td><td>dBm</td></tr><tr><td>...</td><td>...</td><td></td></tr><tr><td>[Carriers]</td><td>Total Power of Carrier [Carriers]</td><td>dBm</td></tr></table> If the result is not available, NaN (9.91E+37) is returned. Number of returned values might be changed in future releases
4	Returns comma-separated scalar results, in the following order <table><tr><th>#</th><th>Item</th><th>Unit</th></tr><tr><td>1</td><td>Total Power of LTE FDD carriers</td><td>dBm</td></tr><tr><td>2</td><td>Total Power of W-CDMA carriers</td><td>dBm</td></tr><tr><td>3</td><td>Total Power of GSM/EDGE carriers</td><td>dBm</td></tr><tr><td>4</td><td>Total Power of cdma2000 carriers</td><td>dBm</td></tr><tr><td>5</td><td>Total Power of 1xEV-DO carriers</td><td>dBm</td></tr><tr><td>6</td><td>...</td><td></td></tr></table> The number of results is incremented by one when a new format is supported If the result is not available, NaN (9.91E+37) is returned. Number of returned values will be changed in future releases if the number of supported radio format is increased
5	Returns floating point numbers that are the captured trace data of the power (in dBm/resolution BW) of the signal for Trace 2. The frequency span of the captured trace data is specified by the Span control
6	Returns floating point numbers that are the captured trace data of the power (in dBm/resolution BW) of the signal for Trace 3. The frequency span of the captured trace data is specified by the Span control

LTE-Advanced FDD/TDD Mode Measurement Results

n	Results Returned
1 or not specified	Returns scalar results: <table><tr><td>1</td><td>Channel Power</td><td>A floating-point number representing the total channel power in the specified integration bandwidth</td></tr><tr><td>2</td><td>PSD (Power Spectral Density)</td><td>The power in the specified unit bandwidth. The unit bandwidth is selected by "PSD Unit" on page 639; either dBm/Hz or dBm/MHz</td></tr></table>
2	Returns floating point numbers that are the captured trace data of the power (in dBm/resolution BW) of the signal for Trace 1. The frequency span of the captured trace data is specified by "Span" on page 624
3	Returns comma-separated scalar results, in the following order

<table>
<tr><th>n</th><th>Results Returned</th></tr>
<tr><td></td><td>

#	Item	Unit
1	Total Power of Component Carrier 0	dBm
2	Total Power of Component Carrier 1	dBm
3	Total Power of Component Carrier 2	dBm
4	Total Power of Component Carrier 3	dBm
5	Total Power of Component Carrier 4	dBm

If the result is not available, NaN (9.91E+37) is returned</td></tr>
<tr><td>4</td><td>Returns comma-separated scalar results, in the following order. The unit bandwidth is selected by "PSD Unit" on page 639, either dBm/Hz or dBm/MHz

#	Item	Unit
1	Total Power Spectral Density of Component Carrier 0	**PSD Unit**
2	Total Power Spectral Density of Component Carrier 1	**PSD Unit**
3	Total Power Spectral Density of Component Carrier 2	**PSD Unit**
4	Total Power Spectral Density of Component Carrier 3	**PSD Unit**
5	Total Power Spectral Density of Component Carrier 4	**PSD Unit**

If the result is not available, NaN (9.91E+37) is returned</td></tr>
<tr><td>5</td><td>Returns floating point numbers that are the captured trace data of the power (in dBm/resolution BW) of the signal for Trace 2. The frequency span of the captured trace data is specified by **Span**</td></tr>
<tr><td>6</td><td>Returns floating point numbers that are the captured trace data of the power (in dBm/resolution BW) of the signal for Trace 3. The frequency span of the captured trace data is specified by **Span**</td></tr>
</table>

5G NR Mode Measurement Results

<table>
<tr><th>n</th><th>Results Returned</th></tr>
<tr><td>1 or not specified</td><td>Returns scalar results:

1	Channel Power	A floating-point number representing the total channel power in the specified integration bandwidth
2	PSD (Power Spectral Density)	The power in the specified unit bandwidth. The unit bandwidth is selected by "PSD Unit" on page 639; either dBm/Hz or dBm/MHz
</td></tr>
<tr><td>2</td><td>Returns floating point numbers that are the captured trace data of the power (in dBm/resolution BW) of the signal for Trace 1. The frequency span of the captured trace data is specified by "Span" on page 624</td></tr>
<tr><td>3</td><td>Returns comma-separated scalar results, in the following order

#	Item	Unit
1	Total Power of Component Carrier 0	dBm
</td></tr>
</table>

n	Results Returned
	| # | Item | Unit | 2 Total Power of Component Carrier 1 dBm 3 Total Power of Component Carrier 2 dBm ... ... 16 Total Power of Component Carrier 15 dBm If the result is not available, NaN (9.91E+37) is returned
4	Returns comma-separated scalar results, in the following order. The unit bandwidth is selected by **PSD Unit** in either dBm/Hz or dBm/MHz # / Item / Unit 1 Total Power of Component Carrier 0 **PSD Unit** 2 Total Power of Component Carrier 1 **PSD Unit** 3 Total Power of Component Carrier 2 **PSD Unit** ... ... 16 Total Power of Component Carrier 15 **PSD Unit** If the result is not available, NaN (9.91E+37) is returned
5	Returns floating point numbers that are the captured trace data of the power (in dBm/resolution BW) of the signal for Trace 2. The frequency span of the captured trace data is specified by "Span" on page 624
6	Returns floating point numbers that are the captured trace data of the power (in dBm/resolution BW) of the signal for Trace 3. The frequency span of the captured trace data is specified by **Span**

WLAN Channel Power Measurement Results

n	Results Returned
1 or not specified	Returns scalar results: When the radio standard is *not* 802.11ac 80 + 80 MHz or 802.11ax 80 + 80 MHz: **Channel Power** A floating-point number representing the total channel power in the specified integration bandwidth **Peak PSD (Power Spectral Density)** The peak PSD over the integration bandwidth. The unit bandwidth is selected by "PSD Unit" on page 639 in either dBm/Hz or dBm/MHz **Mean PSD (Power Spectral Density)** The mean PSD over the integration bandwidth. The unit bandwidth is selected by **PSD Unit** in either dBm/Hz or dBm/MHz When the radio standard is 802.11ac 80 + 80 MHz or 802.11ax 80 + 80 MHz: **Channel Power** of the carrier of which the center frequency is indicated by Freq Segment 1

n	Results Returned
	A floating-point number representing the total channel power of the first segment in the specified integration bandwidth **Peak PSD (Power Spectral Density)** of the carrier of which the center frequency is indicated by Freq Segment 1 The power in the specified unit bandwidth of the first segment. The unit bandwidth is selected by **PSD Unit** in either dBm/Hz or dBm/MHz **Channel Power** of the carrier of which the center frequency is indicated by Freq Segment 2 A floating-point number representing the total channel power of the second segment in the specified integration bandwidth **Peak PSD (Power Spectral Density)** of the carrier of which the center frequency is indicated by Freq Segment 2 The power in the specified unit bandwidth of the second segment. The unit bandwidth is selected by **PSD Unit** in either dBm/Hz or dBm/MHz **Mean PSD (Power Spectral Density)** of the carrier of which the center frequency is indicated by Freq Segment 1 The power in the specified unit bandwidth of the first segment. The unit bandwidth is selected by **PSD Unit** in either dBm/Hz or dBm/MHz **Mean PSD (Power Spectral Density)** of the carrier of which the center frequency is indicated by Freq Segment 2 The power in the specified unit bandwidth of the second segment. The unit bandwidth is selected by **PSD Unit** in either dBm/Hz or dBm/MHz
2	Returns floating point numbers that are the captured trace data of the power (in dBm/resolution BW) of the signal for Trace 1. The frequency span of the captured trace data is specified by "Span" on page 624
3	n/a
4	n/a
5	Returns floating point numbers that are the captured trace data of the power (in dBm/resolution BW) of the signal for Trace 2. The frequency span of the captured trace data is specified by **Span**
6	Returns floating point numbers that are the captured trace data of the power (in dBm/resolution BW) of the signal for Trace 3. The frequency span of the captured trace data is specified by **Span**

Additionally, WLAN Mode supports an `n` parameter for the following queries:

`:FETCh:CHPower:DENSity[n]?`

`:MEASure:CHPower:DENSity[n]?`

`:READ:CHPower:DENSity[n]?`

For these queries *in WLAN Mode only*, the results returned depend on the value of `n` as follows:

n	Radio Standard	Results Returned
1 or not specified	*Not* 802.11ac 80 +80 MHz or 802.11ax80 +80 MHz	**Peak PSD (Power Spectral Density)** The Peak PSD over the integration bandwidth. The unit bandwidth is

n	Radio Standard	Results Returned
		selected by "PSD Unit" on page 639 in either dBm/Hz or dBm/MHz
	802.11ac 80 +80 MHz or 802.11ax80 +80 MHz	The first value is the peak PSD for segment 1, the second value is the peak PSD for segment 2
2	*Not* 802.11ac 80 +80 MHz or 802.11ax80 +80 MHz	**Mean PSD (Power Spectral Density)** The Mean PSD over the integration bandwidth. The unit bandwidth is selected by **PSD Unit** in either dBm/Hz or dBm/MHz
	802.11ac 80 +80 MHz or 802.11ax80 +80 MHz	The first value is the mean PSD for segment 1, the second value is the mean PSD for segment 2

3.3.1 Views

In SA, WCDMA, WLAN, SRCOMMS, and VMA Modes, there is only one predefined view, the "Normal" on page 552 view.

In MSR, LTEAFDD, LTEATDD, and 5GNR Modes, this measurement has two predefined views:

1. "Normal" on page 552
2. "Carrier Info" on page 552

View selection by name

Selects the results view by specifying the View name.

Remote Command	`:DISPlay:CHPower:VIEW[:SELect] PRESult | CINFormation` `:DISPlay:CHPower:VIEW[:SELect]?`
Example	`:DISP:CHP:VIEW PRES` `:DISP:CHP:VIEW?`
Preset	`PRESult`
State Saved	Saved in instrument state
Range	Power Results | Carrier Info

View selection by number

Selects the results view by specifying the View number.

Remote Command	`:DISPlay:CHPower:VIEW:NSELect <integer>` `:DISPlay:CHPower:VIEW:NSELect?`

Example	`:DISP:CHP:VIEW:NSEL 1` `:DISP:CHP:VIEW:NSEL?`
Preset	1
State Saved	Saved in instrument state
Min/Max	1 / 2

3.3.1.1 Normal

Windows: "Graph" on page 552, "Metrics" on page 553

Dual window view: Channel Power graph and Channel Power metrics.

Example	`:DISP:CHP:VIEW PRES`

3.3.1.2 Carrier Info

Windows: "Graph" on page 552, "Metrics" on page 553

Dual window view: Channel Power graph and Carrier Info table.

Example	`:DISP:CHP:VIEW CINF`
Dependencies	Only available in MSR, LTE-A FDD/TDD and 5G NR Modes

3.3.2 Windows

This section describes the windows that are available in the Channel Power measurement.

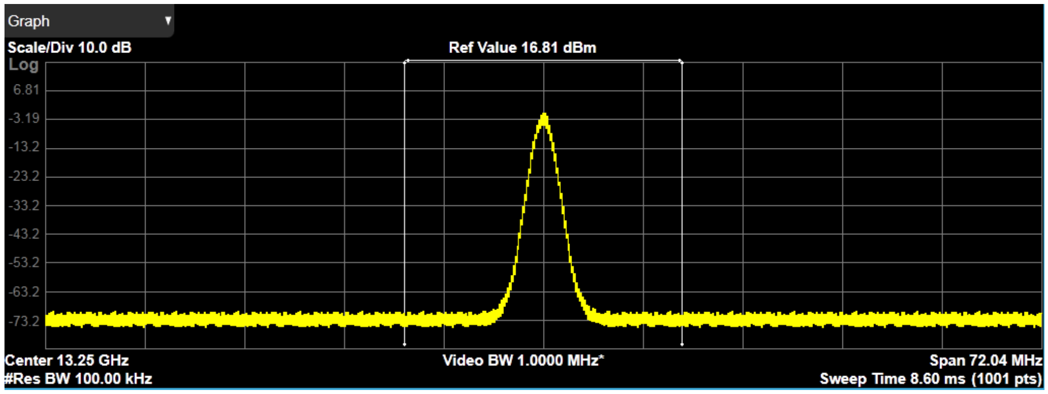
3.3.2.1 Graph

Used to display the spectrum trace and power bars.

The results of the measurement can be displayed as a single spectrum trace view or displayed with a Bar Graph trace on the spectrum trace. The Bar Graph appears between the markers that indicate the measured output power level. The bar graph is activated when the “Bar Graph” control is set to ON under the Display menu. The Graph window appears in the following views.

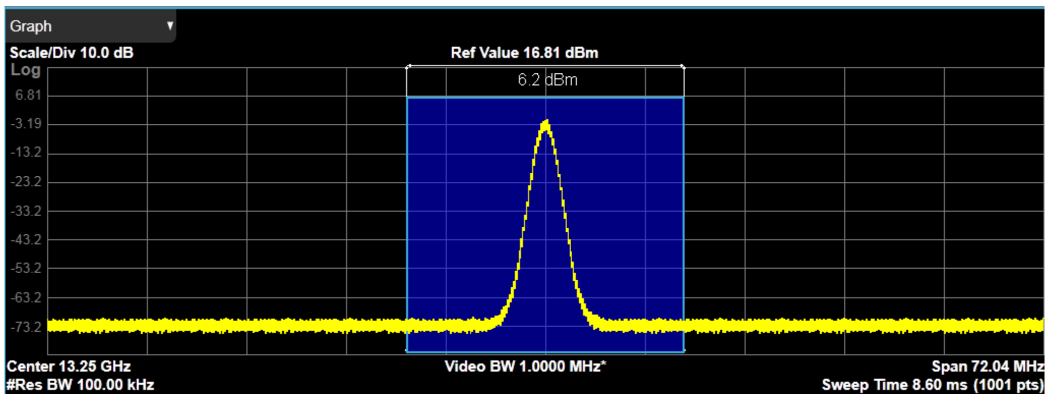
View	Size	Position
Normal	Two thirds, full width	Top
Gate View	One third, full width	Middle

Spectrum View with Bar Graph Off



Spectrum View with Bar Graph On

This is the same as the **Spectrum** view, but has a blue bar between the markers that indicates the measured output power level. The bar graph is activated when the "Bar Graph" control is set to ON under the **Display** hardkey. The actual measured output power level is displayed on the display at the top of the bar.



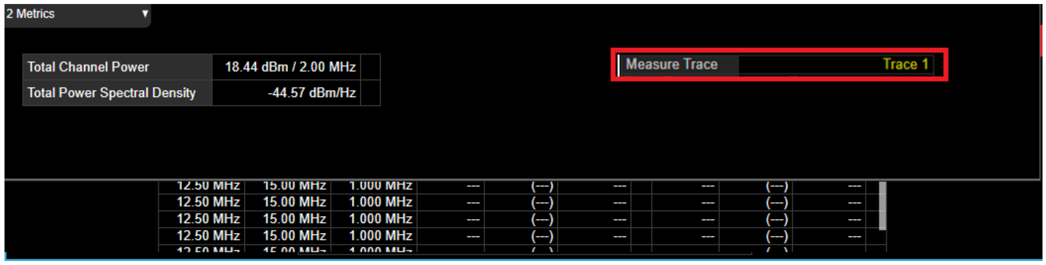
If the current Mode is WLAN and the format is WLAN 802.11ac 80+80 MHz, Spectrum View is slightly different so that the results of both carrier segments can be displayed.

3.3.2.2 Metrics

The actual measured output power level is displayed in the Metrics window

The **Metrics** window appears in the following Views.

View	Size	Position
Normal	One third, full width	Bottom
Gate View	One third, full width	Bottom



Measure Trace

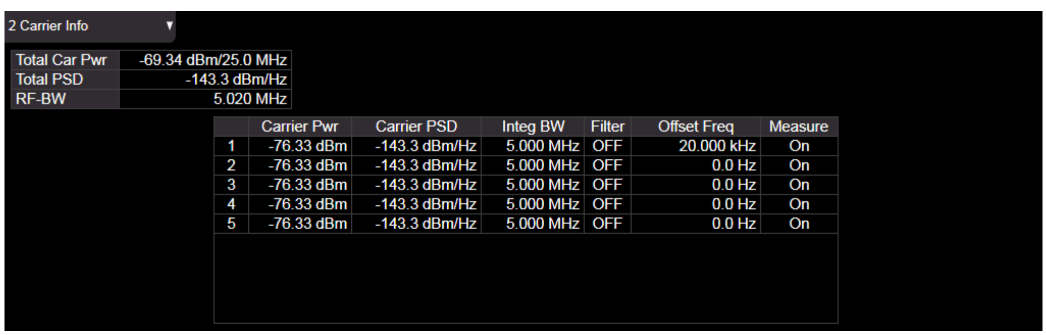
See: "Measure Trace" on page 1734.

Power Results

Total carrier power, total PSD and total format carrier power are displayed in the lower window. Total format carrier power is total power of carriers of the same Radio Format. If there is no carrier of the corresponding format, it is not displayed. Thus, items in the total format power table changes depending on the carrier configuration. Since the metrics window of MSR, LTE-Advanced FDD/TDD and 5G NR is slightly denser than that for common CHP, the vertical positions of total power and power spectral density are raised.

Carrier Info: LTE-Advanced FDD/TDD and 5G NR Modes

The following diagram shows the Metrics Window in the Carrier Info view for LTE-Advanced FDD/TDD and 5G NR. The Power Results window is replaced by the carrier info table.



The text window displays the following results:

Total Carrier Power

This is the total power of all the carriers with carrier measure state setting to On. The power is calculated by integrating across the bandwidth declared by the Carrier Integ Bw parameter for each carrier and then totaling the sums. The total integration bandwidth is shown as part of the result. This will be the total of the Carrier Integ Bw of the carriers used in calculating the total carrier power. If the RRC Filter is on, then the integration bandwidth used is (1 + alpha)/T where T = 1/(Carrier Integ Bw) multiplied by the number of carriers with carrier measure state setting to yes.

RF-BW

Displays the total bandwidth from the lowest carrier to the highest carrier, whether their measurement states are on or off.

Carrier Power

This is the power in all the currently defined carriers. If the carrier is with measurement state being on, the power will be absolute. If the carrier is defined as not having power present, the power will be shown up as dash. The power is calculated by integrating across the bandwidth declared by the Carrier Integ Bw parameter. The integration bandwidth is shown as part of the result. This is the value of the Carrier Integ Bw for the carrier unless the RRC Filter is on, then the integration.

Integration Bandwidth

Displays the channel bandwidth of each carrier.

Filter

Displays whether RRC filter is used or not.

Offset Frequency

Shows the offset frequency from the carrier reference frequency in multi-carrier measurements. The carrier frequency display type determines whether the relative frequency or absolute frequency will be displayed.

Sub-block (LTE-Advanced FDD/TDD Modes only)

For intra-band non-contiguous spectrum operation, the sub-block concept is introduced, which refers to one contiguous allocated block of spectrum for transmission and reception in the intra-band non-contiguous aggregation mode. We support two sub-blocks. It displays which sub-block the carrier belongs to in the intra-band non-contiguous aggregation mode. The column is displayed when the carrier allocation mode is non-contiguous.

Measure

Shows whether the carrier power presents or not.

The highlighted row changes as either Carrier Result or Select Carrier is changed. The highlighted row and these keys are not coupled.

Carrier Info: MSR Mode

The text window displays the following results:

Total Carrier Power

This is the total power of all the carriers with carrier measure state setting to On. The power is calculated by integrating across the bandwidth declared by the Carrier Integ Bw parameter for each carrier and then totaling the sums. The total integration bandwidth is shown as part of the result. This will be the total of the Carrier Integ Bw of the carriers used in calculating the total carrier power. If the RRC Filter is on, then the integration bandwidth used is (1 + alpha)/T where T = 1/(Carrier Integ Bw) multiplied by the number of carriers with carrier measure state setting to yes.

RF-BW

Displays the total bandwidth from the lowest carrier to the highest carrier, whether their measurement states are on or off.

Carrier Power

This is the power in all the currently defined carriers. If the carrier is with measurement state being on, the power will be absolute. If the carrier is defined as not having power present, the power will be shown up as dash. The power is calculated by integrating across the bandwidth declared by the Carrier Integ Bw parameter. The integration bandwidth is shown as part of the result. This is the value of the Carrier Integ Bw for the carrier unless the RRC Filter is on, then the integration.

Integration Bandwidth

Displays the channel bandwidth of each carrier.

Filter

Displays whether RRC filter is used or not.

Offset Frequency

Shows the offset frequency from the carrier reference frequency in multi-carrier measurements. The carrier frequency display type determines whether the relative frequency or absolute frequency will be displayed.

Sub-block

For intra-band non-contiguous spectrum operation, the sub-block concept is introduced, which refers to one contiguous allocated block of spectrum for transmission and reception in the intra-band non-contiguous aggregation mode. We support two sub-blocks. It displays which sub-block the carrier belongs to in the intra-band non-contiguous aggregation mode. The column is displayed when the carrier allocation mode is non-contiguous.

Measure

Shows whether the carrier power presents or not.

The highlighted row changes according to whether Carrier Result or Select Carrier is changed. The highlighted row and these keys are not coupled.

Parameter Set

Displays which format parameter set is selected.

3.3.2.3 Gate

Turning on Gate View displays the Gate Window, which allows you to see your Gating signal at the same time as the measured data. See the description under **Gate View** in **Trigger**, **Gate Settings**.

View	Size	Position
Gate View	One third, full width	Top

3.3.3 Amplitude

Activates the **Amplitude** menu and selects **Reference Level** or **Reference Value** as the active function, depending on the measurement.

Some features in this menu apply to multiple measurements. Some other features apply only to specific measurements and their controls are blanked or grayed-out in measurements that do not support the feature.

3.3.3.1 Y Scale

Contains controls that pertain to the Y axis parameters of the measurement. These parameters control how data on the vertical (Y) axis is displayed and control instrument settings that affect the vertical axis.

Ref Value

Sets the value for the absolute power reference. The reference line is at the top, center, or bottom of the graticule, depending on the value of "Ref Position" on page 565.

Remote Command	`:DISPlay:CHPower:WINDow[1]:TRACe:Y[:SCALe]:RLEVel <real>` `:DISPlay:CHPower:WINDow[1]:TRACe:Y[:SCALe]:RLEVel?`

Example	:DISP:CHP:WIND:TRAC:Y:RLEV 10 dBm :DISP:CHP:WIND:TRAC:Y:RLEV?
Couplings	When "Auto Scaling" on page 565 is ON (default), this value is automatically determined by the measurement result. When you set a value manually, **Auto Scaling** changes to OFF Attenuation is not coupled to **Ref Value**
Preset	10.00 dBm
State Saved	Saved in instrument state
Min/Max	-250.00 dBm / 250.00 dBm
Annotation	Ref <value> top left of graph
Backwards Compatibility SCPI	:DISPlay:CHPower:VIEW[1]:WINDow[1]:TRACe:Y[:SCALe]:RLEVel

Scale/Div

For measurements that support a logarithmic Y-Axis, **Scale/Div** sets the height of one division of the graticule in the current Y-Axis unit.

Scale/Div also determines the displayed amplitude range in the log plot graph. Since there are usually 10 vertical graticule divisions on the display, the total amplitude range of the graph is typically 10x this amount. For example, if **Scale/Div** is 10 dB, then the total range of the graph is 100 dB.

Remote Command	:DISPlay:CHPower:WINDow[1]:TRACe:Y[:SCALe]:PDIVision <rel_ampl> :DISPlay:CHPower:WINDow[1]:TRACe:Y[:SCALe]:PDIVision?
Example	:DISP:CHP:WIND:TRAC:Y:PDIV 5 :DISP:CHP:WIND:TRAC:Y:PDIV?
Couplings	Coupled to "Scale Range" on page 1538 as follows: **Scale/Div** = **Scale Range**/10 (number of divisions) When "Auto Scaling" on page 565 is ON, this value is automatically determined by the measurement result When you change a value, **Auto Scaling** automatically changes to OFF
Preset	10.00 dB / Div
State Saved	Saved in instrument state
Min	0.10 dB
Max	20 dB
Annotation	<value> dB/ left upper of graph
Backwards Compatibility SCPI	:DISPlay:CHPower:VIEW[1]:WINDow[1]:TRACe:Y[:SCALe]:PDIVision

Scale Range

Sets the Y-Axis scale range.

Remote Command	Replace `<meas>` with the identifier for the current measurement
	`:DISPlay:<meas>:WINDow[1]:TRACe:Y[:SCALe]:RANGe <rel_ampl>`
	`:DISPlay:<meas>:WINDow[1]:TRACe:Y[:SCALe]:RANGe?`

Example	`:DISP:CHP:WIND:TRAC:Y:RANG 100` `:DISP:CHP:WIND:TRAC:Y:RANG?`
Couplings	Coupled to **Scale/Div** as follows **Scale Range** = **Scale/Div** * 10 (number of divisions) When you change this value, **Auto Scaling** automatically changes to `OFF`
Preset	100 dB
State Saved	Saved in instrument state
Min	1
Max	200

Y Axis Unit

Displays a dropdown menu that enables you to change the vertical (Y) axis amplitude unit. This setting affects how the data is read over the remote interface. When using the remote interface, only numerical values are returned, so you must know what the Y Axis Unit is to interpret the results. This is described in more detail in "Amplitude Data Query and Y Axis Unit" on page 562 below.

For measurements that support both Log and Lin scales, the instrument retains the entered Y Axis Unit separately for both Log and Lin amplitude Display Scales. For example, if Display Scale has been set to Log, and you set Y Axis Unit to dBm, pressing **Display Scale (Log)** sets the Y Axis Unit to dBm. If Display Scale has been set to Lin and you set Y Axis Unit to V, pressing **Display Scale (Lin)** sets the Y Axis Unit to V. Pressing **Display Scale (Log)** again sets the Y Axis Unit back to dBm.

If an Amplitude Correction is being applied that has an associated Transducer Unit, all selections but **Xducer Unit** are grayed-out. For more information, see "Transducer Unit" on page 563 below.

Remote Command	`:UNIT:POWer DBM | DBMV | DBMA | V | W | A | DBUV | DBUA | DBPW | DBUVM | DBUAM | DBPT | DBG` `:UNIT:POWer?`

Example	`:UNIT:POW dBmV`
	`:UNIT:POW?`
	See also "Remote Interface Examples" on page 560 below

Notes	The Y axis unit has either logarithmic or linear characteristics. The set of units that is logarithmic consists of dBm, dBmV, dBmA, dBmV, dBmA, dBmV/m, dBmA/m, dBpT, and dBG. The set of units that are linear consists of V, W, and A. The chosen unit will determine how the reference level and all the amplitude-related outputs like trace data, marker data, etc., read out
Dependencies	Appears only in Spectrum Analyzer Mode If an amplitude correction with a Transducer Unit other than None is applied and enabled: – The Transducer Unit selection is forced, and is the only Y Axis Unit available. The specific Transducer Unit is shown in square brackets in the dropdown, and all other Y Axis Unit choices are grayed-out – If you turn off that correction or set Apply Corrections to NO, the Y Axis Unit that existed before the Transducer Unit was applied is restored When Normalize is ON (in the **Trace**, **Normalize** menu), Y Axis Unit is grayed-out, and forced to dBm
Couplings	The instrument retains the entered Y Axis Unit separately for both Log and Lin amplitude Display Scales
Preset	dBm for log scale, V for linear. The true 'preset' value is dBm, since at preset the Y Display Scale is set to logarithmic
State Saved	Saved in instrument state
Annotation	The Y Axis Unit is shown after Ref Level value at the top of the graticule

Unit	Example	Notes
dBm	`:UNIT:POW DBM`	Y Axis Unit is set to dBm
dBmV	`:UNIT:POW DBMV`	Y Axis Unit is set to dBmV
dBmA	`:UNIT:POW DBMA`	Y Axis Unit is set to dBmA
W	`:UNIT:POW W`	Y Axis Unit is set to W
V	`:UNIT:POW V`	Y Axis Unit is set to V
A	`:UNIT:POW A`	Y Axis Unit is set to A
dBmV	`:UNIT:POW DBUV`	Y Axis Unit is set to dBmV
dBmA	`:UNIT:POW DBUA`	Y Axis Unit is dBmA. The unit dBuA can also appear as a Transducer Unit
dBpW	`:UNIT:POW DBPW`	Y Axis Unit is set to dBpW

Remote Interface Examples

Command examples and details appear in the table below. Note that each of the commands below sets the amplitude unit only for the *selected* amplitude scale (Log or Lin), the other scale is unaffected.

Unit	Example	Notes
dBm	:UNIT:POW DBM	dB relative to one milliwatt
dBmV	:UNIT:POW DBMV	dB relative to one millivolt
dBmA	:UNIT:POW DBMA	dB relative to one milliamp
W	:UNIT:POW W	Watts
V	:UNIT:POW V	Volts
A	:UNIT:POW A	Amperes
dBmV	:UNIT:POW DBUV	dB relative to one microvolt
dBmA	:UNIT:POW DBUA	dB relative to one microamp The unit dBuA can also appear as a "Transducer Unit" on page 563 When querying the Y-Axis unit, you can query the Transducer Unit to distinguish between regular dBuA and the dBuA transducer unit. If :CORR:CSET:ANT? returns NOC (for No Conversion), you are using a normal Y Axis dBuA. If it returns UA, you are using a Transducer Unit dBuA
dBpW	:UNIT:POW DBPW	dB relative to one picowatt
dBmV/m (Transducer Unit)	:UNIT:POW DBUVM	Sets the amplitude unit for the selected amplitude scale (log/lin) to dBmV/meter. This selection is only available if a Correction is turned on, and the Transducer Unit for that Correction is not None See "Transducer Unit" on page 563
dBmA/m (Transducer Unit)	:UNIT:POW DBUAM	Sets the amplitude unit for the selected amplitude scale (log/lin) to dBmA/meter. This selection is only available if a Correction is turned on, and the Transducer Unit for that Correction is not None See "Transducer Unit" on page 563
dBpT (Transducer Unit)	:UNIT:POW DBPT	Sets the amplitude unit for the selected amplitude scale (log/lin) to dBpT (dB relative to one picotesla). This selection is only available if a Correction is turned on, and the Transducer Unit for that Correction is not None See "Transducer Unit" on page 563
dBG (Transducer Unit)	:UNIT:POW DBG	Sets the amplitude unit for the selected amplitude scale (log/lin) to dBG (dB relative to one Gauss). This selection is only available if a Correction is turned on, and the Transducer Unit for that Correction is not None See "Transducer Unit" on page 563
dBmA (Transducer Unit)	:UNIT:POW DBUA	Sets the amplitude unit for the selected amplitude scale (log/lin) to dBmA. This selection is only available as a Transducer Unit if a Correction is turned on, and the Transducer Unit for that Correction is not None See "Transducer Unit" on page 563 The unit dBuA can also appear as a normal Y Axis Unit (see above) dBuA as a Transducer Unit is used when using current probes, because current

Unit	Example	Notes
		probes are often supplied with conversion tables that provide the transducer factors. When dBuA is used as a Transducer Unit, the normal conversion from power to amps for dBuA (based on the instrument input impedance) is not done, but instead the conversion is based solely on the Correction that contains the transducer factors. This is what distinguishes dBuA as a normal unit from dBuA as a transducer unit When querying the Y-Axis unit, you can query the Transducer Unit to distinguish between regular dBuA and the dBuA Transducer Unit. If `:CORR:CSET:ANT?` returns `NOC` (for No Conversion), you are using a normal Y-Axis dBuA. If it returns `UA`, you are using a Transducer Unit dBuA

Amplitude Data Query and Y Axis Unit

The settings of Y-Axis Unit and Display Scale affect how the data is returned over the remote interface in response to a query. When using the remote interface, no unit is returned, so you must know what the Y-Axis unit is to interpret the results:

Example 1

Set the following:

- Display Scale (Log)
- Y Axis Unit, dBm
- Scale/Div, 1 dB
- Ref Level, 10 dBm

This sets the top line to 10 dBm with each vertical division representing 1 dB. Thus, if a point on trace 1 is on the fifth graticule line from the top, it represents 5 dBm and will read out remotely as 5.

Example 2

Set the following:

- Display Scale (Lin)
- Y Axis Unit, Volts
- Ref Level, 100 mV (10 mV/div)

This sets the top line to 100 mV and the bottom line to 0 V, so each vertical division represents 10 mV. Thus, if a point on trace 1 is on the fifth graticule line from the top, it represents 50 mV and will read out remotely as 50.

NOTE **The units of current (A, dBmA, dBuA) are calculated based on 50 Ω input impedance.**

Transducer Unit

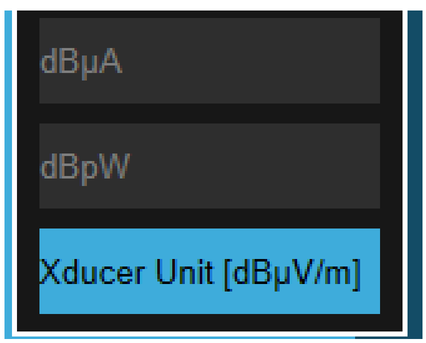
Transducer Units (formerly called Antenna Units) are units of field strength rather than amplitude, and are used when correcting the response of device such as antennas whose amplitude characteristics are measured in units of field strength. All five of the Transducer Units (dBmA/m, dBmV/m, dBG, dBpT, dBmA) are treated by the instrument exactly as though they were dBmV, when uncorrected. You must load an appropriate correction factor using Input/Output, Corrections for accurate and meaningful results.

If a remote command is sent to the instrument that uses one of the Transducer Units as a terminator, the instrument treats it as though DBUV had been sent as the terminator.

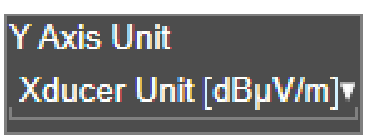
When a Correction is turned on that uses a Transducer Unit, the Y Axis Unit changes to that Transducer Unit. All of the selections in the **Y-Axis Unit** dropdown are then grayed-out, except the Transducer Unit selection. The unit being used is shown on this selection in square brackets, and appears on the control in square brackets preceded by **Xducer Unit**.

Example:

If the Transducer Unit in the Correction is dBmV/m, then the selection in the dropdown looks like this:



And on the control it looks like this:



NOTE If a Transducer Unit is set, it is displayed as **Xducer Unit** in the **Y Axis Unit** dropdown. However, you can only *change* the Transducer Unit via the **Edit Correction** dialog in the **Input/Output**, **Corrections** menu. In that dialog, tap **Settings** then **Transducer Unit**. You can also turn off Transducer Unit from the same menu, by selecting **None**.

If a Transducer Unit is set, it is displayed as **Xducer Unit** in the **Y Axis Unit** dropdown. However, you can only *change* the Transducer Unit via the **Edit Correction** dialog in the **Input/Output**, **Corrections** menu. In that dialog, tap **Settings** then **Transducer Unit**. You can also turn off Transducer Unit from the same menu, by selecting **None**.

The Transducer Units are:

Units	Example
dBmV/m	:UNIT:POW DBUVM
dBmA/m	:UNIT:POW DBUAM
dBpT	:UNIT:POW DBPT
dBG	:UNIT:POW DBG
dBmA	:UNIT:POW DBUA
None	n/a

Ref Level Offset

Adds an offset value to the displayed reference level. The reference level is the absolute amplitude represented by the top graticule line on the display.

The on/off switch turns **Ref Level Offset** on or off. Setting a value turns **Ref Level Offset**ON.

Remote Command	:DISPlay:WINDow[1]:TRACe:Y[:SCALe]:RLEVel:OFFSet <rel_ampl> :DISPlay:WINDow[1]:TRACe:Y[:SCALe]:RLEVel:OFFSet?
Example	Set **Ref Level Offset** to 12.7 dB. The only valid suffix is dB. If no suffix is sent, dB is assumed: :DISP:WIND:TRAC:Y:RLEV:OFFS 12.7 :DISP:WIND:TRAC:Y:RLEV:OFFS?
Dependencies	Appears only in Spectrum Analyzer Mode
Preset	0 dBm
State Saved	Saved in instrument state
Min	Variable. Limited to values that keep the reference level within the range: -327.6 dB to 327.6 dB
Max	327.6 dB
Annotation	The offset is displayed as “Ref Offset <value>” to the right of the reference level annotation if nonzero. When the offset is zero, no annotation is shown

Auto Function

Remote Command	:DISPlay:WINDow[1]:TRACe:Y[:SCALe]:RLEVel:OFFSet:STATe OFF | ON | 0 | 1 :DISPlay:WINDow[1]:TRACe:Y[:SCALe]:RLEVel:OFFSet:STATe?
Example	:DISP:WIND:TRAC:Y:RLEV:OFFS:STAT ON Turns Ref Level Offset On
Preset	OFF

Ref Position

Positions the reference level at the top, center, or bottom of the Y Scale display. Changing the reference position does not change the reference level value.

Remote Command	:DISPlay:CHPower:WINDow[1]:TRACe:Y[:SCALe]:RPOSition TOP | CENTer | BOTTom :DISPlay:CHPower:WINDow[1]:TRACe:Y[:SCALe]:RPOSition?
Example	:DISP:CHP:WIND:TRAC:Y:RPOS CENT :DISP:CHP:WIND:TRAC:Y:RPOS?
Preset	TOP
State Saved	Saved in instrument state
Range	TOP|CENTer|BOTTom
Annotation	The greater than (>) and less than (<) symbols are displayed on both sides of the graph to indicate the Reference Position
Backwards Compatibility SCPI	:DISPlay:CHPower:VIEW[1]:WINDow[1]:TRACe:Y[:SCALe]:RPOSition

Auto Scaling

Toggles **Auto Scaling** On or Off.

Remote Command	:DISPlay:CHPower:WINDow[1]:TRACe:Y[:SCALe]:COUPle 0 | 1 | OFF | ON :DISPlay:CHPower:WINDow[1]:TRACe:Y[:SCALe]:COUPle?
Example	:DISP:CHP:WIND:TRAC:Y:COUP OFF :DISP:CHP:WIND:TRAC:Y:COUP?
Couplings	When **Auto Scaling** is ON, and the **Restart** front-panel key is pressed, this function automatically sets the scale per division to 10 dB and determines the reference values based on the measurement results When you change the value of **Scale/Div**, **Ref Value**, or **Scale Range**, **Auto Scaling** automatically changes to OFF
Preset	1
State Saved	Saved in instrument state

Range	OFF|ON
Backwards Compatibility SCPI	:DISPlay:CHPower:VIEW[1]:WINDow[1]:TRACe:Y[:SCALe]:COUPle

3.3.3.2 Attenuation

Controls the attenuator functions and interactions between the attenuation system components.

There are two attenuator configurations in the X-Series. One is a Dual-Attenuator configuration consisting of a mechanical attenuator and an optional electronic attenuator. The other configuration uses a single attenuator with combined mechanical and electronic sections that controls all the attenuation functions. Different models in the X-Series come with different configurations.

- See "Dual-Attenuator Configurations" on page 566
- See "Single-Attenuator Configuration" on page 567

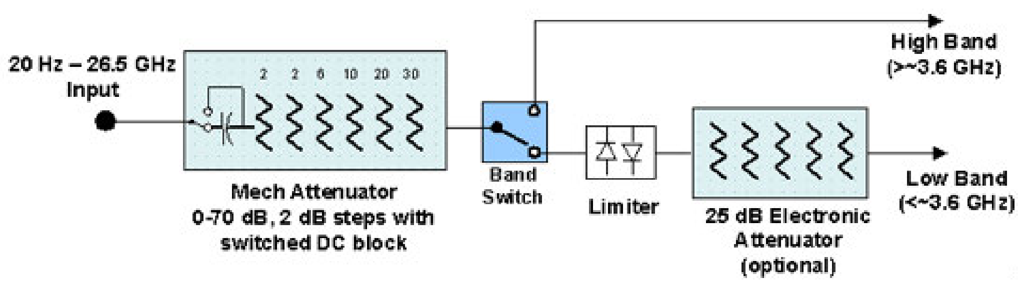
Most attenuation settings are the same for all measurements – they do not change as you change measurements. Settings like these are called “Meas Global” and are unaffected by **Meas Preset**.

Only available when the hardware set includes an input attenuator, which is typically only the case for Keysight’s benchtop instruments. For example, this tab does *not* appear in VXT models M9421A/10A/11A, nor in UXM. In UXM, all **Attenuation** and **Range** settings are disabled, as the expected input power level is handled by the Call Processing App that drives the DUT power control.

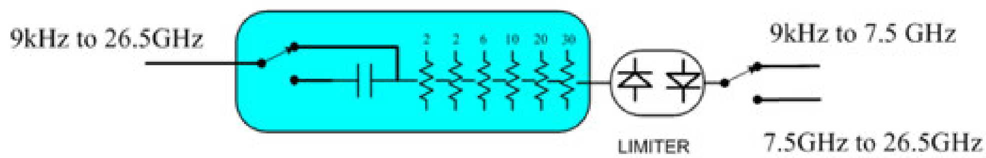
Dependencies	In measurements that support the I/Q inputs, unavailable when I/Q is the selected input. Replaced by the **Range** tab in that case

Dual-Attenuator Configurations

Configuration 1: Mechanical attenuator + optional electronic attenuator

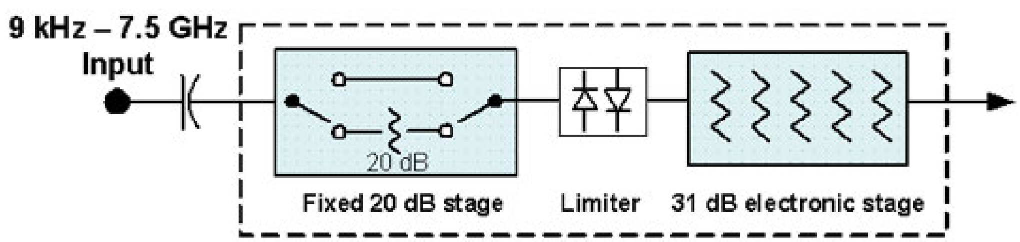


Configuration 2: Mechanical attenuator, no optional electronic attenuator

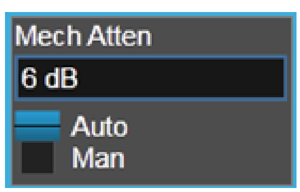


Note that Configuration 2 is not strictly speaking a dual-section attenuator, since there is no electronic section available. However, it behaves exactly like Configuration 1 without the Electronic Attenuator Option EA3, therefore for the sake of this document it is grouped into the “Dual-Attenuator” configuration.

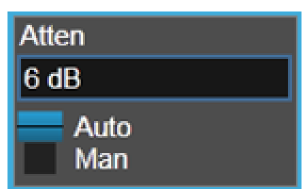
Single-Attenuator Configuration



You can tell which attenuator configuration you have by pressing the Attenuation tab, which (in most Modes) opens the Attenuation menu. If the first control in the Attenuation menu says **Mech Atten** you have the Dual-Attenuator configuration. If the first control says **Atten** you have the Single-Attenuator configuration.



Dual Attenuator



Single Attenuator

(Note that depending on the measurement, there may be no Auto/Man functionality on the Mech Atten control.)

In the Single-Attenuator configuration, you control the attenuation with a single control, as the fixed stage has only two states. In the Dual-Attenuator configuration, both stages have significant range, so you are given separate control of the mechanical and electronic attenuator stages.

When you have the Dual-Attenuator configuration, you may still have only a Single-Attenuator, because unless Option EA3 (the Electronic Attenuator option) is available, and you purchase it, you will have only the mechanical attenuator.

Full Range Atten

This control and **Attenuator Summary** only appear in N9041B, when the RF input is selected, the RF Input Port is set to RF Input 2, and the Full Range Attenuator is installed. The Full Range Attenuator adds a second input attenuator in front of RF Input 2, which enhances the protection and optimizes the performance of the extra internal mixers used by RF Input 2.

Remote Command	`[:SENSe]:POWer[:RF]:FRATten <rel_ampl>` `[:SENSe]:POWer[:RF]:FRATten?`
Example	`:POW:FRAT 14` `:POW:FRAT?`
Notes	When you enter an amplitude value that falls between valid values, the value will be incremented to the next smallest valid value
Dependencies	Only appears if input RF is selected, RF Input Port 2 is selected, and the Full Range Attenuator exists
Couplings	This value is never changed by any coupling, but other couplings use this value. See **Reference Level** and "Mech Atten" on page 1935 command descriptions
Preset	20 dB
State Saved	Saved in instrument state
Min	0 dB
Max	Only valid values are 0, 6, 14, 20 dB
Annotation	When the **Input** is **RF**, and the **Input Port** is **RF Input 2**, and the Full Range Attenuator is installed: On the Meas Bar, the field “Atten” displays as follows: – If the sweep is entirely < 50 GHz, the value shown after “Atten:” is equal to Mech Atten + Elec Atten + Full Range Atten – If the sweep is entirely > 50 GHz, the value shown after “Atten:” is equal to Full Range Atten – If the sweep straddles 50 GHz, the value shown after “Atten:” is preceded by the symbol “>=” and is equal to Full Range Atten In the **Amplitude**, "Y Scale" on page 1929 menu, and the Atten **Meas Bar** dropdown menu panel, a summary is displayed as follows: “Total Atten below 50 GHz” followed by the value of Full Range Atten + Mech Atten + Elec Atten “Total Atten above 50 GHz” followed by the value of Full Range Atten For example, if Mech Atten = 6 dB, Elec Atten = 4 dB, and Full Range Atten = 20 dB, the summary below is shown: – Attenuator summary: – Total Atten below 50 GHz: 30 dB – Total Atten above 50 GHz: 20 dB

Mech Atten

Labeled **Mech Atten** in Dual-Attenuator models and **Atten** in Single-Attenuator models. In the Dual-Attenuator configuration, this control only affects the mechanical attenuator.

Lets you modify the attenuation applied to the RF input signal path. This value is normally auto-coupled to the Ref Level, the Internal Preamp Gain, any External Gain that is entered, and the Max Mixer Level, as described in the table below.

See "Attenuator Configurations and Auto/Man" on page 571

Remote Command	`[:SENSe]:POWer[:RF]:ATTenuation <rel_ampl>`
	`[:SENSe]:POWer[:RF]:ATTenuation?`
	`[:SENSe]:POWer[:RF]:ATTenuation:AUTO OFF | ON | 0 | 1`
	`[:SENSe]:POWer[:RF]:ATTenuation:AUTO?`

Example	`:POW:ATT 20`
	Dual-Attenuator configuration: sets the mechanical attenuator to 20 dB
	Single-Attenuator mode: sets the main attenuation to 20 dB (see below for definition of "main" attenuation)
	In either case, if the attenuator was in Auto, it is set to Manual
	`:POW:ATT:AUTO ON`
	Turn Auto Mech Atten ON

Dependencies	Some measurements do not support Auto setting of "Mech Atten" on page 569. In these measurements, the **Auto/Man** selection is not available, and the Auto/Man toggle function is not available In Dual-Attenuator configurations, when the electronic attenuator is enabled, the mechanical attenuator has no auto setting, and the Auto/Man toggle function is not available. The state of Auto/Man is remembered and restored when the electronic attenuator is once again disabled. This is described in more detail in "Elec Atten" on page 1937 See "Attenuator Configurations and Auto/Man" on page 571 for more information on the Auto/Man functionality `:POW:ATT:AUTO` is only available in measurements that support Mech Atten Auto, such as Swept SA
Couplings	If the RF Input Port is the RF Input: – If the USB Preamp is connected to USB, use 0 dB for Mech Atten – Otherwise compute the auto-selected value of Mech Atten based on **Reference Level**, Int Preamp, External Gain, Ref Level Offset, Max Mixer Level, µW Path Control and IF Gain settings. Limit this value to be no less than 6 dB (total attenuation below 6 dB can never be chosen by Auto) – In the N9041B, if the RF Input Port is RF Input 2, use the formula above and subtract the Full Range Atten value from the result to determine the Mech Atten. Limit the value so that it is never lower than 0 dB and so that total attenuation, including Full Range Atten, is never less than 6 dB

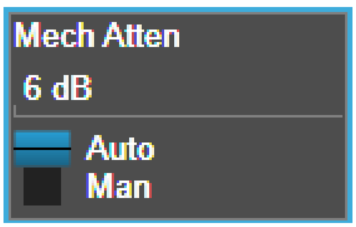
	(total attenuation, including Full Range Atten below 6 dB, can never be chosen by Auto) In External Mixing and BBIQ, where the Attenuator is not in the signal path, the Attenuator setting changes as described above when "Mech Atten" on page 569 is in Auto, but no changes are made to the actual attenuator hardware setting until the input is changed back to the RF Input For CXA-m with option FSA (Fine-Step Attenuator or 2 dB steps), the FSA-like behavior is only available when the frequency setting is <= 7.5 GHz. So, when the frequency is changed from below 7.5 GHz to above 7.5 GHz, the attenuation setting will be changed to a multiple of 10 dB which will be no smaller than the previous setting. For example, 4 dB attenuation will be changed to 10 dB
Preset	The preset for Mech Attenuation is “Auto” The Auto value of attenuation is 10 dB ON
State Saved	Saved in instrument state
Min	0 dB The attenuation set by this control cannot be decreased below 6 dB with the knob or step keys. Values below 6 dB must be directly entered from the keypad or via SCPI. This protects against setting a dangerously small attenuation value, which can put the instrument at risk of damage to input circuitry. If the current mechanical attenuation is below 6 dB, it can be increased with the knob and step keys, but not decreased
Max	CXA Option 503 or 507: 50 dB EXA: 60 dB All other models: 70 dB Note that in the Single-Attenuator configuration, the total of ATT and EATT cannot exceed 50 dB. So, if the EATT is set to 24 dB first, the main attenuation cannot be greater than 26 dB and will be reduced accordingly; if the main attenuator is set to 40 dB first, EATT cannot be greater than 10 dB
Annotation	The current value for Total Atten is displayed in the Measurement Bar at the top of the display. A value appears for Electronic Attenuation only if the Electronic Attenuator is enabled. The annotation appears as Atten: <total> dB (e<elec>) The e letter is in amber in Single-Attenuator configurations For example: Dual-Attenuator configuration: Atten: 24 dB (e14) Indicating the total attenuation is at 24 dB and the electronic attenuation is at 14 dB Single-Attenuator configuration: A: 24 dB (e14) Indicating the total attenuation is at 24 dB and the “soft” attenuation is at 14 dB (see below for definition of “soft” attenuation) When in Manual, a # sign appears in front of Atten in the annotation

Attenuator Configurations and Auto/Man

As described under "Y Scale" on page 1929, there are two distinct attenuator configurations available in the X-Series, the single attenuator and Dual-Attenuator configurations. In Dual-Attenuator configurations, we have the mechanical attenuation and the electronic attenuation, and the current total attenuation is the sum of the electronic + mechanical attenuation. In Single-Attenuator configurations, we refer to the attenuation set using "Mech Atten" on page 569 (or `:POW:ATT`) as the “main” attenuation; and the attenuation that is set by `:POW:EATT` as the “soft” attenuation (`:POW:EATT` is honored even in the Single-Attenuator configuration, for compatibility purposes). Then the current total attenuation is the sum of the main + soft attenuation.

See "Elec Atten" on page 1937 for more about “soft” attenuation.

NOTE In some measurements, the **Mech Atten** control has an Auto/Man function. In these measurements, an Auto/Man switch is shown on the **Mech Atten** control:



Note that in configurations that include an Electronic Attenuator, this switch is only shown when the Electronic Attenuator is disabled.

In other measurements, **Mech Atten** has no Auto/Man function. In these measurements, no switch is shown on the **Mech Atten** control:

Mech Atten also appears with no switch, as above, in configurations that include an Electronic Attenuator but when the Electronic Attenuator is enabled.

Elec Atten

Controls the Electronic Attenuator in Dual-Attenuator configurations. Does not appear in Single-Attenuator configurations, because the control of both the mechanical and electronic stages of the Single-Attenuator is integrated into the single **Atten** control.

This control includes an **Enable/Disable** toggle switch; it is only possible to enter a value for the Electronic Attenuator when this switch is in the **Enable** position.

For more details about the Electronic Attenuator, see "More Information" on page 573

Remote Command	`[:SENSe]:POWer[:RF]:EATTenuation <rel_ampl>`
	`[:SENSe]:POWer[:RF]:EATTenuation?`
	`[:SENSe]:POWer[:RF]:EATTenuation:STATe OFF | ON | 0 | 1`
	`[:SENSe]:POWer[:RF]:EATTenuation:STATe?`

Example	`:POW:EATT 10`
	`:POW:EATT?`
	`:POW:EATT:STAT ON`
	`:POW:EATT:STAT?`

Notes	Electronic Attenuation's specification is defined only when Mechanical Attenuation is 6 dB
Dependencies	Only appears in Dual-Attenuator models with an Electronic Attenuator installed and licensed. Does not appear in models with the Single-Attenuator configuration, because in the Single-Attenuator configuration there is no "electronic attenuator"; there is only a single integrated attenuator (which has both a mechanical and electronic stage). However, in the Single-Attenuator configuration, EATT SCPI commands are accepted for compatibility with other X-series instruments, and set a "soft" attenuation. The "soft" attenuation is treated as an addition to the "main" attenuation value set by the **Attenuation** control or `:POW:ATT`, and affects the total attenuation displayed on the **Attenuation** control and the Meas Bar The electronic attenuator, and the "soft" attenuation function provided in Single-Attenuator configurations, are unavailable above the low band (0-3.6 GHz, 0-3.4 GHz, 0-3 GHz, depending on the model). If the low band range is from 0-3.6 GHz, and Stop Frequency of the instrument is > 3.6 GHz, then the **Enabled/Disabled** section of the **Elec Atten** control will be `OFF` and grayed-out If "Internal Preamp" on page 1959 is `ON` (that is, set to Low Band or Full), the electronic attenuator (and the "soft" attenuation function provided in Single-Attenuator configurations) is unavailable. In this case the **Enabled/Disabled** section of the **Elec Atten** control will be `OFF` and grayed-out If either of the above is true, and the SCPI command is sent, an error indicating that the electronic attenuator is unavailable is returned If both the above are true, pressing the control generates error message -221, in other words, the frequency range lockout takes precedence If the electronic/soft Attenuator is enabled, then the **Stop Freq** of the instrument is limited to 3.6 GHz and **Internal Preamp** is unavailable If "LNA" on page 1960 is `ON`, the electronic attenuator (and the "soft" attenuation function provided in Single-Attenuator configurations) is unavailable. In this case the **Enabled/Disabled** section of the **Elec Atten** control will be `OFF` and grayed-out. This coupling works in the following modes/measurements: – Channel Power, Occupied BW, ACP, SEM, Spurious Emissions, Power Stat CCDF measurements in all Modes – Transmit On|Off Power measurement in 5GNR Mode – Power vs. Time and Transmit Power measurement in GSM/EDGE Mode – Burst Power measurement in Spectrum Analyzer Mode

	The SCPI-only "soft" electronic attenuation for the single-attenuator configuration is not available in all measurements; in particular, it is not available in the Swept SA measurement
Couplings	Enabling and disabling the Electronic Attenuator affects the setting of the Mechanical Attenuator (in Dual-Attenuator configurations). This is described in more detail below and in "Mechanical Attenuator Transition Rules" on page 573
Preset	0 dB OFF (Disabled) for Swept SA measurement ON (Enabled) for all other measurements that support the electronic attenuator
State Saved	Saved in instrument state
Min	0 dB
Max	Dual-Attenuator configuration: 24 dB Single-Attenuator configuration: the total of ATT and EATT cannot exceed 50 dB. So, if the EATT is set to 24 dB first, the main attenuation cannot be greater than 26 dB and will be reduced accordingly; if the main attenuator is set to 40 dB first, EATT cannot be greater than 10 dB
Annotation	See Annotation under the **Mech Atten** control description

More Information

The electronic attenuator offers finer steps than the mechanical attenuator, has no acoustical noise, is faster, and is less subject to wear. These advantages primarily aid in remote operation and are negligible for front panel use. See "Using the Electronic Attenuator: Pros and Cons" on page 574 for a detailed discussion of the pros and cons of using the electronic attenuator.

For the Single-Attenuator configuration, for SCPI backwards compatibility, the "soft" attenuation feature replaces the Dual-Attenuator configuration's electronic attenuator. All the same couplings and limitations apply. See "Attenuator Configurations and Auto/Man" on page 1937

Mechanical Attenuator Transition Rules

When the Electronic Attenuator is enabled, the Mechanical Attenuator transitions to a state that has no Auto function. Below are the rules for transitioning the Mechanical Attenuator. Note that the information below *only* applies to the Dual-Attenuator configurations, and *only* when the Electronic Attenuator is installed:

When the Electronic Attenuation is enabled from a disabled state:

- The Mechanical Attenuator is initialized to 10 dB (this is its optimal performance setting). You can then set it as desired with SCPI, numeric keypad, step keys, or knob, and it behaves as it normally would in manual mode
- The Auto/Man state of (Mech) Atten is saved

- The Auto/Man toggle on the (Mech) Atten control disappears, and the auto rules are disabled
- The Electronic Attenuator is set to 10 dB less than the previous value of the Mechanical Attenuator, within the limitation that it must stay within the range of 0 to 24 dB of attenuation

Examples in the Dual-Attenuator configuration:

- Mech Atten at 20 dB. Elec Atten enabled, Mech Atten set to 10 dB, and Elec Atten set to 10 dB. New total attenuation equals the value before Elec Atten enabled
- Mech Atten at 0 dB. Elec Atten enabled, Mech Atten set to 10 dB, and Elec Atten set to 0 dB. New total attenuation does not equal the value before Elec Atten enabled
- Mech Atten at 40 dB. Elec Atten enabled, Mech Atten set to 10 dB, and Elec Atten set to 24 dB. New total attenuation does not equal the value before Elec Atten enabled

When the Electronic Attenuation is disabled from an enabled state:

- The Elec Atten control is grayed out
- The Auto/Man state of (Mech) Atten is restored
- If now in Auto, (Mech) Atten recouples
- If now in Man, (Mech) Atten is set to the value of total attenuation that existed before the Elec Atten was disabled. The resulting value is rounded up to the smallest value possible given the (Mech) Atten Step setting - (That is, 57 dB changes to 58 dB when (Mech) Atten Step is 2 dB)

Using the Electronic Attenuator: Pros and Cons

The electronic attenuator offers finer steps than the mechanical attenuator, has no acoustical noise, is faster, and is less subject to wear.

The “finer steps” advantage of the electronic attenuator is beneficial in optimizing the alignment of the instrument dynamic range to the signal power in the front panel as well as remote use. Thus, you can achieve improved relative signal measurement accuracy. Compared to a mechanical attenuator with 2 dB steps, the 1 dB resolution of the electronic attenuator only gives better resolution when the odd-decibel steps are used. Those odd-decibel steps are less accurately calibrated than the even-decibel steps, so one tradeoff for this superior relative accuracy is reduced absolute amplitude accuracy.

Another disadvantage of the electronic attenuator is that the spectrum analyzer loses its “Auto” setting, making operation less convenient.

Also, the relationship between the dynamic range specifications (TOI, SHI, compression, and noise) and instrument performance are less well-known with the electrical attenuator. With the mechanical attenuator, TOI, SHI, and compression threshold levels increase dB-for-dB with increasing attenuation, and the noise floor does as well. With the electronic attenuator, there is an excess attenuation of about 1 to 3 dB between 0 and 3.6 GHz, making the effective TOI, SHI, and so forth, less well known. Excess attenuation is the actual attenuation relative to stated attenuation. Excess attenuation is accounted for in the instrument calibration.

Adjust Atten for Min Clipping

Sets the combination of mechanical and electronic attenuation and gain based on the current measured signal level so that clipping will be at a minimum.

This is an immediate action function, that is, it executes once, when the control is pressed.

The algorithms that are used for the adjustment are documented under "Pre-Adjust for Min Clipping" on page 1942.

Remote Command	`[:SENSe]:POWer[:RF]:RANGe:OPTimize IMMediate`
Example	`:POW:RANG:OPT IMM`
Notes	Executing **Adjust Atten for Min Clipping** initiates the measurement
Dependencies	Does not appear in the Swept SA, RTSA, Monitor Spectrum and Complex Spectrum measurements Appears in the Waveform measurement in 5G NR Mode only

Adjust Atten

Allows you to select;

– Electric attenuator only

– Combination of Electric attenuator and Mechanical attenuator

when `[:SENSe]:POWer[:RF]:RANGe:OPTimize IMMediate` is executed.

Remote Command	`[:SENSe]:POWer[:RF]:RANGe:OPTimize:TYPE EONLy | COMBined` `[:SENSe]:POWer[:RF]:RANGe:OPTimize:TYPE?`
Example	`:POW:RANG:OPT:TYPE EONL` `:POW:RANG:OPT:TYPE?`
Dependencies	Does not appear in the Swept SA, RTSA, Monitor Spectrum and Complex Spectrum measurements

	Appears in the Waveform measurement in 5G NR Mode only
Preset	COMBined
State Saved	Saved in instrument state

Pre-Adjust for Min Clipping

If this function is ON, it applies the adjustment described under "Adjust Atten for Min Clipping" on page 1941 each time a measurement restarts. Therefore, in Continuous measurement mode, it only executes before the first measurement.

In Dual-Attenuator models, you can set **Elec+Mech Atten**, in which case both attenuators participate in the autoranging, or **Elec Atten Only**, in which case the mechanical attenuator does not participate in the autoranging. This latter case results in less wear on the mechanical attenuator and is usually faster.

See "Adjustment Algorithm" on page 577

Selection	SCPI	Note
Off	OFF	This is the default setting
On	ON	Available in Single-Attenuator instruments. For compatibility with models that do not have an input attenuator, the ON parameter is supported and mapped to COMBined
Elec Atten Only	ELECtrical	Selects only the electric attenuator to participate in auto ranging. This offers less wear on the mechanical attenuator and is usually faster
Elec+Mech Atten	COMBined	In Dual-Attenuator models, this selects both attenuators to participate in the autoranging

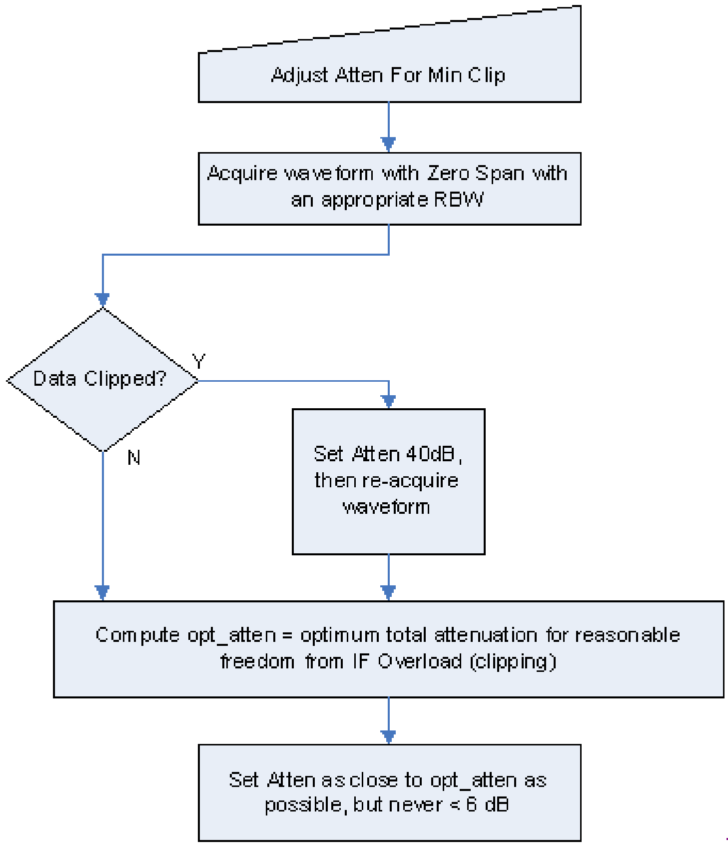
Remote Command	`[:SENSe]:POWer[:RF]:RANGe:OPTimize:ATTenuation OFF | ON | ELECtrical | COMBined` `[:SENSe]:POWer[:RF]:RANGe:OPTimize:ATTenuation?`
Example	`:POW:RANG:OPT:ATT OFF` `:POW:RANG:OPT:ATT?`
Notes	The parameter option ELECtrical sets this function to ON in Single-Attenuator models The parameter option COMBined is mapped to ELECtrical in Single-Attenuator models. If you send COMBined, it sets the function to ON and returns ELEC to a query For SCPI compatibility with models that do not have an input attenuator, the ON parameter is honored and mapped to COMBined
Dependencies	Only appears in Dual-Attenuator models with an Electronic Attenuator installed In instruments with Dual-Attenuator model, when "Elec Atten" on page 1937 is OFF or grayed-out, "Pre-Adjust for Min Clipping" on page 576 is grayed-out Does not appear in the Swept SA, RTSA, Monitor Spectrum and Complex Spectrum measurements For the Waveform measurement, available only in 5G NR Mode

Preset	OFF when Elec Atten is Disabled at preset, otherwise ELEC
State Saved	Saved in instrument state
Range	Dual-Attenuator models: Off | Elec Atten Only | Mech + Elec Atten Single-Attenuator models: Off | On
Notes	ON aliases to "Elec Atten Only" (:POW:RANG:OPT:ATT ELEC) OFF aliases to "Off" (:POW:RANG:OPT:ATT OFF) :POW:RANG:AUTO? returns true if :POW:RANG:OPT:ATT is not OFF
Backwards Compatibility SCPI	[:SENSe]:POWer[:RF]:RANGe:AUTO ON | OFF | 1 | 0 [:SENSe]:POWer[:RF]:RANGe:AUTO?

Adjustment Algorithm

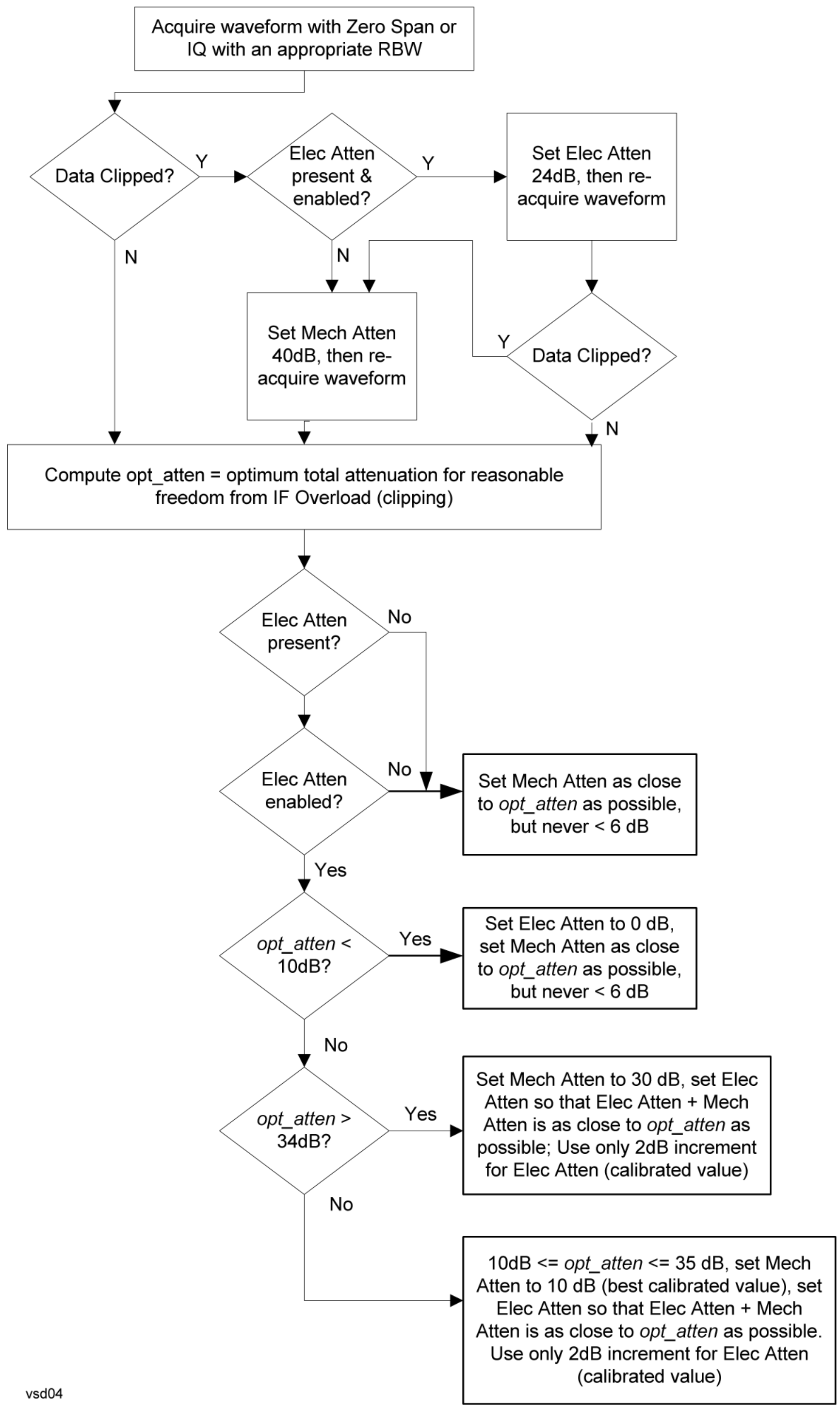
The algorithms for the adjustment are documented below:

Single-Attenuator Models



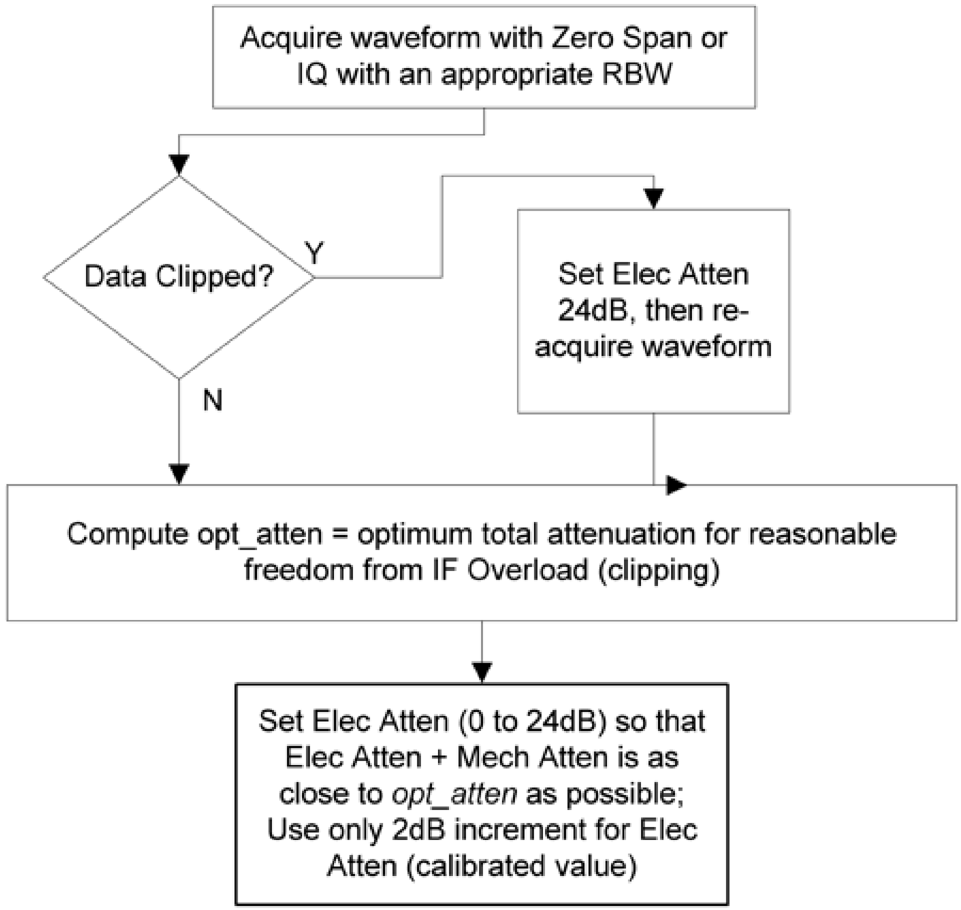
Dual-Attenuator models

"Adjust Atten for Min Clipping" on page 1941 or "Pre-Adjust for Min Clipping" on page 576 selection is Mech + Elec Atten:


Acquire waveform with Zero Span or IQ with an appropriate RBW
Data Clipped?
Y
N
Elec Atten present & enabled?
Y
N
Set Elec Atten 24dB, then re-acquire waveform
Set Mech Atten 40dB, then re-acquire waveform
Y
Data Clipped?
N
Compute opt_atten = optimum total attenuation for reasonable freedom from IF Overload (clipping)
Elec Atten present?
No
Elec Atten enabled?
No
Set Mech Atten as close to opt_atten as possible, but never < 6 dB
Yes
opt_atten < 10dB?
Yes
Set Elec Atten to 0 dB, set Mech Atten as close to opt_atten as possible, but never < 6 dB
No
opt_atten > 34dB?
Yes
Set Mech Atten to 30 dB, set Elec Atten so that Elec Atten + Mech Atten is as close to opt_atten as possible; Use only 2dB increment for Elec Atten (calibrated value)
No
10dB <= opt_atten <= 35 dB, set Mech Atten to 10 dB (best calibrated value), set Elec Atten so that Elec Atten + Mech Atten is as close to opt_atten as possible. Use only 2dB increment for Elec Atten (calibrated value)
vsd04

"Pre-Adjust for Min Clipping" on page 576 selection is Elec Only.

Note that the **Mech Atten** value is not adjusted, and the value previously set is used. Therefore, there is a case that IF Overload is still observed depending on the input signal level and the Mech Atten setting.



Mech Atten Step

Controls the step size used when making adjustments to the input attenuation.

Labeled **Mech Atten Step** in Dual-Attenuator models and **Atten Step** in Single-Attenuator models. In the Dual-Attenuator configuration, only affects the step size of the mechanical attenuator.

Remote Command	`[:SENSe]:POWer[:RF]:ATTenuation:STEP[:INCRement] 10 dB | 2 dB`

	`[:SENSe]:POWer[:RF]:ATTenuation:STEP[:INCRement]?`
Example	`:POW:ATT:STEP 2` `:POW:ATT:STEP?`
Notes	Has a toggle control on the front panel, but takes a specific value (in dB) when used remotely. The only valid values are 2 and 10
Dependencies	Blanked in EXA, CXA and CXA-m if option FSA (2 dB steps) is not present. If blanked, attempts to set it via SCPI yield an error
Couplings	When the attenuation step size changes, the current mechanical attenuation value is adjusted (if necessary) to be quantized to the new step size. That is, if step is set to 10 dB, mech atten is increased if necessary so it is a multiple of 10 dB
Preset	EXA, CXA and CXA-m: 10 dB (2 dB with option FSA) All other models: 2 dB
State Saved	Saved in instrument state

Max Mixer Level

Allows you to set the maximum level to be applied to the mixer for a signal at the top of the screen. By setting this value up or down you can allow more or less signal through the system.

The major impact of changes to **Max Mixer Level** is seen in changes to the value to which **Reference Level** is limited. Max Ref Level depends on Max Mixer Level and Attenuation, and therefore a higher Max Mixer Level may let you set Ref Level higher. However, changing this value can impact your TOI, compression, or dynamic range. The preset value of this function is best for most measurements.

See also "Max Mixer Lvl Rules" on page 1948.

Remote Command	`[:SENSe]:POWer[:RF]:MIXer:RANGe[:UPPer] <real>` `[:SENSe]:POWer[:RF]:MIXer:RANGe[:UPPer]?`
Example	`:POW:MIX:RANG -15 dBm` `:POW:MIX:RANG?`
Dependencies	Only appears in Swept SA and RTSA measurements
Preset	-10 dBm
State Saved	Saved in instrument state
Min	-50 dBm
Max	0 dBm

Max Mixer Lvl Rules

Allows you to optimize the Max Mixer Level setting for certain kinds of measurements.

`NORMal`	The historical, and thus backwards compatible, setting range (–50 to 0 dBm) and default setting (–10 dBm). The instrument has been designed so that, at the default setting, any signal below the Reference Level is extremely unlikely to create ADC overloads. At this mixer level the scale fidelity will be within specifications, thus compression with be negligible
`TOI`	Allows a range of settings of the "Max Mixer Level" on page 1947, –50 to –10 dBm, that can be optimum for measurements limited by the instrument third-order dynamic range. The default setting, –25 dBm, is commonly appropriate but RBW affects this. A good setting for Max Mixer Level would be higher than the optimum mixer level by half of the attenuator step size
`COMPression`	Allows a range of settings of the Max Mixer Level, –10 to +10 dBm or more, that can be optimum for measurements limited by the tradeoffs between instrument accuracy due to compression, and dynamic range due to the noise floor. The default setting, –3 dBm, is commonly appropriate, representing mixer drive levels that cause 1 dB or less compression at most carrier frequencies Typical measurements that would be optimized by this setting are the measurement of low sideband levels, including nulls, in angle-modulated signals (FM and PM). Also pulsed-RF measurements, including finding nulls to estimate pulse width, which are often best done with significant overdrive (compression) of the front end

Setting Name (readback)	Setting Name (verbose)	Max Mixer Level Preset Value, dBm	Max Mixer Level minimum value, dBm	Max Mixer Level maximum value, dBm
`NORMal`	Normal – balance TOI, noise, and compression	–10	–50	0
`TOI`	TOI-limited dynamic range	–25	–50	–10
`COMPression`	Compression-limited dynamic range	–3	–10	+30

Remote Command	`[:SENSe]:POWer[:RF]:MIXer:RULEs NORMal | TOI | COMPression` `[:SENSe]:POWer[:RF]:MIXer:RULEs?`
Example	`:POW:MIX:RULE:COMP`
Dependencies	Only appears in the Swept SA and RTSA measurements
Preset	`NORM`

3.3.3.3 Range (Non-attenuator models)

Only available for Keysight’s modular signal analyzers and certain other Keysight products, such as VXT

State Saved	No

Range

Represents the amplitude of the largest sinusoidal signal that could be present within the IF without being clipped by the ADC. For signals with high peak-to-average ratios, the range may need to exceed the rms signal power by a significant amount to avoid clipping.

This is a measurement global setting.

Remote Command	`[:SENSe]:POWer[:RF]:RANGe <real>` `[:SENSe]:POWer[:RF]:RANGe?`
Example	`:POW:RANG 10 dBm` `:POW:RANG?`
Notes	The MIN and MAX values are affected by the External Gain parameters, and by the **Center Frequency** The hardware compensates for frequency response and alters the Range setting
Preset	0 dBm
State Saved	Yes
Min	-100
Max	100
Annotation	Meas Bar

Adjust Range for Min Clipping

Sets the combination of attenuation and gain based on the current measured signal level so that clipping will be at a minimum.

This is an "immediate action" function, that is, it executes once, when the key is pressed.

This key does not appear in measurements that do not support this functionality.

Remote Command	`[:SENSe]:POWer[:RF]:RANGe:OPTimize IMMediate`
Notes	Executing Adjust Range for Min Clipping initiates the measurement
Dependencies	Does not appear in the Swept SA and Monitor Spectrum measurements

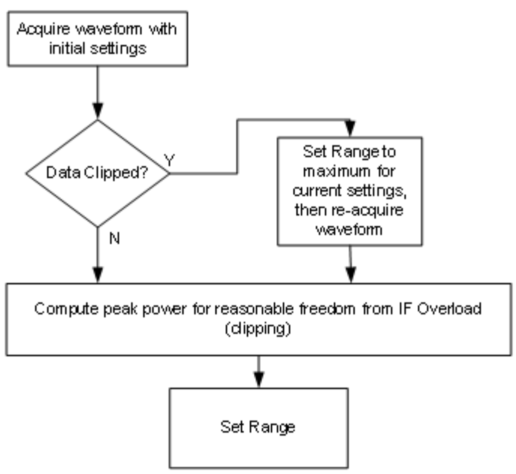
Pre-Adjust for Min Clipping

If this function is ON, it applies the adjustment described under Adjust Range For Min Clipping each time a measurement restarts. Therefore, in Continuous measurement mode, it only executes before the first measurement.

Remote Command	`[:SENSe]:POWer[:RF]:RANGe:OPTimize:ATTenuation OFF | ON | ELECtrical | COMBined` `[:SENSe]:POWer[:RF]:RANGe:OPTimize:ATTenuation?`
Notes	Because there is no attenuator control available in these models, the control displays only ON and OFF choices. However, for SCPI compatibility with other platforms, all three parameters (ELECtrical, COMBined, and ON) are honored and all are mapped to ELECtrical, so if any of these three parameters is sent, a subsequent query will return ELEC
Dependencies	Does not appear in the Swept SA and Monitor Spectrum measurements
Preset	OFF for Swept SA measurement; ON for all other measurements that support **Pre-Adjust for Min Clipping**
State Saved	Saved in instrument state

Adjustment Algorithm

The algorithm for the adjustment is documented below:



Peak-to-Average Ratio

Used with "Range (Non-attenuator models)" on page 1953 to optimize the level control in the instrument. The value is the ratio, in dB, of the peak power to the average power of the signal to be measured. A ratio of 0 should be used for sinusoidal signals; for 802.11g OFDM signals use 9 dB.

All Modes show the current value of Peak-to-Average ratio on the control. However, some Modes do not permit changing the value. In these situations, the control is grayed-out.

Remote Command	`[:SENSe]:POWer[:RF]:RANGe:PARatio <real>` `[:SENSe]:POWer[:RF]:RANGe:PARatio?`
Example	`:POW:RANG:PAR 12 dB`
Notes	In some Modes, this parameter is read-only; meaning the value will appear on the control and query via SCPI, but is not changeable. In such applications the control is grayed-out. Attempting to change the value via SCPI will be ignored but no error message will be generated
Dependencies	Does not appear in Spectrum Analyzer Mode
Preset	10 dB VXT Models M9410A/11A: 0 dB
State Saved	Saved in instrument state
Min	0 dB
Max	20 dB VXT Models M9410A/11A: 50 dB

Mixer Lvl Offset

This is an advanced setting to adjust target Range at the input mixer, which in turn affects the signal level in the instrument’s IF. This setting can be used when additional optimization is needed after setting "Peak-to-Average Ratio" on page 1955. Positive values of offset optimize noise performance over distortion, negative values optimize distortion performance over noise.

Remote Command	`[:SENSe]:POWer[:RF]:RANGe:MIXer:OFFSet <real>` `[:SENSe]:POWer[:RF]:RANGe:MIXer:OFFSet?`
Example	`:POW:RANG:MIX:OFFS -5 dB`
Preset	0 dB
State Saved	Saved in instrument state
Min	-35 dB VXT Models M9410A/11A: -34 dB
Max	30 dB

3.3.3.4 Signal Path

Contains controls that pertain to the routing of the signal through the frontend of the instrument.

In general, only appears in instruments whose hardware supports this signal routing. For example, this tab does not appear in many of the modular instrument products, including VXT Model M9421A, or UXM.

This tab *does* appear in VXT Models M9410A/11A, because "Software Preselection" on page 1971 is under this tab, and VXT Models M9410A/11A implement a version of Software Preselection.

Presel Center

Adjusts the centering of the preselector filter to optimize the amplitude accuracy at the frequency of the selected marker. If the selected marker is not on when **Presel Center** is pressed, the instrument turns on the selected marker, performs a peak search, and then performs centering on the marker's center frequency. If the selected marker is already on and between the start and stop frequencies of the instrument, the instrument performs the preselector calibration on that marker's frequency. If the selected marker is already on, but outside the frequency range between **Start Freq** and **Stop Freq**, the instrument first performs a peak search, and then performs centering on the marker's center frequency.

The value displayed on "Preselector Adjust" on page 1958 changes to reflect the new preselector tuning.

Certain considerations should be observed to ensure proper operation, as detailed in "Proper Preselector Operation" on page 587.

Remote Command	`[:SENSe]:POWer[:RF]:PCENter`
Example	`:POW:PCEN`
Notes	The rules outlined above under the control description apply for the remote command as well as the key. The result of the command depends on marker position, etc. Any message generated by the control press is also generated in response to the remote command
Dependencies	Does not appear in CXA-m, nor in VXT Models M9410A/11A Grayed-out if the microwave preselector is off – If the selected marker's frequency is below Band 1, an advisory message is generated "Preselector not used in this frequency range" and no action is taken – Grayed-out if entirely in Band 0, that is, if **Stop Freq** is below about 3.6 GHz Grayed-out if entirely above 50 GHz, that is, if **Start Freq** is above 50 GHz – Blanked in models that do not include a preselector, such as Option 503. If the remote command is sent in these instruments, accepted without error, and the query always returns 0 – Grayed-out in the Spectrogram View
Couplings	The active marker position determines where the centering will be attempted If the instrument is in a measurement such as averaging when centering is initiated, the act of centering the preselector restarts averaging, but the first average trace will not be taken until the centering is completed

	The offset applied to do the centering appears in "Preselector Adjust" on page 1958
Status Bits/OPC dependencies	When centering the preselector, `*OPC` does not return true until the process is complete and a subsequent measurement has completed, nor are results returned in response to `:READ` or `:MEASure` queries The `Measuring` bit remains set (true) while this command is operating, and does not go false until the subsequent sweep/measurement has completed

Proper Preselector Operation

Certain considerations should be observed to ensure proper operation:

1. If the selected marker is **Off**, the instrument turns on a marker, performs a peak search, and adjusts the preselector using the selected marker's frequency. It uses the "highest peak" peak search method unqualified by threshold or excursion, so that there is no chance of a 'no peak found' error. It continues with that peak, even if it is the peak of just noise. Therefore, for this operation to work properly, there should be a signal on-screen in a preselected range for the peak search to find
2. If the selected marker is already **On**, the instrument attempts the centering at that marker's frequency. There is no preselector for signals below about 3.6 GHz, so if the marker is on a signal below 3.6 GHz, no centering is attempted, and an advisory message is generated
3. In some models, the preselector can be bypassed. If it is bypassed, no centering is attempted in that range and a message is generated

Preselector Adjust

Lets you manually adjust the preselector filter frequency to optimize its response to the signal of interest. Only available when "Presel Center" on page 1956 is available.

For general purpose signal analysis, using **Presel Center** is recommended. Centering the filter minimizes the impact of long-term preselector drift. **Preselector Adjust** can be used instead to manually optimize the preselector. One application of manual optimization would be to peak the preselector response, which both optimizes the signal-to-noise ratio and minimizes amplitude variations due to small (short-term) preselector drifting.

When **Presel Center** is performed, the offset applied to do the centering becomes the new value of **Preselector Adjust**.

Remote Command	`[:SENSe]:POWer[:RF]:PADJust <freq>` `[:SENSe]:POWer[:RF]:PADJust?`
Example	`:POW:PADJ 100KHz` `:POW:PADJ?`

Notes	The value on the control is displayed to 0.1 MHz resolution
Dependencies	– Does not appear in CXA-m – Does not appear in VXT Models M9410A/11A – Grayed-out if microwave preselector is off – Grayed-out if entirely in Band 0, that is, if Stop Freq is lower than about 3.6 GHz – Grayed-out if entirely above 50 GHz, that is, if Start Freq is higher than 50 GHz – Blank in models that do not include a preselector, such as Option 503. If the command is sent in these instruments, it is accepted without error, and the query always returns 0 – Grayed-out in the Spectrogram View
Preset	0 MHz
State Saved	The **Preselector Adjust** value set by "Presel Center" on page 1956, or by manually adjusting **Preselector Adjust** Not saved in instrument state, and does not survive a Preset or power cycle
Min	-500 MHz
Max	500 MHz
Backwards Compatibility SCPI	`[:SENSe]:POWer[:RF]:MW:PADJust` `[:SENSe]:POWer[:RF]:MMW:PADJust`

Notes	The command has no effect, and the query always returns `MWAVe`
Backwards Compatibility SCPI	`[:SENSe]:POWer[:RF]:PADJust:PRESelector MWAVe | MMWave | EXTernal` `[:SENSe]:POWer[:RF]:PADJust:PRESelector?`

Internal Preamp

Accesses a menu of controls for the internal preamps. Turning on the preamp gives a better noise figure, but a poorer inter-modulation distortion (TOI) to noise floor dynamic range. You can optimize this setting for your measurement.

The instrument takes the preamp gain into account as it sweeps. If you sweep outside of the range of the preamp, the instrument will also account for that. The displayed result always reflects the correct gain.

For some measurements, when the preamp is on and any part of the displayed frequency range is below the lowest frequency for which the preamp has specifications, a warning condition message appears in the status line. For example, for a preamp with a 9 kHz lowest specified frequency: "Preamp: Accy unspec'd below 9 kHz".

Selection	Example	Note
Off	`:POW:GAIN OFF`	
Low Band	`:POW:GAIN ON` `:POW:GAIN:BAND LOW`	Sets the internal preamp to use only the low band. The frequency range of the installed (optional) low-band preamp is displayed in square brackets on the Low Band selection in the dropdown
Full Range	`:POW:GAIN ON` `:POW:GAIN:BAND FULL`	Sets the internal preamp to use its full range. The low band (0-3.6 GHz, 0-3.4 GHz, 0-3 GHz, depending on the model) is supplied by the low band preamp and the frequencies above low band are supplied by the high band preamp The frequency range of the installed (optional) low-band preamp is displayed in square brackets on the Full Range selection in the dropdown. If the high band option is not installed the Full Range selection does not appear

NOTE The maximum **Center Frequency** for Low Band, displayed in square brackets, can change based on the selected IFBW for measurements that support IFBW (for example, Waveform measurement across all Modes that support it). In certain models (such as N9042B & N9032B), IFBW values <= 40 MHz have a maximum Low Band frequency of 3.6 GHz, while 40 MHz < IFBW <= 1 GHz have a maximum of 3.3 GHz, and 1 GHz < IFBW <= 1.5 GHz have a maximum of 3.5 GHz. IFBW values > 1.5 GHz do not support a **Center Frequency** that can reach the Low Band maximum frequency. In these cases, **N/A** is displayed in the square brackets for Low Band.

Remote Command	`[:SENSe]:POWer[:RF]:GAIN:BAND LOW | FULL`
	`[:SENSe]:POWer[:RF]:GAIN:BAND?`
	`[:SENSe]:POWer[:RF]:GAIN[:STATe] OFF | ON | 0 | 1`
	`[:SENSe]:POWer[:RF]:GAIN[:STATe]?`

Example	`:POW:GAIN:BAND LOW`
	`:POW:GAIN:BAND?`
	`:POW:GAIN OFF`
	`:POW:GAIN?`

Dependencies	Not available on all hardware platforms. If the preamp is not present or is unlicensed, this control is not shown Does not appear in VXT Models M9410A/11A/15A/16A If `:POW:GAIN:BAND FULL` is sent when a low band preamp is available, the preamp band parameter is set to `LOW` instead of `FULL`, and an "Option not installed" message is generated Not available when the electronic/soft attenuator is enabled
Preset	`LOW`

	`OFF`
State Saved	Saved in instrument state
Annotation	When the USB Preamp is not connected to USB, the Preamp annotation in the Meas Bar says "Off" if the preamp is off and displays the frequency range of the low band or full range preamp depending on the setting. For example, if the Preamp is set to Low Band and the Low Band is 3.6 GHz the annotation says "3.6 GHz". If it is a 13.6 GHz preamp and it is set to Full Range the annotation says "13.6 GHz" When the USB Preamp is connected to USB, the Preamp annotation says "Preamp: USB" if the internal preamp is off or "Preamp: USB, Int" if the internal preamp is on (only for measurements that support the USB preamp)

LNA

Lets you turn the Low Noise Amplifier (**LNA**) on or off.

LNA is an additional preamplifier that provides superior DANL and frequency range compared to "Internal Preamp" on page 1959. LNA provides lower system noise figure, especially at frequencies above 100 MHz, and can be operated up to the full range of 50 GHz instruments.

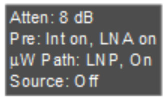
For best possible sensitivity, **LNA** can be turned on *together* with "Internal Preamp" on page 1959, although if you operate both preamps together, note that the TOI (distortion) specifications are impacted. The sensitivity improvement of this combination is substantial when operating in high band (frequencies above 3.6 GHz).

For more details about annotation, see "More Information" on page 590

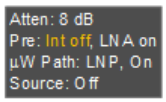
Remote Command	`[:SENSe]:POWer[:RF]:GAIN:LNA[:STATe] OFF | ON | 0 | 1` `[:SENSe]:POWer[:RF]:GAIN:LNA[:STATe]?`
Example	`:POW:GAIN:LNA ON`
Dependencies	Requires Option LNA, except for VXT models M9415A/16A Does not appear in VXT models M9421A/10A/11A May not appear in some measurements **LNA** is not available when the electronic/soft attenuator is enabled
Preset	`OFF`
State Saved	Saved in State

More Information

When **LNA** is installed, the preamp annotation changes to show the state of both **LNA** and **Internal Preamp**. Below is an example:



Note that when operating entirely in the low band (below about 3.6 GHz), if **LNA** is on, **Internal Preamp** is switched off (even if you have its switch set to ON). This is because the noise performance is actually degraded in low band if both preamps are on. In this case, the annotation reflects the actual state of the two preamps, but the **Internal Preamp** annotation displays in amber, to warn you that the actual state of **Internal Preamp** does not match its switch control display:



µW Path Control

Options for this control include **µW Preselector Bypass** (Option MPB), **Low Noise Path** (Option LNP) and **Full Bypass Enable** in the High Band path circuits.

When the µW Preselector is bypassed, flatness is improved, but will be subject to spurs from out of band interfering signals. When **Low Noise Path Enable** is selected, the instrument automatically bypasses certain circuitry in the high frequency bands that can contribute to noise, when it is appropriate based on other instrument settings.

For most applications, the preset state is **Standard Path**, which provides the best remote-control throughput, minimizes acoustic noise from switching and minimizes the risk of wear in the hardware switches, particularly in remote test scenarios where both low band and high band setups will follow in rapid succession. In this path, the bypass of the low band/high band switch and microwave preamp is never activated, which can cause some noise degradation but preserves the life of the bypass switch.

For applications that utilize the wideband IF paths, the preset state is **µW Preselector Bypas**s, if option MPB is present. This is because, when using a wideband IF such as the 140 MHz IF, the µW Preselector's bandwidth can be narrower than the available IF bandwidth, causing degraded amplitude flatness and phase linearity, so it is desirable to bypass the preselector in the default case.

You may choose **Low Noise Path Enable** for a lower noise floor, especially in the 21-26.5 GHz region, though without improving many measures of dynamic range, and without giving the best possible noise floor. The preamp, if purchased and used, gives better noise floor than does **Low Noise Path Enable**, but the preamp's compression threshold and third-order intercept are much poorer than that of **Low Noise Path Enable**.

A fourth choice is **Full Bypass Enable**, which combines **µW Preselector Bypass** and **Low Noise Path Enable**. Because this can bypass most of the circuitry between the

input and the first mixer, care should be taken when using this setting to avoid damaging the mixer. **Full Bypass Enable** is only available if both options LNP and MPB are present, as well as option FBP.

Path	Example	Note
Standard Path	`:POW:MW:PATH STD`	Normal setting for most measurements. µW Preselector in circuit, Low Noise Path disabled
Low Noise Path Enable	`:POW:MW:PATH LNP`	See "Low Noise Path Enable" on page 595
µW Preselector Bypass	`:POW:MW:PATH MPB`	See "µW Preselector Bypass" on page 597
Full Bypass Enable	`:POW:MW:PATH FULL`	See "Full Bypass Enable" on page 598

Remote Command	`[:SENSe]:POWer[:RF]:MW:PATH STD | LNPath | MPBypass | FULL` `[:SENSe]:POWer[:RF]:MW:PATH?`

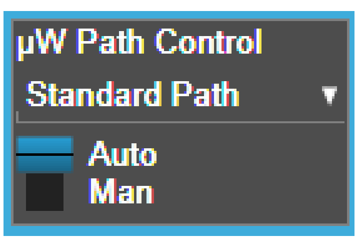
Example	`:POW:MW:PATH LNP`
	Enables the Low Noise path
	`:POW:MW:PATH?`

Notes	If "Presel Center" on page 1956 is performed, the instrument will momentarily switch to the Standard Path, regardless of the setting of **µW Path Control** The DC Block will always be switched in when the low noise path is switched in, to protect succeeding circuitry from DC. Note that this does not mean “when the low noise path is enabled” but when, based on the Low Noise Path rules, the path is actually switched in. This can happen when the selection is **Low Noise Path Enable** or **Full Bypass Enable**. In the case where the DC Block is switched in the instrument is now AC coupled. However, if you selected DC coupling, the UI would still behave as though it were DC coupled, including all annunciation, warnings, status bits, and responses to SCPI queries. This is because, based on other settings, the instrument could switch out the low noise path at any time and hence go back to being DC coupled Alignment switching ignores the settings in this menu, and restores them when finished
Dependencies	Does not appear in CXA-m, VXT Models M9410A/11A, nor in BBIQ and External Mixing – The **Low Noise Path Enable** selection does not appear unless Option LNP is present and licensed – The **µW Preselector Bypass** selection does not appear unless Option MPB is present and licensed – The **Full Bypass Enable** selection does not appear unless options LNP and MPB are both present as well as option FBP In any of these cases, if the required options are not present and the SCPI command is sent, error -241, "Hardware missing; Option not installed" is generated **Low Noise Path Enable** and **Full Bypass Enable** are grayed-out if the current measurement does not support them **Low Noise Path Enable** and **Full Bypass Enable** are not supported in Avionics and MMR Modes (non-modulation measurements). In any of these cases (that is, the feature is not supported in either measurement or Mode), if the SCPI command is sent, the following error is generated: -221, “Setting Conflict; Feature not supported for this measurement”

<table>
<tr><td>Preset</td><td><table><tr><th>Mode</th><th>Value</th></tr><tr><td>IQ Analyzer
Pulse
Avionics</td><td>MPB option present and licensed: <code>MPB</code>
MPB option not present and licensed: <code>STD</code></td></tr><tr><td>All other Modes</td><td><code>STD</code></td></tr></table></td></tr>
<tr><td>State Saved</td><td>Save in instrument state</td></tr>
<tr><td>Range</td><td>Standard Path | Low Noise Path Enable | µW Presel Bypass | Full Bypass Enable</td></tr>
<tr><td>Annotation</td><td>In the Meas Bar, if the Standard path is chosen:
µW Path: Standard
If Low Noise Path is enabled but the LNP switch is not thrown:
µW Path: LNP,Off
If the Low Noise Path is enabled and the LNP switch is thrown:
µW Path: LNP,On
If the preselector is bypassed:
µW Path: Bypass
If Full Bypass Enable is selected but the LNP switch is not thrown:
µW Path: FByp,Off
If Full Bypass Enable is selected and the LNP switch is thrown:
µW Path: FByp,On</td></tr>
</table>

µW Path Control Auto

In VMA, WLAN, 5G NR, CQM Modes, an **Auto/Man** switch is added to **µW Path Control**:



This allows the function to automatically switch based on certain Auto Rules as shown below:

VMA Mode

Measurement	When µW Path Control is in Auto
Digital Demod	Use Standard Path unless tuned frequency > 3.6 GHz and IFBW > 15 MHz, in which case choose Preselector Bypass
Monitor Spectrum	Always Presel Bypass

Measurement	When µW Path Control is in Auto
IQ Waveform	Use Standard Path unless tuned frequency > 3.6 GHz and IFBW > 15 MHz, in which case choose Preselector Bypass
Custom OFDM	Use Standard Path unless tuned frequency > 3.6 GHz and IFBW > 15 MHz, in which case choose Preselector Bypass
Channel Power	Always Presel Bypass
Occupied BW	Always Presel Bypass
CCDF	Use Standard Path unless tuned frequency > 3.6 GHz and IFBW > 15 MHz, in which case choose Preselector Bypass
ACP	Always Presel Bypass
SEM	Always Presel Bypass
Spurious Emissions	Always Standard Path

WLAN Mode

Measurement	When µW Path Control is in Auto
Modulation Analysis	Always Presel Bypass
Spectral Flatness	Always Presel Bypasss
Power vs Time	Always Presel Bypass
Monitor Spectrum	Always Presel Bypass
IQ Waveform	Always Presel Bypass
Channel Power	Always Presel Bypass
Occupied BW	Always Presel Bypass
CCDF	Always Presel Bypass
SEM	For 11be 320M, when 'Enabled Wideband IF for FFT' is OFF or 'Sweep Type Rule' is Best Dynamic Range, auto µW path is standard For other cases, auto µW path is presel bypass if presel bypass is enabled, auto µW path is standard if presel bypass is not enabled
Spurious Emissions	Always Standard Path

5G NR Mode

Measurement	When µW Path Control is in Auto
Modulation Analysis	Use Standard Path unless tuned frequency > 3.6 GHz and IFBW > 15 MHz, in which case choose Full Bypass if conditions warrant(FBP Option is available and "Allow Full Bypass in Auto" is On), otherwise choose Preselector Bypass
Monitor Spectrum	Always Standard Path
IQ Waveform	Use Standard Path unless tuned frequency > 3.6 GHz and IFBW > 15 MHz, in which case choose Full Bypass if conditions warrant(FBP Option is available and

Measurement	When µW Path Control is in Auto
	"Allow Full Bypass in Auto" is On), otherwise choose Preselector Bypass
Channel Power	Always Standard Path
Occupied BW	Always Standard Path
CCDF	Use Standard Path unless tuned frequency > 3.6 GHz and IFBW > 15 MHz, in which case choose Preselector Bypass
ACP	Always Standard Path
SEM	Always Standard Path
Spurious Emissions	Always Standard Path
Transmit On|Off Power	Use Standard Path unless tuned frequency > 3.6 GHz and Info BW > 15 MHz, in which case choose Preselector Bypass

Channel Quality Mode

Measurement	When µW Path Control is in Auto
Group Delay	Use Standard Path unless tuned frequency > 3.6 GHz and IFBW > 15 MHz, in which case choose Full Bypass if conditions warrant(FBP Option is available and "Allow Full Bypass in Auto" is On), otherwise choose Preselector Bypass
Monitor Spectrum	Always Standard Path
IQ Waveform	Use Standard Path unless tuned frequency > 3.6 GHz and IFBW > 15 MHz, in which case choose Preselector Bypass
CCDF	Use Standard Path unless tuned frequency > 3.6 GHz and IFBW > 15 MHz, in which case choose Preselector Bypass

Remote Command	`[:SENSe]:POWer[:RF]:MW:PATH:AUTO ON | OFF | 1 | 0` `[:SENSe]:POWer[:RF]:MW:PATH:AUTO?`
Example	`:POW:MW:PATH:AUTO ON` `:POW:MW:PATH:AUTO?`
Dependencies	Only appears in VMA, WLAN, 5G NR and CQM Modes
Couplings	See the tables above
Preset	ON
Range	ON|OFF

Low Noise Path Enable

Low Noise Path Enable provides a lower noise floor under some circumstances, particularly when operating in the 21–26.5 GHz region. With the Low Noise Path enabled, the low band/high band switch and microwave preamp are bypassed whenever *all* the following are true:

- The instrument is not in the Low Band, meaning:
- the start frequency is above 3.5 GHz and
- the stop frequency is above 3.6 GHz
- The internal preamp is not installed, or if installed, is set to **Off** or **Low Band**

Note that this means that, when any part of a sweep is done in Low Band, the Low Noise Path is not used, whether or not the **Low Noise Path Enable** is selected in the user interface. Also, if the preamp is turned on, the Low Noise Path is not used, whether or not the **Low Noise Path Enable** is selected in the user interface. The only time the Low Noise Path is used is when **Low Noise Path Enable** is selected, the sweep is completely in High Band (> 3.6 GHz) and no preamp is in use.

For measurements that use IQ acquisition, the low noise path is used when **Center Frequency** is in High Band (> 3.6 GHz) and no preamp is in use. In other words, the rules above are modified to use only the center frequency to qualify which path to switch in. This is not the case for FFTs in the Swept SA measurement; they use the same rules as swept measurements.

Note that the Low Noise Path, while giving improved DANL, has the disadvantage of decreased TOI performance and decreased gain compression performance relative to the standard path.

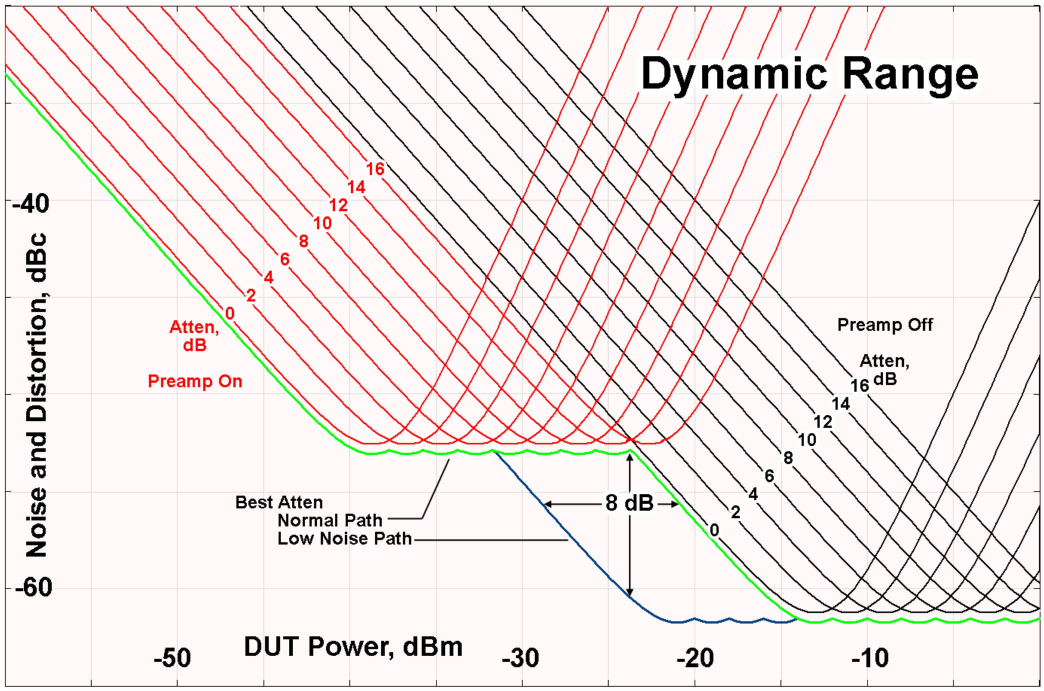
Note also that the bypass switch is a mechanical switch and has finite life, so if the **Low Noise Path Enable** is selected, it is possible to cause frequent cycling of this switch by frequently changing instrument settings such that the above conditions hold true only some of the time. A user making tests of this nature should consider opting for the **Standard Path**, which will never throw the bypass switch, at the expense of some degraded noise performance.

The low noise path is useful for situations where the signal level is so low that the instrument performance is dominated by noise even with 0 dB attenuation, but still high enough that the preamp option would have excessive third-order intermodulation or compression. The preamp, if purchased and used, gives better noise floor than does the “Low Noise Path.” However, its compression threshold and third-order intercept are much poorer than that of the non-preamp path.

There are some applications, typically for signals around –30 dBm, for which the third-order dynamic range of the standard path is good enough, but the noise floor is not low enough even with 0 dB input attenuation. When the third-order dynamic range of the preamp path is too little and the noise floor of the standard path is too high, the Low Noise Path can provide the best dynamic range

The graph below illustrates the concept. It shows, in red, the performance of an instrument at different attenuation settings, both with the preamp on and off, in a measurement that is affected by both instrument noise and instrument TOI. The green shows the best available dynamic range, offset by 0.5 dB for clarity. The blue

shows how the best available dynamic range improves for moderate signal levels with the low noise path switched in. In this illustration, the preamp improves the noise floor by 15 dB while degrading the third-order intercept by 30 dB, and the low noise path reduces loss by 8 dB. The attenuator step size is 2 dB.



There are other times where selecting the low noise path improves performance, too. Compression-limited measurements such as finding the nulls in a pulsed-RF spectrum can profit from the low noise path in a way similar to the TOI-limited measurement illustrated. Accuracy can be improved when the low noise path allows the optimum attenuation to increase from a small amount like 0, 2 or 4 dB to a larger amount, giving better return loss at the instrument input. Harmonic measurements, such as second and third harmonic levels, are much improved using the low noise path because of the superiority of that path for harmonic (though not intermodulation) distortion performance.

µW Preselector Bypass

Toggles the preselector bypass switch for band 1 and higher. When the microwave presel is on, the signal path is preselected. When the microwave preselector is off, the signal path is not preselected. The preselected path is the normal path for the instrument.

The preselector is a tunable bandpass filter which prevents signals away from the frequency of interest from combining in the mixer to generate in-band spurious

signals (images). The consequences of using a preselector filter are its limited bandwidth, the amplitude and phase ripple in its passband, and any amplitude and phase instability due to center frequency drift.

Option MPB or pre-selector bypass provides an unpreselected input mixer path for certain X-Series signal analyzers with frequency ranges above 3.6 GHz. This signal path allows a wider bandwidth and less amplitude variability, which is an advantage when doing modulation analysis and broadband signal analysis. The disadvantage is that, without the preselector, image signals will be displayed. Another disadvantage of bypassing the preselector is increased LO emission levels at the front panel input port.

Image responses are separated from the real signal by twice the 1st IF. For IF Paths of 10 MHz and 25 MHz, the 1st IF is 322.5 MHz, so the image response and the real signal will be separated by 645 MHz. The 1st IF will be different for other IF Path settings. When viewing a real signal and its corresponding image response in internal mixing, the image response will be to the left of the real signal.

Also, the image response and the real signal typically have the same amplitude and exhibit the same shape factor.

However, if Option FS1 (Fast Sweep Capability) is enabled, the image response in the Swept SA measurement appears lower in amplitude and has a much wider shape factor compared to the real signal.

Full Bypass Enable

With **Full Bypass Enable** selected, the microwave preselector is bypassed. In addition, the low band/high band switch and microwave preamp are bypassed whenever *all* the following are true:

- The instrument is not in the Low Band, meaning:
- the start frequency is above 3.5 GHz and
- the stop frequency is above 3.6 GHz.
- the internal preamp is not installed or if installed, is set to **Off** or **Low Band**

Note that this means that, when any part of a sweep is done in Low Band, the Low Noise Path is not used, whether or not the **Full Bypass Enable** is selected in the user interface. Also, if the preamp is turned on, the Low Noise Path is not used, whether or not the **Full Bypass Enable** is selected in the user interface. The only time the Low Noise Path is used is when **Full Bypass Enable** is selected, the sweep is completely in High Band (> 3.6 GHz) and no preamp is in use.

CAUTION When **Full Bypass Enable** is selected, and "Y Scale" on page 1929 is set to 0 dB, there will be a direct AC connection between the input and the first converter when the Low Noise Path switches in (when Start Freq >3.6 GHz and the Preamp is either not licensed, set to Low Band, or Off). This puts the first converter at considerable risk to be damaged by high AC power. Consequently, whenever **Full Bypass Enable** is selected, a warning message appears in the status bar:

"Full Bypass Enabled, maximum safe input power reduced"

Microwave Preselector Bypass Backwards Compatibility

Example	`:POW:MW:PRES OFF` Bypasses the microwave preselector
Notes	Included for Microwave Preselector Bypass backwards compatibility The `ON` parameter sets the `STD` path (`:POW:MW:PATH STD`) The `OFF` parameter sets path `MPB` (`:POW:MW:PATH MPB`)
Preset	`ON`
Backwards Compatibility SCPI	`[:SENSe]:POWer[:RF]:MW:PRESelector[:STATe] ON | OFF | 0 | 1` `[:SENSe]:POWer[:RF]:MW:PRESelector[:STATe]?`

Frequency Extender Preselection Bypass

Only applies to the high frequency path of the Frequency Extender, and only if the Frequency Extender allows it. For example, the V3050A high frequency path is 50 – 110 GHz and *does* allow control of the preselector bypass.

When the Frequency Extender's preselection is bypassed, flatness is improved, but will be subject to spurs from out-of-band interfering signals. For bandwidths greater than 2.5 [GHz], it is recommended that the signal bypass the Frequency Extender Preselector since the max bandwidth of the Preselector can be as narrow as 2.5 [GHz].

For most applications, the preset state is `OFF`, which gives the best remote-control throughput, minimizes acoustic noise from switching, minimizes out of band spurs, and minimizes the risk of wear in the hardware switches.

Preselector and Bandwidth Conflict

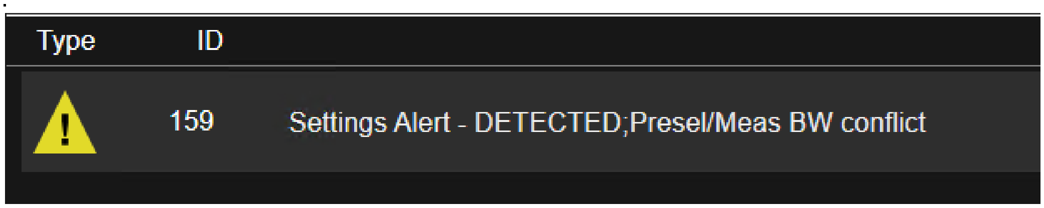
When the Frequency Extender Preselector is applied and the signal bandwidth is greater than 2.5 [GHz], then a settings alert message will show to warn the user that the signal may be distorted due to the limitation of the Frequency Extender Preselector bandwidth.

An example of the settings alert message is shown below.

Settings Alert message in the Status Bar at the bottom of the display.

Settings Alert message in the error queue

.



Software Preselection

Provided in some instruments, either to compensate for issues with provided hardware preselection or to provide the preselection function when there is no hardware preselector.

N9041B

Software Preselection compensates for the frequency range limit of the microwave preselector. Since the microwave preselector only goes up to 50 GHz, software preselection must be used to suppress and separate images above 50 GHz. The specific algorithm used for software preselection is specified by the SW Preselection Type selection – Normal or Advanced.

In N9041B, **Software Preselection** only applies for frequencies above 50 GHz, therefore it is only used for RF Input 2. Even if turned on, it is not used for other inputs, and never for frequencies below 50 GHz. This is why the label of this control contains the parenthetical note “(>~50 GHz)”.

Note that in N9041B, in Swept SA measurement, **Software Preselection** works even if the measurement is using an FFT Sweep Type. In measurements other than Swept SA, Software Preselection is not used if the measurement is using an FFT sweep type.

N9042B+V3050A

Software Preselection compensates for the frequency range limit of the microwave preselector. Since the microwave preselector only goes up to 50 GHz, software preselection must be used to suppress and separate images above 50 GHz. The specific algorithm used for software preselection is specified by the SW Preselection

Type selection – Normal or Advanced.

For N9042B+V3050A, Software Preselection only applies for frequencies above 50 GHz, therefore it is only used for External RF. Even if it is turned on, it will not be used for other inputs and never for frequencies below 50 GHz. This is why the label of this control contains the parenthetical note “(>~50 GHz)”.

Note that for N9042B+V3050A, in the Swept SA measurement, Software Preselection works even if the measurement is using an FFT Sweep Type. In measurements other than Swept SA, Software Preselection is not used if the measurement is using an FFT Sweep Type.

VXT models M9410A/11A

Software Preselection is used to provide the preselection function, as there is no hardware preselector in these models. Two background traces are taken and compared point by point, and the point with the lowest amplitude from the two traces is used. This provides a method to reduce spurs that are internally generated within the VXT, but you should note the following when using Software Preselection:

- There is some speed cost due to the need to take multiple captures
- Taking the point with the lowest amplitude in each trace will make the average noise level lower at all points that do not have a spur. This can reduce the accuracy of the measurement of noise and noise-like signals

Because of the difficulty in identifying spurs manually, you are recommended to leave Software Preselection ON at all times in VXT models M9410A/11A. If you turn it off in order to speed up your measurement or improve noise accuracy, be aware of unwanted onscreen spurs.

Remote Command	`[:SENSe]:POWer[:RF]:SWPResel:STATe 0 | 1 | ON | OFF` `[:SENSe]:POWer[:RF]:SWPresel:STAT?`
Example	`:POW:SWPR:STAT 1` `:POW:SWPR:STAT?`
Dependencies	Only appears in N9041B, N9042B+V2050A, and VXT models M9410A/11A. Does not appear in all measurements
Couplings	Affects **Sweep Time** **Auto Tune** supports **Software Preselection**, so **Auto Tune** should be performed after setting the **Software Preselection** state
Preset	N9041B: OFF N9042B+V3050A: ON M9410A/11A: ON
State Saved	Saved in instrument state

SW Preselection Type

Specifies the algorithm used for software preselection.

Two hidden sweeps occur in succession. The second sweep is offset in LO frequency by 2 * IF / N. For each point in each trace, the smaller amplitude from the two traces is taken and placed in that point in the selected trace. The Peak detector is auto-selected to improve the image suppression effectiveness. Responses of each trace that lie on top of one another will remain and are valid signals. Other signals are images, which are suppressed. The action of taking the smaller of the two traces will make the average noise level lower in all points that do not have an image, thus reducing the accuracy of the measurement of noise and noise-like signals.

- `NORMal` - mathematically removes all image and multiple responses of signals present at the input
- `ADVanced` - any trace processing (such as "max hold" or trace averaging) is performed on the points of both candidate traces before the "select minimum" operation occurs. This form of processing works better for non-stationary signals, such as pulsed-RF signals

Remote Command	`[:SENSe]:POWer[:RF]:SWPResel NORMal | ADVanced` `[:SENSe]:POWer[:RF]:SWPResel?`
Example	`:POW:SWPR NORM` `:POW:SWPR?`
Dependencies	Only appears in N9041B and N9042B+V3050A. Only appears in measurements that use the Swept method Grayed-out when "Software Preselection" on page 1971 is `OFF`. The grayout message is "Unavailable unless SW Presel enabled"
Preset	N9041B: `ADVanced` N9042B+V3050A: `NORMal`
State Saved	Saved in instrument state

SW Preselection BW

Specifies the effective bandwidth to be used for Software Preselection.

The options are:

- `NORMal` – when making Swept measurements, a software preselection algorithm is used which takes up to 4 background acquisitions, then post-processes the result. This algorithm can remove images from signals with an occupied

bandwidth up to around 3 GHz. (Default/Preset setting). When making FFT measurements, this algorithm is not used, instead the same algorithm is used as for NARRow (below)

– NARRow– a software preselection algorithm is used which takes two background acquisitions, then post-processes the result to detect and remove images from wideband signals with occupied bandwidths up to 2 GHz. This increases the risk of images failing to be rejected, but improves the measurement speed

Remote Command	`[:SENSe]:POWer[:RF]:SWPResel:BW NORMal | NARRow` `[:SENSe]:POWer[:RF]:SWPResel:BW?`
Example	`:POW:SWPR:BW NARR`
Dependencies	Only appears in N9041B and N9042B+V3050A. Only appears in measurements that use the Swept method Grayed-out when "Software Preselection" on page 1971 is `OFF`. The grayout message is “Unavailable unless SW Presel enabled” For N9042B+V3050A, the parameter is SCPI-only, and always set to `NARRow` when **Software Preselection** is enabled
Preset	N9041B: `NORMal` N9042B+V3050A: `NARRow`
State Saved	Saved in instrument state

High Freq Prefilter

Lets you set the state of Prefilter for center frequencies above 1310 MHz.

In VXT Models M9410A/11A, the Receiver RF path has a bank of filters that come after the RF Attenuator in the signal path. Since this bank of filters precedes the mixer they are known as the “Prefilter” bank. Their purpose is to eliminate unwanted in-band mixing products by filtering out all but the desired frequencies before the signals get to the mixer. There are 13 prefilter bands to cover the frequencies between 9 kHz and 6000 MHz. The Prefilter provides the necessary rejection of the unwanted signal.

Remote Command	`[:SENSe]:<measurement>:PFILter[:STATe] ON | OFF | 1 | 0` `[:SENSe]:<measurement>:PFILter[:STATe]?`

Example	Enable High Freq Prefilter for the Complex Spectrum Measurement in BASIC Mode:
	`:SPEC:PFIL ON`
	Enable High Freq Prefilter for the IQ Waveform Measurement, in multiple Modes:
	`:WAV:PFIL ON`
	Enable High Freq Prefilter for the Swept SA Measurement in SA Mode:

	`:SAN:PFIL ON`
Dependencies	Only appears in VXT models M9410A/11A with center frequency above 1310 MHz
Preset	See "Prefilter Presets" on page 604 below
State Saved	Saved in instrument state

Prefilter Presets

Meas	Mode	Preset
SPEC	BASIC	OFF
WAV	BASIC, WCDMA, WLAN, LTEAFDD, LTEATDD, 5GNR, VMA	OFF
MON	WCDMA, WLAN, LTEAFDD, LTEATDD, 5GNR, VMA	OFF
RHO	WCDMA	OFF
CDP	WCDMA	OFF
PCON	WCDMA	OFF
EVMQ	WCDMA	OFF
CHP	WCDMA, WLAN, LTEAFDD, LTEATDD, 5GNR, VMA, SA	OFF
OBW	WCDMA, WLAN, LTEAFDD, LTEATDD, 5GNR, VMA, SA	OFF
ACP	WCDMA, LTEAFDD, LTEATDD, 5GNR, VMA, SA	OFF
SEM	WCDMA, WLAN, LTEAFDD, LTEATDD, 5GNR, VMA, SA	OFF
PST	WCDMA, WLAN, LTEAFDD, LTEATDD, 5GNR, VMA, SA	OFF
PVT	WLAN, LTEAFDD, LTEATDD, 5GNR	OFF
EVM	WLAN, LTEAFDD, LTEATDD, 5GNR	OFF
FLAT	WLAN	OFF
EVMM	WLAN	OFF
CEVM	LTEAFDD, LTEATDD	OFF
PAVT	5GNR, VMA	OFF
DDEM	VMA	OFF
OFDM	VMA	OFF
SAN	SA	ON
HARM	SA	ON

3.3.4 BW

Opens the Bandwidth (**BW**) menu, which contains controls for the Resolution Bandwidth and Video Bandwidth functions of the instrument.

The Resolution BW functions control filter bandwidth and filter type. There are two filter types, Gaussian and Flattop. The Gaussian filters have a response curve that is parabolic on a log scale. The Flattop filter shape is a close approximation of a rectangular filter.

3.3.4.1 Settings

Contains the basic bandwidth functions. In most measurements it is the only tab under Bandwidth.

Res BW

Activates the resolution bandwidth active function, which allows you to manually set the resolution bandwidth (RBW) of the instrument.

Normally, **Res BW** (**Auto**) selects automatic coupling of **Res BW** to "Span" on page 624, using the ratio set by **Span:3 dB RBW** (some measurements do not have a Span:3 dB RBW control, in which case the measurement chooses the optimal ratio). To decouple the resolution bandwidth, press the **Auto/Man** toggle on **Res BW**, or simply enter a different value for **Res BW**.

When **Res BW** is manually selected, you can return it to the coupled state by pressing the **Auto/Man** toggle on **Res BW**. This may also be done by pressing "Auto Couple" on page 1995 or by performing a **Preset**.

For more details, see "More Information" on page 606

Remote Command	`[:SENSe]:CHPower:BANDwidth[:RESolution] <bandwidth>` `[:SENSe]:CHPower:BANDwidth[:RESolution]?`
Example	`:CHP:BAND 5 MHz` `:CHP:BAND?`
Notes	For numeric entries, all RBW Types choose the nearest (arithmetically, on a linear scale, rounding up) available RBW to the value entered The setting and querying of values depend on the current bandwidth type
Couplings	Sweep time is coupled to RBW. As RBW changes, the sweep time (if set to **Auto**) is changed to maintain amplitude calibration Video bandwidth (VBW) is coupled to RBW. As the resolution bandwidth changes, the video bandwidth (if set to **Auto**) changes to maintain the ratio of VBW/RBW (10:1) When Res BW is set to **Auto**, the resolution bandwidth is auto-coupled to the span. The ratio of Span/RBW is approximately 106:1 when auto coupled. When Res BW is set to Man, and the bandwidths are entered manually, these bandwidths are used regardless of other instrument settings
Preset	See "RBW Presets" on page 606
State Saved	Saved in instrument state
Min	1 Hz
Max	8 MHz is the max equivalent –3 dB RBW, which means that the named RBW (the one shown on the control etc.) can actually exceed 8 MHz if using a filter other than –3 dB Gaussian
Annotation	A “#” mark appears before “RBW” in the annotation when it is switched from Auto to Manual coupling

Backwards Compatibility Notes	For backwards compatibility, this command supports both the `BANDwidth` and `BWIDth` forms

Auto Function

Remote Command	`[:SENSe]:CHPower:BANDwidth[:RESolution]:AUTO ON | OFF | 1 | 0` `[:SENSe]:CHPower:BANDwidth[:RESolution]:AUTO?`
Example	`:CHP:BAND:AUTO ON` `:CHP:BAND:AUTO?`

RBW Presets

Mode	Preset Value
LTEAFDD	Auto
LTEATDD	Auto
MSR	100 kHz
NR5G	Auto
SA	Auto
SRCOMMS	3.9 kHz
VMA	240 kHz
WCDMA	240 kHz
WLAN	100 kHz

More Information

When **Res BW** is set to **Auto**, the bandwidth selected depends on "RBW Filter Type" on page 609.

Only certain discrete resolution bandwidths are available. The available bandwidths are dependent on **Filter Type** or **EMC Standard**. If an unavailable bandwidth is entered with the numeric keypad, the closest available bandwidth is selected.

In some PowerSuite measurements, in the LTE-Advanced (both FDD and TDD) and 5G NR modes, when **Res BW** is in **Auto**, the resolution bandwidth is predefined based on the corresponding bandwidth of the single carrier, as shown in the table below. In the Multi-carrier case, the narrowest RBW among the active carriers is used.

LTE-A FDD/TDD Modes

Carrier BW	Auto RBW, kHz
1.4 MHz	20
3 MHz	43

Carrier BW	Auto RBW, kHz
5 MHz	68
10 MHz	150
15 MHz	220
20 MHz	270
200 kHz (NB-IoT in FDD)	10

5G NR Mode

Bandwidth	Auto RBW, kHz
5 MHz	68
10 MHz	150
15 MHz	220
20 MHz	270
25 MHz	360
30 MHz	430
35 MHz	510
40 MHz	560
45 MHz	620
50 MHz	680
60 MHz	820
70 MHz	1000
80 MHz	1100
90 MHz	1300
100 MHz	1500
200 MHz	2700
400 MHz	3000
800 MHz	3000
1600 MHz	3000
2000 MHz	3000

Video BW

Lets you change the instrument post-detection filter (VBW or “Video Bandwidth”) from 1 Hz to 8 MHz in approximately 10% steps. In addition, a wide-open video filter bandwidth may be chosen by selecting 50 MHz. The VBW is annotated at the bottom of the display, in the center.

Normally, **Video BW (Auto)** selects automatic coupling of the Video BW to RBW using the ratio set by **VBW:3 dB RBW**. To decouple the resolution bandwidth, press the **Auto/Man** toggle on **Video BW**, or simply enter a different value for **Video BW**.

When the **Video BW** is manually selected, it may be returned to the coupled state by pressing the **Auto/Man** toggle on **Video BW**. This may also be done by pressing "Auto Couple" on page 1995 or by performing a **Preset**.

Remote Command	`[:SENSe]:CHPower:BANDwidth:VIDeo <bandwidth>` `[:SENSe]:CHPower:BANDwidth:VIDeo?`
Example	`:CHP:BAND:VID 2.4 MHz` `:CHP:BAND:VID?`
Notes	For numeric entries, the instrument chooses the nearest (arithmetically, on a linear scale, rounding up) available VBW to the value entered. The 50 MHz VBW is defined to mean "wide open" The values shown in this table reflect the conditions after a Mode Preset
Dependencies	Sometimes the displayed **Video BW** is not actually used to process the trace data: When the Average Detector is selected and **Sweep Type** is set to **Swept,** the video bandwidth filter cannot be used, because it uses the same hardware as the Average Detector When the Quasi-Peak, EMI Average or RMS Average detector is selected the VBW is implemented by the digital IF as part of the detector When this is the case, VBW still acts to change the Sweep Time, if "Sweep Time" on page 1085 is in **Auto**, and still affects the data on other traces for which this is not the case
Couplings	Video bandwidth (VBW) is normally coupled to "Res BW" on page 605. If **VBW** is set to **Auto**, then VBW is changed as RBW changes, to maintain the ratio set by **VBW:3 dB RBW** (usually 10:1 for measurements that do not have a **VBW:3 dB RBW** control)
Preset	Auto (unless noted in table below)
State Saved	Saved in instrument state
Min	1 Hz
Max	50 MHz
Annunciation	A "#" mark appears before "VBW" in the annotation when it is not coupled
Annotation	In the bottom center of the screen, "VBW <value> <units>" indicates the current video bandwidth value. Note that for some detectors this is not the value actually used for VBW (see above)
Backwards Compatibility Notes	For backwards compatibility, this command supports both the `BANDwidth` and `BWIDth` forms

Auto Function

Remote Command	`[:SENSe]:CHPower:BANDwidth:VIDeo:AUTO ON | OFF | 1 | 0` `[:SENSe]:CHPower:BANDwidth:VIDeo:AUTO?`
Example	`:CHP:BAND:VID:AUTO OFF` `:CHP:BAND:VID:AUTO?`
Preset	`ON`

VBW Presets

Unless noted in the table below, the Preset value of VBW is **Auto**.

Mode	Preset Value
WCDMA	2.40 MHz

RBW Filter Type

Selects the type for the resolution bandwidth filters. Historically, the Res BW filters in HP/Agilent/Keysight spectrum instruments were Gaussian filters, specified using the –3 dB bandwidth of the filter. That is, a 10 MHz Res BW filter was a Gaussian shape with its –3 dB points 10 MHz apart. In X-Series, the **RBW Filter BW** menu lets you choose between a Gaussian and Flat Top filter shape, for varying measurement conditions.

Filter Type	SCPI Example
Gaussian	`:BAND:SHAP GAUS`
Flattop	`:BAND:SHAP FLAT`

Remote Command	`[:SENSe]:CHPower:BANDwidth:SHAPe GAUSsian | FLATtop` `[:SENSe]:CHPower:BANDwidth:SHAPe?`
Example	`:CHP:BAND:SHAP GAUS` `:CHP:BAND:SHAP?`
Notes	`GAUSsian`= Gaussian `FLATtop` = Flattop We use `SHAPe` instead of `TYPE` (even though the control name uses Type) because `TYPE` is used for backwards compatibility
Preset	"Auto Couple" on page 1995 selects the preset value
State Saved	Saved in instrument state
Annotation	The annotation under RBW in the bottom left of the screen shows the type of filter or bandwidth that is being used. The following examples illustrate this:
Backwards	`[:SENSe]:CHPower:BWIDth:SHAPe`

–3 dB (Normal) filter BW	Res BW 300 Hz
–6 dB filter BW	Res BW (–6 dB) 422 Hz
Noise filter BW	Res BW (Noise) 317 Hz
Impulse filter BW	Res BW (Impulse) 444 Hz
CISPR filter BW	Res BW (CISPR) 200 Hz
MIL filter BW	Res BW (MIL) 1 kHz
Flattop filter type	Res BW (Flattop) 300 Hz

Compatibility SCPI	

3.3.5 Display

Lets you configure display items for the current Mode, Measurement View or Window.

3.3.5.1 Meas Display

Contains controls for setting up the display for the current Measurement, View or Window.

Bar Graph On/Off

Turns the Bar Graph On or Off.

Remote Command	`:DISPlay:CHPower:WINDow[1]:BGRaph ON | OFF | 1 | 0` `:DISPlay:CHPower:WINDow[1]:BGRaph?`
Example	`:DISP:CHP:WIND:BGR ON` `:DISP:CHP:WIND:BGR?`
Preset	`OFF`
State Saved	Saved in instrument state
Range	`ON|OFF`
Backwards Compatibility SCPI	`:DISPlay:CHPower:VIEW[1]:WINDow[1]:BGRaph`

3.3.5.2 Annotation

Contains controls for setting up the annotation for the current Mode or Measurement.

Graticule

Turns the display graticule On or Off for all windows with graticules in all measurements in the current Mode. Also turns the graticule Y-Axis annotation on and off.

Remote Command	`:DISPlay:GRATicule[:STATe] OFF | ON | 0 | 1` `:DISPlay:GRATicule[:STATe]?`

Example	`:DISP:GRAT OFF`
Notes	The graticule is the set of horizontal and vertical lines that make up the grid/divisions for the X-Axis and Y-Axis
Preset	`ON`
State Saved	Saved in instrument state

Backwards Compatibility SCPI	`:DISPlay:WINDow[1]:TRACe:GRATicule:GRID[:STATe] OFF | ON | 0 | 1`
	`:DISPlay:WINDow[1]:TRACe:GRATicule:GRID[:STATe]?`
	This command is accepted for backwards compatibility with older instruments, but the `WINDow`, `TRACe` and `GRID` parameters are ignored

Screen Annotation

Controls the display of the annunciation and annotation around the graticule, including any annotation on lines (such as the display line, the threshold line, etc.) and the Y-Axis annotation, for all windows with screen annotation in all measurements in the current Mode.

This does *not* include marker annotation (or the N dB result). When `OFF`, the graticule expands to fill the entire graticule area, leaving only the 1.5% gap above the graticule, as described in the **Trace** section.

Remote Command	`:DISPlay:ANNotation:SCReen[:STATe] OFF | ON | 0 | 1` `:DISPlay:ANNotation:SCReen[:STATe]?`
Example	`:DISP:ANN:SCR OFF`
Dependencies	Grayed-out and forced to `OFF` when **System Display Settings**, **Annotation** is `OFF`
Preset	`ON` This remains `OFF` through a Preset when **System Display Settings**, **Annotation** is set to `OFF`
State Saved	Saved in instrument state

Trace Annotation

Turns on and off the labels on the traces, showing their detector (or their Math Mode) as described in the **Trace** section, for all windows in all measurements in the current Mode for which Trace Annotation on/off is supported.

If Trace Math is being performed on a trace, then the Trace Math annotation replaces the detector annotation.

For measurements that support limit lines, this key also turns on and off the labels on the Limit Lines. The label is the Limit number annotation and Limit Comment displayed on the graph. If the length of the comment is greater than 20 characters, the first 8 characters and the last 8 characters are displayed, joined with ….

Remote Command	:DISPlay:ANNotation:TRACe[:STATe] ON | OFF | 1 | 0 :DISPlay:ANNotation:TRACe[:STATe]?
Example	:DISP:ANN:TRAC OFF
Preset	OFF
State Saved	Saved in instrument state

Control Annotation

Turns on and off the display of values on the Active Function controls for all measurements in the current Mode. This is a security feature.

Remote Command	:DISPlay:ACTivefunc[:STATe] ON | OFF | 1 | 0 :DISPlay:ACTivefunc[:STATe]?
Example	:DISP:ACT OFF
Dependencies	Grayed out and forced to OFF when **System Display Settings**, **Annotation** is OFF
Preset	ON This remains OFF through a Preset when **System Display Settings**, **Annotation** is set to OFF
State Saved	Saved in instrument state

Frequency Annotation

Turns on and off the absolute frequency annotation in the main display for all windows in all measurements in the current Mode for which Frequency Annotation on/off is supported.

The affected annotations include Center Frequency, Start/Stop Frequency, Frequency Offset, Marker Frequency. Any relative frequency annotation such as Span and Marker Delta are not affected.

The frequency annotations in any other associated display, such as in Active Function, Softkey label, Limit Editor, Amp Corr Editor and Marker Table are not changed.

Frequency annotations that are not associated with the spectrum, such as RBW, IBW, Sweep Time, are excluded and they are shown regardless of this selection.

Remote Command	:DISPlay:ANNotation:FREQuency[:STATe] ON | OFF | 1 | 0 :DISPlay:ANNotation:FREQuency[:STATe]?
Example	:DISP:ANN:FREQ OFF
Dependencies	Only appears in the Swept SA measurement in Spectrum Analyzer Mode
Preset	ON

Meas Bar

Turns the Measurement Bar at the top of the screen on and off for all measurements in the current Mode. When OFF, the graticule area expands to fill the area formerly occupied by the Measurement Bar.

Remote Command	:DISPlay:ANNotation:MBAR[:STATe] OFF | ON | 0 | 1 :DISPlay:ANNotation:MBAR[:STATe]?
Example	:DISP:ANN:MBAR OFF
Dependencies	Grayed out and forced to OFF when **System Display Settings**, **Annotation** is OFF
Preset	ON This remains OFF through a Preset when **System Display Settings**, **Annotation** is set to OFF
State Saved	Saved in instrument state

Display Enable (Remote Command Only)

Turns the display on/off, including the display drive circuitry. The backlight stays lit to confirm that the instrument is on. The display enable setting is mode global. Theare three reasons for turning the display off:

1. To increase speed as much as possible by freeing the instrument from having to update the display
2. To reduce emissions from the display, drive circuitry
3. For security purposes

If you have turned off the display:

- and you are in local operation, the display can be turned back on by pressing any key or by sending :SYSTem:DEFaults MISC or :DISPlay:ENABle ON (neither *RST nor :SYSTem:PRESet enable the display)
- and you are in remote operation, the display can be turned back on by pressing the **Local** or **Esc** keys, or by sending :SYSTem:DEFaults MISC or :DISPlay:ENABle ON (neither *RST nor :SYSTem:PRESet enable the display)
- and you are using either the :SYSTem:KLOCk command or GPIB local lockout, then *no* front-panel key press will turn the display back on. You must turn it back on remotely.

If the display is OFF, many SCPI commands related to User Views and Multiscreen functionality do not work, and return the error messages “-221, Settings conflict; Screen SCPI cannot be used when Display is disabled” or “221, Settings conflict; View SCPI cannot be used while Display is disabled”. These commands include:

Name	Command
Select User View	:DISPlay:VIEW:ADVanced:SELect
Rename User View	:DISPlay:VIEW:ADVanced:REName
Delete User View	:DISPlay:VIEW:ADVanced:DELete
Create User View	:DISPlay:VIEW:ADVanced:NAME
Select Screen	:INSTrument:SCReen:SELect
Delete Screen	:INSTrument:SCReen:DELete
Delete All But This Screen	:INSTrument:SCReen:DELete:ALL
Add Screen	:INSTrument:SCReen:CREate
Rename Screen	:INSTrument:SCReen:REName
Sequencer On/Off	:SYSTem:SEQuencer

Remote Command	:DISPlay:ENABle OFF | ON | 0 | 1 :DISPlay:ENABle?
Example	:DISP:ENAB OFF
Couplings	:DISP:ENAB OFF turns Backlight OFF and :DISP:ENAB ON turns Backlight ON, but changing Backlight settings does *not* change the state of :DISP:ENAB
Preset	ON Set by :SYST:DEF MISC, but not affected by *RST or :SYSTem:PRESet
State Saved	Not saved in instrument state
Backwards Compatibility Notes	:SYST:PRES no longer turns on :DISPlay:ENABle as it did in legacy analyzers

3.3.5.3 View

Contains controls for selecting the current **View**, and for editing User Views.

View

See "Views" on page 551.

User View

Lets you choose a View from the saved User Views for the current measurement. This panel only appears if a User View exists for the current measurement.

Remote	:DISPlay:VIEW:ADVanced:SELect <alphanumeric>

Command	`:DISPlay:VIEW:ADVanced:SELect?`
Example	Select Baseband as the current View `:DISP:VIEW:ADV:SEL “Baseband”`

Notes	You must be in the measurement whose View you are trying to set to send the command. You can only set Views for the current measurement using this command
	For predefined views, the parameter is derived from the view name that is shown in the View list in the user interface. For example, if you are trying to select the Trace Zoom view in the Swept SA measurement, you send:
	`:DISP:VIEW:ADV:SEL "Trace Zoom"`
	because “Trace Zoom” is the name of the View as seen in the Mode/Meas dialog or in the Display, View menu
	You *cannot* use the legacy View parameter (which in this case would be `TZOom`) with `:DISP:VIEW:ADV:SEL`
	`<alphanumeric>` is case insensitive; you can specify mixed case, however the name will be evaluated on a single case. Thus, both of the following forms work:
	`:DISP:VIEW:ADV:SEL "Trace Zoom"`
	`:DISP:VIEW:ADV:SEL "TRACE ZOOM"`
	If the specified view is not a valid View, the query returns the error message “-224, Illegal parameter value; View with the name <alphanumeric> does not exist”
	If the display is disabled (via `:DISP:ENAB OFF`) then the error message “-221, Settings conflict; View SCPI cannot be used while Display is disabled” is generated

Backwards Compatibility SCPI	The legacy node `:DISPlay:VIEW[:SELect]` is retained for backwards compatibility, but it only supports predefined views

Restore Layout to Default

Restores the Layout to the default for Basic.

Modified Views are very temporary; if you exit the current measurement they are discarded, and they are not saved in State. To retain this View for later use, and to be able to return easily to your original Basic View, you can save your edited View as a “User View”.

Save Layout as New View

Saves your new View as a User View. An alpha keyboard appears, which lets you name your new View; the default is the old View name plus a number.

Remote Command	`:DISPlay:VIEW:ADVanced:NAME <alphanumeric>`
Example	`:DISP:VIEW:ADV:NAME “Baseband”`

	Creates a new View named Baseband from the current View, and selects it as the current View
Notes	<alphanumeric> is case insensitive; you can specify mixed case, however the name will be evaluated on a single case If <alphanumeric> name already exists as a View, the error message "-224, Illegal parameter value; View <alphanumeric> already exists" is generated If the display is disabled (via :DISP:ENAB OFF) then the error message "-221, Settings conflict; User View SCPI cannot be used while Display is disabled" is generated

Re-Save User View

You can re-edit a User View; if you make changes, then an asterisk will appear next to the User View's name. You can then tap **Re-Save User View** to save it back to its existing name, or **Save Layout as New View** to add another, new User View.

This is a front panel function only, there is no remote command available to perform this function. To do this remotely, you must first perform **Save Layout as New View**, then delete the old User View and rename the new one with the name of the View you just deleted.

Rename User View

You can rename the current View by giving it a new unique name. Only User Views can be renamed, if the current View is a Predefined View, an error occurs.

Remote Command	:DISPlay:VIEW:ADVanced:REName <alphanumeric>
Example	:DISP:VIEW:ADV:REN "Baseband"
Notes	<alphanumeric> is case insensitive; you can specify mixed case, however the name will be evaluated on a single case If the <alphanumeric> specifying the new name is already present in the list of View names, the error message "-224, Illegal parameter value; View <alphanumeric> already exists" is generated If the current View is a Predefined View, the error message "-224, Illegal parameter value; Cannot rename a Predefined View" is generated If the display is disabled (via :DISP:ENAB OFF) then the error message "-221, Settings conflict; View SCPI cannot be used while Display is disabled" is generated

Delete User View

You can delete the current View if it is a User View. The default view becomes the current view for the Measurement.

Remote Command	:DISPlay:VIEW:ADVanced:DELete

Example	`:DISP:VIEW:ADV:DEL`
Notes	`<alphanumeric>` is case insensitive; you can specify mixed case, however the name will be evaluated on a single case If the `<alphanumeric>` is not present in the list of View names, the error message "-224, Illegal parameter value; View <alphanumeric> does not exist" is generated If the current View is a Predefined View, the error message "-224, Illegal parameter value; Cannot delete a Predefined View" is generated If the display is disabled (via `:DISP:ENAB OFF`) then the error message "-221, Settings conflict; View SCPI cannot be used while Display is disabled" is generated

Delete All User Views

Deletes all previously saved User Views. The default view becomes the current view for the Measurement if a User View was the current view when this command was executed.

Remote Command	`:DISPlay:VIEW:ADVanced:DELete:ALL`
Example	`:DISP:VIEW:ADV:DEL:ALL`
Notes	Disabled if there are no User Views

View Editor Remote Commands

The following remote commands help you manage Views and User Views. Note that the SCPI node for User Views handles both Predefined and User Views. The legacy nodes, `:DISPlay:VIEW[:SELect]` and `:DISPlay:VIEW:NSEL`, are retained for backwards compatibility, but they only support predefined views.

View Listing Query

Returns a string containing a comma-separated list of names for *all* the Views, including User Views, available for the current Measurement.

Remote Command	`:DISPlay:VIEW:ADVanced:CATalog?`
Example	`:DISP:VIEW:ADV:CAT?`
Notes	Returns a quoted string of the available Views for the current measurement, separated by commas. The list includes names for *all* the Views, including User Views, available for the current Measurement Example: `"Normal,Trace Zoom,Spectrogram,Baseband,myView1,yourView1"` No distinction is made between Predefined and User Views

If you switch measurements with the display disabled (via `:DISP:ENAB OFF`), then query the list of available Views, the result is undefined

User View Listing Query

Returns a string containing a comma-separated list of names for *only* the User Views available for the current Measurement.

Remote Command	`:DISPlay:VIEW:ADVanced:USER:CATalog?`
Example	`:DISP:VIEW:ADV:USER:CAT?`
Notes	Returns a quoted string of the available User Views for the current measurement, separated by commas. Example: `"Baseband,myView1,yourView1"` If you switch measurements with the display disabled (see "Display Enable (Remote Command Only)" on page 1983), then query the list of available Views, the result is undefined

3.3.6 Frequency

Contains controls that allow you to control the frequency and channel parameters of the instrument.

Some features in the **Frequency** menu are the same for all measurements in the current Mode – they do not change as you change measurements. Settings like these are called “Meas Global” and are unaffected by "Meas Preset" on page 643. For example, **Center Frequency** is the same for all measurements — it does not change as you change measurements.

3.3.6.1 Settings

Contains controls that pertain to the X axis parameters of the measurement. These parameters control how data on the vertical (X) axis is displayed and control instrument settings that affect the horizontal axis.

Center Frequency

Sets the frequency that corresponds to the horizontal center of the graticule. While adjusting **Center Frequency**, "Span" on page 624 is held constant.

The **Center Frequency** setting is the same for all measurements within a mode, that is, it is Meas Global. Some Modes are also able to share a Mode Global Center

Frequency value. If this is the case, the Mode will have a **Global** tab in its **Meas Setup** menu.

The **Center Frequency** function sets (and queries) the center frequency for the currently selected input. If your instrument has multiple inputs, and you select another input, **Center Frequency** changes to the value for that input. SCPI commands are available to directly set **Center Frequency** for a specific input.

Center Frequency is remembered as you go from input to input. Thus, you can set a **Center Frequency** of 10 GHz with the RF Input selected, change to BBIQ and set a **Center Frequency** of 20 MHz, then switch to External Mixing and set a **Center Frequency** of 60 GHz, and when you go back to the RF Input, **Center Frequency** will go back to 10 GHz; back to BBIQ and it is 20 MHz; back to External Mixing and it is 60 GHz.

See:

– "RF Center Freq" on page 622

– "Ext Mix Center Freq" on page 623

– "I/Q Center Freq" on page 623

– "Center Frequency Presets" on page 620

– "VXT Models with Radio Heads/CIU Frequency Range" on page 622

Remote Command	`[:SENSe]:FREQuency:CENTer <freq>` `[:SENSe]:FREQuency:CENTer?`

Example	Set Center Frequency to 50 MHz:
	`:FREQ:CENT 50 MHz`
	Increment the Center Frequency by the value of CF Step:
	`:FREQ:CENT UP`
	Return the current value of Center Frequency:
	`:FREQ:CENT?`

Notes	Sets the RF, External Mixing or I/Q Center Frequency depending on the selected input: – For RF input, equivalent to `:FREQ:RF:CENT` – For I/Q input, equivalent to `:FREQ:IQ:CENT` – For External Mixer, equivalent to `:FREQ:EMIX:CENT` Preset and Max values depend on Hardware Options If no terminator (for example, MHz) is sent, the terminator Hz is used. If a terminator with unit other than frequency is used, an invalid suffix error message is generated
Dependencies	Not available in MSR, LTE-Advanced FDD/TDD and 5G NR Modes
Preset	Depends on instrument maximum frequency, mode, measurement, and selected input

	See "Center Frequency Presets" on page 620 and "RF Center Freq" on page 622 and "Ext Mix Center Freq" on page 623 and "I/Q Center Freq" on page 623 and "VXT Models with Radio Heads/CIU Frequency Range" on page 622
State Saved	Saved in instrument state
Min/Max	Depends on instrument maximum frequency, mode, measurement, and selected input See "Center Frequency Presets" on page 620 and "RF Center Freq" on page 622 and "I/Q Center Freq" on page 623 and "VXT Models with Radio Heads/CIU Frequency Range" on page 622
Annotation	Center <value> appears in the lower left corner of the display
Status Bits/OPC dependencies	Non-overlapped

Center Frequency Presets

The following table provides the Center Frequency Presets for the Spectrum Analyzer mode, and the Max Freq, for the various frequency options:

Freq Option	CF after Mode Preset	Stop Freq after Mode Preset	Max Freq (can't tune above)
503 (all but CXA)	1.805 GHz	3.6 GHz	3.7 GHz
503 (CXA)	1.505 GHz	3.0 GHz	3.08 GHz
507 (all but CXA)	3.505 GHz	7.0 GHz	7.1 GHz
507 (CXA)	3.755 GHz	7.5 GHz	7.58 GHz
508 (all but MXE)	1.805 GHz	3.6 GHz	8.5 GHz
508 (MXE)	4.205 GHz	8.4 GHz	8.5 GHz
513	6.805 GHz	13.6 GHz	13.8 GHz
526 (except CXA and MXE)	13.255 GHz	26.5 GHz	27.0 GHz*
526 (CXA)	13.255 GHz	26.5 GHz	26.55 GHz
526 (MXE)	1.805 GHz	3.6 GHz	27.0 GHz
532	16.005 GHz	32.0 GHz	32.5 GHz
540	20.005 GHz	40.0 GHz	40.5 GHz
543	21.505 GHz	43.0 GHz	43.0 GHz
544	22.005 GHz	44.0 GHz	45.0 GHz
550	25.005 GHz	50.0 GHz	52 GHz
F03 (CXA-m)	1.505 GHz	3.0 GHz	3.08 GHz
F07 (CXA-m)	3.755 GHz	7.5 GHz	7.575 GHz
F13 (CXA-m)	6.805 GHz	13.6 GHz	13.8 GHz
F26 (CXA-m)	13.255 GHz	26.5 GHz	26.55 GHz
504 (M9421A, M8920A)	2.145 GHz	3.88GHz	3.88 GHz

Freq Option	CF after Mode Preset	Stop Freq after Mode Preset	Max Freq (can't tune above)
506 (M9421A, M8920A)	3.245 GHz	6.08GHz	6.08 GHz
F06 (M9410A/11A)	1.0 GHz	6.08 GHz	6.08 GHz
F06 (M9415A)	1 GHz	1.08 GHz	6.6 GHz
F08 (M9415A)	1 GHz	1.08 GHz	8.6 GHz
F12 (M9415A)	1 GHz	1.08 GHz	12.9 GHz

*For option 526, the Max CF in RTSA is 26.999999995 GHz.

N9041B Center Freq Presets

Input	CF after Mode Preset	Stop Freq after Mode Preset	Max Freq (can't tune above)
Input 1, all models	25.005 GHz	50.0 GHz	52 GHz
Input 2, opt 585	42.505 GHz	85.0 GHz	86 GHz
Input 2, opt 590	45.005 GHz	90.0 GHz	92 GHz
Input 2, opt 5CX	55.005 GHz	110.0 GHz	110 GHz

Input 2, CXA and MXE

Model	CF after Mode Preset	Stop Freq after Mode Preset	Max Freq (can't tune above)
CXA opt C75	0.7505 GHz	1.5 GHz	1.58 GHz
MXE	505 MHz	1 GHz	1.000025 GHz

Tracking Generator Frequency Limits (CXA only)

Tracking Generator Option	Min Freq (clips to this freq when turn TG on and can't tune below while TG on)	If above this Freq, Stop Freq clipped to this Freq when TG turned on	Max Freq (can't tune above) while TG on
T03	9 kHz	3.0 GHz	3.08 GHz
T06	9 kHz	6.0 GHz	6.05 GHz

Tracking Generator Frequency Limits(CXA-m only)

Tracking Generator Option	Min Freq (clips to this freq when turn TG on and can't tune below while TG on)	If above this Freq, Stop Freq clipped to this Freq when TG turned on	Max Freq (can't tune above) while TG on
T03	2 MHz	3.08 GHz	3.08 GHz
T07	2 MHz	7.575 GHz	7.575 GHz

Tracking Generator Option	Min Freq (clips to this freq when turn TG on and can't tune below while TG on)	If above this Freq, Stop Freq clipped to this Freq when TG turned on	Max Freq (can't tune above) while TG on
T13	2 MHz	13.8 GHz	13.8 GHz
T26	2 MHz	26.55 GHz	26.55 GHz

VXT Models with Radio Heads/CIU Frequency Range

The following table shows the Center Frequency Presets and Range for VXT modes with Radio Heads/CIU.

Products with Radio Heads/CIU	Preset	Start frequency	Stop frequency
M9421A + CIU	6 GHz	5.9 GHz	12 GHz
M9410A + CIU	6 GHz	5.9 GHz	12 GHz
M9410A + CIU + RRH	25 GHz	24.25 GHz	43.5 GHz

RF Center Freq

Sets the **Center Frequency** to use when the RF input is selected, even if the RF input is not the input that is selected at the time the command is sent. Note that **Center Frequency** in the **Frequency** menu on the front panel *always* applies to the currently selected input.

Remote Command	`[:SENSe]:FREQuency:RF:CENTer <freq>` `[:SENSe]:FREQuency:RF:CENTer?`
Example	`:FREQ:RF:CENT 30 MHz` `:FREQ:RF:CENT?`
Notes	This command is the same in all Modes, but the parameter is Measurement Global, so the value is independent in each mode and common across all the measurements in the mode
Dependencies	If the electronic/soft attenuator is enabled, any attempt to set **Center Frequency** such that the Stop Frequency would be >3.6 GHz fails and results in an advisory message If the equivalent SCPI command is sent, this same message is generated as part of a "-221, Settings conflict" warning
Preset	See table above
State Saved	Saved in instrument state
Min	-79.999995 MHz
Max	26.999999995 GHz See "Center Frequency Presets" on page 620. Basically, instrument maximum frequency - 5 Hz If the knob or step keys are being used, also depends on "Span" on page 624

Ext Mix Center Freq

Sets the **Center Frequency** to use when the External Mixer is selected, even if the External Mixer input is not the input which is selected at the time the command is sent. Note that **Center Frequency** in the **Frequency** menu on the front panel *always* applies to the currently selected input.

Remote Command	`[:SENSe]:FREQuency:EMIXer:CENTer <freq>` `[:SENSe]:FREQuency:EMIXer:CENTer?`
Example	`:FREQ:EMIX:CENT 60 GHz` `:FREQ:EMIX:CENT?`
Notes	This command is the same in all Modes, but the parameter is Measurement Global, so the value is independent in each Mode and common across all measurements in the Mode
Couplings	When returning to External Mixing after having been switched to one of the other inputs (for example, RF), you will return to the settings that you had when you left External Mixing, so you will return to the band you were in, with the **Center Frequency** that you had. However, "Span" on page 624 is not an input-dependent parameter, so you will retain the span from the other input. Therefore, the instrument comes back with the span from the previous input, limited as necessary by the current mixer setup
Preset	When a Mode Preset is performed while in External Mixing, the Start frequency of the current Mode is set to the nominal Min Freq of the lowest harmonic range in the Harmonic Table for the current mixer setup. Similarly, the Stop frequency of the current Mode is set to the nominal Max Freq of the highest harmonic range in the Harmonic Table. **Center Frequency** thus presets to the point arithmetically equidistant from these two frequencies Note that, if the current measurement has a limited **Span** available to it, and cannot achieve the **Span** shown in the table (Span = Stop Freq – Start Freq), the instrument uses the maximum **Span** the measurement allows, and still sets **Center Frequency** to the midpoint of the Start and Stop Freq values in the Harmonic Table When **Restore Input/Output Defaults** is performed, the mixer presets to the 11970A values, whose Start and Stop frequencies are 26.5 and 40 GHz respectively. The center of these two frequencies is 33.25 GHz Therefore, following **Restore Input/Output Defaults**, if you go into External Mixing and do a Mode Preset while in Spectrum Analyzer Mode, the resulting **Center Frequency** is 33.25 GHz
State Saved	Yes
Min	The minimum frequency in the currently selected mixer band + 5 Hz If the knob or step keys are being used, also depends on **Span**
Max	The maximum frequency in the currently selected mixer band – 5 Hz If the knob or step keys are being used, also depends on **Span**

I/Q Center Freq

Sets the **Center Frequency** to use when the I/Q input is selected, even if the I/Q input is not the input which is selected at the time the command is sent. Note that **Center Frequency** in the **Frequency** menu on the front panel always applies to the currently selected input.

Remote Command	`[:SENSe]:FREQuency:IQ:CENTer <freq>` `[:SENSe]:FREQuency:IQ:CENTer?`
Example	`:FREQ:IQ:CENT 30 MHz`
Notes	This command is the same in all Modes, but the parameter is Measurement Global, so the value is independent in each Mode and common across all measurements in the Mode
Preset	0 Hz
State Saved	Saved in instrument state
Min/Max	–/+40.049995 MHz

Span

Changes the displayed frequency range symmetrically about the center frequency. While adjusting **Span**, **Center Frequency** is held constant, which means that both Start Frequency and Stop Frequency will change.

If **Span** is set to a value greater than the maximum allowable span of the instrument, an error message is generated indicating the data is out of range and was clipped to upper limit.

The default (and minimum) **Span** is calculated using the number of carriers and the carrier width where;

Span = (Upper Carrier Freq + (max offset IBW * (1 + alpha)) / 2) – (Lower Carrier Freq – (max offset IBW * (1 + alpha)) / 2)

If the RRC Filter is on, then span is increased by a factor of 1 + Filter Alpha.

See "Span Presets" on page 626

Remote Command	`[:SENSe]:CHPower:FREQuency:SPAN <freq>` `[:SENSe]:CHPower:FREQuency:SPAN?`
Example	`:CHP:FREQ:SPAN 10 MHz` `:CHP:FREQ:SPAN?`
Dependencies	If the electrical attenuator is enabled, any attempt to set Span such that the Stop Frequency would be >3.6 GHz results in an error In instruments with an RF Preselector, such as MXE, you cannot sweep across the band break at 3.6 GHz while the RF Preselector is on in Continuous sweep, as there is a mechanical switch which bypasses the RF Preselector above 3.6 GHz. See the Stop Frequency control description for details of this limitation For MSR Mode, this control is not shown For WLAN 802.11ac (80 MHz + 80 MHz), the control is not enabled, and its value is coupled with the spacing between the center frequencies of the two carriers Span = | Center Frequency 1 – Center Frequency 2| + Integ BW + 40 MHz Margin

	When the calculated span is over 1 GHz, it is still coupled to its maximum value, which is 1 GHz
Couplings	**Span** affects "Res BW" on page 605, Sweep Time, FFT & Sweep choice (including FFT Width, Phase Noise Optimization and ADC Dither auto couplings) Any value of **Center Frequency** or **Span** that is within the frequency range of the instrument is allowed *when* the value is being set through the front panel numeric keypad or the SCPI command. The other parameter is forced to a different value if needed, to keep the Start and the Stop Frequencies within the instrument's frequency range When using the knob or the step up/down keys or the `UP` | `DOWN` keywords in SCPI, the value that is being changed, that is, **Center Frequency** or **Span**, is limited so that the other parameter is not forced to a new value When **Res BW** is set to **Auto**, the resolution bandwidth is auto-coupled to span. The ratio of span /RBW is approximately 106:1. When **Res BW** is set to **Man**, bandwidths are entered by the user, and these bandwidths are used regardless of other instrument settings Since **Span** is coupled to **Integ BW** in the factory default condition, if you change the Integ BW setting, the span setting changes by a proportional amount until a limit value is reached. However, the span can be individually set. The minimum value of the span is coupled with the integration bandwidth **Span** cannot be set less than the **Integ BW** value. When **Span** is changed, the ratio of Span/Integ BW is set, and retained when Integ BW is changed
Preset	Depends on instrument maximum frequency, mode, measurement, and selected input See "Span Presets" on page 626
State Saved	Saved in instrument state
Min	100 Hz In 5GNR, LTEAFDD, and LTEATDD Modes, this value is the minimum value required for the measurement, which depends on the Component Carrier configuration
Max	Depends on instrument maximum frequency, mode, measurement, and selected input. See "Span Presets" on page 626 If the knob or step keys are being used, depends on the value of the other three interdependent parameters Center Frequency, Start Frequency, Stop Frequency
Annunciation	Data out of range, value clipped to upper limit
Annotation	Span <value> appears on the first line of the annotation in the lower right corner of display

LTE, 5G NR Modes only:

Remote Command	`[:SENSe]:CHPower:FREQuency:SPAN:AUTO ON | OFF | 1 | 0` `[:SENSe]:CHPower:FREQuency:SPAN:AUTO?`
Example	`:CHP:FREQ:SPAN:AUTO OFF` `:CHP:FREQ:SPAN:AUTO?`
Notes	The span value is adjusted when the relevant carrier parameters such as bandwidth, integration bandwidth, number of component carriers etc., are changed, whatever the span state (**Auto** or **Man**) When in **Man** state, if the input value is less than the required sum of total integration bandwidths and gaps of the multi-carriers, the required span value is set
Dependencies	Only available in LTE/LTE-Advanced FDD/TDD Modes and 5G NR Mode, CHP measurement

Preset	ON
State Saved	Saved in instrument state
Range	Auto|Man

Span Presets

The following table provides the Max Span, for the various frequency options:

Freq Option	Max Span (can't set higher than this)
503 (all but CXA)	3.7 GHz
503, F03 (CXA, CXA-m)	3.08 GHz
507 (all but CXA)	7.1 GHz
507 (CXA, CXA-m)	7.575 GHz
508 (all but MXE)	8.5 GHz
508 (MXE)	8.5 GHz
513, F13	13.8 GHz
526 (all but CXA and MXE)	27.0 GHz
526 (MXE)	27.0 GHz
526, F26 (CXA, CXA-m)	26.55 GHz
544	44.5 GHz
550	52 GHz
F06 (VXT models M9410A/11A)	5.75 GHz
F06 & EP6 (VXT models M9410A/11A)	6.27 GHz
F06 & LFE & EP6 (VXT models M9411A)	6.5999935 GHz
M9415A-F06	6.27 GHz
M9415A-F08	8.27 GHz
M9415A-F12	12.57 GHz

Input 2:

Model	Max Span (can't set higher than this)
CXA opt C75	1.58 GHz
MXE	1.000025 GHz

Note that if you are in External Mixing, the maximum Span will be equal to the Maximum Stop Frequency – Minimum Start Frequency for the currently selected mixer.

Span Presets by Mode

Mode	Radio Std	Preset Value
SA		3 MHz
WCDMA		7.5 MHz
LTE		7.5 MHz
LTETDD		7.5 MHz
5G NR		150 MHz
WLAN	802.11a/g(OFDM/DSSS-OFDM)	30 MHz
	802.11b	37.5 MHz
	802.11n/ac/ax/be 20MHz	30 MHz
	802.11n/ac/ax/be 40MHz	60 MHz
	802.11n/ac/ax/be 80 MHz	120 MHz
	802.11n/ac/ax/be 160 MHz	240 MHz
	802.11n/ac/ax/be 80 MHz + 80 MHz	360 MHz
	802.11be 320 MHz	480MHz
	802.11be 160MHz + 160MHz	440MHz

CF Step

Changes the step size for **Center Frequency** and start and stop frequency functions. Once a step size has been selected and the center frequency function is active, the step keys (and the UP|DOWN parameters for **Center Frequency** from remote commands) change the center frequency by the step-size value. The step size function is useful for finding harmonics and sidebands beyond the current frequency span of the instrument.

Note that the start and stop frequencies also step by the **CF Step** value.

Remote Command	`[:SENSe]:FREQuency:CENTer:STEP[:INCRement] <freq>` `[:SENSe]:FREQuency:CENTer:STEP[:INCRement]?`

Example	`:FREQ:CENT:STEP 500 MHz`
	`:FREQ:CENT UP`
	increases the current center frequency value by 500 MHz
	`:FREQ:CENT:STEP?`

Notes	Preset and Max values depend on Hardware Options
Dependencies	If the electronic/soft attenuator is enabled, any attempt to change the value of the center frequency >3.6 GHz by pressing the Up-arrow key, fails and results in an advisory message. If the equivalent SCPI command is sent, this same message is generated as part of a “-221, Settings conflict” warning Not available in the MSR, LTE-A FDD/TDD and 5G NR Modes
Couplings	When auto-coupled, the center frequency step size is set to 10% of the span
Preset	Auto
State Saved	Saved in instrument state
Min	– (the maximum frequency of the instrument). That is, 27 GHz max freq instrument has a CF step range of ±27 GHz. Note that this is the maximum frequency given the current settings of the instrument, so in External Mixing, for example, it is the maximum frequency of the current mixer band
Max	The maximum frequency of the instrument. That is, 27 GHz max freq instrument has a CF step range of ±27 GHz. Note that this is the maximum frequency given the current settings of the instrument, so in External Mixing, for example, it is the maximum frequency of the current mixer band
Status Bits/OPC dependencies	non-overlapped

Auto Function

Remote Command	`[:SENSe]:FREQuency:CENTer:STEP:AUTO OFF | ON | 0 | 1` `[:SENSe]:FREQuency:CENTer:STEP:AUTO?`
Example	`:FREQ:CENT:STEP:AUTO ON` `:FREQ:CENT:STEP:AUTO?`

Freq Offset

Enables you to set a frequency offset value to account for frequency conversions outside of the instrument. This value is added to the display readout of the marker frequency, center frequency, start frequency, stop frequency, and all other absolute frequency settings in the instrument, including frequency count. When a frequency offset is entered, the value appears below the center of the graticule. To eliminate an offset, perform a **Mode Preset**, or set the frequency offset to 0 Hz.

See "More Information" on page 629.

Remote Command	`[:SENSe]:FREQuency:OFFSet <freq>` `[:SENSe]:FREQuency:OFFSet?`
Example	`:FREQ:OFFS 10 MHz`

	:FREQ:OFFS?
Notes	Preset and Max values depend on Hardware Options
Dependencies	Appears only in Spectrum Analyzer Mode **Freq Offset** is not available in External Mixing. In this case the control is grayed-out and shows a value of zero. However, the value of CF Offset that was set for the RF Input is retained and restored when you switch back to the RF Input
Preset	See "Center Frequency Presets" on page 620
State Saved	Saved in instrument state
Min/Max	–/+500 GHz
Annotation	If Frequency Offset is not zero, “Freq Offset <value>” appears on the upper line of the annotation, below the graticule, in the center
Status Bits/OPC dependencies	Non-overlapped
Backwards Compatibility SCPI	:DISPlay:WINDow[1]:TRACe:X[:SCALe]:OFFSet The DISPlay version of the command is in the instrument for compatibility across platforms and is not recommended for new development

More Information

This command does not affect any bandwidths, nor the settings of relative frequency parameters such as delta markers or span. It does not affect the current hardware settings of the instrument, but only the displayed frequency values. Entering an offset does not affect the trace position or display, just the value of the start and stop frequency and the values represented by the trace data. The frequency values of exported trace data, queried trace data, markers, trace data used in calculations such as N dB points, trace math, etc., are all affected by Freq Offset. Changing the offset, even on a trace that is not updating, will immediately change all of the above, without taking new data.

NOTE If a trace is exported with a nonzero Freq Offset, the exported data will contain the trace data with the offset applied. Therefore, if that trace were to be imported back into the instrument, you would want Freq Offset to be 0, or the offset would be applied again to data which is already offset. No such care need be taken when saving a State+Trace file because the data and state are saved together.

Full Span (Remote Command Only)

Changes the span to show the full frequency range of the instrument. It maximizes the span within a range not changing the center frequency.

Remote Command	[:SENSe]:CHPower:FREQuency:SPAN:FULL

Example	`:CHP:FREQ:SPAN:FULL`
Couplings	Selecting full span changes the measurement span value

3.3.7 Marker

Accesses a menu that enables you to select, set up and control the markers for the current measurement. If there are no active markers, **Marker** selects marker 1, sets it to Normal and places it at the center of the display. If the selected marker is Off, it is set to Normal and placed it at the center of the screen on the trace determined by the **Marker Trace** rules.

3.3.7.1 Select Marker

Specifies the *selected marker*. The term "selected marker" is used throughout this document to specify which marker will be affected when you change marker settings, perform a Peak Search, etc.

This control appears above the menu panel, indicating that it applies to all controls in the **Marker** menu panels. If you select a tab whose controls do *not* depend on the selected marker (for example, Counter), then this control is blanked.

For any menu that includes **Select Marker**, the first control is always **Marker Frequency**.

Notes	The selected marker is remembered even when not in the Marker menu and is used if a Search is done or a Band Function is turned on or for Signal Track or Continuous Peak
Preset	Marker 1
State Saved	The number of the selected marker is saved in instrument state
Annunciation	Appears in the marker results block label for **Normal, Delta** and **Fixed** markers

3.3.7.2 Settings

The controls on this tab include the Marker active function and a radio button selection of the marker control mode (**Normal**, **Delta**, or **Off**) for the selected marker, as well as additional functions that help you use markers.

Marker Frequency

Sets the marker X Axis value in the current marker X Axis Scale unit. It has no effect if the control mode is **Off,** but is the SCPI equivalent of entering an X value if the control mode is **Normal** or **Delta**.

Remote Command	`:CALCulate:CHPower:MARKer[1]|2|…|12:X <freq>` `:CALCulate:CHPower:MARKer[1]|2|…|12:X?`
Example	`:CALC:CHP:MARK3:X 0` `:CALC:CHP:MARK3:X?`
Notes	If no suffix is sent, uses the fundamental units for the current marker X Axis Scale. If a suffix is sent that does not match the current marker X Axis Scale unit, an error “Invalid suffix” is generated The query returns the marker’s absolute X Axis value if the control mode is **Normal**, or the offset from the marker’s reference marker if the control mode is **Delta**. The query is returned in the fundamental units for the current marker X Axis scale: Hz for **Frequency** and Inverse Time, seconds for Period and Time
Preset	After a preset, all markers are turned OFF, so Marker X-Axis Value query returns Not A Number (NAN)
State Saved	Saved in instrument state
Min/Max	–/+9.9E+37
Annotation	Mkr # <X value> and <Marker value> upper right on graph

Marker X Axis Position (Remote Command Only)

Sets the marker X-Axis Scale position in trace points. This setting has no effect if the control mode is **Off,** but is the SCPI equivalent of entering a value if the control mode is **Normal** or **Delta**, except in trace points rather than X-Axis Scale units. The entered value is immediately translated into the current X-Axis Scale units for setting the value of the marker.

Remote Command	`:CALCulate:CHPower:MARKer[1]|2|…|12:X:POSition <real>` `:CALCulate:CHPower:MARKer[1]|2|…|12:X:POSition?`
Example	`:CALC:CHP:MARK10:X:POS 0` `:CALC:CHP:MARK10:X:POS?`
Notes	The query returns the marker’s absolute X-Axis value in trace points if the control mode is **Normal**, or the offset from the marker’s reference marker in trace points if the control mode is **Delta**. The value is returned as a real number, not an integer, corresponding to the translation from X-Axis Scale units to trace points . When a marker is turned on, it is placed at the center of the screen on the trace. Therefore, the default value depends on instrument condition. If the marker is **Off**, the response is Not A Number
Preset	After a preset, all markers are turned **Off**, so the query returns Not A Number (NAN)
State Saved	Saved in instrument state
Min/Max	–/+9.9E+37

Marker Y Axis Value (Remote Query only)

Returns the marker Y Axis value in the current marker Y-Axis unit.

Remote Command	`:CALCulate:CHPower:MARKer[1]|2|…|12:Y?`

Example	`:CALC:CHP:MARK11:Y?`
Notes	Returns the marker Y-Axis result if the control mode is **Normal** or **Delta** If the marker is **Off**, then the response is Not A Number
Preset	Result dependent on Markers setup and signal source
State Saved	No
Backwards Compatibility SCPI	`:CALCulate:CHPower:MARKer[1]|2|…|12:FUNCtion:RESult?`

Marker Mode

Sets the marker control mode to `POSition` (**Normal**), `DELTa`, or `OFF`. All interactions and dependencies detailed under the control description are enforced when the remote command is sent. If the selected marker is `OFF`, pressing **Marker** sets it to `POSition` and places it at the center of the screen on the trace determined by the **Marker Trace** rules. At the same time, **Marker X Axis Value** appears on the Active Function area.

The default active function is the active function for the currently selected marker control mode. If the current control mode is `OFF`, there is no active function, and the active function is turned off.

Remote Command	`:CALCulate:CHPower:MARKer[1]|2|…|12:MODE POSition | DELTa | OFF` `:CALCulate:CHPower:MARKer[1]|2|…|12:MODE?`
Example	`:CALC:CHP:MARK3:MODE POS` `:CALC:CHP:MARK3:MODE?`
Preset	`OFF`
State Saved	Saved in instrument state
Range	`POSition|DELTa|OFF`
Annotation	Mkr # <X value> and <Marker value> upper right on graph When Marker Trace is Polar in WCDMA mode: Mkr # <Chip Value (RHO & QPSKEVM)/Symbol Value (CDP)>, <X value> and <Y value> upper right on graph

Backwards Compatibility SCPI Commands

Sets or queries the state of a marker. Setting a marker that is `OFF` to `ON` (1) puts it in `POSition` (**Normal**) mode and places it at the center of the screen.

Example	`:CALC:CHP:MARK3:STAT ON`

	`:CALC:CHP:MARK3:STAT?`
Preset	`OFF`
State Saved	Saved in instrument state
Range	`OFF|ON`
Backwards Compatibility SCPI	`:CALCulate:CHPower:MARKer[1]|2|…|12:STATe OFF | ON | 0 | 1` `:CALCulate:CHPower:MARKer[1]|2|…|12:STATe?`

Delta Marker (Reset Delta)

This control has exactly the same effect as pressing **Delta** in "Marker Mode" on page 632. The selected marker becomes a **Delta** marker. If the selected marker is already a **Delta** marker, the reference marker is moved to the current position of the selected marker, thus resetting the Delta to zero.

Marker Settings Diagram

Lets you configure the Marker system using a visual utility.

All Markers Off

Turns off all markers.

Remote Command	`:CALCulate:CHPower:MARKer:AOFF`
Example	`:CALC:CHP:MARK:AOFF`

3.3.7.3 Peak Search

The controls on this tab allow you to move the marker to selected peaks of the signal, giving you enormous analysis capabilities, particularly when combined with "Marker Delta" on page 634.

NOTE: Pressing the **Peak Search** hardkey automatically moves you to the **Peak Search** page of the **Marker** menu *and* performs a Peak Search.

Pressing the **Peak Search** tab once you are already *in* the **Marker** menu does *not* perform a Peak Search.

Marker Frequency

This is the fundamental control that you use to move a marker around on the trace. It is the same as "Marker Frequency" on page 630 in the **Settings** tab.

Peak Search

Moves the selected marker to the trace point that has the maximum Y-Axis value for that marker's trace.

NOTE: Pressing the **Peak Search** hardkey automatically moves you to the **Peak Search** page of the **Marker** menu *and* performs a Peak Search.

Remote Command	`:CALCulate:CHPower:MARKer[1]|2|…|12:MAXimum`

Example	`:CALC:CHP:MARK2:MAX`
	`:SYST:ERR?`
	can be used to query the errors to determine if a peak is found. Following an unsuccessful search, the message "No peak found" is returned

Notes	Sending this command selects the subopcoded marker In W-CDMA Mode, this command does not work when the selected marker is located on the polar trace. In this case, the command is ignored

Marker Delta

Pressing this button has exactly the same effect as pressing **Delta** in "Marker Mode" on page 632 on the **Settings** tab. The selected marker becomes a **Delta** marker. If the selected marker is already a **Delta** marker, the reference marker is moved to the current position of the selected marker, thus resetting the Delta to zero.

The control is duplicated here to allow you to conveniently perform a peak search and change the marker's control mode to **Delta** without having to access two separate menus.

3.3.7.4 Properties

The controls on this tab are used to set certain properties of the selected marker.

Marker Frequency

This is the fundamental control that you use to move a marker around on the trace. This is the same as "Marker Frequency" on page 630 in the **Settings** tab.

Relative To

Selects the marker to which the selected marker is relative (its reference marker).

Every marker has another marker to which it is relative. This marker is referred to as the “reference marker” for that marker. The marker must be a **Delta** marker to make this attribute relevant. If it is a **Delta** marker, the reference marker determines how the marker is controlled and how its value is displayed. A marker cannot be relative to itself.

Remote Command	`:CALCulate:CHPower:MARKer[1]|2|…|12:REFerence <integer>` `:CALCulate:CHPower:MARKer[1]|2|…|12:REFerence?`
Example	`:CALC:CHP:MARK:REF 5` `:CALC:CHP:MARK:REF?`
Notes	Causes the marker specified with the subopcode to become selected Range (for SCPI command): 1 to 12. If the range is exceeded the value is clipped A marker cannot be relative to itself so that choice is not available, and if sent from SCPI generates error -221: “Settings conflict; marker cannot be relative to itself” When queried a single value is returned (the specified marker numbers relative marker)
Couplings	The act of specifying the selected marker’s reference marker makes the selected marker a **Delta** marker If the reference marker is **Off**, it is turned on in **Normal** mode at the delta marker location
Preset	The preset default “Relative To” marker (reference marker) is the next higher numbered marker (current marker +1). For example, if marker 2 is selected, then its default reference marker is marker 3. The exception is marker 12, which has a default reference of marker 1 Set to the defaults by using **Restore Mode Defaults**. Not reset by **Marker Off**, **All Markers Off**, or **Preset**
State Saved	Saved in instrument state. Not affected by Marker Off, and hence not affected by Preset or power cycle
Min	1
Max	12
Annunciation	Appears in the marker label of a **Delta** marker

Marker Trace

Selects the trace on which you want your marker placed. A marker is associated with one and only one trace. This trace is used to determine the placement, result, and X-Axis Scale of the marker. All markers have an associated trace; it is from that trace that they determine their attributes and behaviors, and it is to that trace that they go when they become **Normal** or **Delta** markers.

Specifying a Marker Trace manually or with this command associates the marker with the specified trace. If the marker is not **Off**, it moves the marker from the trace it was on to the new trace. If the marker is **Off**, it stays off but is now associated with the specified trace.

The query returns the number of the trace on which the marker is currently placed.

Remote Command	`:CALCulate:CHPower:MARKer[1]|2|…|12:TRACe 1	2	3` `:CALCulate:CHPower:MARKer[1]|2|…|12:TRACe?`
Example	`:CALC:CHP:MARK2:TRAC 2` `:CALC:CHP:MARK2:TRAC?`
Notes	A marker may be placed on a blanked and/or inactive trace, even though the trace is not visible and/or updating An application may register a trace name to be displayed on the control instead of a trace number
Couplings	The state of **Marker Trace** is not affected by "Auto Couple" on page 1995 Sending the remote command causes the addressed marker to become selected
Preset	1
State Saved	Saved in instrument state

Marker Settings Diagram

Lets you configure the Marker system using a visual utility. This is the same as "Marker Settings Diagram" on page 633 in the **Settings** tab.

3.3.8 Meas Setup

Contains functions for setting up the measurement parameters and also contains functions for setting up parameters global to all measurements in the Mode.

3.3.8.1 Settings

Contains frequently used **Meas Setup** functions to which you will want the fastest access.

Avg/Hold Number

Specifies the number of measurement averages used to calculate the measurement result. The average is displayed at the end of each sweep. After the specified number of average counts, the averaging mode (terminal control) setting determines the averaging action.

Remote Command	`[:SENSe]:CHPower:AVERage:COUNt <integer>` `[:SENSe]:CHPower:AVERage:COUNt?`
Example	`:CHP:AVER:COUN 15` `:CHP:AVER:COUN?`
Preset	SA, WLAN: 10 WCDMA, LTEAFDD, LTEATDD, 5G NR, MSR: 200
State Saved	Saved in instrument state
Min/Max	1 / 10000
Annotation	The average count is displayed in the measurement bar on the front panel display. The annotation appears in the format `n/N` where `n` is the current average and `N` is the average count

Averaging On/Off

Turns averaging on or off for this measurement.

NOTE In this measurement, the **Average Type** is preset to the `Log-Pwr Avg (Video)` method. Other averaging methods are not available.

Remote Command	`[:SENSe]:CHPower:AVERage[:STATe] ON | OFF | 1 | 0` `[:SENSe]:CHPower:AVERage[:STATe]?`
Example	`:CHP:AVER ON` `:CHP:AVER?`
Preset	`ON`
State Saved	Yes
Range	`ON|OFF`

Avg Mode

Allows you to select the type of termination control used for the averaging function. This determines the averaging action after the specified number of data acquisitions (average count) is reached. Options are:

- `EXPonential`: The measurement averaging continues using the specified number of averages to compute each exponentially-weighted averaged value. The average is displayed at the end of each sweep
- `REPeat`: The measurement resets the average counter each time the specified number of averages is reached

Remote Command	[:SENSe]:CHPower:AVERage:TCONtrol EXPonential | REPeat [:SENSe]:CHPower:AVERage:TCONtrol?
Example	:CHP:AVER:TCON EXP :CHP:AVER:TCON?
Preset	EXP
State Saved	Yes
Range	EXPonential|REPeat

Integ BW

Specifies the range of integration used in calculating the power in the channel. The integration bandwidth (IBW) is displayed on the trace as two markers connected by an arrow.

Remote Command	[:SENSe]:CHPower:BANDwidth:INTegration <bandwidth> [:SENSe]:CHPower:BANDwidth:INTegration?
Example	:CHP:BAND:INT 10MHz :CHP:BAND:INT?
Dependencies	For LTE-Advanced FDD/TDD, 5G NR and MSR Modes, this control is not shown
Couplings	The minimum value of the span is coupled with Integ BW When you change Integ BW, the span changes accordingly by keeping the same ratio of Span/Integ BW
Preset	(see table below)
State Saved	Saved in instrument state

Preset:

Mode	Radio Std	Integ BW
SA		2 MHz
WCDMA		5 MHz
LTEAFDD, LTEATDD		5 MHz
WLAN	802.11a/g(OFDM/DSSS-OFDM)	20 MHz
	802.11b	25 MHz
	802.11n/ac/ax/be (20MHz)	20 MHz
	802.11n/ac/ax/be (40MHz)	40 MHz
	802.11n/ac/ax/be (80MHz)	80 MHz
	802.11ax/be (80 MHz + 80 MHz)	80 MHz
	802.11ac/ax/be (160 MHz)	160 MHz
	802.11be (160 MHz + 160MHz)	160 MHz
	802.11be (320MHz)	320 MHz

Min/Max	100 Hz / Hardware Maximum Span
Backwards Compatibility SCPI	`[:SENSe]:CHPower:BWIDth:INTegration`

PSD Unit

Sets the unit bandwidth for Power Spectral Density. The available units are dBm/Hz (DBMHZ) and dBm/MHz (DBMMHZ).

Remote Command	`:UNIT:CHPower:POWer:PSD DBMHZ | DBMMHZ` `:UNIT:CHPower:POWer:PSD?`
Example	`:UNIT:CHP:POW:PSD DBMMHZ` `:UNIT:CHP:POW:PSD?`
Couplings	When the PSD unit is changed, the response to `:MEAS|READ|FETCH:CHP1?` also changes by the PSD unit basis (either dBm/Hz or dBm/MHz)
Preset	WLAN mode or SA mode with WLAN radio standard: DBMMHZ Otherwise: DBMHZ
State Saved	Saved in instrument state
Range	dBm/Hz | dBm/MHz

IF Gain

Sets **IF Gain** to Auto, Low Gain or High Gain. These settings affect sensitivity and IF overloads.

Remote Command	`[:SENSe]:CHPower:IF:GAIN[:STATe] ON | OFF | 1 | 0` `[:SENSe]:CHPower:IF:GAIN[:STATe]?`
Example	`:CHP:IF:GAIN ON` `:CHP:IF:GAIN?`
Notes	ON = high gain OFF = low gain
Dependencies	The IF Gain controls (FFT IF Gain and Swept IF Gain) have no effect when the U7227A USB Preamplifier is connected. This is not annotated or reflected on any control; there are no controls grayed out nor any SCPI locked out. The instrument simply behaves as though both FFT IF Gain and Swept IF Gain are set to Low regardless of the setting on the controls Not available in VXT model M9421A
Preset	OFF
State Saved	Saved in instrument state
Range	Low Gain | High Gain

Auto Function

Remote Command	[:SENSe]:CHPower:IF:GAIN:AUTO[:STATe] ON | OFF | 1 | 0 [:SENSe]:CHPower:IF:GAIN:AUTO[:STATe]?
Example	:CHP:IF:GAIN:AUTO ON :CHP:IF:GAIN:AUTO?
Couplings	Auto sets IF Gain to High Gain if the input attenuator is set to 0 dB, or if the preamp is turned on and the frequency range is under 3.6 GHz For other conditions, Auto sets IF Gain to Low Gain
Preset	OFF

Spur Avoidance

Because VXT models M9410A/11A/15A are direct-conversion (zero-IF) receivers, feedthrough leakage from the local oscillator appears as a spurious signal (spur) at the center frequency. The **Spur Avoidance** function is provided to eliminate this spur, at the expense of some measurement speed.

When **Spur Avoidance** is enabled (the default), the instrument uses a software algorithm to remove this spur from the displayed measurement data, but the algorithm only operates under certain conditions. Specifically, it only operates in the multiple capture case.

You can disable this function to speed up your measurement by setting **Spur Avoidance** to "Disabled" (OFF).

Note that when **Spur Avoidance** is not in effect, either because you have disabled it or because you are not in multiple capture, the following warning message will appear in the status bar:

`Settings Alert;Spur Avoidance Off`

This is to alert you that measurement accuracy might be negatively impacted.

Remote Command	[:SENSe]:CHPower:SAVoid[:STATe] ON | OFF | 0 | 1 [:SENSe]:CHPower:SAVoid[:STATe]?
Example	:CHP:SAV ON :CHP:SAV?
Dependencies	Only appears in VXT models M9410A/11A/15A
Preset	OFF
State Saved	Saved in instrument state
Range	ON|OFF

Meas Setup Summary Table

Lets you view and access many of the parameters in the **Meas Setup** menus on one screen.

Auto Couple

Immediately puts all **Auto/Man** functions into **Auto**. **Auto Couple** is confined to the current measurement only. It does not affect other measurements in the Mode.

In the **Auto** state, **Auto/Man** functions are said to be “coupled”, meaning their values change as you make changes to other values in the measurement. This helps ensure accurate measurements and optimum dynamic range. **Auto Couple** is an immediate action function, and when it is executed, all the **Auto/Man** controls for the current measurement are set to **Auto**, and all measurement settings coupled to the **Auto/Man** parameters are automatically set to their optimal values.

For further details of measurement-specific settings (if any), see "Measurement-Specific Details" on page 642 below.

Remote Command	`:COUPle ALL`
Example	`:COUP ALL`
Backwards Compatibility SCPI	`:COUPLE ALL | NONE`
Backwards Compatibility Notes	`:COUP:NONE` puts all Auto/Man parameters in manual mode, decoupling all the coupled instrument parameters. It is retained for backwards compatibility and is *not* recommended for making measurements or new designs

All **Auto/Man** parameter couplings in the measurement are set to **Auto**. This includes couplings that may be unavailable or grayed-out due to the current state. For example, in the Swept SA measurement, there is no **Auto/Man** coupling for **RBW** while in Zero Span. Nonetheless, if **Auto Couple** were executed while in Zero Span, it would set **RBW** to Auto "behind the scenes" so that, on exit from Zero Span, it would be in **Auto**.

Any **Auto/Man** selection specific (local) to the other measurements in the current Mode are not affected by **Auto Couple**. Any functions that are *not* coupled with other instrument parameters, such as ranging or leveling variables, such as **AutoRange** or **AutoScale**, are not affected.

Executing **Auto Couple** generates the informational message, "All Auto/Man functions have been set to Auto".

Each parameter, upon being set to **Auto**, selects and sets the appropriate auto-coupled value based on that parameter's coupling rules. The Dependency Resolver orchestrates the couplings for parameters that depend on one or more other parameters. The coupling and dependency rules for each parameter are defined in the section describing that parameter.

Executing **Auto Couple***does not* affect markers, marker functions, trace or display attributes, or any other instrument setting other than those specifically mentioned above.

Measurement-Specific Details

TOI (SA Mode only)

Parameters affected by **Auto Couple** are:

- Center Frequency Step
- Resolution Bandwidth
- Span/RBW Ratio
- Sweep Time
- Video BANDwidth VBW/RBW ratio
- Upper and Lower Tone (set to Sense)
- Zero span measurement Resolution Bandwidth
- Zero span measurement Dwell Time

Harmonics (SA Mode only)

Parameters affected by **Auto Couple** are:

- Resolution Bandwidth
- Fundamental Frequency
- Dwell Time
- Range Table Resolution Bandwidths
- Range Table Dwell Times

Meas Preset

Restores all measurement parameters to their default values.

Remote Command	`:CONFigure:CHPower`
Example	`:CONF:CHP`

3.3.8.2 Meas Method

Allows you to choose between Integration Bandwidth and RRC Weighted methods of making the measurement, and to set certain other relevant parameters.

In MSR, LTE-A FDD/TDD and 5G NR Modes, this feature is not supported.

Meas Method

Selects either the Integration BW (`OFF`) or RRC Weighted (`ON`) methods. Selecting the RRC Weighted method turns the Root Raised Cosine (RRC) filter on. The a value (roll off) for the filter is set to the value of "RRC Filter Alpha" on page 643, and the RRC filter bandwidth is set to "RRC Filter BW" on page 644.

Remote Command	`[:SENSe]:CHPower:FILTer[:RRC][:STATe] OFF | ON | 0 | 1` `[:SENSe]:CHPower:FILTer[:RRC][:STATe]?`
Example	`:CHP:FILT OFF` `:CHP:FILT?`
Notes	This parameter is normally used when TETRA is selected as the Radio Std
Dependencies	For WLAN 802.11 ac (80 + 80 MHz), RRC Weighted is not supported
Preset	`OFF`
State Saved	Saved in instrument state
Range	Integration BW | RRC Weighted

RRC Filter Alpha

Inputs the alpha value for the Root Raised Cosine (RRC) filter.

Remote Command	`[:SENSe]:CHPower:FILTer[:RRC]:ALPHa <real>` `[:SENSe]:CHPower:FILTer[:RRC]:ALPHa?`
Example	`:CHP:FILT:ALPH 0.5` `:CHP:FILT:ALPH?`

Notes	This parameter is normally used when TETRA is selected as the Radio Std
Preset	0.22
State Saved	Saved in instrument state
Min/Max	0.01 / 1.00

RRC Filter BW

Sets the Root Raised Cosine (RRC) filter bandwidth. Normally, the filter bandwidth is the same as the symbol rate of the signal.

Remote Command	`[:SENSe]:CHPower:FILTer[:RRC]:BANDwidth <real>` `[:SENSe]:CHPower:FILTer[:RRC]:BANDwidth?`
Example	`:CHP:FILT:BAND 10MHz` `:CHP:FILT:BAND?`
Notes	This parameter is normally used when TETRA is selected as the Radio Std
Preset	SA, WCDMA, LTE, LTETDD Modes: 3.84 MHz WLAN Mode: **Radio Std** / **Value** 802.11a/g (OFDM/DSSS-OFDM): 16.6 MHz 802.11b: 22 MHz 802.11n (20MHz): 17.8 MHz 802.11n (40MHz: 36.6 MHz
State Saved	Saved in instrument state
Min/Max	100 Hz / 100 MHz
Backwards Compatibility SCPI	`[:SENSe]:CHPower:FILTer[:RRC]:BWIDth`

3.3.8.3 Meas Standard

Contains controls that allow you to preset the PowerSuite measurements to conform to various communications standards.

Radio Standard Presets

Lets you specify the Radio Standard to be used. Spectrum Analyzer Mode supports many Radio Standards. You can select the desired Radio Standard using the **Radio Std Presets** dialog, which is a cascading list of standards. When you have the selected the desired Standard, press **OK** and the measurement settings will change to reflect that standard.

Remote Command	`[:SENSe]:RADio:STANdard[:SELect] NONE | JSTD | IS95a | IS97D | IS98D | GSM | W3GPP | C2000MC1 | C20001X | NADC | PDC | BLUEtooth | TETRa | WL802DOT11A | WL802DOT11B | WL802DOT11G | HIPERLAN2 | DVBTLSN | DVBTGPN | DVBTIPN | FCC15 | SDMBSE | UWBINDOOR | LTEB1M4 | LTEB3M | LTEB5M | LTEB10M | LTEB15M | LTEB20M | WL11N20M | WL11N40M | WL11AC20M | WL11AC40M | WL11AC80M | WL11AC160M | WL11AX20M | WL11AX40M | WL11AX80M | WL11AX160M | WL11BE20M | WL11BE40M | WL11BE80M | WL11BE160M | WL11BE320M | WL11AD2G | WL11AY2G16 | WL11AY4G32 | WL11AY6G48 | WL11AY8G64 | NR5GFR1B100M` `[:SENSe]:RADio:STANdard[:SELect]?`
Example	`:RAD:STAN NONE` `:RAD:STAN?`
Dependencies	Some selections appear only when support license is valid
Couplings	By changing the radio standard, the measurement parameters will be automatically set to an appropriate default value
State Saved	Saved in instrument state

The **Radio** column in the table lets you specify the device to be used. It is a global setting that affects the Device selection, between Mobile (MS) and Base Station (BTS) settings, for all relevant PowerSuite measurements. The Device SCPI command has the same effect as a selection in the **Radio** column:

Remote Command	`[:SENSe]:RADio:STANdard:DEVice BTS | MS` `[:SENSe]:RADio:STANdard:DEVice?`
Example	`:RAD:STAN:DEV MS` `:RAD:STAN:DEV?`
Preset	`BTS`
State Saved	Saved in instrument state
Range	`BTS|MS`

Chart for Standard and Available Measurements

Note that not every measurement in Spectrum Analyzer Mode is available for every standard. The chart below describes which measurements are available for each Radio Standard.

For TOI or Harmonics measurements, *no* Radio Standards are available.

	Swept SA	CHP	OBW	ACP	CCDF	Burst Power	Spurious Emission	SEM	List Sweep
None	X	X	X	X	X	X	X	X	(X)
3GPP 5G NR	(X)	X	X	X	X			X	(X)
3GPP LTE	(X)	X	X	X	X			X	(X)
3GPP W-CDMA	(X)	X	X	X	X	X		X	(X)

	Swept SA	CHP	OBW	ACP	CCDF	Burst Power	Spurious Emission	SEM	List Sweep
GSM/EDGE	(X)				X	X			(X)
cdma2000 1x	(X)	X	X	X	X	X			(X)
IS-95A	(X)	X	X	X	X	X			(X)
J-STD-008	(X)	X	X	X	X	X			(X)
IS-97D/98D	(X)	X	X	X	X				(X)
NADC	(X)	X	X	X	X	X			(X)
PDC	(X)	X	X	X	X	X			(X)
Bluetooth	(X)				X	X			(X)
W-LAN 802.11a	(X)							X	(X)
W-LAN 802.11b	(X)							X	(X)
W-LAN 802.11g	(X)							X	(X)
W-LAN 802.11n	(X)	X	X		X			X	(X)
W-LAN 802.11ac	(X)	X	X		X			X	(X)
W-LAN 802.11ax	(X)	X	X		X			X	(X)
W-LAN 802.11be	(X)	X	X		X			X	(X)
W-LAN 802.11ad	(X)	X	X		X			X	(X)
W-LAN 802.11ay	(X)	X	X		X			X	(X)
W-LAN HiperLAN/2	(X)							X	(X)
TETRA	(X)	X		X					(X)
DVB-T L/SECAM/NICAM	(X)	X			X				(X)
FCC Part 15 Subpart F	(X)	X			X				(X)
DVBT-T G/PAL/NICAM	(X)	X			X				(X)
DVB-T I/PAL/NICAM	(X)						X		(X)
S-DMB System E	(X)	X	X	X					(X)
UWB Indoor	(X)						X		(X)

General Radio Standards

The table below lists the settings and provides an example for each general Radio Standard.

None	Command Example	:RAD:STAN NONE
	IBW	2 MHz
	Span	3 MHz
	RBW	Auto rules
	VBW	Auto rules
TETRA	Command Example	:RAD:STAN TETR
	IBW	18 kHz
	Span	27 kHz
	RBW	1.2 kHz
	VBW	Auto rules
	RRC Filter	On
	RRC Filter Alpha	0.35
FCC Part15 Subpart F	Command Example	:RAD:STAN FCC15

Video Radio Standards

The table below lists the settings and provides an example for each video Radio Standard.

DVB-T L/SECAM/NICAM	Command Example	:RAD:STAN DVBTLSN
	IBW	7.61 MHz
	Span	24 MHz
	RBW	3.9 kHz
	VBW	Auto rules
	Sweep Points	8001
DVB-T G/PAL/NICAM	Command Example	:RAD:STAN DVBTGPN
	IBW	7.61 MHz
	Span	24 MHz
	RBW	3.9 kHz
	VBW	Auto rules
	Sweep Points	8001

DVB-T I/PAL/NICAM	Command Example	:RAD:STAN DVBTIPN
	IBW	7.61 MHz
	Span	24 MHz
	RBW	3.9 kHz
	VBW	Auto rules
	Sweep Points	8001
S-DMB System E	Command Example	:RAD:STAN SDMBSE
	IBW	25 MHz
	Span	37.5 MHz
	RBW	360 kHz
	VBW	Auto rules
	RRC Filter	Off
	RRC Filter Alpha	0.22

Cellular Radio Standards

The table below lists the CHP settings and provides an example for each cellular Radio Standard.

GSM/EDGE	Command Example	:RAD:STAN GSM
3GPP 5G NR	Command Example	:RAD:STAN NR5GFR1B100M
	IBW	100 MHz
	Span	150 MHz
	RBW	Auto rules
	VBW	Auto rules
3GPP W-CDMA	Command Example	:RAD:STAN W3GPP
	IBW	5 MHz
	Span	7.5 MHz
	RBW	240 kHz
	VBW	Auto rules
	RRC Filter	Off
	RRC Filter Alpha	0.22
3GPP LTE 1.4 MHz	Command Example	:RAD:STAN LTEB1M4
	IBW	1.4 MHz
	Span	2.1 MHz
	RBW	Auto rules
	VBW	Auto rules

3GPP LTE 3 MHz	Command Example	:RAD:STAN LTEB3M
	IBW	3 MHz
	Span	4.5 MHz
	RBW	Auto rules
	VBW	Auto rules
3GPP LTE 5 MHz	Command Example	:RAD:STAN LTEB5M
	IBW	5 MHz
	Span	7.5 MHz
	RBW	Auto rules
	VBW	Auto rules
3GPP LTE 10 MHz	Command Example	:RAD:STAN LTEB10M
	IBW	10 MHz
	Span	15 MHz
	RBW	Auto rules
	VBW	Auto rules
3GPP LTE 15 MHz	Command Example	:RAD:STAN LTEB15M
	IBW	15 MHz
	Span	22.5 MHz
	RBW	Auto rules
	VBW	Auto rules
3GPP LTE 20 MHz	Command Example	:RAD:STAN LTEB20M
	IBW	20 MHz
	Span	30 MHz
	RBW	Auto rules
	VBW	Auto rules
cdma2000	Command Example	:RAD:STAN C20001X :RAD:STAN C2000MC1 :RAD:STAN? (Query always returns C20001X)
	IBW	1.23 MHz
	Span	1.845 MHz
	RBW	24 kHz
	VBW	Auto rules

IS-95A	Command Example	:RAD:STAN IS95
	IBW	1.23 MHz
	Span	1.845 MHz
	RBW	24 kHz
	VBW	Auto rules
J-STD-008	Command Example	:RAD:STAN JSTD
	IBW	1.23 MHz
	Span	1.845 MHz
	RBW	24 kHz
	VBW	Auto rules
NADC	Command Example	:RAD:STAN NADC
	IBW	32.8 kHz
	Span	49.2 kHz
	RBW	1.2 kHz
	VBW	Auto rules
PDC	Command Example	:RAD:STAN PDC
	IBW	21 kHz
	Span	31.5 kHz
	RBW	6.2 kHz
	VBW	Auto rules
IS-97D/98D	Command Example	:RAD:STAN IS97D :RAD:STAN IS98D :RAD:STAN IS95C :RAD:STAN? Query always returns `IS97D`
	IBW	1.23 MHz
	Span	1.845 MHz
	RBW	24kHz
	VBW	Auto rules

Band Class (IS-97D/98D only)

The following function is only available when you have selected the standard: IS-97D/98D. It lets you select the band class.

Remote Command	`[:SENSe]:RADio:STANdard:BAND:CLASs BC0 | BC1` `[:SENSe]:RADio:STANdard:BAND:CLASs?`
Example	`:RAD:STAN:BAND:CLAS BC0` `:RAD:STAN:BAND:CLAS?`

Preset	BC0
State Saved	Saved in instrument state
Range	0 (800 MHz Band)|1 (1900 MHz Band)

Wireless Radio Standards

The table below lists the CHP settings and provides an example for each wireless Radio Standard.

WLAN 802.11a	Command Example	:RAD:STAN WL802DOT11A
	IBW	20 MHz
	Span	30 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11g	Command Example	:RAD:STAN WL802DOT11G
	IBW	20 MHz
	Span	30 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11b	Command Example	:RAD:STAN WL802DOT11B
	IBW	25 MHz
	Span	37.5 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11n 20 MHz	Command Example	:RAD:STAN WL11N20M
	IBW	20 MHz
	Span	30 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11n 40 MHz	Command Example	:RAD:STAN WL11N40M
	IBW	40 MHz
	Span	60 MHz
	RBW	100 kHz
	VBW	Auto rules

WLAN 802.11ac 20 MHz	Command Example	:RAD:STAN WL11AC20M
	IBW	20 MHz
	Span	30 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11ac 40 MHz	Command Example	:RAD:STAN WL11AC40M
	IBW	40 MHz
	Span	60 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11ac 80 MHz	Command Example	:RAD:STAN WL11AC80M
	IBW	80 MHz
	Span	120 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11ac 160 MHz	Command Example	:RAD:STAN WL11AC160M
	IBW	160 MHz
	Span	240 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11ax 20 MHz	Command Example	:RAD:STAN WL11AX20M
	IBW	20 MHz
	Span	30 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11ax 40 MHz	Command Example	:RAD:STAN WL11AX40M
	IBW	40 MHz
	Span	60 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11ax 80 MHz	Command Example	:RAD:STAN WL11AX80M
	IBW	80 MHz
	Span	120 MHz
	RBW	100 kHz
	VBW	Auto rules

WLAN 802.11ax 160 MHz	Command Example	:RAD:STAN WL11AX160M
	IBW	160 MHz
	Span	240 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11be 20 MHz	Command Example	:RAD:STAN WL11BE20M
	IBW	20 MHz
	Span	30 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11be 40 MHz	Command Example	:RAD:STAN WL11BE40M
	IBW	40 MHz
	Span	60 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11be 80 MHz	Command Example	:RAD:STAN WL11BE80M
	IBW	80 MHz
	Span	120 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11be 160 MHz	Command Example	:RAD:STAN WL11BE160M
	IBW	160 MHz
	Span	240 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11be 320 MHz	Command Example	:RAD:STAN WL11BE320M
	IBW	320 MHz
	Span	480 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11ad 2 GHz	Command Example	:RAD:STAN WL11AD2G
	IBW	2.16 GHz
	Span	3.24 GHz
	RBW	1 MHz
	VBW	Auto rules

WLAN 802.11ay 2.16 GHz	Command Example	:RAD:STAN WL11AY2G16
	IBW	2.16 GHz
	Span	3.24 GHz
	RBW	1 MHz
	VBW	Auto rules
WLAN 802.11ay 4.32 GHz	Command Example	:RAD:STAN WL11AY4G32
	IBW	4.32 GHz
	Span	6.48 GHz
	RBW	1 MHz
	VBW	Auto rules
WLAN 802.11ay 6.48 GHz	Command Example	:RAD:STAN WL11AY6G48
	IBW	6.48 GHz
	Span	9.72 GHz
	RBW	1 MHz
	VBW	Auto rules
WLAN 802.11ay 8.64 GHz	Command Example	:RAD:STAN WL11AY8G64
	IBW	8.64 GHz
	Span	12.96 GHz
	RBW	1 MHz
	VBW	Auto rules
3GPP 5G NR 5G NR FR1 100MHz	Command Example	:RAD:STAN NR5GFR1B100M
	IBW	100 MHz
	Span	150 MHz
	RBW	Auto rules
	VBW	Auto rules

WLAN HiperLAN/2	Command Example	:RAD:STAN HIPERLAN2
	UWB Indoor	Command Example RAD:STAN UWBINDOOR
	Bluetooth	Command Example RAD:STAN BLUE

Packet Type (Bluetooth only)

The command below sets the packet type for the Bluetooth measurement

Remote Command	`[:SENSe]:RADio:STANdard:PACKet DH1 | DH3 | DH5` `[:SENSe]:RADio:STANdard:PACKet?`
Example	`:RAD:STAN:PACK DH1` `:RAD:STAN:PACK?`
Notes	The packet length is:

	DH1	366 µs
	DH3	1622 µs
	DH5	2870 µs
Preset	DH1	
State Saved	Saved in instrument state	
Range	DH1 | DH3 | DH5	

Radio Standard Presets Hierarchy

General	None	
	TETRA	BTS
		MS
	FCC Part 15 Subpart F	
	APCO-25	
	DMR	
	dPMR	
Video	DVB-T	L/SECAM/NICAM
		G/PAL/NICAM
		I/PAL/NICAM
	S-DMB System E	

Cellular	3GPP 5G NR	BTS	FR1 100 MHz
		MS	FR1 100 MHz
	3GPP LTE	BTS	1.4 MHz (6 RB)
			3 MHz (15 RB)
			5 MHz (25 RB)
			10 MHz (50 RB)
			15 MHz (75 RB)
			20 MHz (100 RB)
		MS	1.4 MHz (6 RB)
			3 MHz (15 RB)
			5 MHz (25 RB)
			10 MHz (50 RB)
			15 MHz (75 RB)
			20 MHz (100 RB)
	3GPP W-CDMA	BTS	
		MS	
	GSM/EDGE	BTS	
		MS	
	cdma2000 1x	BTS	
		MS	
	IS-95A	BTS	
		MS	
	J-STD-008	BTS	
		MS	
	IS-97D/98D	BTS	Band Class 0
			Band Class 1
		MS	Band Class 0
			Band Class 1
	NADC	BTS	
		MS	
	PDC	BTS	
		MS	

Wireless	W-LAN	802.11a	
		802.11b	
		802.11g	
		802.11n	20 MHz
			40 MHz
		802.11ac	20 MHz
			40 MHz
			80 MHz
			160 MHz
		802.11ax	20 MHz
			40 MHz
			80 MHz
			160 MHz
		802.11be	20 MHz
			40 MHz
			80 MHz
			160 MHz
			320 MHz
		802.11ad	
		802.11ay	2.16 GHz
			4.32 GHz
			6.48 GHz
			8.64 GHz
		HiperLAN/2	
	Bluetooth	DH1	
		DH3	
		DH5	
	UWB Indoor		

Each Radio Standard has the preset parameter set for the measurement.

When a standard is selected, the default value of the measurement parameters are overwritten by those preset values.

When the standard is `NONE`, or the standard does not specify the firm RBW requirement, then the table displays “auto”, and the following definition is used to compute the proper RBW setting:

1. Compute the guard-band = [Offset Freq A] - 0.5*([Chan Integ BW] + [Ref BW])
2. Divide by 4.5. Call the result GuardbandGoalRBW

3. Compute the greater of the Reference and Offset A integration bandwidths. Divide that result by 100 and call it the ChannelWidthGoalRBW
4. Find the smallest integration bandwidth of any of the offsets; divide it by two and call the result IntegBWGoalRBW
5. Compute AutoRBWGoal = min(IntegBWGoal, max(GuardbandGoalRBW, ChannelWidthGoalRBW))
6. Compute the RBW to be selected to be the largest available RBW that is smaller than AutoRBWGoal

Measurements that are unavailable for a particular Radio Standard are grayed-out. Radio Standards that are unavailable for the current active measurement are also grayed-out.

However, remote operations, such as `:CONF` allow the measurement to be active even if it is not a supported format. In this case, the measurement configuration should be set to `NONE`.

Enable Non-Std Meas

Lets you specify whether all measurements and radio standards are enabled or not.

By default, **Enable Non-Std Measurements** is set to `NO`, so you can select only valid combinations of preset available standards and measurements. Combinations of measurement and standard that would have no valid preset value are grayed-out.

When **Enable Non-Std Measurements** is set to `YES`, all measurements and standard selections are enabled, so you can select any combination.

NOTE **If you select an unavailable measurement or unavailable radio standard using the Enable Non-Std Meas control, the measurement results may not conform to the selected standard.**

Remote Command	`[:SENSe]:RADio:STANdard:EAMeas YES | NO` `[:SENSe]:RADio:STANdard:EAMeas?`
Example	`:RAD:STAN:EAM YES` `:RAD:STAN:EAM?`
Preset	`NO`
State Saved	Saved in instrument state
Range	`YES|NO`

3.3.8.4 Limits

Allows you to set up the test limit for channel power or power spectral density.

When DVB-T radio standard is selected in SA Mode, this functionality is disabled, and the input signal is instead compared against a pre-defined spectrum mask.

In LTE-A FDD/TDD and 5G NR Modes, this feature is not supported.

In MSR Mode, this feature is not supported, because the power of each carrier may be different.

Power Limit

If **Power Limit** state is ON, this setting is a threshold to determine whether the real measured channel power can be passed or not. If real measured channel power exceeds **Power Limit**, the channel power test fails, otherwise, it passes.

If **Power Limit** state is OFF, the channel power test always passes.

Remote Command	`:CALCulate:CHPower:LIMit:POWer <ampl>` `:CALCulate:CHPower:LIMit:POWer?`
Example	`:CALC:CHP:LIM:POW 16.00` `:CALC:CHP:LIM:POW?`
Notes	This parameter and PSD Limit can determine Pass/Fail criteria

Power Limit state	PSD Limit state	Result
ON	OFF	Pass if power test passes Fail if power test fails
ON	ON	Pass if both power test and PSD test pass Fail if either of power test or PSD test fails
OFF	ON	Pass if PSD test passes Fail if PSD test fails
OFF	OFF	Always Pass

For WLAN 802.11ac (80 MHz + 80 MHz), the power test and the PSD test are performed to both carriers, which means the power (or PSD) readouts of both carriers should be compared with the power (or PSD) limit individually, and the test passes only when *both* values are lower than the limit

Preset	16.00
State Saved	Saved in instrument state
Min/Max	–/+200.0

Auto Function

Remote Command	`:CALCulate:CHPower:LIMit:POWer:STATe OFF | ON | 0 | 1` `:CALCulate:CHPower:LIMit:POWer:STATe?`
Example	`:CALC:CHP:LIM:POW:STAT ON` `:CALC:CHP:LIM:POW:STAT?`

Preset	WLAN Mode: ON All other Modes: OFF
State Saved	Yes
Range	OFF|ON

PSD Limit

Power Spectral Density Limit.

If **PSD Limit** state is ON, **PSD Limit** is a threshold to determine whether the real measured PSD will pass or not. If real measured PSD exceeds PSD Limit, the test fails, otherwise, it passes.

If **PSD Limit** state is OFF, the test always passes.

Remote Command	`:CALCulate:CHPower:LIMit:PSDensity <real>` `:CALCulate:CHPower:LIMit:PSDensity?`
Example	`:CALC:CHP:LIM:PSD 4.00` `:CALC:CHP:LIM:PSD?`
Notes	This parameter and Power Limit can determine Pass/Fail criteria

Power Limit state	PSD Limit state	Result
ON	OFF	Pass if power test passes Fail if power test fails
ON	ON	Pass if both power test and PSD test pass Fail if either of power test or PSD test fails
OFF	ON	Pass if PSD test passes Fail if PSD test fails
OFF	OFF	Always Pass

For WLAN 802.11ac (80 MHz + 80 MHz), the power test and the PSD test are performed to both carriers. Which means the PSD (or power) readouts of both carriers should be compared with the PSD (or power) limit individually, and the test passes only when both values are lower than the limit

Couplings	The value is automatically converted when PSD Unit is changed
Preset	WLAN mode or SA mode with WLAN radio standard: 4.00 dBm/MHz Otherwise: 4.00 dBm/Hz
State Saved	Saved in instrument state
Min/Max	–/+200.0

Auto Function

Remote Command	`:CALCulate:CHPower:LIMit:PSDensity:STATe OFF | ON | 0 | 1`

	:CALCulate:CHPower:LIMit:PSDensity:STATe?
Example	:CALC:CHP:LIM:POW:STAT ON :CALC:CHP:LIM:POW:STAT?
Preset	WLAN Mode: ON All other Modes: OFF
State Saved	Yes
Range	OFF|ON

Power Limit Fail (Remote Query Only)

Queries whether a power test passes or fails. When DVB-T radio standard is selected in SA Mode, the result of this query has no meaning.

While implementing the scpi, don't try to remove the SCPI command from the SCPI tree when DVB-T is selected as current radio standard.

Remote Command	:CALCulate:CHPower:LIMit:POWer:FAIL?
Example	:CALC:CHP:LIM:POW:FAIL?
Notes	Query only When "Power Limit" on page 660 state is OFF, the returned value is always 0 (pass) When **Power Limit** state is ON, the returned value is 0 (pass) if power test passes and 1(fail) if power test fails

PSD Limit Fail (Remote Query only)

Queries whether PSD test passes or fails. When DVB-T radio standard is selected in SA Mode, the result of this query has no meaning.

While implementing the scpi, don't try to remove the SCPI command from the SCPI tree when DVB-T is selected as current radio standard.

Remote Command	:CALCulate:CHPower:LIMit:PSD:FAIL?
Example	:CALC:CHP:LIM:PSD:FAIL?
Notes	Query only When "PSD Limit" on page 661 state is OFF, the returned value is always 0 (pass) When **PSD Limit** state is ON, the returned value is 0 (pass) if PSD test passes and 1(fail) if PSD test fails

3.3.8.5 Advanced

Contains controls for setting advanced functions of the instrument.

Does not appear in VXT.

Phase Noise Optimization

Allows you to select the LO (local oscillator) phase noise behavior for various operating conditions. When in Auto, selects the LO (local oscillator) phase noise behavior to optimize dynamic range and speed for various instrument operating conditions.

For full details, see "Parameter Options, Installed Options & Ranges" on page 663 below.

Remote Command	`[:SENSe]:CHPower:FREQuency:SYNThesis[:STATe] 1 | … | 5`
	For the meaning of each numeric option value, see "Parameter Options, Installed Options & Ranges" on page 663 below
	`[:SENSe]:CHPower:FREQuency:SYNThesis[:STATe]?`

Example	`:CHP:FREQ:SYNT 1` `:CHP:FREQ:SYNT?`
Dependencies	Does not appear in all models. For models in which the control is not displayed, the SCPI command is accepted for compatibility, although no action is taken
Preset	3
State Saved	Saved in instrument state
Range	See "Ranges" on page 668 below

Auto Function

Remote Command	`[:SENSe]:CHPower:FREQuency:SYNThesis:AUTO[:STATe] OFF | ON | 0 | 1` `[:SENSe]:CHPower:FREQuency:SYNThesis:AUTO[:STATe]?`
Example	`:CHP:FREQ:SYNT:AUTO 1` `:CHP:FREQ:SYNT:AUTO?`
Preset	`OFF`

Parameter Options, Installed Options & Ranges

The Phase Noise Optimization control lets you optimize the setup and behavior of the Local Oscillator (LO) depending on your specific measurement conditions. You may wish to trade off noise and speed, for example, to make a measurement faster without regard to noise or with optimum noise characteristics without regard to speed.

Parameter Values Summary

Option	#	Description
"Balanced" on page 665	1	– In instruments with EP0, balances close-in phase noise with spur avoidance – In instruments without EP0 optimizes phase noise for small frequency offsets from the carrier
"Best Wide-offset" on page 665	2	Optimizes phase noise for wide frequency offsets from the carrier
"Fast Tuning" on page 666	3	Optimizes LO for tuning speed
"Best Close-in" on page 664	4 or 1*	– In instruments with EP0, emphasizes close-in phase noise performance without regard to spur avoidance – In instruments without EP0, this setting is accepted but no action is taken
"Best Spurs" on page 665	5	– In instruments with EP0, emphasizes spur avoidance over close-in phase noise performance – In instruments without EP0, this setting is accepted but no action taken
Auto	-	Automatically selects LO (local oscillator) phase noise behavior to optimize dynamic range and speed for various instrument operating conditions

*Dependent on Option EP0 installation. See "Best Close-in" on page 664 below.

The actual behavior varies somewhat depending on model number and option; for example, you always get Fast Tuning by choosing Option #3, but in some models, "Fast Tuning" on page 666 is identical in effect to "Best Close-in" on page 664.

Best Close-in

Without option EP0

```
:FREQ:SYNT 1
```

The LO phase noise is optimized for smaller offsets from the carrier, at the expense of phase noise farther out.

The actual frequency offset within which noise is optimized is shown with in square brackets, as this can vary depending on the hardware set in use. For example, in some instruments this annotation appears as [offset <20 kHz]

With option EP0

```
:FREQ:SYNT 4
```

In instruments with Option EP0, the LO is configured for the best possible close-in phase noise (offsets up to 600 kHz from the carrier), regardless of spurious products that occur with some center frequencies. Because this is generally less desirable for close-in measurements than the "Balanced" on page 665 setting, parameter 1 selects "Balanced" on page 665 in EP0 instruments, in the interests of optimizing code compatibility across the family. Parameter 4 selects "Best Close-in" on page 664, which is usually not as good a choice as "Balanced" on page 665.

Balanced

`:FREQ:SYNT 1`

In instruments with EP0, the LO is configured for the best possible phase noise at offsets up to 600 kHz from the carrier whenever there are no significant spurs within the span observed with an on-screen carrier. When there will be such a spur, the LO is reconfigured in a way that allows the phase noise to increase by 7 dB mostly within ±1 octave around 400 kHz offset. The spurs will always be below –70 dBc.

Best Spurs

`:FREQ:SYNT 5`

In instruments with EP0, the LO is configured for better phase noise than the "Best Wide-offset" on page 665 case close to the carrier, but the configuration has 11 dB worse phase noise than the "Best Close-in" on page 664 case mostly within ±1 octave around 300 kHz offset. Spurs are even lower than in the "Balanced" on page 665 case at better than –90 dBc, whether or not the carrier is on-screen.

This setting is never selected when Phase Noise Optimization is in Auto, you must select it manually.

Best Wide-offset

`:FREQ:SYNT 2`

The LO phase noise is optimized for wider offsets from the carrier. Optimization is especially improved for offsets from 70 kHz to 300 kHz. Closer offsets are compromised and the throughput of measurements (especially remote measurements where the center frequency is changing rapidly), is reduced.

The actual frequency offset beyond which noise is optimized is shown with in square brackets, as this can vary depending on the hardware set in use. For example, in some instruments this annotation appears as [offset >30 kHz]

In instruments with Option EP0, the LO is configured for the best possible phase noise at offsets up to 600 kHz from the carrier whenever there are no significant spurs within the span observed with an on-screen carrier. When there will be such a spur, the LO is reconfigured in a way that allows the phase noise to increase by 7 dB mostly within ±1 octave around 400 kHz offset. The spurs will always be below –70 dBc.

Fast Tuning

`:FREQ:SYNT 3`

In this mode, the LO behavior compromises phase noise at many offsets from the carrier in order to allow rapid measurement throughput when changing the center frequency or span. The term "Fast Tuning" on page 666 refers to the time it takes to move the local oscillator to the start frequency and begin a sweep; this setting does not impact the actual sweep time in any way.

In instruments with EP1, the LO behavior compromises phase noise at offsets below 4 MHz in order to improve measurement throughput. The throughput is especially affected when moving the LO more than 2.5 MHz and up to 10 MHz from the stop frequency to the next start frequency.

In instruments with Option EP0, this is the same configuration as "Best Spurs" on page 665. It is available with the "Fast Tuning" on page 666 label for convenience, and to make the user interface more consistent with other X-Series instrument family members.

(In models whose hardware does not provide for a "Fast Tuning" on page 666 option, the settings for "Best Close-in" on page 664 are used if "Fast Tuning" on page 666 is selected. This gives the fastest possible tuning for that hardware set.)

Auto

`:FREQ:SYNT:AUTO ON`

Selects the LO (local oscillator) phase noise behavior to optimize dynamic range and speed for various instrument operating conditions. The selection rules are as follows.

Auto Optimization Rules

X-Series instruments have several grades of LO, offering different configurations when in the Auto Mode. The rules for Auto selection are as follows:

Models with Option	Conditions	Selection
EP0 Models with option EP0 have a two stage local oscillator, which switches to a single loop for fast tuning (available in UXA)	Center frequency is < 699.9 kHz	"Balanced" on page 665
	Span > 114.1 MHz, *or* RBW > 800 kHz	"Fast Tuning" on page 666
	RBW > 290 kHz, *or* Span > 4.2 MHz	"Best Wide-offset" on page 665
	Other conditions	"Balanced" on page 665

Models with Option	Conditions	Selection
EP1 Models with option EP1 have a two-loop local oscillator, which switches to a single loop for fast tuning (available in PXA)	Span > 44.44 MHz, *or* RBW > 1.9 MHz, *or* Source Mode is set to "Tracking"	"Fast Tuning" on page 666
	Center frequency is < 195 kHz, *or* CF >= 1 MHz *and* Span <= 1.3 MHz *and* RBW <= 75 kHz	"Best Close-in" on page 664
	All other conditions	"Best Wide-offset" on page 665
EP2 Models with option EP2 use a different loop bandwidth for the fast-tuning choice, which is a compromise between tuning speed and phase noise, giving good tuning speed at all offsets. Although not as good as for "Best Close-in" on page 664; this is useful when you have to look across a wide range of spans (available, for example, in MXA for excellent phase noise)	CF < 130 kHz , *or* CF > 12 MHz *and* Span < 495 kHz *and* RBW < 40 kHz	"Best Close-in" on page 664
	Span > 22 MHz, *or* RBW > 400 kHz, *or* CF ≤ 12 MHz *and* Span < 495 kHz *and* RBW < 23 kHz	"Fast Tuning" on page 666
	All other conditions	"Best Wide-offset" on page 665
EP4 (available in CXA for improved phase noise)	Span > 101 MHz *or* RBW > 1.15 MHz *or* Source Mode is set to "Tracking"	"Fast Tuning" on page 666
	CF is < 109 kHz *or* CF >= 4.95 MHz *and* Span <= 666 kHz *and* RBW < 28 kHz	"Best Close-in" on page 664
	All other conditions	"Best Wide-offset" on page 665
All Other Models Note that in these models, the hardware does not actually provide for an extra-fast tuning option, so the settings for "Fast Tuning" on page 666 are actually the same as "Best Close-in" on page 664, but the rules are implemented this way so that the user who doesn't care about phase noise but does care about tuning speed doesn't have to remember which of the other two settings gives faster tuning	Span > 12.34 MHz, *or* RBW > 250 kHz, *or* Source Mode is set to "Tracking"	"Fast Tuning" on page 666
	Center frequency is < 25 kHz, *or* CF >= 1 MHz *and* Span <= 141.4 kHz *and* RBW <= 5 kHz	"Best Close-in" on page 664
	All other conditions	"Best Wide-offset" on page 665

In all the above cases:

- The RBW to be used in the calculations is the equivalent –3 dB bandwidth of the current RBW filter
- The rules apply whether in swept spans, zero span, or FFT spans

Ranges

Option	Option #	Phase Noise Option	Range
No EPx Option	1	Best Close-in	[offset < 20 kHz]
	2	Best Wide-offset	[offset > 30 kHz]
	3	Fast Tuning	[same as Best Close-In]
EP0	4	Best Close-in	[offset < 600 kHz]
	1	Balanced	[offset < 600 kHz]
	5	Best Spurs	[offset < 600 kHz]
	2	Best Wide-offset	[offset > 800 kHz]
	3	Fast Tuning	[same as Best Close-In]
EP1	1	Best Close-in	[offset < 140 kHz]
	2	Best Wide-offset	[offset > 160 kHz]
	3	Fast Tuning	[single loop]
EP2, EP3, EP5	1	Best Close-in	[offset < 70 kHz]
	2	Best Wide-offset	[offset > 100 kHz]
	3	Fast Tuning	[medium loop bw]
EP4	1	Best Close-in	[offset < 90 kHz]
	2	Best Wide-offset	[offset > 130 kHz]
	3	Fast Tuning	[same as Best Close-In]

Noise Floor Extension

Allows you to turn on/configure the Noise Floor Extension (NFE) function. Some Modes (such as Spectrum Analyzer Mode), support two states of NFE, Full and Adaptive. The `ON` state (in Modes which do not support Adaptive NFE) matches the `FULL` state (in Modes that *do* support Adaptive NFE).

In `ON` or `FULL` NFE, the expected noise power of the instrument (derived from a factory calibration) is subtracted from the trace data. This will usually reduce the apparent noise level by about 10 dB in low band, and 8 dB in high band (>~3.6 GHz).

In Adaptive NFE, there is not the same dramatic visual impact on the noise floor as there is in Full NFE. Adaptive NFE controls the amount of correction that is applied based on other instrument settings like RBW, averaging and sweep time. Adaptive

NFE controls the degree of potential improvement in the noise floor to give more improvement for those instrument settings that can make good use of the potential improvement, such as settings that provide more averaging. The result is that when not much averaging is being performed, the signal displays more like the NFE-off case; and when lots of averaging is being performed, the signal displays more like the full-NFE case.

Adaptive NFE (in Modes which support it) is recommended for general-purpose use. For fully ATE (automatic test equipment) applications, where the distraction of a person using the instrument is not a risk, Full NFE is recommended.

NFE works with any RBW, VBW, detector, any setting of Average Type, any amount of trace averaging, and any signal type. It is ineffective when the trace is not smoothed (smoothing processes include narrow VBWs, trace averaging, and long sweep times with the detector set to Average or Peak). It works best with extreme amounts of smoothing, and with the average detector, with the Average Type set to Power.

In those cases where the cancellation is ineffective, it nonetheless has no undesirable side-effects. There is no significant speed impact to having **Noise Floor Extension** on.

The best accuracy is achieved when substantial smoothing occurs in each point before trace averaging. Thus, when using the average detector, results are better with long sweep times and fewer trace averages. When using the sample detector, the VBW filter should be set narrow with less trace averaging, instead of a wide VBW filter with more trace averaging.

NOTE **Noise Floor Extension has no effect unless the RF Input is selected, so it does nothing when External Mixing is selected.**

In Modes that support Adaptive NFE, the default state of NFE is Adaptive (`ON`). In Modes that do not support Adaptive NFE, the default state of NFE is `OFF`. Prior to the introduction of Adaptive NFE (firmware version A.18.00), the default state of NFE was `OFF` for all Modes.

With the introduction of Adaptive NFE, the menu control is changed from **On|Off** to **Full|Adaptive|Off**. For SCPI Backwards Compatibility, the existing SCPI command to turn NFE on or off was retained, and a new command was added to set the state to turn Adaptive On or Off:

- `[:SENSe]:CORRection:NOISe:FLOor ON|OFF|1|0` is retained, default changed to On for modes that support Adaptive NFE
- `[:SENSe]:CORRection:NOISe:FLOor:ADAPtive ON|OFF|1|0` is added (for certain Modes), default = On
- `FULL` = `:CORRection:NOISe:FLOor ON` plus `:CORRection:NOISe:FLOor:ADAPtive ON`

See "More Information" on page 670

Remote Command	`[:SENSe]:CORRection:NOISe:FLOor ON | OFF | 1 | 0` `[:SENSe]:CORRection:NOISe:FLOor?`
Example	`:CORR:NOIS:FLO ON`
Dependencies	Only appears in instruments with the NFE or NF2 license installed. In all others, does not appear, but the SCPI command will be accepted without error but has no effect
Couplings	When NFE is enabled in any mode manually, a prompt will be displayed reminding you to perform the Characterize Noise Floor operation if it is needed. If NFE is enabled through SCPI and a Characterize Noise Floor operation is needed, an error will be entered in the system error queue
Preset	Unaffected by **Mode Preset**. Turned ON at startup and by **Restore Mode Defaults** in Modes that support Adaptive. Turned `OFF` at startup and by **Restore Mode Defaults** in Modes that do not support Adaptive
State Saved	No

Remote Command	`[:SENSe]:CORRection:NOISe:FLOor:ADAptive ON | OFF | 1 | 0` `[:SENSe]:CORRection:NOISe:FLOor:ADAptive?`

Example	Turn NFE ON (Full mode):
	`:CORR:NOIS:FLO ON`
	Set to Adaptive:
	`:CORR:NOIS:FLO:ADAP ON`

Dependencies	Only available in Modes that support Adaptive NFE Only appears in instruments with the NFE or NF2 license installed. In all others, the control does not appear, but the SCPI command is accepted without error (but has no effect)
Couplings	For backwards compatibility, sending `:CORR:NOIS:FLO ON` turns NFE Adaptive `OFF`. To turn Adaptive ON, you must issue the commands in the proper order, as shown in the example above
Preset	Not affected by **Mode Preset**, but set to ON at startup and by **Restore Mode Defaults**
State Saved	No

More Information

The instrument is characterized in the factory (or during a field calibration) with a model of the noise, referred to the input mixer, versus frequency in each band and path combination. Bands are 0 (low band) and 1 through 4 (high band) in a 26.5 GHz instrument, for example. Paths include normal paths, preamp paths, the electronic attenuator, etc.

In most band/path combinations, the noise can be well characterized based on just two parameters and the instrument frequency response before compensation for frequency-dependent losses.

After the noise density at the input mixer is estimated, the effects of the input attenuator, RBW, detector, etc. are computed to get the estimated input-port-referred noise level.

In the simplest case, the measured power (signal plus instrument noise) in each display point (bucket) is compensated by subtracting the estimated noise power, leaving just the signal power. This is the operation when the detector is Average, and the Average Type is set to Power.

In other cases, operation is often not quite as good but still highly effective. With peak detection, the noise floor is estimated based on the RBW and the duration of the bucket using the same equations used in the noise marker function. The voltage of the noise is subtracted from the voltage of the observed signal-plus-noise measurement to compute the estimated signal voltage. The peak detector is one example of processing that varies with detector to give good estimates of the signal level without the instrument noise.

For best operation, the average detector and the power scale are recommended, as already stated. Peak detection for pulsed-RF can still give excellent effectiveness. FFT analysis does not work well, and does not do NFE well, with pulsed-RF signals, so this combination is not recommended. Negative peak detection is not very useful, either. Sample detection works well, but is never better than the average detector because it doesn’t smooth as well. The Normal detector is a combination of peak and negative peak behaviors, and works about as well as these.

For best operation, extreme smoothing is desirable, as already stated. Using narrow VBWs works well, but using very long bucket durations and the average detector works best. Reducing the number of trace points will make the buckets longer.

For best operation, the power scale (Average Type = Power) is optimum. When making CW measurements in the presence of noise without NFE, averaging on the decibel scale has the advantage of reducing the effect of noise. When using NFE, the NFE does an even better job than using the log scale ever could. Using NFE with the log scale is not synergistic, though; NFE with the power scale works a little better than NFE with log averaging type.

The results from NFE with internal preamp can often be lower than the theoretical noise in a signal source at room temperature, a noise density of -174 dBm/Hz. This is expected and useful behavior, because NFE is designed to report the amount of input signal that is in excess of the thermal noise, not the amount that includes the thermal noise. This can be a useful behavior because thermal noise often interferes with what you want to measure, instead of being part of what you want to measure. Note that NFE is not adequately accurate to always be able to read below kTB.

Adaptive NFE provides an alternative to fully-on and -off NFE. Fully-on NFE can, notably in cases with little or no averaging of the spectrum, result in a display that is distractingly unfamiliar in the variability in response to low level signals. Fully-off NFE fails to achieve the potential improvement in dynamic range and associated accuracy of measurement of low-level signals. Adaptive NFE controls the degree of potential improvement in the noise floor to give more improvement for those instrument settings that can make good use of the potential improvement—those settings with high degrees of variance reduction through some variant of averaging.

When the potential improvement is small, the display acts like the NFE-off case, and when it is high, it acts like the fully-on case, and in-between, application is a compromise between attractiveness and effectiveness.

On instruments with the NF2 license installed, the calibrated Noise Floor used by Noise Floor Extensions should be refreshed periodically. Keysight recommends that the **Characterize Noise Floor** operation be performed after the first 500 hours of operation, *and* once every calendar year. The control to perform this is located in the **System, Alignments, Advanced** menu. If you have not done this yourself at the recommended interval, then when you turn on Noise Floor Extensions, the instrument will prompt you to do so with a dialog that says:

"This action will take several minutes to perform. Please disconnect all cables from the RF input and press Enter to proceed. Press ESC to cancel, or Postpone to postpone for a week"

If you **Cancel**, you will be prompted again the next time you turn NFE `ON`. If you **Postpone**, you will be prompted again after a week passes and you then turn NFE `ON`.

3.3.8.6 Global

The controls in this menu apply to all Modes in the instrument.

Some controls (for example, "Global Center Freq" on page 2013) allow you to switch certain Meas Global parameters to a Mode Global state. These switches apply to all Modes that support global settings. For example, no matter what Mode you are in when you set **Global Center Freq** to `ON`, it applies to all Modes that support Global settings.

Other controls (for example, **Extend Low Band**) are actually set in this menu, but apply to all Modes.

Global Center Freq

The software maintains a Mode Global value called **Global Center Freq**.

When **Global Center Freq** is switched `ON`, the current Mode's center frequency is copied into the **Global Center Frequency**, and from then on all Modes that support global settings use the **Global Center Frequency**, so you can switch between any of these Modes and the **Center Frequency** remains unchanged.

Adjusting the **Center Frequency** of any Mode that supports Global Settings, while **Global Center Freq** is `ON`, modifies the **Global Center Freq**.

When **Global Center Freq** is switched `OFF`, the **Center Frequency** of the current Mode is unchanged, but now the **Center Frequency** of each Mode is once again independent.

When **Mode Preset** is pressed while **Global Center Freq** is `ON`, the **Global Center Freq** is preset to the preset **Center Frequency** of the current Mode.

This function resets to `OFF` when "Restore Defaults" on page 2016 is pressed, or when **System**, **Restore Defaults**, **All Modes** is pressed.

Remote Command	`:INSTrument:COUPle:FREQuency:CENTer ALL | NONE` `:INSTrument:COUPle:FREQuency:CENTer?`
Example	`:INST:COUP:FREQ:CENT ALL` `:INST:COUP:FREQ:CENT?`
Preset	Set to `OFF` on **Global** Settings, **Restore Defaults** and **System, Restore Defaults, All Modes**
Range	`ALL|NONE`

Preset	`OFF`
Backwards Compatibility SCPI	`:GLOBal:FREQuency:CENTer[:STATe] 1 | 0 | ON | OFF` `:GLOBal:FREQuency:CENTer[:STATe]?`

Global EMC Std

When this control is switched `ON`, the current Mode's EMC Std is copied into the **Global EMC Std**, and from then on all Modes that support global settings use the **Global EMC Std**, so you can switch between any of these Modes and the EMC Std remains unchanged.

Adjusting the EMC Std of any Mode that supports Global settings, while **Global EMC Std** is `ON` modifies the **Global EMC Std**.

When **Global EMC Std** is switched `OFF`, the EMC Std of the current Mode remains unchanged, but now the EMC Std of each Mode is once again independent. When **Mode Preset** is pressed while **Global EMC Std** is `ON`, **Global EMC Std** is preset to the preset EMC Std of the current Mode.

This function resets to `OFF` when "Restore Defaults" on page 2016 is pressed, or when **System, Restore Defaults, All Modes** is pressed.

Remote Command	`:INSTrument:COUPle:EMC:STANdard ALL | NONE` `:INSTrument:COUPle:EMC:STANdard?`
Example	`:INST:COUP:EMC:STAN ALL` `:INST:COUP:EMC:STAN?`
Dependencies	Only available if Option EMC is installed
Preset	Set to `OFF` on **Global** Settings, **Restore Defaults** and **System, Restore Defaults, All Modes**
Range	`ALL | NONE`

Global Limit Lines (Freq and Amptd)

When this control is set to ALL, the current Mode's Limit Line is copied into the **Global Limit Lines**, and from there to all Modes that support Global settings and use **Global Limit Lines**, so you can switch between any of these Modes and the Limit Lines remain unchanged.

Adjusting the Limit Lines of any Mode that supports **Global** Settings, while **Global Limit Lines** is ALL, modifies the **Global Limit Lines**.

When **Global Limit Lines** is set to NONE, the Limit Lines of the current Mode are unchanged, but now the Limit Lines of each Mode are once again independent. When **Mode Preset** is pressed while **Global Limit Lines** is ALL, **Global Limit Lines** is preset to the preset Limit Lines of the current Mode.

This function is reset to NONE when "Restore Defaults" on page 2016 is pressed, or when **System**, **Restore Defaults**, **All Modes** is pressed.

Remote Command	`:INSTrument:COUPle:LLINe ALL | NONE` `:INSTrument:COUPle:LLINe?`
Example	`:INST:COUP:LLIN ALL | NONE` `:INST:COUP:LLIN?`
Preset	Set to OFF on **Global** Settings, **Restore Defaults** and **System, Restore Defaults, All Modes**
Range	ALL | NONE

Extend Low Band

The software maintains a Mode Global value called **Extend Low Band**.

Under the current sweep configuration crossing over two bands, when **Extend Low Band** is turned ON, the instrument checks whether one band can cover the whole sweep frequency range or not. If it can, then the instrument locks the band; otherwise, it does nothing (the band crossover occurs).

This function does *not* work when **Band Lock** under **System** > **Service** > **Lock Functions** is not -1 (no Band Lock). In that case, **Band Lock** takes priority over **Extend Low Band**.

This function resets to OFF when "Restore Defaults" on page 2016 is pressed, or when **System**, **Restore Defaults**, **All Modes** is pressed.

Remote Command	`:INSTrument:COUPle:FREQuency:BAND:EXTend 0 | 1 | ON | OFF` `:INSTrument:COUPle:FREQuency:BAND:EXTend?`
Example	`:INST:COUP:FREQ:BAND:EXT 1` `:INST:COUP:FREQ:BAND:EXT?`

Preset	Set to `OFF` by **Global** Settings > **Restore Defaults** and **System** > **Restore Defaults** > **All Modes**
Range	`ON`|`OFF`

Restore Defaults

Resets all functions in the **Global** settings menu to `OFF`. Pressing **System**, **Restore Defaults**, **All Modes** has the same effect.

Remote Command	`:INSTrument:COUPle:DEFault`
Example	`:INST:COUP:DEF`
Backwards Compatibility SCPI	`:GLOBal:DEFault`

3.3.9 Sweep

Accesses controls to configure and control the acquisition of data, and the X-axis parameters of the instrument.

Depending on the selected mode and measurement, these controls might include: **Sweep Time**, **Continuous/Single**, **Pause/Resume**, **X Scale** and **Number of Points**.

3.3.9.1 Sweep/Control

Accesses controls that let you operate the sweep and control functions of the instrument, such as **Sweep Time** and **Continuous/Single**.

Sweep Time

Controls the time the instrument takes to sweep the current frequency span in swept measurements, displays the sweep time in swept measurements, and displays the equivalent Sweep Time in FFT measurements.

When **Sweep Time** is in Auto, the instrument computes a time that will give accurate measurements based on other settings, such as RBW and VBW.

You can select a shorter sweep time to improve the measurement throughput (with some potential unspecified accuracy reduction), but the **Meas Uncal** indicator will appear if the sweep time you set is less than the calculated Auto Sweep time.

You can also select a longer sweep time, which can be useful (for example) for obtaining accurate insertion loss measurements on very narrowband filters.

NOTE Significantly faster sweep times are available with Option FS1.

NOTE The **Meas Uncal** (measurement uncalibrated) warning is displayed in the Status Bar at the bottom of the screen when the manual Sweep time entered is faster than the time computed by the instrument’s Sweep time equations, that is, the Auto Sweep Time. The instrument’s computed Sweep time will provide accurate measurements; if you sweep faster than this your measurements may be inaccurate. A **Meas Uncal** condition may be corrected by returning the Sweep Time to Auto; by entering a longer Sweep Time; or by choosing a wider RBW and/or VBW.

NOTE On non-sweeping hardware, this control is grayed-out. The value shown on this control is an estimate. It is the measurement’s turnaround time, which is the sum of signal acquisition time, FFT time, and other overhead time, to complete the entire span of the measurement. If you need to specify the same “Sweep Time” as you would for sweeping hardware, send `[:SENSe]:<meas>:SWEep:TIME <time>`. The measurement emulates the “Sweep Time” effect, but this emulation is not straightforward, and therefore the behavior is not specified. Instead, we recommend using Minimum Acquisition Time, which provides better control.

Remote Command	`[:SENSe]:<meas>:SWEep:TIME <time>` `[:SENSe]:<meas>:SWEep:TIME?`

Example	Channel Power measurement:
	`:CHP:SWE:TIME 25ms`
	`:CHP:SWE:TIME?`

Notes	In the ACP measurement in WCDMA Mode, this parameter is preset by **Meas Method** selection. Preset values are as follows: – IBW: 29 ms – IBWR: 108 ms – FAST 7.5 ms
Dependencies	On non-sweeping hardware, this control is grayed out, and the Auto/Man toggle disappears. The read-only control shows estimated sweep time In those instruments, "Minimum Acquisition Time" on page 1087 is available
Couplings	Coupled to **Span**, **RBW**, **VBW**, and **Sweep Time Rules** when **Sweep Time** is set to Auto; **Sweep Time** changes when these parameters are changed When you manually set a value when in the **Auto** state, the state automatically changes to **Man**
Preset	Automatically Calculated unless noted below WCDMA Mode – Channel Power: 1.0 msOBW: 32.6 ms – ACP: 29 ms

State Saved	Saved in instrument state
Min	Other than non-sweeping hardware: Typically, 1 ms Non-sweeping hardware: N/A In the ACP measurement, when **Meas Method** is **Fast Power**, the minimum sweep time is span-dependent and automatically calculated
Max	Other than non-sweeping hardware: 4000 s Non-sweeping hardware: N/A
Annotation	The sweep time is displayed in the lower-right corner of the screen. The number of points is displayed parenthetically, as: Sweep 13.3 ms (1001 points) A "#" mark appears before "Sweep" in the annotation when it is switched from Auto to Manual coupling
Status Bits/OPC dependencies	Meas Uncal is Bit 0 in the register: `STATus:QUEStionable:INTegrity:UNCalibrated`

Auto Function

Remote Command	`[:SENSe]:<meas>:SWEep:TIME:AUTO OFF | ON | 0 | 1` `[:SENSe]:<meas>:SWEep:TIME:AUTO?`

Example	Channel Power measurement:
	`:CHP:SWE:TIME:AUTO OFF`
	`:CHP:SWE:TIME:AUTO?`

Preset	WCDMA Mode: `OFF` All others: `ON`

Minimum Acquisition Time

Available on non-sweeping hardware.

Specifies the minimum acquisition time for each "chunk" of the measurement result. The instrument automatically divides Span into multiple chunks if needed. Therefore, the total signal acquisition time for the entire Span is:

~(>~Minimum Acquisition Time) * (The number of chunks)

When in Auto, this parameter's value is determined by other parameters, such as **Span**, **RBW** and **VBW**.

You can manually increase this parameter value from this Auto value.

If increased, the instrument acquires signal for the specified time duration for each chunk. It performs additional FFTs, and averages or peak-holds the FFT results for a chunk, depending on **Detector** settings.

Note that the actual acquisition time for each chunk may exceed the **Minimum Acquisition Time** value, in order to satisfy FFT time required by other parameters, and to perform an integer number of FFTs.

Remote Command	`[:SENSe]:<meas>:SWEep:ACQuisition:TIME <time>`
	`[:SENSe]:<meas>:SWEep:ACQuisition:TIME?`
	`<meas>` is the identifier for the current measurement; any one of `CHPower-|ACPower|OBWidth|MONitor`

Example	Channel Power measurement
	`:CHP:SWE:ACQ:TIME 500 ms`
	`:CHP:SWE:ACQ:TIME?`

Dependencies	Available only on non-sweeping hardware
Couplings	Coupled to **Span**, **RBW**, and **VBW** when in the Auto state When you manually set a value when in the **Auto** state, the state automatically changes to **Man**
Preset	Automatically calculated
State Saved	Saved in instrument state
Min	100 ns
Max	4.00 ks

Auto Function

Remote Command	`[:SENSe]:<meas>:SWEep:ACQuisition:TIME:AUTO OFF | ON | 0 | 1`
	`[:SENSe]:<meas>:SWEep:ACQuisition:TIME:AUTO?`
	`<meas>` is the identifier for the current measurement; any one of `CHPower-|ACPower|OBWidth|MONitor`

Example	Channel Power measurement: `:CHP:SWE:ACQ:TIME:AUTO OFF`
Preset	`ON`

Sweep/Measure

Lets you toggle between **Continuous** and **Single** sweep or measurement operation. The single/continuous state is Meas Global, so the setting affects all measurements.

The front-panel key **Single/Cont** performs exactly the same function

See "More Information" on page 679

Remote Command	`:INITiate:CONTinuous OFF | ON | 0 | 1` `:INITiate:CONTinuous?`
Example	Put instrument into **Single** measurement operation: `:INIT:CONT 0`

	`:INIT:CONT OFF`
	Put instrument into **Continuous** measurement operation:
	`:INIT:CONT 1`
	`:INIT:CONT ON`

Preset	`ON` Note that `:SYST:PRES` sets `:INIT:CONT` to `ON`, but `*RST` sets `:INIT:CONT` to `OFF`
State Saved	Saved in instrument state
Annunciation	The **Single/Continuous** icon in the Meas Bar changes depending on the setting: – A line with an arrow is **Single** – A loop with an arrow is **Continuous**
Backwards Compatibility Notes	X-Series A-models had **Single** and **Cont** hardkeys in place of the **SweepSingleCont** softkey. In the X-Series A-models, if in single measurement, the **Cont** hardkey (and `INIT:CONT ON`) switched to continuous measurement, but never restarted a measurement and never reset a sweep X-Series B-models have a **Cont/Single** toggle control instead of **Single** and **Cont** hardkeys, but it is still true that, if in single measurement, the **Cont/Single** toggle control never restarts a measurement and never resets a sweep

More Information

Continuous Mode	The instrument takes repetitive sweeps, averages, measurements, etc., when in continuous mode. If in average or Max/Min Hold, and the average/hold count reaches the **Average/Hold Num**, the count stops incrementing, but the instrument keeps sweeping See the **Trace** key description under **Trace Average** for the averaging formula used both before and after the **Average/Hold Num** is reached. The trigger condition must be met prior to each sweep The type of trace processing for multiple sweeps is set under the **Trace** key, with choices of **Trace Average**, **Max Hold**, or **Min Hold**
Single Mode	The instrument takes a single sweep when in **Single** mode, or if in average or Max/Min Hold, or if there is a **Waterfall** window displayed, it takes multiple sweeps until the average/hold count reaches the **Average/Hold Num**, then the count stops incrementing, and the instrument stops sweeping See the **Trace** key description under **Trace Average** for the averaging formula used. The trigger condition must be met prior to the sweep The type of trace processing for multiple sweeps is set under the **Trace** key, with choices of **Trace Average**, **Max Hold**, or **Min Hold**

If the instrument is in **Single** measurement mode, pressing the **Cont/Single** toggle control does not zero the count and does not cause the sweep to be reset; the only action is to put the instrument into Continuous measurement operation.

If the instrument is already in **Continuous** sweep:

– `:INIT:CONT 1` has no effect

– `:INIT:CONT 0` places the instrument in Single Sweep but has no effect on the current sequence until k = N, at which point the current sequence will stop and the instrument will go to the idle state

See "Restart" on page 2018 for details of `:INIT:IMMediate`.

If the instrument is already in **Single** sweep, `:INIT:CONT OFF` has no effect.

If the instrument is already in **Single** sweep, then pressing **Cont/Single** in the middle of a sweep does not restart the sweep or sequence. Similarly, pressing **Cont/Single** does not restart the sweep or sequence if the sweep is not in the idle state (for example, if you are taking a very slow sweep, or the instrument is waiting for a trigger). Even though pressing **Cont/Single** in the middle of a sweep does not restart the sweep, sending `:INIT:IMM` *does* reset it.

If the instrument is in **Single** sweep, and *not* Averaging/Holding, and you want to take one more sweep, press **Restart**.

If the instrument is in **Single** sweep, *and* Averaging/Holding, and you want to take one more sweep without resetting the Average trace or count, go to **Meas Setup** and increment the average count by 1 by pressing the **Step-Up** key while **Average/Hold Num** is the active function. You can also do this by sending `:CALC:AVER:TCON UP`.

Restart

Restarts the current sweep, or measurement, or set of averaged/held sweeps or measurements. If you are Paused, pressing **Restart** performs a Resume.

The front-panel key **Restart** performs exactly the same function.

The **Restart** function is accessed in several ways:

– Pressing the **Restart** key

– Sending `:INIT:IMM`

– Sending `:INIT:REST`

See "More Information" on page 681

Remote Command	`:INITiate[:IMMediate]` `:INITiate:RESTart`
Example	`:INIT:IMM` `:INIT:REST`
Notes	`:INIT:REST` and `:INIT:IMM` perform exactly the same function

Couplings	Resets average/hold count k. For the first sweep overwrites all active (update = on) traces with new current data. For application modes, it resets other parameters as required by the measurement
Status Bits/OPC dependencies	This is an Overlapped command The `STATus:OPERation` register bits 0 through 8 are cleared , *except* bit 6 (Waiting for Periodic Sync). Initiating a measurement and Waiting for Periodic Sync could be asynchronous The `STATus:QUEStionable` register bit 9 (`INTegrity` sum) is cleared The `SWEEPING` bit is set The `MEASURING` bit is set
Backwards Compatibility Notes	For Spectrum Analysis Mode in ESA and PSA, the **Restart** hardkey and the `:INIT:REST` command restarted trace averages (displayed average count reset to 1) for a trace in **Clear Write**, but did not restart **Max Hold** and **Min Hold** In X-Series, the **Restart** hardkey and the `:INIT:REST` command restart not only **Trace Average**, but **MaxHold** and **MinHold** traces as well

More Information

The **Restart** function first aborts the current sweep or measurement as quickly as possible. It then resets the sweep and trigger systems, sets up the measurement and initiates a new data measurement sequence with a new data acquisition (sweep) taken once the trigger condition is met.

If the instrument is in the process of aligning when a **Restart** is executed, the alignment finishes before the restart function is performed.

Even when set for **Single** operation, multiple sweeps may be taken when **Restart** is pressed (for example, when averaging/holding is on). Thus, when we say that **Restart** "restarts a measurement", depending on the current settings, we may mean that it:

- Restarts the current sweep
- Restarts the current measurement
- Restarts the current set of sweeps if any trace is in Trace Average, Max Hold or Min Hold
- Restarts the current set of measurements if Averaging, or Max Hold, or Min Hold is on for the measurement

If there is no Average or Max/Min Hold function (no trace in Trace Average or Hold, or **Average/Hold Num** set to 1), and no **Waterfall** window is being displayed, a single sweep is equivalent to a single measurement. A single sweep is taken after the trigger condition is met; and the instrument stops sweeping once that sweep has completed. However, with **Average/Hold Num** >1, and at least one trace set to Trace Average, Max Hold, or Min Hold, or a **Waterfall** window being displayed, multiple sweeps/data acquisitions are taken for a single measurement. The trigger condition must be met prior to each sweep. The sweep is stopped when the average count k equals the number N set for **Average/Hold Num**.

Once the full set of sweeps has been taken, the instrument goes to the idle state. To take one more sweep without resetting the average count, increment the average count by 1, by pressing the **Step-Up** key while **Average/Hold Number** is the active function, or by sending the remote command `:CALC:AVER:TCON UP`.

Trace Update

The numeric results are not blanked at any time during the restart cycle.

For slow sweeps (see **Trace Update** section in **Trace/Detector**), the traces are updated real-time during the sweep. There may be a special circumstance in application mode measurements where an exception is made and the traces and/or results need to be blanked before displaying the new results.

To summarize, the following list shows what happens to the trace data on various events:

Event	Trace Effect
Clear/Write pressed (even if already in Clear/Write)	Set to mintracevalue
Max Hold pressed (even if already in Max Hold)	Set to mintracevalue
Min Hold pressed (even if already in Min Hold)	Set to maxtracevalue
Trace Average pressed (even if already in Trace Average)	Trace data unaffected but start new sweep/avg/hold
Restart pressed	Trace data unaffected but start new sweep/avg/hold
Parameter requiring restart changed (e.g., RBW)	Trace data unaffected but start new sweep/avg/hold

Sweep and Trigger Reset

Resetting the sweep system resets the average/hold count k to 0. It also resets the set point counter to 0. Resetting the trigger system resets the internal auto trig timer to the value set by the **Auto Trig** control.

Averaging

The weighting factor used for averaging is k. This k is also the average/hold count for how many valid sweeps (data acquisitions) have been done. This k is used for comparisons with N, as those comparisons always needs to be based on valid completed sweeps.

The displayed average/hold, K, shows the count for the sweep (data acquisition) in progress. K = k + 1, with a limit of N. The displayed value K changes from its previous value to 1 as soon as the trigger condition for the first data acquisition (sweep) is met.

Pause/Resume

Pauses a measurement after the current data acquisition is complete.

When paused, the label on the control changes to **Resume**. Pressing **Resume** un-pauses the measurement. When paused, pressing **Restart** performs a Resume.

Remote Command	`:INITiate:PAUSe` `:INITiate:RESume`
Example	`:INIT:PAUS` `:INIT:RES`
Dependencies	Not displayed in Modes that do not support pausing
Annotation	Only on control

Abort (Remote Command Only)

Stops the current measurement. Aborts the current measurement as quickly as possible, resets the sweep and trigger systems, and puts the measurement into an "idle" state. If the instrument is in the process of aligning when `:ABORt` is sent, the alignment finishes *before* the abort function is performed, so `:ABORt` does not abort an alignment.

If the instrument is set for **Continuous** measurement, it sets up the measurement and initiates a new data measurement sequence with a new data acquisition (sweep) taken once the trigger condition is met.

If the instrument is set for **Single** measurement, it remains in the "idle" state until an `:INIT:IMM` command is received.

Remote Command	`:ABORt`
Example	`:ABOR`
Notes	If :`INIT:CONT` is `ON`, then a new continuous measurement will start immediately, with sweep (data acquisition) occurring once the trigger condition has been met If :`INIT:CONT` is `OFF`, then `:INIT:IMM` is used to start a single measurement, with sweep (data acquisition) occurring once the trigger condition has been met
Dependencies	For continuous measurement, `:ABORt` is equivalent to the **Restart** key Not all measurements support this command
Status Bits/OPC dependencies	The `STATus:OPERation` register bits 0 through 8 are cleared , *except* bit 6 (Waiting for Periodic Sync). Initiating a measurement and Waiting for Periodic Sync could be asynchronous

The STATus:QUEStionable register bit 9 (INTegrity sum) is cleared

Since all the bits that feed into OPC are cleared by :ABORt, the Abort command will cause the *OPC query to return true

Sweep Time Annotation (Remote Query Only)

Returns the **Sweep Time Annotation** value. Available only on non-sweeping hardware.

This value is also displayed in the result trace window.

The value returned is the estimated turnaround time of each measurement cycle, in seconds. The turnaround time is the sum of the signal acquisition time, FFT time, and other overhead time, to complete the entire span of each measurement cycle.

Remote Command	`[:SENSe]:<meas>:SWEep:ETIMe?` `<meas>` is the identifier for the current measurement; any one of CHPower-|ACPower|OBWidth|MONitor
Example	Channel Power measurement `:CHP:SWE:ETIMe?`
Dependencies	Available only on non-sweeping hardware
Preset	Automatically calculated

3.3.9.2 Sweep Config

Accesses controls that enable you to configure the Sweep and Control functions of the instrument, such as Sweep Rules.

Sweep Time Rules

Switches the instrument between NORMal and ACCuracy sweep states.

Setting **Auto Sweep Time** to ACCuracy results in slower sweep times (usually about three times as long) but yields better amplitude accuracy for CW signals. The instrument amplitude accuracy specifications only apply when **Auto Sweep Time** is set to ACCuracy.

Additional amplitude errors that occur when **Auto Sweep Time** is set to NORMal are usually well under 0.1 dB, though this is not guaranteed. Because of the faster sweep times and still low errors, NORMal is the preferred setting of **Auto Sweep Time**. **Auto Sweep Time** is set to NORMal on a **Preset**. This means that in the Preset state, instrument amplitude accuracy specifications do not apply.

Remote Command	`[:SENSe]:CHPower:SWEep:TIME:AUTO:RULes NORMal | ACCuracy`

	`[:SENSe]:CHPower:SWEep:TIME:AUTO:RULes?`
Example	`:CHP:SWE:TIME:AUTO:RUL NORM` `:CHP:SWE:TIME:AUTO:RUL?`
Dependencies	Does not appear in Spectrum Analyzer Mode in VXT model M9421A
Preset	`NORMal`
State Saved	Saved in instrument state
Range	`NORMal|ACCuracy`

Points

Sets the number of points taken per sweep, and displayed in the traces. The current value of **Points** is displayed parenthetically, next to the sweep time in the lower-right corner of the display. Using more points provides greater resolution. Using fewer points compacts the data and decreases the time required to access a trace over the remote interface.

Increasing the number of points does not increase the sweep time. However, it can slightly impact the trace processing time and therefore the overall measurement speed. Decreasing the number of points does not decrease the sweep time, but it may speed up the measurement, depending on the other sweep settings (for example, in FFT sweeps). Fewer points will always speed up the I/O.

Due to minimum sweep rate limitations of the hardware, the minimum sweep time available to the user will increase above its normal value of 1 ms as the number of sweep points increases above 15001.

Changing the number of sweep points has several effects on the instrument.Since markers are read at the point location, the marker reading may change.The sweep time resolution will change. Trace data for all the traces will be cleared and, if "Sweep/Measure" on page 2016 is **Cont**, a new trace taken. If any trace is in average or hold, the averaging starts over.

Due to sweep time quantization issues, the knob and up/down keys cannot be used to adjust the number of points.

When in a split screen display each window may have its own value for points.

When sweep points is changed, an informational message is displayed, "Sweep points changed, all traces cleared."

Remote Command	`[:SENSe]:CHPower:SWEep:POINts <integer>` `[:SENSe]:CHPower:SWEep:POINts?`
Example	`:CHP:SWE:POIN 501` `:CHP:SWE:POIN?`
Dependencies	Not available when Signal ID is ON in External Mixing

	Neither the knob nor the step keys can be used to change this value. If it is tried, a warning is given Not displayed in Modes that do not support Swept
Couplings	Whenever the number of sweep points change: – All trace data is erased – Any traces with Update Off also switch to Display Off (equivalent to switching from View to Blank in older instruments) – Sweep time is re-quantized – Any limit lines that are on will be updated – If averaging/hold is on, averaging/hold starts over The resolution of setting the sweep time depends on the number of points selected
Preset	1001
State Saved	Saved in instrument state
Min/Max	101 / 100,001
Annotation	On second line of annotations, in lower right corner in parenthesis behind the sweep annotation

IF Dithering

Lets you turn IF Dithering on or off. This is a technique used in unpreselected instruments (such as Keysight's modular instruments) to enhance the rejection of images and internally-generated spurious signals.

Remote Command	`[:SENSe]:SWEep:IF:DITHer OFF | ON | 0 | 1` `[:SENSe]:SWEep:IF:DITHer?`
Dependencies	Only appears in Spectrum Analyzer Mode in VXT models
Preset	`OFF`
State Saved	Saved in instrument state

Image Protection

Lets you turn IF Protection on or off. This is a technique used in unpreselected instruments (such as Keysight's modular instruments) to detect and suppress images and spurs that may be present in non-preselected hardware.

IF Protection takes two sweeps and by correlating the data between them, provides a single, correct power-versus-frequency trace.

Remote Command	`[:SENSe]:SWEep:IMAGeprot OFF | ON | 0 | 1` `[:SENSe]:SWEep:IMAGeprot?`

Dependencies	Only appears in Spectrum Analyzer Mode in VXT models
Preset	ON
State Saved	Saved in instrument state

3.3.10 Trace

Lets you control the acquisition, display, storage, detection and manipulation of trace data for the available traces. The Trace Control tab of this menu contains radio-button selections for the trace type (**Clear/Write, Trace Average, Max Hold, Min Hold**) and **View/Blank** setting for the selected trace.

3.3.10.1 Select Trace

Specifies the *selected trace*, which is the trace that will be affected when you change trace settings.

Select Trace appears above the menu panel, indicating that it applies to *all* controls in the menu panel. **Select Trace** is blanked if you select a tab whose controls do *not* depend on the selected trace (for example, **Trace Function**).

Notes	The selected trace is remembered even when not in the **Trace** menu
Dependencies	For the Swept SA measurement: – In Image Suppress mode, when you select a trace it becomes the active trace, and the formerly active trace goes into View – When you turn on Image Suppress, Update turns off for all traces except the selected trace For the ACP measurement, when **Meas Method** is `RBW`, `FAST` or `FPOWer`, **Select Trace** is disabled
Preset	Trace 1
State Saved	Yes

3.3.10.2 Trace Control

The controls on this tab allow you to set the "Trace Type" on page 1905 and its update mode.

There are four Trace Types:

- **Clear/Write**
- **Trace Average**

- Max Hold
- Min Hold

Each type handles data in a different way.

Each trace also has two values that determine whether it is being written or not, and whether it is being displayed or not. These values, **Update** and **Display,** are described fully in the "View/Blank" on page 1721 control description. Essentially, when **Update** is `ON`, a trace is updating, and when **Update** is `OFF` it is not. When **Display** is `ON`, it is visible and when **Display** is `OFF` it is not. These terms are used throughout the descriptions in this section.

Trace Type

There are four trace Types:

Option	Parameter	SCPI Example	Details
Clear/Write	`WRITe`	`:TRAC2:TYPE WRIT`	See: "Clear/Write" on page 691
Trace Average	`AVERage`	`:TRAC2:TYPE AVER`	See: "Trace Average" on page 691
Maximum Hold	`MAXHold`	`:TRAC3:TYPE MAXH`	See: "Max Hold" on page 692
Minimum Hold	`MINHold`	`:TRAC5:TYPE MINH`	See: "Min Hold" on page 692

Full descriptions of each type are provided below. You may select one of these types for each trace. Re-selecting the current **Trace Type** initiates the same action that selecting it the first time did, even though it is already selected. For example, selecting **Clear/Write** while **Clear/Write** is already selected will nonetheless clear the trace and begin rewriting it.

Besides the **Trace Type**, the "View/Blank" on page 1721 state must be set to **Active** (**Update**: `ON`, **Display**: `ON`) for a trace to be updating and visible. Selecting any **Trace Type** automatically makes the trace **Active**.

See also: "Trace Mode Backwards Compatibility Commands" on page 689

Remote Command	For Swept SA Measurement (in SA Mode):
	`:TRACe[1]|2|…|6:TYPE WRITe | AVERage | MAXHold | MINHold`
	`:TRACe[1]|2|…|6:TYPE?`
	For all other measurements:
	`:TRACe[1]|2|3:<meas>:TYPE WRITe | AVERage | MAXHold | MINHold`
	`:TRACe[1]|2|3:<meas>:TYPE?`
	where `<meas>` is the identifier for the current measurement

Example	`:TRAC:TYPE WRIT` `:TRAC:TYPE?`

Couplings	Selecting a **Trace Type** (by pressing any of the Trace Type selections or sending `:TRAC:TYPE`) sets the Trace to **Active** (**Update**: `ON`, **Display**: `OFF`), even if the same trace type was already selected When Detector setting is "Auto" (`[:SENSe]:<meas>:DETector:AUTO?)`, Detector (`[:SENSe]:<meas>:DETector[:FUNCtion]?`) switches aligning with the switch of this parameter: "`NORMal`" with `WRITe` (Clear Write), "`AVERage`" with `AVERage`, "`POSitive` (peak)" with `MAXHold`, and "`NEGative` (peak)" with `MINHold`
Preset	Swept SA and Monitor Spectrum: `WRITe` All other measurements: `AVERage` Following **Preset**, all traces are cleared (all trace points set to mintracevalue)
State Saved	The type of each trace is saved in instrument state
Annunciation	The type for each trace is indicated in the Trace annunciator panel on the Measurement Bar

Trace Mode Backwards Compatibility Commands

In earlier instruments, the "Trace Modes" were: Clear/Write, Max Hold, Min Hold, View and Blank. Averaging was global to all traces and was controlled under the **BW/Avg** menu.

In X-Series, trace averaging can be done on a per-trace basis. The Trace Modes (now called Trace Types) are Clear/Write, Trace Average, Max Hold and Min Hold. View and Blank are set separately under "View/Blank" on page 1721.

While this provides more flexibility, it also gives rise to potential backwards compatibility problems. To mitigate these, the old Trace Mode command has been retained and a new Trace Type command has been added. The :`TRACe:MODE` command is retained for backwards compatibility, and the :`TRACe:TYPE`, :`TRACe:UPDate` and :`TRACe:DISPlay` commands introduced for ongoing use. The old Trace Modes are selected using `:TRAC:MODE`, whose parameters are mapped into calls to `:TRACe:TYPE`, `:TRACe:UPDate` and `:TRACe:DISPlay`, and the old global Averaging command `[:SENSe]:AVERage[:STATe]` is provided for backwards compatibility. See the individual command descriptions for details.

When **Average/Hold** in the **Meas Setup**, **Legacy Compatibility** menu is `ON`, the following is true for traces in Max Hold and Min Hold:

- They ignore the **Average/Hold** number; **Single** for Max Hold causes one sweep only, so switching to **Single** stops after the current sweep, and switching to **Cont** starts again without clearing the accumulated result
- Max Hold is not cleared on a **Restart**, **Single** or `:INIT:IMM`, but changing a measurement parameter, like frequency or bandwidth etc., still restarts the Max Hold

Preset	`WRITe`
State Saved	The trace mode is an alias only
Backwards	`:TRACe[1]|2|…|6:MODE WRITe | MAXHold | MINHold | VIEW | BLANk`

Compatibility SCPI	`:TRACe[1]|2|…|6:MODE?`
Backwards Compatibility Notes	The legacy `:TRACe:MODE` command is retained for backwards compatibility. In conjunction with the legacy `:AVErage` command, it works as follows: – `:AVErage ON|OFF` sets/clears a variable that we will call average for the sake of this discussion. This variable is maintained by the instrument solely for backwards compatibility. See the `[:SENSe]:AVERage[:STATe]` command description below – `:TRACe:MODE WRITe` sets `:TRACe:TYPE WRITe` (Clear/Write) unless average is true, in which case it sets it to `:TRACe:TYPE AVErage`. It also sets `:TRACe:UPDate ON`, `:TRACe:DISPlay ON`, for the selected trace – `:TRACe:MODE MAXHold` sets `:TRACe:TYPE MAXHold` (Max Hold). It also sets `:TRACe:UPDate ON`, `:TRACe:DISPlay ON`, for the selected trace – `:TRACe:MODE MINHold` sets `:TRACe:TYPE MINHold` (Min Hold). It also sets `:TRACe:UPDate ON`, `:TRACe:DISPlay ON`, for the selected trace – `:TRACe:MODE VIEW` sets `:TRACe:UPDate OFF`, `:TRACe:DISPlay ON`, for the selected trace – `:TRACe:MODE BLANk` sets `:TRACe:UPDate OFF`, `:TRACe:DISPlay OFF`, for the selected trace The query returns the same value as `:TRACe:TYPE?`, meaning that if you set `:TRACe:MODE:VIEW` or `:TRACe:MODE:BLANk`, the query response will not be what you sent `:TRACe[n]:MODE` was formerly used to set the type or “writing mode” of the trace. At that time, View and Blank were writing modes. The new `:TRACe:TYPE` command should be used in the future, but `:TRACe:MODE` is retained to provide backwards compatibility In X-Series, unlike earlier instruments, Max Hold and Min Hold now obey the Average Number and counts up to a terminal value as Average always has As the **Average/Hold Number** now affects **Min Hold** and **Max Hold**, the operations that restart Averaging (for example, the **Restart** key) now also restart **Min Hold** and **Max Hold** As a result of these changes, legacy code that restarts averaging while retaining a running Max Hold will need to be rewritten, because the Max Hold will now restart when the Average does Also, previous to X-Series: – Pressing **Max Hold** while already in **Max Hold** (or doing so remotely) had no effect. Now it will clear the trace and restart the sweep and the Max Hold sequence – Changing the vertical scale (Log/Lin or dB/div) of the display restarted **Max Hold** and **Min Hold**. This is no longer the case

Preset	`OFF`
State Saved	The state of Average is saved in Instrument State for ghosting purposes
Backwards Compatibility SCPI	`[:SENSe]:AVERage[:STATe] ON | OFF | 1 | 0` `[:SENSe]:AVERage[:STATe]?`

Backwards Compatibility Notes	Previous to X-Series, Averaging (also sometimes known as trace averaging) was global to all traces, that is, it was either on or off for all active traces. The legacy command `[:SENSe]:AVERage [:STATe] ON|OFF|1|0` was used to turn Averaging on or off In X-Series, Averaging is turned on or off on a per-trace basis, so it can be on for one trace and off for another For backwards compatibility, the old global Average State variable is retained solely as a legacy variable, turned on and off and queried by the legacy command `[:SENSe]:AVERage[:STATe] OFF|ON|0|1.` When Average is turned on, any trace in Clear/Write will get put into Average. While Average is on, any trace put into Clear/Write by the old `:TRAC:MODE` command will instead get put into Average. When Average is turned off, any trace in Average will get put into Clear/Write

Trace Type Details

Clear/Write

Each trace update replaces the old data in the trace with new data.

Pressing **Clear/Write** for the selected trace, or sending `:TRAC:TYPE WRIT` for the specified trace, sets the trace type to **Clear/Write** and clears the trace, even if you are already in **Clear/Write**. Then a new sweep is initiated. Trigger conditions must be met before the sweep actually starts, and if in **Single** the sweep won't start until **Restart** is pressed.

Pressing **Clear/Write** stops the current sweep and initiates a new one, so **Trace Average, Max Hold** and **Min Hold** data may be interrupted in mid-sweep when **Clear/Write** is pressed, and therefore may not accurately reflect the displayed count. Therefore, when **Clear/Write** is pressed for one trace, **Trace Average, Max Hold** and **Min Hold** must restart for all traces.

When in **Clear/Write**, if a measurement-related instrument setting is changed (that is, one which requires new data to be taken, like **Center Frequency** or **Attenuation**), a new sweep is initiated but the trace is not cleared.

Trace Average

The instrument maintains and displays an average trace, which represents the cumulative average on a point-by-point basis of the new trace data and previous averaged trace data.

Pressing **Trace Average** (for the selected trace), or sending `:TRAC:TYPE AVER` (for the specified trace), sets the trace type to **Trace Average**, clears the trace, initiates a new sweep, and restarts the Average sequence.

Details of the count limiting behavior and the averaging calculations may be found under **Avg|Hold Number** and **Average Type** under **Meas Setup.**

When in **Trace Average**, if a measurement-related instrument setting is changed (that is, one which requires new data to be taken, like Center Frequency or Attenuation), the average restarts and a new sweep is initiated but the trace is not cleared.

Restarting the average means:

- The average/hold count k is set to 1, so that the next time the average trace is displayed it simply represents one trace of new data
- A new sweep is initiated
- Once the new sweep starts, the trace is overwritten with current trace data as the first trace of the new average

Remember that restarting averaging also restarts **Max Hold** and **Min Hold**, as there is only one count for Trace Average and Hold.

Max Hold

The instrument maintains and displays a max hold trace, which represents the maximum data value on a point-by-point basis of the new trace data and previous trace data. Details of the count limiting behavior may be found under **Avg|Hold Number** under **Meas Setup.**

Pressing **Max Hold** for the selected trace, or sending `:TRAC:TYPE MAXH` for the specified trace, sets the Trace Type to **Max Hold,** clears the trace , initiates a new sweep, and restarts the hold sequence, even if you are already in **Max Hold**.

When in **Max Hold**, if a measurement-related instrument setting is changed(that is, one which requires new data to be taken, like **Center Frequency** or **Attenuation**), the **Max Hold** sequence restarts and a new sweep is initiated but the trace is not cleared.

Restarting the **Max Hold** sequence means:

- The average/hold count k is set to 1, so that the next time the max hold trace is displayed it simply represents one trace of new data
- A new sweep is initiated.

Remember that restarting **Max Hold** also restarts averaging and **Min Hold**, as there is only one count for Trace Average and Hold.

Min Hold

The instrument maintains and displays a min hold trace, which represents the minimum data value on a point-point basis of the new trace data and previous trace data. Details of the count limiting behavior may be found under **Avg|Hold Number** under the **Meas Setup** functions.

Pressing **Min Hold** for the selected trace, or sending `:TRAC:TYPE MINH` for the specified trace, sets the Trace Type to **Min Hold,** clears the trace, initiates a new sweep, and restarts the hold sequence, even if you are already in **Min Hold**.

When in **Min Hold**, if a measurement-related instrument setting is changed(that is, one which requires new data to be taken, like **Center Frequency** or **Attenuation**), the **Min Hold** sequence restarts and a new sweep is initiated but the trace is not cleared.

Restarting the **Min Hold** sequence means:

- The average/hold count k is set to 1, so that the next time the min hold trace is displayed it simply represents one trace of new data
- A new sweep is initiated

Remember that restarting **Min Hold** also restarts **Max Hold** and averaging, because there is only one count for Trace Average and Hold.

Clear and Write | Restart Averaging | Restart Max/Min Hold

Starts the trace writing, as though the "Trace Type" on page 1905 had just been selected. The effect is exactly the same as reselecting the current **Trace Type** again – the control is provided because it may not be obvious that reselecting the same selection from a radio button menu will take any action.

This control displays different labels, depending on the selected Trace Type:

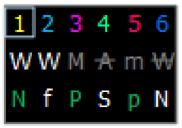
- **Clear/Write**: Clear and Write
- **Trace Average**: Restart Averaging
- **Max Hold**: Restart Max Hold
- **Min Hold**: Restart Min Hold

View/Blank

Lets you set the state of the two trace variables: **Update** and **Display**. The choices available in this dropdown menu are:

Active	Update and Display both `ON`
View	Update `OFF`; Display `ON`
Blank	Update `OFF`; Display `OFF`
Background	Update `ON`, Display `OFF` Allows a trace to be blanked *and* continue to update "in the background", which was not possible in the past

In the Swept SA measurement, a trace with **Display**`OFF` is indicated by a strikethrough of the type letter in the trace annotation panel in the Measurement Bar. A trace with **Update**`OFF` is indicated by dimming the type letter in the trace annotation panel in the Measurement Bar. In the example below, Traces 3, 4, 5 and 6 have **Update**`OFF`, and Traces 4 and 6 have **Display**`OFF`.



See: "More Information" on page 695

Notes	For the commands to control the two variables, Update and Display, see "Trace Update State On/Off" on page 694 and "Trace Display State On/Off" on page 695 below
Dependencies	When Signal ID is on, this key is grayed-out
Couplings	Selecting a Trace Type for a trace (pressing the key or sending the equivalent command) puts the trace in **Active** (Update `ON` and Display `ON`), even if that trace type was already selected Selecting a detector for a trace (pressing the key or sending `[:SENS]:DET:TRAC`) puts the trace in **Active** (**Update**`ON` and **Display**`ON`), even if that detector was already selected Selecting a "Math Function" on page 1724 other than `OFF` for a trace (pressing the key or sending the equivalent command) puts the trace in **Active** (**Update**`ON` and **Display**`ON`), even if that Math Mode was already selected Loading a trace from a file puts that trace in **View** regardless of the state it was in when it was saved; as does being the target of a **Copy** or a participant in an **Exchange**

Trace Update State On/Off

Remote Command	For Swept SA Measurement (in SA Mode):
	`:TRACe[1]|2|…|6:UPDate[:STATe] ON | OFF | 1 | 0`
	`:TRACe[1]|2|…|6:UPDate[:STATe]?`
	For all other measurements:
	`:TRACe[1]|2|3:<meas>:UPDate[:STATe] ON | OFF | 1 | 0`
	`:TRACe[1]|2|3:<meas>:UPDate[:STATe]?`
	where <meas> is the identifier for the current measurement

Example	Make trace 2 inactive (stop updating): `:TRAC2:UPD 0`
Couplings	Whenever you set **Update** to `ON` for any trace, the **Display** is set to `ON` for that trace

Preset	For Swept SA Measurement (in SA Mode):
	`1|0|0|0|0|0`
	`ON` for Trace 1; `OFF` for 2–6
	For all other measurements:
	`1|0|0`

	ON for Trace 1; OFF for 2 &3
State Saved	Saved in instrument state

Trace Display State On/Off

Remote Command	For Swept SA Measurement (in SA Mode):
	`:TRACe[1]|2|…|6:DISPlay[:STATe] ON | OFF | 1 | 0`
	`:TRACe[1]|2|…|6:DISPlay[:STATe]?`
	For all other measurements:
	`:TRACe[1]|2|3:<meas>:DISPlay[:STATe] ON | OFF | 1 | 0`
	`:TRACe[1]|2|3:<meas>:DISPlay[:STATe]?`
	where <meas> is the identifier for the current measurement

Example	Make trace 1 visible:
	`:TRAC2:DISP 1`
	Blank trace 3:
	`:TRAC3:DISP 3`

Couplings	Whenever you set **Update** to ON for any trace, the **Display** is set to ON for that trace

Preset	For Swept SA Measurement (in SA Mode):
	`1|0|0|0|0|0`
	ON for Trace 1; OFF for 2–6
	For all other measurements:
	`1|0|0`
	ON for Trace 1; OFF for 2 &3

State Saved	Saved in instrument state

More Information

When a trace becomes inactive, any update from the `:SENSe` system (detectors) immediately stops, without waiting for the end of the sweep. The trace data remains unchanged, but stops updating. If the trace is blanked, this still does not affect the data in the trace. Traces that are blanked (**Display**=OFF) do not display nor appear on printouts, but their data stays intact, they may be queried, and markers may be placed on them

In most cases, inactive traces are static and unchanging; however, there are cases when an inactive trace will update, specifically:

– if data is written to that trace from remote

– if trace data is loaded from mass storage

– if the trace is the target of a **Copy** or participant in an **Exchange**

– if the trace is cleared using **Clear Trace**

Inactive traces that are also being displayed (traces in **View**) are displayed at half intensity. Traces in **View** display across the entire X-Axis of the instrument. Their horizontal placement does not change, even if X-Axis settings subsequently are changed, although Y-Axis settings do affect the vertical placement of data.

When a trace becomes active (**Update**=`ON`), the trace is cleared, the average count is reset, and a new sweep is initiated.

Note that putting a trace into **Display**=`OFF` and/or **Update**=`OFF` does *not* restart the sweep and does *not* restart Averaging or Hold functions for any traces.

3.3.10.3 Math

Lets you turn on and configure Trace Math functions.

Math Function

Trace Math functions perform mathematical operations between traces and, in some cases, user-specified offsets. When in a Trace Math function, the indicated function is performed during the sweep with the math function used in place of a detector. The trace operands for the math function are set using the "Operand 1 / Operand 2" on page 1730 controls.

– See "How trace math is processed" on page 700

Remote Command	For option details, see "Trace Math Options" on page 698
	For Swept SA Measurement (in SA Mode):
	`:CALCulate:MATH <trace_num>, PDIFference | PSUM | LOFFset | LDIFference | OFF, <trace_num>, <trace_num>, <real>,<real>`
	`:CALCulate:MATH? <trace_num>`
	where `<trace_num>` is any one of:
	`TRACE1|…|TRACE6`
	For all other measurements:
	`:CALCulate:<meas>:MATH <trace_num>, PDIFference | PSUM | LOFFset | LDIFference | OFF, <trace_num>, <trace_num>, <real>,<real>`
	`:CALCulate[:<meas>]:MATH? <trace_num>`
	where:
	`<meas>` is the identifier for the current measurement, and
	`<trace_num>` is any one of:

	`TRACe1|TRACe2|TRACe3` Note that the format of the `TRACe<n>` parameter differs from that for the Swept SA Measurement

Example	`:CALC:MATH TRACE3,PDIF,TRACE1,TRACE2,0,0`
	Sets Trace 3 to Power Diff trace math function, and sets the First Trace operand (for Trace 3) to Trace 1 and the Second Trace operand (for Trace 3) to Trace 2
	`:CALC:MATH TRACE3,PSUM,TRACE1,TRACE2,0,0`
	Sets Trace 3 to Power Sum trace math function and sets the First Trace operand (for Trace 3) to Trace 1 and the Second Trace operand (for Trace 3) to Trace 2
	`:CALC:MATH TRACE3,LOFF,TRACE1,TRACE2,-6.00,0`
	Sets Trace 3 to Log Offset trace math function, sets the First Trace operand (for Trace 3) to Trace 1, leaves the Second Trace operand (for Trace 3) unchanged (it is irrelevant for this function) and sets the Log Offset (for Trace 3) to -6 dB
	`:CALC:MATH TRACE3,LDIF,TRACE1,TRACE2,0,-6.00`
	Sets Trace 3 to Log Diff trace math function, sets the First Trace operand (for Trace 3) to Trace 1, sets the Second Trace operand (for Trace 3) to Trace 2, and sets the Log Difference reference (for Trace 3) to -6 dBm
	`:CALC:MATH TRACE1,OFF,TRACE2,TRACE3,0,0`
	Turns off trace math for trace 1

Notes	The Trace Math Function command has 6 main set of parameters:
	- Set 1 defines the “result trace”:
	`TRACE1|…|TRACE6`
	-Set 2 defines the “function”:
	`PDIFference|PSUM|LOFFset|LDIFference|OFF`
	- Set 3 is a “trace operand” (1):
	`TRACE1|…|TRACE6`
	- Set 4 is a “trace operand” (2):
	`TRACE1|…|TRACE6`
	- Set 5 defines the “Log Offset” (in dB)
	- Set 6 defines the “Log Difference Reference” (in dBm)
	Note that the trace math mode is an enumeration; that is, when a math function is set for a trace, it turns off any math function that is on for that trace, then sets the new math function
	The parameters sent in the command are reflected in the values in the control menu. There is no default for any parameter; all 6 parameters must be sent to satisfy the parser. Failure to specify a parameter will result in a missing parameter message
	The query returns the math mode, the operand traces, the offset and the reference for the specified trace, all separated by commas

Dependencies	Trace Math is not available if **Normalize** is on Trace Math is not available if Signal ID is on None of the trace operands can be the destination trace. If any of the three trace math commands is sent with a destination trace number matching one of the operands, a warning is generated and the

	function does not turn on
Couplings	When a math function is changed for a trace, that trace is set to Display = ON; and Update = ON

Preset	For Swept SA Measurement (in SA Mode):
	`OFF,TRACE5,TRACE6,0,0 | OFF,TRACE6,TRACE1,0,0 | OFF,TRACE1,TRACE2,0,0 | OFF,TRACE2,TRACE3,0,0 | OFF,TRACE3,TRACE4,0,0 | OFF,TRACE4,TRACE5,0,0`
	For all other measurements:
	`OFF,TRACE2,TRACE3,0,0 | OFF,TRACE3,TRACE1,0,0 | OFF,TRACE1,TRACE2,0,0`

State Saved	The trace math function for each trace is saved in instrument state
Annunciation	An "f" is shown on the trace annunciation panel in the Measurement Bar when a math function is on; and the function is annotated on the trace if Trace Annotation is on
Status Bits/OPC dependencies	*OPC can be used to detect the completion of a sweep, which will also correspond to the completion of the math operation, since all math takes place during the sweep

Trace Math Options

IMPORTANT

To generate a trace math result, *you must take a sweep*. The trace math engine, described below, operates in concert with the sweep engine in the instrument. Until a sweep has been taken, even if the constituent traces are not in Update mode, no result is generated.

Note that certain events can affect the trace in ways that affects all points at once. This can happen in any number of ways, including:

- A trace clear taking place
- A trace being loaded from the file system
- Trace data being sent in from the remote interface
- A copy or exchange of trace data

You should try to avoid these occurrences during a sweep, as they will tend to invalidate the math result being accumulated.

The Trace Math functions are:

Power Diff (Op1 - Op2)

Calculates a power difference between the `First Trace` operand and the `Second Trace` operand and puts the result in the destination trace.

During the sweep, the following formula is executed for each point in the trace operands, and the corresponding point is generated for the destination trace:

```
DestinationTrace = 10 log(10(1/10)(FirstTrace) – 10(1/10)(SecondTrace))
```

The values of the trace points are assumed to be in a decibel scale, as they are internally stored.

If a point in `FirstTrace` is equal to `maxtracevalue`, the resultant point is also `maxtracevalue`.

Otherwise, if the result of the subtraction is less than or equal to 0, the resultant point is `mintracevalue`.

Power Sum (Op1 + Op2)

Calculates a power sum between the `First Trace` operand and the `Second Trace` operand and puts the result in the destination trace.

During the sweep, the following formula is executed for each point in the trace operands, and the corresponding point is generated for the destination trace.

```
DestinationTrace = 10 log(10(1/10)(FirstTrace) + 10(1/10)(SecondTrace))
```

The values of the trace points are assumed to be in a decibel scale, as they are internally stored.

If a point in either trace operand is equal to `maxtracevalue`, the resultant point is also `maxtracevalue`.

Log Offset (Op1 + Offset)

Calculates a log offset from the `First Trace` operand and puts the result in the destination trace. This is like the B-DL function in some older instruments. The offset is entered on the `Offset` control, which only appears when this math function is in force for the selected trace. Each destination trace has its own offset.

During the sweep, the following formula is executed for each point in the trace operand, and the corresponding point is generated for the destination trace.

```
DestinationTrace = FirstTrace + Offset
```

The values of the trace points are assumed to be in dBm (as they are internally stored) and the offset is in dB.

If a point in the trace operand is equal to `maxtracevalue`, the resultant point is also `maxtracevalue`.

If a point in the trace operand is equal to `mintracevalue`, the resultant point is also `mintracevalue`.

Example: If offset is 25 dB, then our destination trace will be higher than the operand trace by 25 dB.

Note that the `Second Trace` operand is not used for this function.

Log Diff (Op1 - Op2 + Ref)

Offsets the difference between the `First Trace` operand and the `Second Trace` operand by a reference and puts the result in the destination trace. This is like the A-B+DL function in some older instruments. The Reference is entered on the **Reference** control, which only appears when this math function is in force for the selected trace. Each destination trace has its own reference.

Offsets the difference between the `First Trace` operand and the `Second Trace` operand by a reference and puts the result in the destination trace. This is like the A-B+DL function in some older instruments. The Reference is entered on the **Reference** control, which only appears when this math function is in force for the selected trace. Each destination trace has its own reference.

During the sweep, the following formula is executed for each point in the trace operands, and the corresponding point is generated for the destination trace.

```
DestinationTrace = (FirstTrace - SecondTrace) + Reference
```

The values of the operand trace points are assumed to be in decibel units (as they are internally stored) and the reference is in dBm so the result is in dBm.

Example: If the first operand trace 1 is at 5 dBm, the second operand trace 2 is at –5 dBm, and the reference is –25 dBm, then the destination trace will be –15 dBm.

Example: If the first operand trace1 is at 60 dBuV, the second operand trace 2 is at 50 dBuV, and the reference is 35 dBuV, then the destination trace will be 45 dBuV.

If a point in `FirstTrace` is equal to `maxtracevalue`, the resultant point is also `maxtracevalue`.

If a point in `FirstTrace` is equal to `mintracevalue`, the resultant point is also `mintracevalue`.

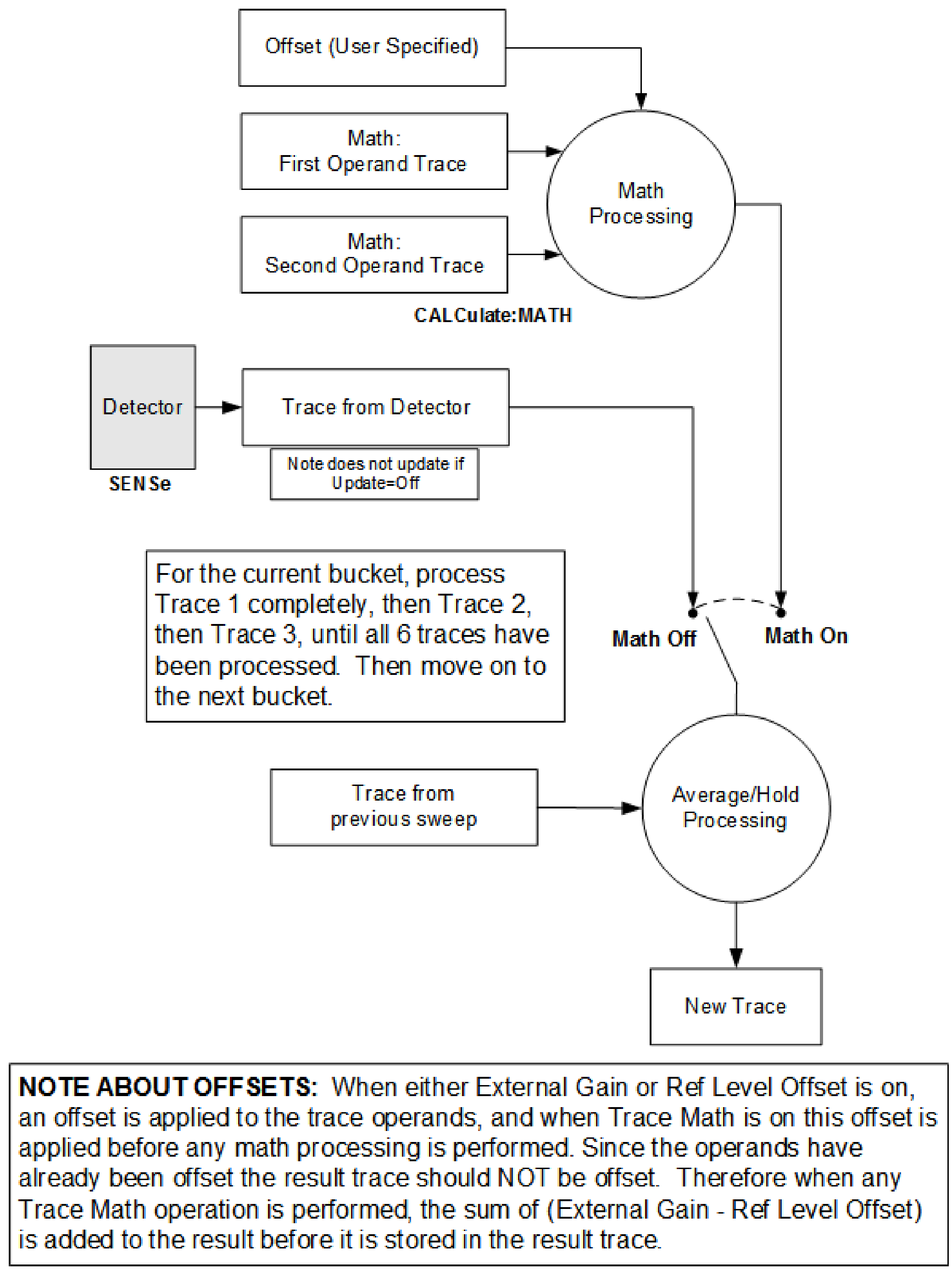
If neither of the above is true for a given point, then:

- If that point in `SecondTrace` is equal to `maxtracevalue`, the resultant point is `mintracevalue`.
- If that point in `SecondTrace` is equal to `mintracevalue`, the resultant point is `maxtracevalue`.

How trace math is processed

Whenever a trace math function is turned on, or the parameters and/or operands of an existing trace math function are changed, the destination trace is cleared. After the trace is cleared, all x-axis values in the trace, and the domain of the trace, are set to match the X-Axis settings of the first trace operand. When this is complete, a new sweep is initiated.

The process of acquiring data, processing it using the math and Average/Hold functions, and presenting it as trace data, consists of several functional blocks, as shown below:



For each active trace, the current trace point is processed for `Trace 1`, then `Trace 2`, then `Trace 3`, etc. Trace data is taken from either the detector for that trace, or from the mathematical result of up to two other traces and an offset, depending on whether trace math is on or not. The resultant data is then fed to the Average/Hold processing block, where (if the trace type is **Average**, **Max Hold**, or **Min Hold**) it is processed with previous trace data. The new trace data resulting from this process is then available for display, storage or remote output.

When the processing is complete for `Trace 1`, `Trace 2` is processed, and so on until all six traces have been processed. This allows a downstream trace to use as one of its math components a fully processed upstream trace. In other words, if math is `ON` for `Trace 4`, and its operand traces are `Trace 2` and `Trace 3`, then all detector, math, average and hold processing for Traces 2 and 3 is completed before the math is performed for `Trace 4`. When the current trace point is completed for all traces, the instrument moves on to the next trace point.

This allows very flexible and powerful math functions to be configured. For example, `Trace 1` can be an average trace, which can be fed with an offset to `Trace 2`, which can also be in **Max Hold**, allowing you to obtain the **Max Hold** of an Average trace.

Note that none of this processing is performed on inactive traces.

Note also that for any active trace with math `ON`, the Operand traces should have *lower* numbers than the trace (for example, using `Trace 4` as an operand for `Trace 1` will cause the data coming from `Trace 4` to be delayed by one sweep).

Operand 1 / Operand 2

These two controls select the first and second trace operands to be used for the trace math functions for the destination trace. The operands are common to all math functions for a given trace. The most recently sent `:CALCulate:MATH` command for a given trace sets the operands for that trace. Those settings are displayed on the trace operand controls for that trace.

Example	The following examples are for the Swept SA measurement
	Set Trace 3 to Power Diff trace math function. Set the First Trace operand (for Trace 3) to Trace 1 and the Second Trace operand (for Trace 3) to Trace 2:
	`:CALC:MATH TRACE3,PDIF,TRACE1,TRACE2,0,0`
	Set Trace 3 to Log Offset trace math function. Set the First Trace operand (for Trace 3) to Trace 1, leave the Second Trace operand (for Trace 3) unchanged (it is irrelevant for this function) and set the Log Offset (for Trace 3) to -6 dB:
	`:CALC:MATH TRACE3,LOFF,TRACE1,TRACE2,-6.00,0`

Notes	See "Math Function" on page 1724 for how to specify Operands 1 and 2 using `:CALCulate:MATH`
Dependencies	The destination trace cannot be an operand. The destination trace number is grayed-out on the

	dropdown
Preset	Operand 1: Trace number minus 2 (wraps at 1). For example, for Trace 1, Operand 1 presets to Trace 5; for Trace 6, it presets to Trace 4 Operand 2: Trace number minus 1 (wraps at 1). For example, for Trace 1, Operand 2 presets to Trace 6; for Trace 6, it presets to Trace 5
State Saved	Operands 1 and 2 for each trace are stored in instrument state

Offset

Used by the Log Offset math function.

Example	The following example is for the Swept SA measurement Set Trace 3 to Log Offset trace math function, set the First Trace operand (for Trace 3) to Trace 1, leave the Second Trace operand (for Trace 3) unchanged (it is irrelevant for this function) and set the Log Offset (for Trace 3) to -6 dB: `:CALC:MATH TRACE3,LOFF,TRACE1,TRACE2,-6.00,0`
State Saved	The Log Offset value for each trace is saved in Instrument State
Min	–100 dB
Max	100 dB

Reference

Used by the Log Diff math function.

Example	The following example is for the Swept SA measurement Set Trace 3 to Log Diff trace math function, set the First Trace operand (for Trace 3) to Trace 1, set the Second Trace operand (for Trace 3) to Trace 2, and set the Log Difference reference (for Trace 3) to -6 dBm: `:CALC:MATH TRACE3,LDIF,TRACE1,TRACE2,0,-6.00`
State Saved	The Log Difference reference value for each trace is saved in instrument state
Min/Max	Same as reference level

3.3.10.4 Detector

Lets you choose and configure detectors for the selected trace.

Detector

Selects a detector to be used by the instrument for the current measurement. The following choices are available:

Option	Parameter	Detector Behavior
Auto	n/a	The detector selected depends on marker functions, trace functions, average type, and the trace averaging function This option is set using "Detector Select Auto/Man" on page 705
Normal	`NORMal`	The detector determines the peak of the CW-like signals, and it yields alternating maximums and minimums of noise-like signals. This is also referred to as Rosenfell detection
Average	`AVERage`	The detector determines the average of the signal within the sweep points, using RMS averaging
Peak (Positive)	`POSitive`	The detector determines the maximum of the signal within the sweep points
Sample	`SAMPle`	The detector indicates the instantaneous level of the signal at the center of the sweep points represented by each display point
Negative Peak	`NEGative`	The detector determines the minimum of the signal within the sweep points
RMS	`RMS`	Equivalent to **Average**. See Notes below

Because they may not find a spectral component's true peak, neither **Average** nor **Sample** detectors measure amplitudes of CW signals as accurately as **Peak** or **Normal**, but they do measure noise without the biases of peak detection.

Remote Command	`[:SENSe]:CHPower:DETector[:FUNCtion] NORMal | AVERage | POSitive | SAMPle | NEGative | RMS` `[:SENSe]:CHPower:DETector[:FUNCtion]?`

Example	`:CHP:DET NORM`
	`:CHP:DET?`
	Set the detector to **Average**, which uses RMS averaging, so this is equivalent to selecting an `RMS` detector:
	`:CHP:DET RMS`

Notes	The query returns a name that corresponds to the detector type, as shown below The `RMS` selection sets the detector type to `AVERage` with `RMS` averaging. Therefore, if `RMS` has been selected, the query returns `AVER`

String Returned	Definition
`NORM`	Normal
`AVER`	Average (RMS)
`POS`	Peak
`SAMP`	Sample
`NEG`	Negative Peak

Couplings	When the **Detector** setting is **Auto**, switches to align with "Trace Type" on page 1905: – `NORMal` with Clear Write

	– AVERage with AVERage – POSitive (peak) with MAXHold – NEGative (peak) with MINHold
Preset	AVERage
State Saved	Saved in instrument state
Range	NORMal|AVERage|POSitive|SAMPle|NEGative|RMS

Detector Select Auto/Man

Sets the Detector mode to Auto or Manual. In Auto, the proper detector is chosen based on rules that take into account the measurement settings and other instrument settings.

When you select any detector explicitly, this setting switches automatically to Man (manual).

Remote Command	[:SENSe]:CHPower:DETector:AUTO ON | OFF | 1 | 0 [:SENSe]:CHPower:DETector:AUTO?
Example	:CHP:DET:AUTO ON :CHP:DET:AUTO?
Couplings	When the **Detector** setting is **Auto**, switches to align with "Trace Type" on page 1905: – NORMal with Clear Write – AVERage with AVERage – POSitive (peak) with MAXHold – NEGative (peak) with MINHold
Preset	ON
State Saved	Yes

3.3.10.5 Trace Function

Contains controls to:

- Copy and Exchange traces
- Preset or Clear all traces

From Trace

Selects the trace to be copied to or exchanged with the "To Trace" on page 1732 when a "Copy" on page 1732 or "Exchange" on page 1733 is performed

Preset	1

To Trace

Selects the trace to be copied from or exchanged with the "From Trace" on page 1732 when a "Copy" on page 1732 or "Exchange" on page 1733 is performed

Preset	2

Copy

Executes a Trace Copy based on the "From Trace" on page 1732 and "To Trace" on page 1732 parameters. The copy operation is from the **From Trace** to the **To Trace**. The action is performed once.

The X-Axis settings and domain of a trace are also copied.

Remote Command	For Swept SA Measurement (in SA Mode):
	`:TRACe:COPY TRACE1 | … | TRACE6, TRACE1 | … | TRACE6`
	For all other measurements:
	`:TRACe:<meas>:COPY TRACe1 | TRACe2 | TRACe3, TRACe1 | TRACe2 | TRACe3`
	where `<meas>` is the identifier for the current measurement
	Note that the format of the `TRACe<n>` parameter differs from that for the Swept SA Measurement

Example	Copy Trace 1 to Trace 3 and put Trace 3 in Update=Off, Display=On `:TRAC:COPY TRACE1,TRACE3`
Notes	The command is of the form: `:TRACe:COPY <source_trace>,<dest_trace>`
Dependencies	When Signal ID is on, this key is grayed-out
Couplings	The destination trace is put in **View** (Update = Off, Display = On) after the copy

Preset	For Swept SA Measurement (in SA Mode):
	`TRACE1, TRACE2`
	For all other measurements:
	`TRACe1, TRACe2`

Exchange

Executes a Trace Exchange based on the "From Trace" on page 1732 and "To Trace" on page 1732 parameters. The **From Trace** and **To Trace** values are exchanged with each other. The action is performed once.

The X-Axis settings and domain of a trace are also copied when it is exchanged with another trace.

Remote Command	For Swept SA Measurement (in SA Mode):
	`:TRACe:EXCHange TRACE1 | … | TRACE6, TRACE1 | … | TRACE6`
	For all other measurements:
	`:TRACe:<meas>:EXCHange TRACe1 | TRACe2 | TRACe3, TRACe1 | TRACe2 | TRACe3`
	where `<meas>` is the identifier for the current measurement
	Note that the format of the `:TRACe<n>` parameter differs from that for the Swept SA Measurement

Example	Exchange Trace 1 and Trace 2 and put both traces in Update=`OFF`, Display=`ON`: `:TRAC:EXCH TRACE1,TRACE2`
Notes	The command is of the form: `:TRACe:EXCHange <trace_1>,<trace_2>`
Couplings	Both traces are put in **View** (Update=Off, Display=On) after the exchange

Preset All Traces

Turns on Trace 1 and blanks all other traces. This is useful when you have many traces on and you want to return to having only Trace 1 on the display. Does not affect the trace type, detector or any other aspect of the trace system.

Remote Command	`:TRACe[:<meas>]:PRESet:ALL`
Example	`:TRAC:PRES:ALL`
Dependencies	When Signal ID is on, this key is grayed-out

Clear All Traces

Clears all traces. Does not affect the state of any function or variable in the instrument. Loads `mintracevalue` into all of the points for all traces, except traces in **Min Hold**, in which case it loads `maxtracevalue`, even if **Update** = `OFF`.

Remote Command	`:TRACe[:<meas>]:CLEar:ALL`
Example	`:TRAC:CLE:ALL`
Dependencies	When Signal ID is on, this key is grayed-out

3.3.10.6 Advanced

Contains controls for setting advanced trace functions of the instrument.

Measure Trace

Specifies which trace's scalar results are displayed in the **Metrics** window, and retrieved by sending a `:READ` or `:FETCh` query:

- Trace 1
- Trace 2
- Trace 3

Remote Command	`:CALCulate:<meas>:MTRace TRACe1 | TRACe2 | TRACe3`
	`:CALCulate:<meas>:MTRace?`
	`<meas>` is the identifier for the current measurement; any one of `CHPower | ACPower | OBWidth | SEMask | SPURious | PVTime`

Example	Channel Power
	`:CALC:CHP:MTR TRAC1`
	`:CALC:CHP:MTR?`

Dependencies	In the ACP measurement, this control is grayed-out when **Meas Method** is set to `RBW` or `FAST`, and only Trace 1 is enabled
Preset	`TRACe1`
State Saved	No
Range	Trace 1 | Trace 2 | Trace 3

3.4 Occupied BW Measurement

This measurement computes and displays the bandwidth occupied by a given percentage of the total mean power of a signal.

Measurement Commands

The general functionality of "CONFigure" on page 2732, "INITiate" on page 2733, "FETCh" on page 2733, "MEASure" on page 2735, and "READ" on page 2734 are described in the section **SCPI Operation and Results Query** in the topic **Programming the Instrument**.

Note that, in general, `:CONF:<Measurement>` resets the specified measurement settings to their defaults. X-Series permits the addition of the `NDEFault` node to the command, which prevents a measurement preset after a measurement switch.

The tables below list setup commands for this measurement and queries to retrieve results.

Command	Function
`:INITiate:OBWidth`	Initiates a trigger cycle for the `OBW` measurement, but does not return any data. You must then use `:FETC:OBW[n]?` to retrieve data Does not change any measurement settings
`:CONFigure?`	Returns the long form name of current measurement, in this case, `OBWidth`
`:CONFigure:OBWidth`	Selects `OBW` measurement with Meas Setup settings in preset state – same as Meas Preset
`:CONFigure:OBWidth:NDEFault`	Selects `OBW` measurement *without* affecting settings

The following queries are used to retrieve data. The type of data returned depends on the value of `n`, as detailed in "Remote Command Results" on page 710.

Command	Function
`:FETCh:OBWidth[n]?`	Retrieves the data defined by `n`
`:MEASure:OBWidth[n]?`	Switches to `OBW` measurement, restores default values, starts the measurement, then retrieves the data defined by `n`
`:READ:OBWidth[n]?`	Starts the measurement, then retrieves the data defined by `n`

Backwards Compatibility Queries

Command	Return Value
`:FETCh:OBWidth:OBWidth?`	Returns the Occupied Bandwidth (Hz)
`:MEASure:OBWidth:OBWidth?`	
`:READ:OBWidth:OBWidth?`	

Command	Return Value

`:FETCh:OBWidth:FERRor?`
`:MEASure:OBWidth:FERRor?`
`:READ:OBWidth:FERRor?`
	Returns the Transmit Frequency Error (Hz)

`:FETCh:OBWidth:XDB?`
`:MEASure:OBWidth:XDB?`
`:READ:OBWidth:XDB?`
	Returns the xdB Bandwidth (Hz)

Remote Command Results

The following table describes the results returned by the `FETCh`, `MEASure`, and `READ` queries listed above, according to the index value `n`.

<table>
<tr><th>n</th><th>Results Returned</th></tr>
<tr><td>1, or not specified</td><td>Returns scalar results, in the following order:
<table>
<tr><th>#</th><th>Item</th><th>Unit</th></tr>
<tr><td>1</td><td>Occupied Bandwidth</td><td>Hz</td></tr>
<tr><td>2</td><td>Total Power or OBW Power
Power reference type can be changed with "Power Ref" on page 795 in Meas Setup</td><td>dBm</td></tr>
<tr><td>3</td><td>Span</td><td>Hz</td></tr>
<tr><td>4</td><td>Spectrum Trace Points</td><td>points</td></tr>
<tr><td>5</td><td>Res BW</td><td>Hz</td></tr>
<tr><td>6</td><td>Transmit Frequency Error</td><td>Hz</td></tr>
<tr><td>7</td><td>7. x dB Bandwidth</td><td>Hz</td></tr>
</table></td></tr>
<tr><td>2</td><td>Returns the frequency-domain spectrum trace (data array) for the entire frequency range being measured for Trace 1</td></tr>
<tr><td>3</td><td>Only available in LTEAFDD, LTEATDD, 5GNR Modes
1. Number of active carriers
Returns number of active carriers within Span in Auto detected mode, otherwise the command is out of scope</td></tr>
<tr><td>4</td><td>Returns OBW Boundaries table results in the following order:
<table>
<tr><th>#</th><th>Item</th><th>Unit, if any</th></tr>
<tr><td>1</td><td>Occupied bandwidth</td><td>Hz</td></tr>
<tr><td>2</td><td>Total Power or OBW Power
Power reference type can be changed with "Power Ref" on page 795 in Meas Setup</td><td>dBm</td></tr>
</table></td></tr>
</table>

n	Results Returned		
	#	Item	Unit, if any
	3	x dB Reference Power	dBm
	4	x dB Reference Power Frequency - offset frequency	Hz
	5	x dB Reference Power Frequency – absolute frequency	Hz
	6	NaN (9.91E+37)	-
	7	NaN (9.91E+37)	-
	8	NaN (9.91E+37)	-
	9	Lower OBW boundary - offset frequency	Hz
	10	Lower OBW boundary - absolute frequency	Hz
	11	Lower OBW boundary - absolute power	dBm
	12	Lower OBW boundary - relative power	dBc
	13	Upper OBW boundary - offset frequency	Hz
	14	Upper OBW boundary - absolute frequency	Hz
	15	Upper OBW boundary - absolute power	dBm
	16	Upper OBW boundary - relative power	dBc
	17	Lower x dB BW boundary - offset frequency	Hz
	18	Lower x dB BW boundary - absolute frequency	Hz
	19	Lower x dB BW boundary - absolute power	dBm
	20	NaN (9.91E+37)	-
	21	Upper x dB BW boundary - offset frequency	Hz
	22	Upper x dB BW boundary - absolute frequency	Hz
	23	Upper x dB BW boundary - absolute power	dBm
	24	NaN (9.91E+37)	-
	Results 6, 7, 8, 20 and 24 always return NaN (9.91E+37)		
5	Returns the frequency-domain spectrum trace (data array) for the entire frequency range being measured for Trace 2		
6	Returns the frequency-domain spectrum trace (data array) for the entire frequency range being measured for Trace 3		

3.4.1 Views

This measurement has three predefined views:

Name	SCPI Name	SCPI #
"OBW Results" on page 712	OBWResults	1
"OBW Boundaries" on page 713	BOUNdaries	2

Name	SCPI Name	SCPI #
"Gate" on page 713	See "Gate View On/Off" on page 2665	

These are multiple-window views. When in a multiple-window view, you select a window by touching it. The menu controls may sometimes change depending on which window is selected.

Whenever the **View** changes, the default menu is **Frequency**, unless otherwise specified in the **View** description.

The following SCPI commands can be used to select any view other than **Gate**.

View Selection by Name

Remote Command	`:DISPlay:OBWidth:VIEW[:SELect] OBWResults | BOUNdaries` `:DISPlay:OBWidth:VIEW[:SELect]?`
Example	`:DISP:OBW:VIEW OBWR` `:DISP:OBW:VIEW?`
Preset	`OBWResults`
State Saved	Saved in instrument state
Range	`OBWResults|BOUNdaries`

View Selection by Number

Remote Command	`:DISPlay:OBWidth:VIEW:NSELect <integer>` `:DISPlay:OBWidth:VIEW:NSELect?`
Example	`:DISP:OBW:VIEW:NSEL 2` `:DISP:OBW:VIEW:NSEL?`
Preset	1
State Saved	Saved in instrument state
Min/Max	1/2

3.4.1.1 OBW Results

Windows: "Graph" on page 713, "Metrics - OBW Results" on page 714

The spectrum trace is displayed in the upper window. Measurement results such as Occupied Bandwidth or Power are displayed in the lower window.

Example	`:DISP:OBW:VIEW OBWR`

3.4.1.2 OBW Boundaries

Windows: "Graph" on page 713, "Metrics – OBW Boundaries" on page 716

The spectrum trace is displayed in the upper window. The lower window of OBW Results view is replaced by the OBW boundaries table in this view. Occupied bandwidth and X dB bandwidth for both lower and upper boundaries are displayed.

Example	`:DISP:OBW:VIEW BOUN`

3.4.1.3 Gate

See "Gate View On/Off" on page 2665

3.4.2 Windows

There are four available window types. The **Gate** window is available only when "Gate View On/Off" on page 2665 is `ON` in the **Gate Settings** menu under **Trigger**.

View	#
"Graph" on page 713	1
"OBW Results" on page 712	2
"OBW Boundaries" on page 713	3
"Gate" on page 717	4

3.4.2.1 Graph

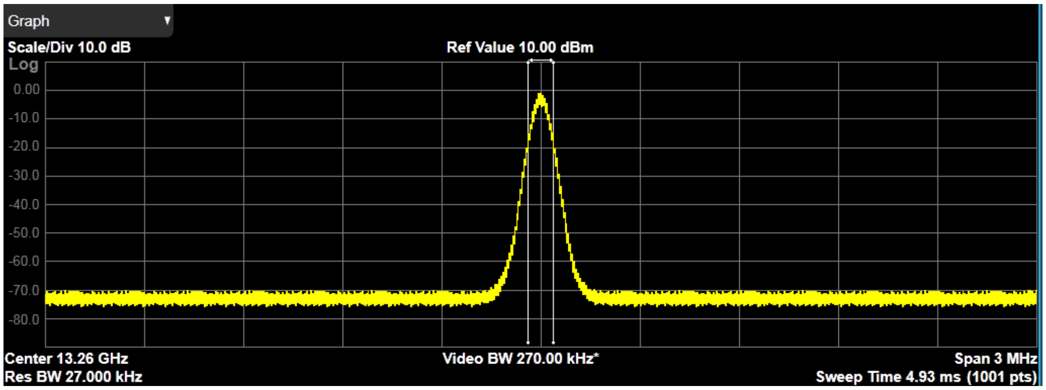
Window #1

Appears in two Views, as follows:

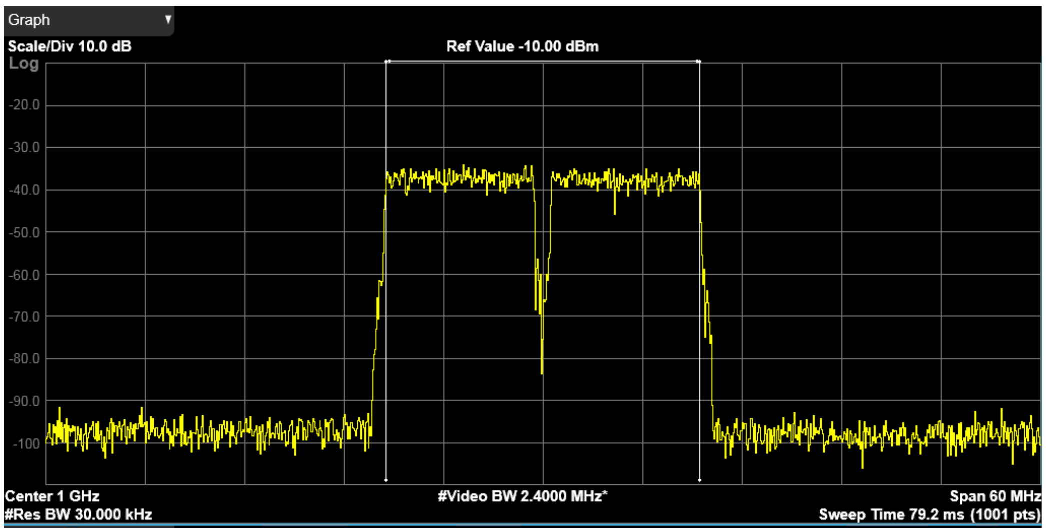
View	Size	Position
"OBW Results" on page 712	Three fifth, full width	Top
"OBW Boundaries" on page 713	Half, full width	Top

Spectrum View

For SA, WCDMA, WLAN mode:



For LTE-Advanced FDD/TDD mode only



3.4.2.2 Metrics - OBW Results

Window #2

Displays the textual results of the Occupied BW measurement.

View	Size	Position
"OBW Results" on page 712	Two fifth, full width	Bottom
Gate	One third, full width	Bottom

For the LTE-Advanced FDD/TDD and 5G NR modes, the metric result is shown as below:

Occupied Bandwidth

The occupied bandwidth result is $f_2 – f_1$, where f_1 and f_2 are the lower and upper carrier boundary point. f_1 and f_2 are calculated with Occupied Bandwidth algorithms.

Total Power or OBW Power

The total power is the power integrated in the specified span setting. The OBW power is calculated from multiplying the total power by OBW percent power. The user can select the total power or the OBW power with the Power Ref control in Meas Setup.

Transmit Freq Error

The transmit freq error (transmit frequency error) result is calculated as the difference between $(f_2+f_1)/2$ and the tuned center frequency of the signal, where f_1 and f_2 are the lower and upper carrier boundary point.

x dB Bandwidth

The x dB result is a bandwidth measured between two points on the signal which are a certain number of dBs down from the highest signal point within the OBW Span. For example, If the ‘x dB’ parameter is set to –26 dB, and the ‘Occupied BW Span’ is set to 10 MHz, then the maximum signal power level is first determined from the 10 MHz wide trace sweep. Next, the two furthest frequencies below (xdb_f_1) and above (xdb_f_2) the frequency of the maximum level occurrence are found where the signal level is 26 dB below the peak level. This calculation also uses linear interpolation to find the lower and upper carrier boundary point within the width of a sweep point (the span divided by the number of sweep points).

The x dB bandwidth is calculated to be xdb_f2 – xdb_f1.

% of OBW Power

This is the setting parameter. See "% of OBW Power" on page 795

x dB

This is the setting parameter. See "x dB" on page 796.

Active Carriers

In the LTE-Advanced FDD/TDD and 5G NR modes, the number of active carriers is displayed to show how many carriers are identified as active in auto detected mode of span, otherwise “-” is displayed to indicate that it is out of scope. When there is one active carrier, Transmit Freq Error is displayed. Otherwise, “---“ is displayed.

Measure Trace

See "Measure Trace" on page 1734.

3.4.2.3 Metrics - OBW Boundaries

Window #3

Displays occupied bandwidth and X dB bandwidth for both lower and upper boundaries.

View	Size	Position
"OBW Boundaries" on page 713	Half, full width	Bottom
Gate	One third, full width	Bottom

Occupied Bandwidth

The occupied bandwidth result is $f_2 - f_1$, where f_1 and f_2 are the lower and upper carrier boundary point. f_1 and f_2 are calculated with Occupied Bandwidth algorithms.

Total Power or OBW Power

Total Power is the power integrated in the specified span setting. OBW Power is calculated from multiplying the total power by OBW percent power. The user can select the total power or the OBW power with the Power Ref control in Meas Setup.

x dB

This is the setting parameter. See "x dB" on page 796.

x dB Ref Pwr

The x dB reference power result shows the power of the highest signal point within the OBW Span.

x dB At Freq

The x dB reference power frequency result shows the frequency of the highest signal point within the OBW Span. The frequency display type, either Offset or Absolute, can be selected with the Boundary Frequency control under Display.

OBW Boundary Results

Name	Unit	Corresponding Results
Lower OBW boundary - offset frequency	Hz	Offset frequency of the lower OBW boundary from center frequency
Lower OBW boundary - absolute power	dB	Absolute power on the point of lower OBW boundary
Lower OBW boundary - relative power	dBc	Relative power on the point of lower OBW boundary
Upper OBW boundary - offset frequency	Hz	Offset frequency of the upper OBW boundary from center frequency
Upper OBW boundary - absolute power	dB	Absolute power on the point of upper OBW boundary
Upper OBW boundary - relative power	dBc	Relative power on the point of upper OBW boundary
Lower x dB BW boundary - offset frequency	Hz	Offset frequency of the lower x dB BW boundary from center frequency
Lower x dB BW boundary - absolute power	dB	Absolute power on the point of lower x dB BW boundary
Upper x dB BW boundary - offset frequency	Hz	Offset frequency of the lower x dB BW boundary from center frequency
Upper x dB BW boundary - absolute power	dB	Absolute power on the point of lower x dB BW boundary

3.4.2.4 Gate

Window #4

Turning on **Gate** View shows the **Gate** Window, which lets you see your Gating signal at the same time as the measured data. See the description in "Gate View On/Off" on page 2665 under **Trigger**, **Gate Settings**.

Views in which this window appears:

View	Size	Position
Gate	One third, full width	Top

3.4.3 Amplitude

Activates the **Amplitude** menu and selects **Reference Level** or **Reference Value** as the active function, depending on the measurement.

Some features in this menu apply to multiple measurements. Some other features apply only to specific measurements and their controls are blanked or grayed-out in measurements that do not support the feature.

3.4.3.1 Y Scale

Contains controls that pertain to the Y axis parameters of the measurement. These parameters control how data on the vertical (Y) axis is displayed and control instrument settings that affect the vertical axis.

Ref Value

Sets the value for the absolute power reference. The reference line is at the top, center, or bottom of the graticule, depending on the value of the Ref Position function.

Remote Command	`:DISPlay:OBWidth:WINDow[1]:TRACe:Y[:SCALe]:RLEVel <real>` `:DISPlay:OBWidth:WINDow[1]:TRACe:Y[:SCALe]:RLEVel?`
Example	`:DISP:OBW:WIND:TRAC:Y:RLEV 125` `:DISP:OBW:WIND:TRAC:Y:RLEV?`
Couplings	When "Auto Scaling" on page 726 is ON (default), this value is automatically determined by the measurement result. When you set a value manually, **Auto Scaling** changes to OFF "Attenuation" on page 1932 is not coupled to **Ref Value**
Preset	10.00 dBm
State Saved	Saved in instrument state
Min/Max	-250.00 dBm / 250.00 dBm
Annotation	Ref <value> top left of graph
Backwards Compatibility SCPI	`:DISPlay:OBWidth:VIEW[1]:WINDow[1]:TRACe:Y[:SCALe]:RLEVel`

Scale/Div

For measurements that support a logarithmic Y-Axis, **Scale/Div** sets the height of one division of the graticule in the current Y-Axis unit.

Scale/Div also determines the displayed amplitude range in the log plot graph. Since there are usually 10 vertical graticule division on the display, the total amplitude range of the graph is typically 10x this amount. For example, if Scale/Div is 10 dB, then the total range of the graph is 100 dB.

Remote Command	`:DISPlay:OBWidth:WINDow[1]:TRACe:Y[:SCALe]:PDIVision <rel_ampl>` `:DISPlay:OBWidth:WINDow[1]:TRACe:Y[:SCALe]:PDIVision?`
Example	`:DISP:OBW:WIND:TRAC:Y:PDIV 5` `:DISP:OBW:WIND:TRAC:Y:PDIV?`
Couplings	Coupled to Scale Range as follows Scale/Div = Scale Range/10 (number of divisions) When the Auto Scaling is On, this value is automatically determined by the measurement result When you change a value, Auto Scaling automatically changes to Off
Preset	10.00 dB / Div
State Saved	Saved in instrument state
Min	0.10 dB
Max	20 dB
Annotation	<value> dB/ left upper of graph
Backwards Compatibility SCPI	`:DISPlay:OBWidth:VIEW[1]:WINDow[1]:TRACe:Y[:SCALe]:PDIVision`

Scale Range

Sets the Y-Axis scale range.

Remote Command	Replace `<meas>` with the identifier for the current measurement
	`:DISPlay:<meas>:WINDow[1]:TRACe:Y[:SCALe]:RANGe <rel_ampl>`
	`:DISPlay:<meas>:WINDow[1]:TRACe:Y[:SCALe]:RANGe?`

Example	`:DISP:CHP:WIND:TRAC:Y:RANG 100` `:DISP:CHP:WIND:TRAC:Y:RANG?`
Couplings	Coupled to **Scale/Div** as follows **Scale Range** = **Scale/Div** * 10 (number of divisions) When you change this value, **Auto Scaling** automatically changes to `OFF`
Preset	100 dB
State Saved	Saved in instrument state
Min	1
Max	200

Y Axis Unit

Displays a dropdown menu that enables you to change the vertical (Y) axis amplitude unit. This setting affects how the data is read over the remote interface. When using the remote interface, only numerical values are returned, so you must know what the Y Axis Unit is to interpret the results. This is described in more detail in "Amplitude Data Query and Y Axis Unit" on page 722 below.

For measurements that support both Log and Lin scales, the instrument retains the entered Y Axis Unit separately for both Log and Lin amplitude Display Scales. For example, if Display Scale has been set to Log, and you set Y Axis Unit to dBm, pressing **Display Scale (Log)** sets the Y Axis Unit to dBm. If Display Scale has been set to Lin and you set Y Axis Unit to V, pressing **Display Scale (Lin)** sets the Y Axis Unit to V. Pressing **Display Scale (Log)** again sets the Y Axis Unit back to dBm.

If an Amplitude Correction is being applied that has an associated Transducer Unit, all selections but **Xducer Unit** are grayed-out. For more information, see "Transducer Unit" on page 723 below.

Remote Command	`:UNIT:POWer DBM | DBMV | DBMA | V | W | A | DBUV | DBUA | DBPW | DBUVM | DBUAM | DBPT | DBG` `:UNIT:POWer?`

Example	`:UNIT:POW dBmV`
	`:UNIT:POW?`
	See also "Remote Interface Examples" on page 721 below

Notes	The Y axis unit has either logarithmic or linear characteristics. The set of units that is logarithmic consists of dBm, dBmV, dBmA, dBmV, dBmA, dBmV/m, dBmA/m, dBpT, and dBG. The set of units that are linear consists of V, W, and A. The chosen unit will determine how the reference level and all the amplitude-related outputs like trace data, marker data, etc., read out
Dependencies	Appears only in Spectrum Analyzer Mode If an amplitude correction with a Transducer Unit other than None is applied and enabled: – The Transducer Unit selection is forced, and is the only Y Axis Unit available. The specific Transducer Unit is shown in square brackets in the dropdown, and all other Y Axis Unit choices are grayed-out – If you turn off that correction or set Apply Corrections to NO, the Y Axis Unit that existed before the Transducer Unit was applied is restored When Normalize is ON (in the **Trace**, **Normalize** menu), Y Axis Unit is grayed-out, and forced to dBm
Couplings	The instrument retains the entered Y Axis Unit separately for both Log and Lin amplitude Display Scales
Preset	dBm for log scale, V for linear. The true 'preset' value is dBm, since at preset the Y Display Scale is set to logarithmic
State Saved	Saved in instrument state
Annotation	The Y Axis Unit is shown after Ref Level value at the top of the graticule

Unit	Example	Notes
dBm	:UNIT:POW DBM	Y Axis Unit is set to dBm
dBmV	:UNIT:POW DBMV	Y Axis Unit is set to dBmV
dBmA	:UNIT:POW DBMA	Y Axis Unit is set to dBmA
W	:UNIT:POW W	Y Axis Unit is set to W
V	:UNIT:POW V	Y Axis Unit is set to V
A	:UNIT:POW A	Y Axis Unit is set to A
dBmV	:UNIT:POW DBUV	Y Axis Unit is set to dBmV
dBmA	:UNIT:POW DBUA	Y Axis Unit is dBmA. The unit dBuA can also appear as a Transducer Unit
dBpW	:UNIT:POW DBPW	Y Axis Unit is set to dBpW

Remote Interface Examples

Command examples and details appear in the table below. Note that each of the commands below sets the amplitude unit only for the *selected* amplitude scale (Log or Lin), the other scale is unaffected.

Unit	Example	Notes
dBm	:UNIT:POW DBM	dB relative to one milliwatt
dBmV	:UNIT:POW DBMV	dB relative to one millivolt
dBmA	:UNIT:POW DBMA	dB relative to one milliamp
W	:UNIT:POW W	Watts
V	:UNIT:POW V	Volts
A	:UNIT:POW A	Amperes
dBmV	:UNIT:POW DBUV	dB relative to one microvolt
dBmA	:UNIT:POW DBUA	dB relative to one microamp The unit dBuA can also appear as a "Transducer Unit" on page 723 When querying the Y-Axis unit, you can query the Transducer Unit to distinguish between regular dBuA and the dBuA transducer unit. If :CORR:CSET:ANT? returns NOC (for No Conversion), you are using a normal Y Axis dBuA. If it returns UA, you are using a Transducer Unit dBuA
dBpW	:UNIT:POW DBPW	dB relative to one picowatt
dBmV/m	:UNIT:POW DBUVM	Sets the amplitude unit for the selected amplitude scale (log/lin) to dBmV/meter. This selection is only available if a Correction is turned on, and the Transducer Unit

Unit	Example	Notes
(Transducer Unit)		for that Correction is not None See "Transducer Unit" on page 723
dBmA/m (Transducer Unit)	`:UNIT:POW DBUAM`	Sets the amplitude unit for the selected amplitude scale (log/lin) to dBmA/meter. This selection is only available if a Correction is turned on, and the Transducer Unit for that Correction is not None See "Transducer Unit" on page 723
dBpT (Transducer Unit)	`:UNIT:POW DBPT`	Sets the amplitude unit for the selected amplitude scale (log/lin) to dBpT (dB relative to one picotesla). This selection is only available if a Correction is turned on, and the Transducer Unit for that Correction is not None See "Transducer Unit" on page 723
dBG (Transducer Unit)	`:UNIT:POW DBG`	Sets the amplitude unit for the selected amplitude scale (log/lin) to dBG (dB relative to one Gauss). This selection is only available if a Correction is turned on, and the Transducer Unit for that Correction is not None See "Transducer Unit" on page 723
dBmA (Transducer Unit)	`:UNIT:POW DBUA`	Sets the amplitude unit for the selected amplitude scale (log/lin) to dBmA. This selection is only available as a Transducer Unit if a Correction is turned on, and the Transducer Unit for that Correction is not None See "Transducer Unit" on page 723 The unit dBuA can also appear as a normal Y Axis Unit (see above) dBuA as a Transducer Unit is used when using current probes, because current probes are often supplied with conversion tables that provide the transducer factors. When dBuA is used as a Transducer Unit, the normal conversion from power to amps for dBuA (based on the instrument input impedance) is not done, but instead the conversion is based solely on the Correction that contains the transducer factors. This is what distinguishes dBuA as a normal unit from dBuA as a transducer unit When querying the Y-Axis unit, you can query the Transducer Unit to distinguish between regular dBuA and the dBuA Transducer Unit. If `:CORR:CSET:ANT?` returns `NOC` (for No Conversion), you are using a normal Y-Axis dBuA. If it returns `UA`, you are using a Transducer Unit dBuA

Amplitude Data Query and Y Axis Unit

The settings of Y-Axis Unit and Display Scale affect how the data is returned over the remote interface in response to a query. When using the remote interface, no unit is returned, so you must know what the Y-Axis unit is to interpret the results:

Example 1

Set the following:

- Display Scale (Log)
- Y Axis Unit, dBm
- Scale/Div, 1 dB
- Ref Level, 10 dBm

This sets the top line to 10 dBm with each vertical division representing 1 dB. Thus, if a point on trace 1 is on the fifth graticule line from the top, it represents 5 dBm and will read out remotely as 5.

Example 2

Set the following:

- Display Scale (Lin)
- Y Axis Unit, Volts
- Ref Level, 100 mV (10 mV/div)

This sets the top line to 100 mV and the bottom line to 0 V, so each vertical division represents 10 mV. Thus, if a point on trace 1 is on the fifth graticule line from the top, it represents 50 mV and will read out remotely as 50.

NOTE **The units of current (A, dBmA, dBuA) are calculated based on 50 Ω input impedance.**

Transducer Unit

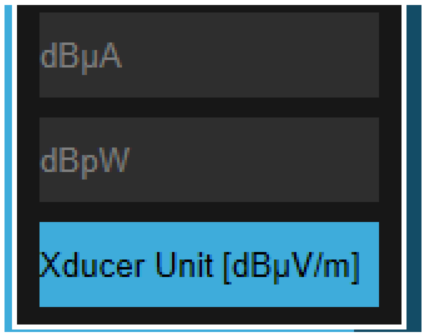
Transducer Units (formerly called Antenna Units) are units of field strength rather than amplitude, and are used when correcting the response of device such as antennas whose amplitude characteristics are measured in units of field strength. All five of the Transducer Units (dBmA/m, dBmV/m, dBG, dBpT, dBmA) are treated by the instrument exactly as though they were dBmV, when uncorrected. You must load an appropriate correction factor using Input/Output, Corrections for accurate and meaningful results.

If a remote command is sent to the instrument that uses one of the Transducer Units as a terminator, the instrument treats it as though DBUV had been sent as the terminator.

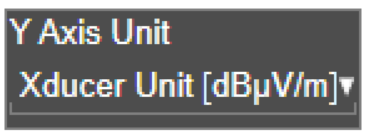
When a Correction is turned on that uses a Transducer Unit, the Y Axis Unit changes to that Transducer Unit. All of the selections in the **Y-Axis Unit** dropdown are then grayed-out, except the Transducer Unit selection. The unit being used is shown on this selection in square brackets, and appears on the control in square brackets preceded by **Xducer Unit**.

Example:

If the Transducer Unit in the Correction is dBmV/m, then the selection in the dropdown looks like this:



And on the control it looks like this:



NOTE

If a Transducer Unit is set, it is displayed as **Xducer Unit** in the **Y Axis Unit** dropdown. However, you can only *change* the Transducer Unit via the **Edit Correction** dialog in the **Input/Output**, **Corrections** menu. In that dialog, tap **Settings** then **Transducer Unit**. You can also turn off Transducer Unit from the same menu, by selecting **None**.

If a Transducer Unit is set, it is displayed as **Xducer Unit** in the **Y Axis Unit** dropdown. However, you can only *change* the Transducer Unit via the **Edit Correction** dialog in the **Input/Output**, **Corrections** menu. In that dialog, tap **Settings** then **Transducer Unit**. You can also turn off Transducer Unit from the same menu, by selecting **None**.

The Transducer Units are:

Units	Example
dBmV/m	:UNIT:POW DBUVM
dBmA/m	:UNIT:POW DBUAM
dBpT	:UNIT:POW DBPT
dBG	:UNIT:POW DBG
dBmA	:UNIT:POW DBUA
None	n/a

Ref Level Offset

Adds an offset value to the displayed reference level. The reference level is the absolute amplitude represented by the top graticule line on the display.

The on/off (AUTO) switch turns **Ref Level Offset** on or off. Setting a value for **Ref Level Offset** turns AUTOOFF.

Remote Command	`:DISPlay:WINDow[1]:TRACe:Y[:SCALe]:RLEVel:OFFSet <rel_ampl>`
	`:DISPlay:WINDow[1]:TRACe:Y[:SCALe]:RLEVel:OFFSet?`
	`:DISPlay:WINDow[1]:TRACe:Y[:SCALe]:RLEVel:OFFSet:STATe OFF | ON | 0 | 1`
	`:DISPlay:WINDow[1]:TRACe:Y[:SCALe]:RLEVel:OFFSet:STATe?`

Example	Set **Ref Level Offset** to 12.7 dB. The only valid suffix is dB. If no suffix is sent, dB is assumed:
	`:DISP:WIND:TRAC:Y:RLEV:OFFS 12.7`
	`:DISP:WIND:TRAC:Y:RLEV:OFFS?`
	Turn **Ref Level Offset**AUTOON:
	`:DISP:WIND:TRAC:Y:RLEV:OFFS:STAT ON`

Dependencies	Appears only in Spectrum Analyzer Mode
Preset	0 dBm OFF
State Saved	Saved in instrument state
Min	Variable. Limited to values that keep the reference level within the range of -327.6 dB to 327.6 dB
Max	327.6 dB
Annotation	The offset is displayed as “Ref Offset <value>” to the right of the reference level annotation if nonzero. When the offset is zero, no annotation is shown

Ref Position

Positions the reference level at the top, center, or bottom of the Y Scale display. Changing the reference position does not change the reference level value.

Remote Command	`:DISPlay:OBWidth:WINDow[1]:TRACe:Y[:SCALe]:RPOSition TOP | CENTer | BOTTom` `:DISPlay:OBWidth:WINDow[1]:TRACe:Y[:SCALe]:RPOSition?`
Example	`:DISP:OBW:WIND:TRAC:Y:RPOS CENT` `:DISP:OBW:WIND:TRAC:Y:RPOS?`
Preset	TOP
State Saved	Saved in instrument state
Range	TOP|CENTer|BOTTom
Annotation	The greater than (>) and less than (<) symbols are displayed on both sides of the graph to indicate the

	Reference Position
Backwards Compatibility SCPI	:DISPlay:OBWidth:VIEW[1]:WINDow[1]:TRACe:Y[:SCALe]:RPOSition

Auto Scaling

Toggles **Auto Scaling** On or Off.

Remote Command	:DISPlay:OBWidth:WINDow[1]:TRACe:Y[:SCALe]:COUPle 0 | 1 | OFF | ON :DISPlay:OBWidth:WINDow[1]:TRACe:Y[:SCALe]:COUPle?
Example	:DISP:OBW:WIND:TRAC:Y:COUP OFF :DISP:OBW:WIND:TRAC:Y:COUP?
Couplings	When **Auto Scaling** is ON, and the **Restart** front-panel key is pressed, this function automatically sets the scale per division to 10 dB and determines the reference values based on the measurement results When you change a value of "Scale/Div" on page 718, "Ref Value" on page 718, or "Scale Range" on page 1538, **Auto Scaling** automatically changes to OFF
Preset	1
State Saved	Saved in instrument state
Range	OFF|ON
Backwards Compatibility SCPI	:DISPlay:OBWidth:VIEW[1]:WINDow[1]:TRACe:Y[:SCALe]:COUPle

3.4.3.2 Attenuation

Controls the attenuator functions and interactions between the attenuation system components.

There are two attenuator configurations in the X-Series. One is a Dual-Attenuator configuration consisting of a mechanical attenuator and an optional electronic attenuator. The other configuration uses a single attenuator with combined mechanical and electronic sections that controls all the attenuation functions. Different models in the X-Series come with different configurations.

- See "Dual-Attenuator Configurations" on page 727
- See "Single-Attenuator Configuration" on page 727

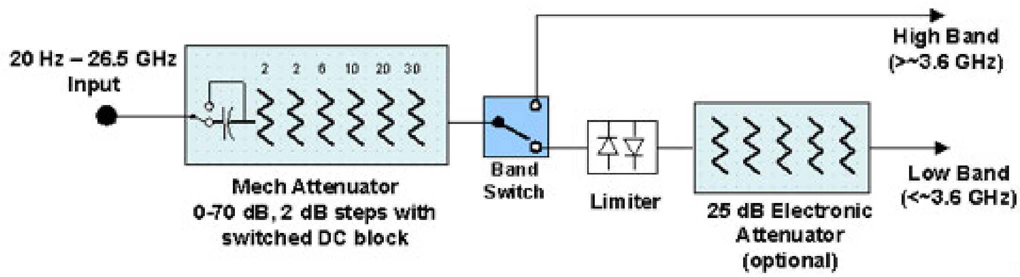
Most attenuation settings are the same for all measurements – they do not change as you change measurements. Settings like these are called “Meas Global” and are unaffected by **Meas Preset**.

Only available when the hardware set includes an input attenuator, which is typically only the case for Keysight’s benchtop instruments. For example, this tab does *not* appear in VXT models M9421A/10A/11A, nor in UXM. In UXM, all **Attenuation** and **Range** settings are disabled, as the expected input power level is handled by the Call Processing App that drives the DUT power control.

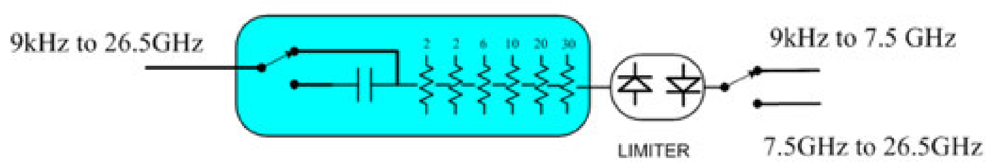
Dependencies	In measurements that support the I/Q inputs, unavailable when I/Q is the selected input. Replaced by the **Range** tab in that case

Dual-Attenuator Configurations

Configuration 1: Mechanical attenuator + optional electronic attenuator

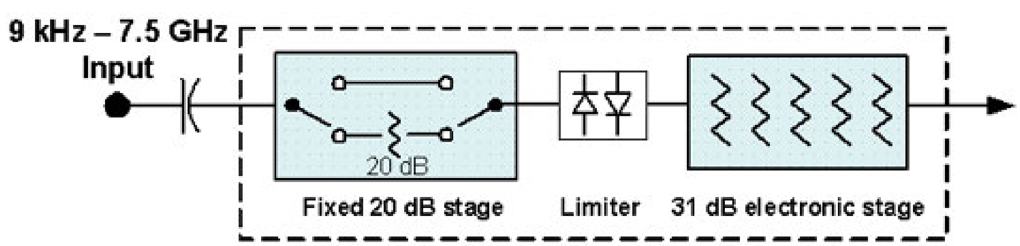


Configuration 2: Mechanical attenuator, no optional electronic attenuator



Note that Configuration 2 is not strictly speaking a dual-section attenuator, since there is no electronic section available. However, it behaves exactly like Configuration 1 without the Electronic Attenuator Option EA3, therefore for the sake of this document it is grouped into the “Dual-Attenuator” configuration.

Single-Attenuator Configuration



You can tell which attenuator configuration you have by pressing the Attenuation tab, which (in most Modes) opens the Attenuation menu. If the first control in the Attenuation menu says **Mech Atten** you have the Dual-Attenuator configuration. If the first control says **Atten** you have the Single-Attenuator configuration.

Dual Attenuator **Single Attenuator**

(Note that depending on the measurement, there may be no Auto/Man functionality on the Mech Atten control.)

In the Single-Attenuator configuration, you control the attenuation with a single control, as the fixed stage has only two states. In the Dual-Attenuator configuration, both stages have significant range, so you are given separate control of the mechanical and electronic attenuator stages.

When you have the Dual-Attenuator configuration, you may still have only a Single-Attenuator, because unless Option EA3 (the Electronic Attenuator option) is available, and you purchase it, you will have only the mechanical attenuator.

Full Range Atten

This control and **Attenuator Summary** only appear in N9041B, when the RF input is selected, the RF Input Port is set to RF Input 2, and the Full Range Attenuator is installed. The Full Range Attenuator adds a second input attenuator in front of RF Input 2, which enhances the protection and optimizes the performance of the extra internal mixers used by RF Input 2.

Remote Command	`[:SENSe]:POWer[:RF]:FRATten <rel_ampl>` `[:SENSe]:POWer[:RF]:FRATten?`
Example	`:POW:FRAT 14` `:POW:FRAT?`
Notes	When you enter an amplitude value that falls between valid values, the value will be incremented to the next smallest valid value
Dependencies	Only appears if input RF is selected, RF Input Port 2 is selected, and the Full Range Attenuator exists
Couplings	This value is never changed by any coupling, but other couplings use this value. See **Reference Level** and "Mech Atten" on page 1935 command descriptions
Preset	20 dB

State Saved	Saved in instrument state
Min	0 dB
Max	Only valid values are 0, 6, 14, 20 dB
Annotation	When the **Input** is **RF**, and the **Input Port** is **RF Input 2**, and the Full Range Attenuator is installed: On the Meas Bar, the field "Atten" displays as follows: – If the sweep is entirely < 50 GHz, the value shown after "Atten:" is equal to Mech Atten + Elec Atten + Full Range Atten – If the sweep is entirely > 50 GHz, the value shown after "Atten:" is equal to Full Range Atten – If the sweep straddles 50 GHz, the value shown after "Atten:" is preceded by the symbol ">=" and is equal to Full Range Atten In the **Amplitude**, "Y Scale" on page 1929 menu, and the Atten **Meas Bar** dropdown menu panel, a summary is displayed as follows: "Total Atten below 50 GHz" followed by the value of Full Range Atten + Mech Atten + Elec Atten "Total Atten above 50 GHz" followed by the value of Full Range Atten For example, if Mech Atten = 6 dB, Elec Atten = 4 dB, and Full Range Atten = 20 dB, the summary below is shown: – Attenuator summary: – Total Atten below 50 GHz: 30 dB – Total Atten above 50 GHz: 20 dB

Mech Atten

Labeled **Mech Atten** in Dual-Attenuator models and **Atten** in Single-Attenuator models. In the Dual-Attenuator configuration, this control only affects the mechanical attenuator.

Lets you modify the attenuation applied to the RF input signal path. This value is normally auto-coupled to the Ref Level, the Internal Preamp Gain, any External Gain that is entered, and the Max Mixer Level, as described in the table below.

See "Attenuator Configurations and Auto/Man" on page 731

Remote Command	`[:SENSe]:POWer[:RF]:ATTenuation <rel_ampl>`
	`[:SENSe]:POWer[:RF]:ATTenuation?`
	`[:SENSe]:POWer[:RF]:ATTenuation:AUTO OFF | ON | 0 | 1`
	`[:SENSe]:POWer[:RF]:ATTenuation:AUTO?`

Example	`:POW:ATT 20` Dual-Attenuator configuration: sets the mechanical attenuator to 20 dB Single-Attenuator mode: sets the main attenuation to 20 dB (see below for definition of "main"

	attenuation) In either case, if the attenuator was in Auto, it is set to Manual `:POW:ATT:AUTO ON` Turn Auto Mech Atten ON
Dependencies	Some measurements do not support Auto setting of "Mech Atten" on page 729. In these measurements, the **Auto/Man** selection is not available, and the Auto/Man toggle function is not available In Dual-Attenuator configurations, when the electronic attenuator is enabled, the mechanical attenuator has no auto setting, and the Auto/Man toggle function is not available. The state of Auto/Man is remembered and restored when the electronic attenuator is once again disabled. This is described in more detail in "Elec Atten" on page 1937 See "Attenuator Configurations and Auto/Man" on page 731 for more information on the Auto/Man functionality `:POW:ATT:AUTO` is only available in measurements that support Mech Atten Auto, such as Swept SA
Couplings	If the RF Input Port is the RF Input: – If the USB Preamp is connected to USB, use 0 dB for Mech Atten – Otherwise compute the auto-selected value of Mech Atten based on **Reference Level**, Int Preamp, External Gain, Ref Level Offset, Max Mixer Level, µW Path Control and IF Gain settings. Limit this value to be no less than 6 dB (total attenuation below 6 dB can never be chosen by Auto) – In the N9041B, if the RF Input Port is RF Input 2, use the formula above and subtract the Full Range Atten value from the result to determine the Mech Atten. Limit the value so that it is never lower than 0 dB and so that total attenuation, including Full Range Atten, is never less than 6 dB (total attenuation, including Full Range Atten below 6 dB, can never be chosen by Auto) In External Mixing and BBIQ, where the Attenuator is not in the signal path, the Attenuator setting changes as described above when "Mech Atten" on page 729 is in Auto, but no changes are made to the actual attenuator hardware setting until the input is changed back to the RF Input For CXA-m with option FSA (Fine-Step Attenuator or 2 dB steps), the FSA-like behavior is only available when the frequency setting is <= 7.5 GHz. So, when the frequency is changed from below 7.5 GHz to above 7.5 GHz, the attenuation setting will be changed to a multiple of 10 dB which will be no smaller than the previous setting. For example, 4 dB attenuation will be changed to 10 dB
Preset	The preset for Mech Attenuation is "Auto" The Auto value of attenuation is 10 dB `ON`
State Saved	Saved in instrument state
Min	0 dB The attenuation set by this control cannot be decreased below 6 dB with the knob or step keys. Values below 6 dB must be directly entered from the keypad or via SCPI. This protects against setting a dangerously small attenuation value, which can put the instrument at risk of damage to input circuitry. If the current mechanical attenuation is below 6 dB, it can be increased with the knob and step keys, but not decreased

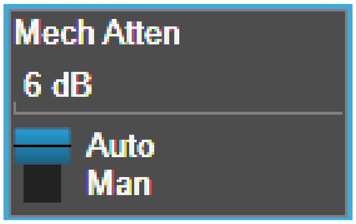
Max	CXA Option 503 or 507: 50 dB EXA: 60 dB All other models: 70 dB Note that in the Single-Attenuator configuration, the total of ATT and EATT cannot exceed 50 dB. So, if the EATT is set to 24 dB first, the main attenuation cannot be greater than 26 dB and will be reduced accordingly; if the main attenuator is set to 40 dB first, EATT cannot be greater than 10 dB
Annotation	The current value for Total Atten is displayed in the Measurement Bar at the top of the display. A value appears for Electronic Attenuation only if the Electronic Attenuator is enabled. The annotation appears as Atten: <total> dB (e<elec>) The e letter is in amber in Single-Attenuator configurations For example: Dual-Attenuator configuration: Atten: 24 dB (e14) Indicating the total attenuation is at 24 dB and the electronic attenuation is at 14 dB Single-Attenuator configuration: A: 24 dB (e14) Indicating the total attenuation is at 24 dB and the “soft” attenuation is at 14 dB (see below for definition of “soft” attenuation) When in Manual, a # sign appears in front of Atten in the annotation

Attenuator Configurations and Auto/Man

As described under "Y Scale" on page 1929, there are two distinct attenuator configurations available in the X-Series, the single attenuator and Dual-Attenuator configurations. In Dual-Attenuator configurations, we have the mechanical attenuation and the electronic attenuation, and the current total attenuation is the sum of the electronic + mechanical attenuation. In Single-Attenuator configurations, we refer to the attenuation set using "Mech Atten" on page 729 (or `:POW:ATT`) as the “main” attenuation; and the attenuation that is set by `:POW:EATT` as the “soft” attenuation (`:POW:EATT` is honored even in the Single-Attenuator configuration, for compatibility purposes). Then the current total attenuation is the sum of the main + soft attenuation.

See "Elec Atten" on page 1937 for more about “soft” attenuation.

NOTE **In some measurements, the Mech Atten control has an Auto/Man function. In these measurements, an Auto/Man switch is shown on the Mech Atten control:**



Note that in configurations that include an Electronic Attenuator, this switch is only shown when the Electronic Attenuator is disabled.

In other measurements, **Mech Atten** has no Auto/Man function. In these measurements, no switch is shown on the **Mech Atten** control:

Mech Atten also appears with no switch, as above, in configurations that include an Electronic Attenuator but when the Electronic Attenuator is enabled.

Elec Atten

Controls the Electronic Attenuator in Dual-Attenuator configurations. Does not appear in Single-Attenuator configurations, because the control of both the mechanical and electronic stages of the Single-Attenuator is integrated into the single **Atten** control.

This control includes an **Enable/Disable** toggle switch; it is only possible to enter a value for the Electronic Attenuator when this switch is in the **Enable** position.

For more details about the Electronic Attenuator, see "More Information" on page 734

Remote Command	`[:SENSe]:POWer[:RF]:EATTenuation <rel_ampl>`
	`[:SENSe]:POWer[:RF]:EATTenuation?`
	`[:SENSe]:POWer[:RF]:EATTenuation:STATe OFF | ON | 0 | 1`
	`[:SENSe]:POWer[:RF]:EATTenuation:STATe?`

Example	`:POW:EATT 10`
	`:POW:EATT?`
	`:POW:EATT:STAT ON`
	`:POW:EATT:STAT?`

Notes	Electronic Attenuation’s specification is defined only when Mechanical Attenuation is 6 dB

Dependencies	Only appears in Dual-Attenuator models with an Electronic Attenuator installed and licensed. Does not appear in models with the Single-Attenuator configuration, because in the Single-Attenuator configuration there is no “electronic attenuator”; there is only a single integrated attenuator (which has both a mechanical and electronic stage). However, in the Single-Attenuator configuration, EATT SCPI commands are accepted for compatibility with other X-series instruments, and set a “soft” attenuation. The “soft” attenuation is treated as an addition to the “main” attenuation value set by the **Attenuation** control or `:POW:ATT`, and affects the total attenuation displayed on the **Attenuation** control and the Meas Bar The electronic attenuator, and the “soft” attenuation function provided in Single-Attenuator configurations, are unavailable above the low band (0-3.6 GHz, 0-3.4 GHz, 0-3 GHz, depending on the model). If the low band range is from 0-3.6 GHz, and Stop Frequency of the instrument is > 3.6 GHz, then the **Enabled/Disabled** section of the **Elec Atten** control will be `OFF` and grayed-out If "Internal Preamp" on page 1959 is `ON` (that is, set to Low Band or Full), the electronic attenuator (and the “soft” attenuation function provided in Single-Attenuator configurations) is unavailable. In this case the **Enabled/Disabled** section of the **Elec Atten** control will be `OFF` and grayed-out If either of the above is true, and the SCPI command is sent, an error indicating that the electronic attenuator is unavailable is returned If both the above are true, pressing the control generates error message -221, in other words, the frequency range lockout takes precedence If the electronic/soft Attenuator is enabled, then the **Stop Freq** of the instrument is limited to 3.6 GHz and **Internal Preamp** is unavailable If "LNA" on page 1960 is `ON`, the electronic attenuator (and the “soft” attenuation function provided in Single-Attenuator configurations) is unavailable. In this case the **Enabled/Disabled** section of the **Elec Atten** control will be `OFF` and grayed-out. This coupling works in the following modes/measurements: – Channel Power, Occupied BW, ACP, SEM, Spurious Emissions, Power Stat CCDF measurements in all Modes – Transmit On|Off Power measurement in 5GNR Mode – Power vs. Time and Transmit Power measurement in GSM/EDGE Mode – Burst Power measurement in Spectrum Analyzer Mode The SCPI-only “soft” electronic attenuation for the single-attenuator configuration is not available in all measurements; in particular, it is not available in the Swept SA measurement
Couplings	Enabling and disabling the Electronic Attenuator affects the setting of the Mechanical Attenuator (in Dual-Attenuator configurations). This is described in more detail below and in "Mechanical Attenuator Transition Rules" on page 734
Preset	0 dB `OFF` (Disabled) for Swept SA measurement `ON` (Enabled) for all other measurements that support the electronic attenuator
State Saved	Saved in instrument state
Min	0 dB
Max	Dual-Attenuator configuration: 24 dB Single-Attenuator configuration: the total of ATT and EATT cannot exceed 50 dB. So, if the EATT is set

	to 24 dB first, the main attenuation cannot be greater than 26 dB and will be reduced accordingly; if the main attenuator is set to 40 dB first, EATT cannot be greater than 10 dB
Annotation	See Annotation under the **Mech Atten** control description

More Information

The electronic attenuator offers finer steps than the mechanical attenuator, has no acoustical noise, is faster, and is less subject to wear. These advantages primarily aid in remote operation and are negligible for front panel use. See "Using the Electronic Attenuator: Pros and Cons" on page 735 for a detailed discussion of the pros and cons of using the electronic attenuator.

For the Single-Attenuator configuration, for SCPI backwards compatibility, the “soft” attenuation feature replaces the Dual-Attenuator configuration’s electronic attenuator. All the same couplings and limitations apply. See "Attenuator Configurations and Auto/Man" on page 1937

Mechanical Attenuator Transition Rules

When the Electronic Attenuator is enabled, the Mechanical Attenuator transitions to a state that has no Auto function. Below are the rules for transitioning the Mechanical Attenuator. Note that the information below *only* applies to the Dual-Attenuator configurations, and *only* when the Electronic Attenuator is installed:

When the Electronic Attenuation is enabled from a disabled state:

- The Mechanical Attenuator is initialized to 10 dB (this is its optimal performance setting). You can then set it as desired with SCPI, numeric keypad, step keys, or knob, and it behaves as it normally would in manual mode
- The Auto/Man state of (Mech) Atten is saved
- The Auto/Man toggle on the (Mech) Atten control disappears, and the auto rules are disabled
- The Electronic Attenuator is set to 10 dB less than the previous value of the Mechanical Attenuator, within the limitation that it must stay within the range of 0 to 24 dB of attenuation

Examples in the Dual-Attenuator configuration:

- Mech Atten at 20 dB. Elec Atten enabled, Mech Atten set to 10 dB, and Elec Atten set to 10 dB. New total attenuation equals the value before Elec Atten enabled
- Mech Atten at 0 dB. Elec Atten enabled, Mech Atten set to 10 dB, and Elec Atten set to 0 dB. New total attenuation does not equal the value before Elec Atten enabled

- Mech Atten at 40 dB. Elec Atten enabled, Mech Atten set to 10 dB, and Elec Atten set to 24 dB. New total attenuation does not equal the value before Elec Atten enabled

When the Electronic Attenuation is disabled from an enabled state:

- The Elec Atten control is grayed out
- The Auto/Man state of (Mech) Atten is restored
- If now in Auto, (Mech) Atten recouples
- If now in Man, (Mech) Atten is set to the value of total attenuation that existed before the Elec Atten was disabled. The resulting value is rounded up to the smallest value possible given the (Mech) Atten Step setting - (That is, 57 dB changes to 58 dB when (Mech) Atten Step is 2 dB)

Using the Electronic Attenuator: Pros and Cons

The electronic attenuator offers finer steps than the mechanical attenuator, has no acoustical noise, is faster, and is less subject to wear.

The “finer steps” advantage of the electronic attenuator is beneficial in optimizing the alignment of the instrument dynamic range to the signal power in the front panel as well as remote use. Thus, you can achieve improved relative signal measurement accuracy. Compared to a mechanical attenuator with 2 dB steps, the 1 dB resolution of the electronic attenuator only gives better resolution when the odd-decibel steps are used. Those odd-decibel steps are less accurately calibrated than the even-decibel steps, so one tradeoff for this superior relative accuracy is reduced absolute amplitude accuracy.

Another disadvantage of the electronic attenuator is that the spectrum analyzer loses its “Auto” setting, making operation less convenient.

Also, the relationship between the dynamic range specifications (TOI, SHI, compression, and noise) and instrument performance are less well-known with the electrical attenuator. With the mechanical attenuator, TOI, SHI, and compression threshold levels increase dB-for-dB with increasing attenuation, and the noise floor does as well. With the electronic attenuator, there is an excess attenuation of about 1 to 3 dB between 0 and 3.6 GHz, making the effective TOI, SHI, and so forth, less well known. Excess attenuation is the actual attenuation relative to stated attenuation. Excess attenuation is accounted for in the instrument calibration.

Adjust Atten for Min Clipping

Sets the combination of mechanical and electronic attenuation and gain based on the current measured signal level so that clipping will be at a minimum.

This is an immediate action function, that is, it executes once, when the control is pressed.

The algorithms that are used for the adjustment are documented under "Pre-Adjust for Min Clipping" on page 1942.

Remote Command	`[:SENSe]:POWer[:RF]:RANGe:OPTimize IMMediate`
Example	`:POW:RANG:OPT IMM`
Notes	Executing **Adjust Atten for Min Clipping** initiates the measurement
Dependencies	Does not appear in the Swept SA, RTSA, Monitor Spectrum and Complex Spectrum measurements Appears in the Waveform measurement in 5G NR Mode only

Adjust Atten

Allows you to select;

- Electric attenuator only
- Combination of Electric attenuator and Mechanical attenuator

when `[:SENSe]:POWer[:RF]:RANGe:OPTimize IMMediate` is executed.

Remote Command	`[:SENSe]:POWer[:RF]:RANGe:OPTimize:TYPE EONLy | COMBined` `[:SENSe]:POWer[:RF]:RANGe:OPTimize:TYPE?`
Example	`:POW:RANG:OPT:TYPE EONL` `:POW:RANG:OPT:TYPE?`
Dependencies	Does not appear in the Swept SA, RTSA, Monitor Spectrum and Complex Spectrum measurements Appears in the Waveform measurement in 5G NR Mode only
Preset	`COMBined`
State Saved	Saved in instrument state

Pre-Adjust for Min Clipping

If this function is ON, it applies the adjustment described under "Adjust Atten for Min Clipping" on page 1941 each time a measurement restarts. Therefore, in Continuous measurement mode, it only executes before the first measurement.

In Dual-Attenuator models, you can set **Elec+Mech Atten**, in which case both attenuators participate in the autoranging, or **Elec Atten Only**, in which case the mechanical attenuator does not participate in the autoranging. This latter case results in less wear on the mechanical attenuator and is usually faster.

See "Adjustment Algorithm" on page 738

Selection	SCPI	Note
Off	OFF	This is the default setting
On	ON	Available in Single-Attenuator instruments. For compatibility with models that do not have an input attenuator, the ON parameter is supported and mapped to COMBined
Elec Atten Only	ELECtrical	Selects only the electric attenuator to participate in auto ranging. This offers less wear on the mechanical attenuator and is usually faster
Elec+Mech Atten	COMBined	In Dual-Attenuator models, this selects both attenuators to participate in the autoranging

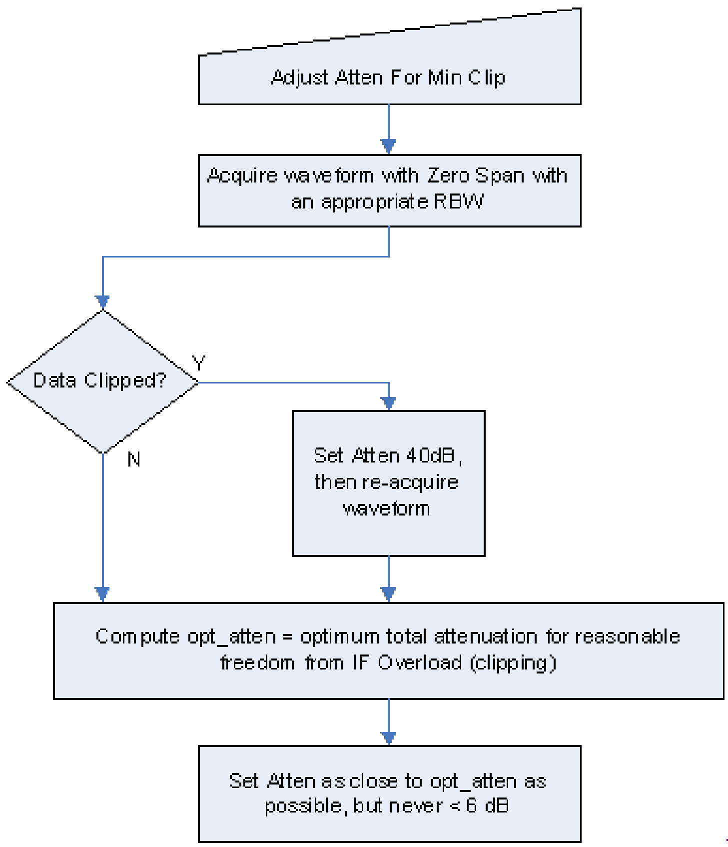
Remote Command	`[:SENSe]:POWer[:RF]:RANGe:OPTimize:ATTenuation OFF | ON | ELECtrical | COMBined` `[:SENSe]:POWer[:RF]:RANGe:OPTimize:ATTenuation?`
Example	`:POW:RANG:OPT:ATT OFF` `:POW:RANG:OPT:ATT?`
Notes	The parameter option ELECtrical sets this function to ON in Single-Attenuator models The parameter option COMBined is mapped to ELECtrical in Single-Attenuator models. If you send COMBined, it sets the function to ON and returns ELEC to a query For SCPI compatibility with models that do not have an input attenuator, the ON parameter is honored and mapped to COMBined
Dependencies	Only appears in Dual-Attenuator models with an Electronic Attenuator installed In instruments with Dual-Attenuator model, when "Elec Atten" on page 1937 is OFF or grayed-out, "Pre-Adjust for Min Clipping" on page 736 is grayed-out Does not appear in the Swept SA, RTSA, Monitor Spectrum and Complex Spectrum measurements For the Waveform measurement, available only in 5G NR Mode
Preset	OFF when Elec Atten is Disabled at preset, otherwise ELEC
State Saved	Saved in instrument state
Range	Dual-Attenuator models: Off | Elec Atten Only | Mech + Elec Atten Single-Attenuator models: Off | On

Notes	ON aliases to "Elec Atten Only" (`:POW:RANG:OPT:ATT ELEC`) OFF aliases to "Off" (`:POW:RANG:OPT:ATT OFF`) `:POW:RANG:AUTO?` returns true if `:POW:RANG:OPT:ATT` is not OFF
Backwards Compatibility SCPI	`[:SENSe]:POWer[:RF]:RANGe:AUTO ON | OFF | 1 | 0` `[:SENSe]:POWer[:RF]:RANGe:AUTO?`

Adjustment Algorithm

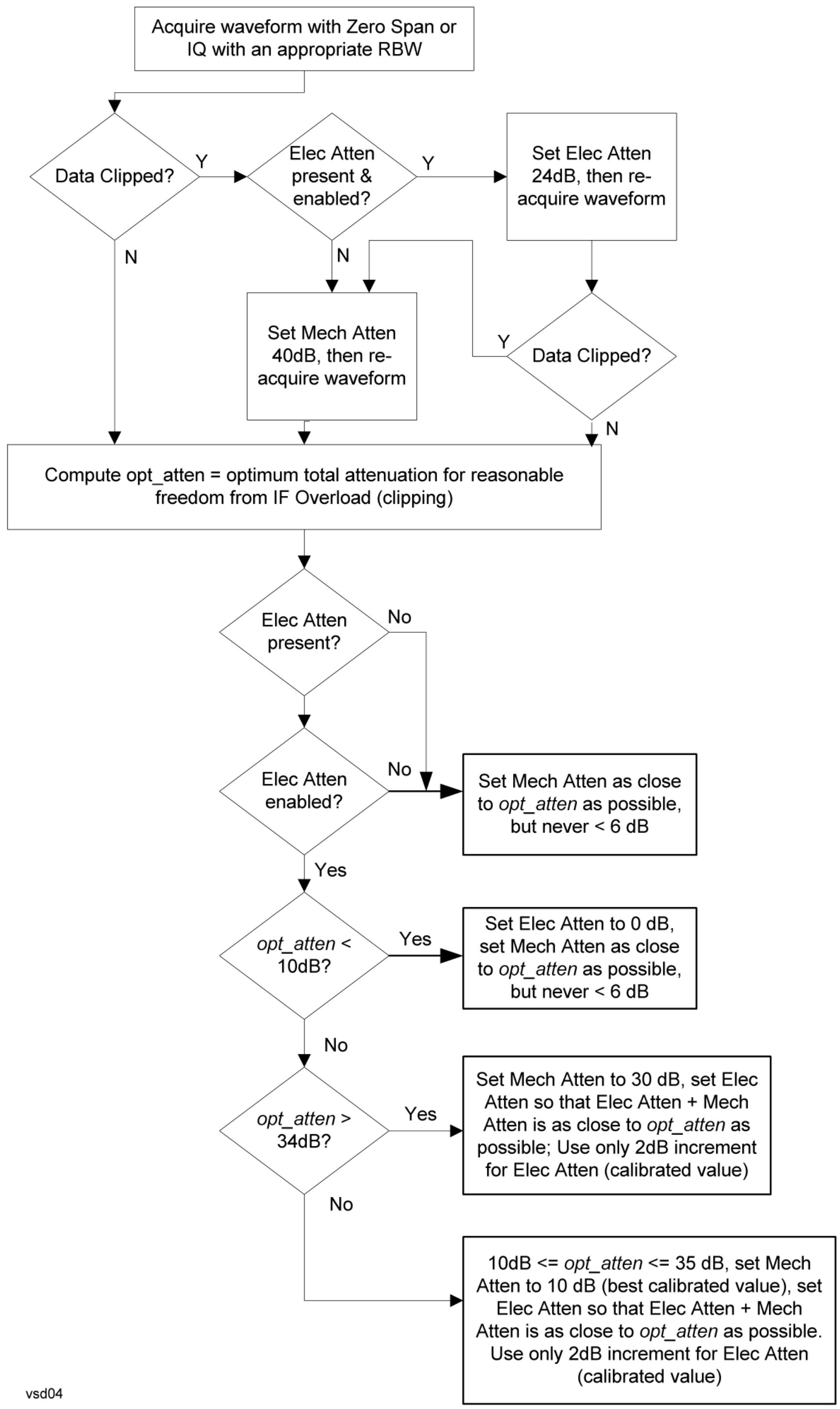
The algorithms for the adjustment are documented below:

Single-Attenuator Models



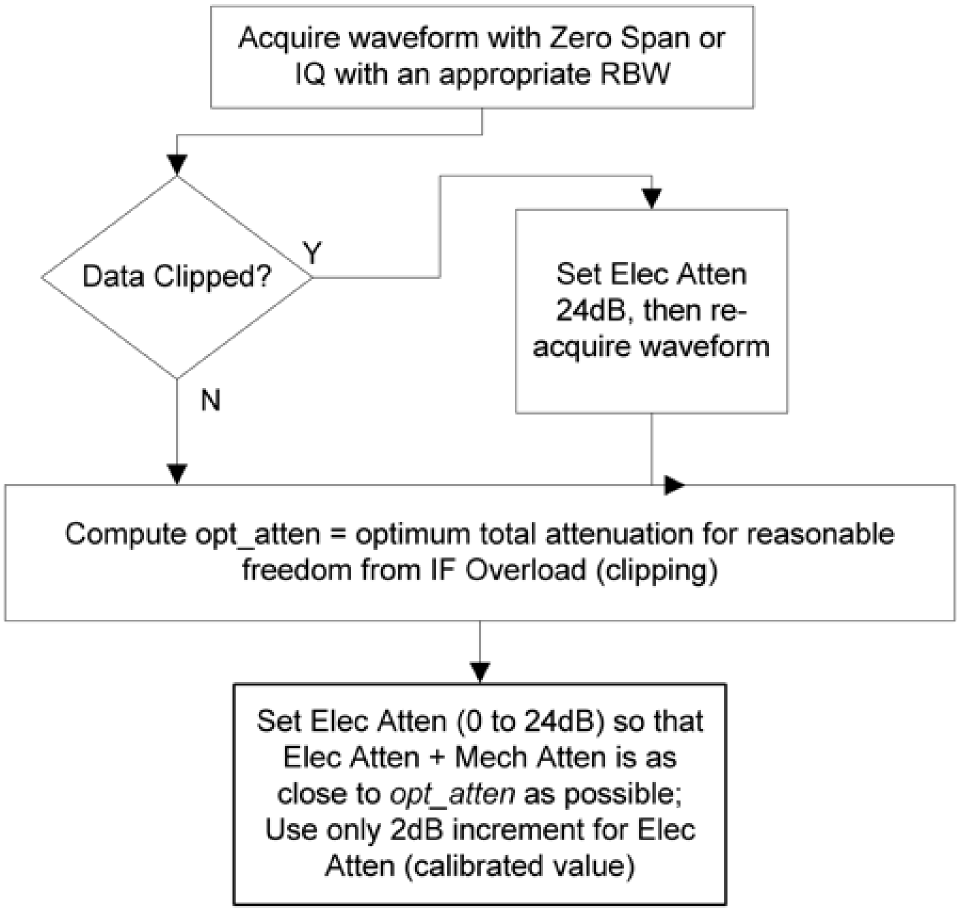
Dual-Attenuator models

"Adjust Atten for Min Clipping" on page 1941 or "Pre-Adjust for Min Clipping" on page 736 selection is Mech + Elec Atten:


Acquire waveform with Zero Span or IQ with an appropriate RBW
Data Clipped?
Y
N
Elec Atten present & enabled?
Y
N
Set Elec Atten 24dB, then re-acquire waveform
Set Mech Atten 40dB, then re-acquire waveform
Y
Data Clipped?
N
Compute opt_atten = optimum total attenuation for reasonable freedom from IF Overload (clipping)
Elec Atten present?
No
Elec Atten enabled?
No
Set Mech Atten as close to opt_atten as possible, but never < 6 dB
Yes
opt_atten < 10dB?
Yes
Set Elec Atten to 0 dB, set Mech Atten as close to opt_atten as possible, but never < 6 dB
No
opt_atten > 34dB?
Yes
Set Mech Atten to 30 dB, set Elec Atten so that Elec Atten + Mech Atten is as close to opt_atten as possible; Use only 2dB increment for Elec Atten (calibrated value)
No
10dB <= opt_atten <= 35 dB, set Mech Atten to 10 dB (best calibrated value), set Elec Atten so that Elec Atten + Mech Atten is as close to opt_atten as possible. Use only 2dB increment for Elec Atten (calibrated value)
vsd04

"Pre-Adjust for Min Clipping" on page 736 selection is Elec Only.

Note that the **Mech Atten** value is not adjusted, and the value previously set is used. Therefore, there is a case that IF Overload is still observed depending on the input signal level and the Mech Atten setting.



Mech Atten Step

Controls the step size used when making adjustments to the input attenuation.

Labeled **Mech Atten Step** in Dual-Attenuator models and **Atten Step** in Single-Attenuator models. In the Dual-Attenuator configuration, only affects the step size of the mechanical attenuator.

Remote Command	`[:SENSe]:POWer[:RF]:ATTenuation:STEP[:INCRement] 10 dB | 2 dB`

	`[:SENSe]:POWer[:RF]:ATTenuation:STEP[:INCRement]?`
Example	`:POW:ATT:STEP 2` `:POW:ATT:STEP?`
Notes	Has a toggle control on the front panel, but takes a specific value (in dB) when used remotely. The only valid values are 2 and 10
Dependencies	Blanked in EXA, CXA and CXA-m if option FSA (2 dB steps) is not present. If blanked, attempts to set it via SCPI yield an error
Couplings	When the attenuation step size changes, the current mechanical attenuation value is adjusted (if necessary) to be quantized to the new step size. That is, if step is set to 10 dB, mech atten is increased if necessary so it is a multiple of 10 dB
Preset	EXA, CXA and CXA-m: 10 dB (2 dB with option FSA) All other models: 2 dB
State Saved	Saved in instrument state

Max Mixer Level

Allows you to set the maximum level to be applied to the mixer for a signal at the top of the screen. By setting this value up or down you can allow more or less signal through the system.

The major impact of changes to **Max Mixer Level** is seen in changes to the value to which **Reference Level** is limited. Max Ref Level depends on Max Mixer Level and Attenuation, and therefore a higher Max Mixer Level may let you set Ref Level higher. However, changing this value can impact your TOI, compression, or dynamic range. The preset value of this function is best for most measurements.

See also "Max Mixer Lvl Rules" on page 1948.

Remote Command	`[:SENSe]:POWer[:RF]:MIXer:RANGe[:UPPer] <real>` `[:SENSe]:POWer[:RF]:MIXer:RANGe[:UPPer]?`
Example	`:POW:MIX:RANG -15 dBm` `:POW:MIX:RANG?`
Dependencies	Only appears in Swept SA and RTSA measurements
Preset	-10 dBm
State Saved	Saved in instrument state
Min	-50 dBm
Max	0 dBm

Max Mixer Lvl Rules

Allows you to optimize the Max Mixer Level setting for certain kinds of measurements.

`NORMal`	The historical, and thus backwards compatible, setting range (–50 to 0 dBm) and default setting (–10 dBm). The instrument has been designed so that, at the default setting, any signal below the Reference Level is extremely unlikely to create ADC overloads. At this mixer level the scale fidelity will be within specifications, thus compression with be negligible
`TOI`	Allows a range of settings of the "Max Mixer Level" on page 1947, –50 to –10 dBm, that can be optimum for measurements limited by the instrument third-order dynamic range. The default setting, –25 dBm, is commonly appropriate but RBW affects this. A good setting for Max Mixer Level would be higher than the optimum mixer level by half of the attenuator step size
`COMPression`	Allows a range of settings of the Max Mixer Level, –10 to +10 dBm or more, that can be optimum for measurements limited by the tradeoffs between instrument accuracy due to compression, and dynamic range due to the noise floor. The default setting, –3 dBm, is commonly appropriate, representing mixer drive levels that cause 1 dB or less compression at most carrier frequencies Typical measurements that would be optimized by this setting are the measurement of low sideband levels, including nulls, in angle-modulated signals (FM and PM). Also pulsed-RF measurements, including finding nulls to estimate pulse width, which are often best done with significant overdrive (compression) of the front end

Setting Name (readback)	Setting Name (verbose)	Max Mixer Level Preset Value, dBm	Max Mixer Level minimum value, dBm	Max Mixer Level maximum value, dBm
`NORMal`	Normal – balance TOI, noise, and compression	–10	–50	0
`TOI`	TOI-limited dynamic range	–25	–50	–10
`COMPression`	Compression-limited dynamic range	–3	–10	+30

Remote Command	`[:SENSe]:POWer[:RF]:MIXer:RULEs NORMal | TOI | COMPression` `[:SENSe]:POWer[:RF]:MIXer:RULEs?`
Example	`:POW:MIX:RULE:COMP`
Dependencies	Only appears in the Swept SA and RTSA measurements
Preset	`NORM`

3.4.3.3 Range (Non-attenuator models)

Only available for Keysight's modular signal analyzers and certain other Keysight products, such as VXT

State Saved	No

Range

Represents the amplitude of the largest sinusoidal signal that could be present within the IF without being clipped by the ADC. For signals with high peak-to-average ratios, the range may need to exceed the rms signal power by a significant amount to avoid clipping.

This is a measurement global setting.

Remote Command	`[:SENSe]:POWer[:RF]:RANGe <real>` `[:SENSe]:POWer[:RF]:RANGe?`
Example	`:POW:RANG 10 dBm` `:POW:RANG?`
Notes	The MIN and MAX values are affected by the External Gain parameters, and by the **Center Frequency** The hardware compensates for frequency response and alters the Range setting
Preset	0 dBm
State Saved	Yes
Min	-100
Max	100
Annotation	Meas Bar

Adjust Range for Min Clipping

Sets the combination of attenuation and gain based on the current measured signal level so that clipping will be at a minimum.

This is an "immediate action" function, that is, it executes once, when the key is pressed.

This key does not appear in measurements that do not support this functionality.

Remote Command	`[:SENSe]:POWer[:RF]:RANGe:OPTimize IMMediate`
Notes	Executing Adjust Range for Min Clipping initiates the measurement
Dependencies	Does not appear in the Swept SA and Monitor Spectrum measurements

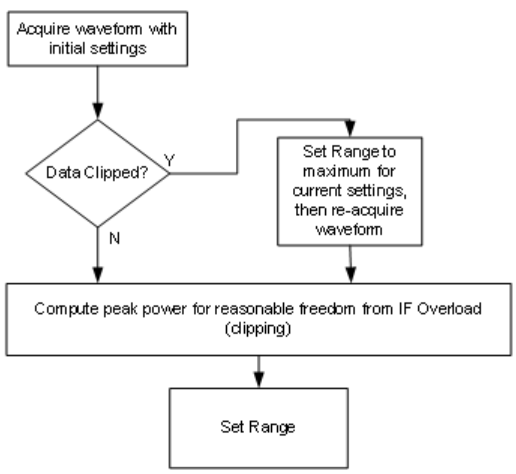
Pre-Adjust for Min Clipping

If this function is ON, it applies the adjustment described under Adjust Range For Min Clipping each time a measurement restarts. Therefore, in Continuous measurement mode, it only executes before the first measurement.

Remote Command	`[:SENSe]:POWer[:RF]:RANGe:OPTimize:ATTenuation OFF | ON | ELECtrical | COMBined` `[:SENSe]:POWer[:RF]:RANGe:OPTimize:ATTenuation?`
Notes	Because there is no attenuator control available in these models, the control displays only ON and OFF choices. However, for SCPI compatibility with other platforms, all three parameters (`ELECtrical`, `COMBined`, and ON) are honored and all are mapped to `ELECtrical`, so if any of these three parameters is sent, a subsequent query will return ELEC
Dependencies	Does not appear in the Swept SA and Monitor Spectrum measurements
Preset	OFF for Swept SA measurement; ON for all other measurements that support **Pre-Adjust for Min Clipping**
State Saved	Saved in instrument state

Adjustment Algorithm

The algorithm for the adjustment is documented below:



Peak-to-Average Ratio

Used with "Range (Non-attenuator models)" on page 1953 to optimize the level control in the instrument. The value is the ratio, in dB, of the peak power to the average power of the signal to be measured. A ratio of 0 should be used for sinusoidal signals; for 802.11g OFDM signals use 9 dB.

All Modes show the current value of Peak-to-Average ratio on the control. However, some Modes do not permit changing the value. In these situations, the control is grayed-out.

Remote Command	`[:SENSe]:POWer[:RF]:RANGe:PARatio <real>` `[:SENSe]:POWer[:RF]:RANGe:PARatio?`
Example	`:POW:RANG:PAR 12 dB`
Notes	In some Modes, this parameter is read-only; meaning the value will appear on the control and query via SCPI, but is not changeable. In such applications the control is grayed-out. Attempting to change the value via SCPI will be ignored but no error message will be generated
Dependencies	Does not appear in Spectrum Analyzer Mode
Preset	10 dB VXT Models M9410A/11A: 0 dB
State Saved	Saved in instrument state
Min	0 dB
Max	20 dB VXT Models M9410A/11A: 50 dB

Mixer Lvl Offset

This is an advanced setting to adjust target Range at the input mixer, which in turn affects the signal level in the instrument's IF. This setting can be used when additional optimization is needed after setting "Peak-to-Average Ratio" on page 1955. Positive values of offset optimize noise performance over distortion, negative values optimize distortion performance over noise.

Remote Command	`[:SENSe]:POWer[:RF]:RANGe:MIXer:OFFSet <real>` `[:SENSe]:POWer[:RF]:RANGe:MIXer:OFFSet?`
Example	`:POW:RANG:MIX:OFFS -5 dB`
Preset	0 dB
State Saved	Saved in instrument state
Min	-35 dB VXT Models M9410A/11A: -34 dB
Max	30 dB

3.4.3.4 Signal Path

Contains controls that pertain to the routing of the signal through the frontend of the instrument.

In general, only appears in instruments whose hardware supports this signal routing. For example, this tab does not appear in many of the modular instrument products, including VXT Model M9421A, or UXM.

This tab *does* appear in VXT Models M9410A/11A, because "Software Preselection" on page 1971 is under this tab, and VXT Models M9410A/11A implement a version of Software Preselection.

Presel Center

Adjusts the centering of the preselector filter to optimize the amplitude accuracy at the frequency of the selected marker. If the selected marker is not on when **Presel Center** is pressed, the instrument turns on the selected marker, performs a peak search, and then performs centering on the marker's center frequency. If the selected marker is already on and between the start and stop frequencies of the instrument, the instrument performs the preselector calibration on that marker's frequency. If the selected marker is already on, but outside the frequency range between **Start Freq** and **Stop Freq**, the instrument first performs a peak search, and then performs centering on the marker's center frequency.

The value displayed on "Preselector Adjust" on page 1958 changes to reflect the new preselector tuning.

Certain considerations should be observed to ensure proper operation, as detailed in "Proper Preselector Operation" on page 747.

Remote Command	`[:SENSe]:POWer[:RF]:PCENter`
Example	`:POW:PCEN`
Notes	The rules outlined above under the control description apply for the remote command as well as the key. The result of the command depends on marker position, etc. Any message generated by the control press is also generated in response to the remote command
Dependencies	Does not appear in CXA-m, nor in VXT Models M9410A/11A Grayed-out if the microwave preselector is off – If the selected marker's frequency is below Band 1, an advisory message is generated "Preselector not used in this frequency range" and no action is taken – Grayed-out if entirely in Band 0, that is, if **Stop Freq** is below about 3.6 GHz Grayed-out if entirely above 50 GHz, that is, if **Start Freq** is above 50 GHz – Blanked in models that do not include a preselector, such as Option 503. If the remote command is sent in these instruments, accepted without error, and the query always returns 0 – Grayed-out in the Spectrogram View
Couplings	The active marker position determines where the centering will be attempted If the instrument is in a measurement such as averaging when centering is initiated, the act of centering the preselector restarts averaging, but the first average trace will not be taken until the centering is completed

	The offset applied to do the centering appears in "Preselector Adjust" on page 1958
Status Bits/OPC dependencies	When centering the preselector, `*OPC` does not return true until the process is complete and a subsequent measurement has completed, nor are results returned in response to `:READ` or `:MEASure` queries The `Measuring` bit remains set (true) while this command is operating, and does not go false until the subsequent sweep/measurement has completed

Proper Preselector Operation

Certain considerations should be observed to ensure proper operation:

1. If the selected marker is **Off**, the instrument turns on a marker, performs a peak search, and adjusts the preselector using the selected marker's frequency. It uses the "highest peak" peak search method unqualified by threshold or excursion, so that there is no chance of a 'no peak found' error. It continues with that peak, even if it is the peak of just noise. Therefore, for this operation to work properly, there should be a signal on-screen in a preselected range for the peak search to find

2. If the selected marker is already **On**, the instrument attempts the centering at that marker's frequency. There is no preselector for signals below about 3.6 GHz, so if the marker is on a signal below 3.6 GHz, no centering is attempted, and an advisory message is generated

3. In some models, the preselector can be bypassed. If it is bypassed, no centering is attempted in that range and a message is generated

Preselector Adjust

Lets you manually adjust the preselector filter frequency to optimize its response to the signal of interest. Only available when "Presel Center" on page 1956 is available.

For general purpose signal analysis, using **Presel Center** is recommended. Centering the filter minimizes the impact of long-term preselector drift. **Preselector Adjust** can be used instead to manually optimize the preselector. One application of manual optimization would be to peak the preselector response, which both optimizes the signal-to-noise ratio and minimizes amplitude variations due to small (short-term) preselector drifting.

When **Presel Center** is performed, the offset applied to do the centering becomes the new value of **Preselector Adjust**.

Remote Command	`[:SENSe]:POWer[:RF]:PADJust <freq>` `[:SENSe]:POWer[:RF]:PADJust?`
Example	`:POW:PADJ 100KHz` `:POW:PADJ?`

Notes	The value on the control is displayed to 0.1 MHz resolution
Dependencies	– Does not appear in CXA-m – Does not appear in VXT Models M9410A/11A – Grayed-out if microwave preselector is off – Grayed-out if entirely in Band 0, that is, if Stop Freq is lower than about 3.6 GHz – Grayed-out if entirely above 50 GHz, that is, if Start Freq is higher than 50 GHz – Blank in models that do not include a preselector, such as Option 503. If the command is sent in these instruments, it is accepted without error, and the query always returns 0 – Grayed-out in the Spectrogram View
Preset	0 MHz
State Saved	The **Preselector Adjust** value set by "Presel Center" on page 1956, or by manually adjusting **Preselector Adjust** Not saved in instrument state, and does not survive a Preset or power cycle
Min	-500 MHz
Max	500 MHz
Backwards Compatibility SCPI	`[:SENSe]:POWer[:RF]:MW:PADJust` `[:SENSe]:POWer[:RF]:MMW:PADJust`

Notes	The command has no effect, and the query always returns `MWAVe`
Backwards Compatibility SCPI	`[:SENSe]:POWer[:RF]:PADJust:PRESelector MWAVe | MMWave | EXTernal` `[:SENSe]:POWer[:RF]:PADJust:PRESelector?`

Internal Preamp

Accesses a menu of controls for the internal preamps. Turning on the preamp gives a better noise figure, but a poorer inter-modulation distortion (TOI) to noise floor dynamic range. You can optimize this setting for your measurement.

The instrument takes the preamp gain into account as it sweeps. If you sweep outside of the range of the preamp, the instrument will also account for that. The displayed result always reflects the correct gain.

For some measurements, when the preamp is on and any part of the displayed frequency range is below the lowest frequency for which the preamp has specifications, a warning condition message appears in the status line. For example, for a preamp with a 9 kHz lowest specified frequency: "Preamp: Accy unspec'd below 9 kHz".

Selection	Example	Note
Off	`:POW:GAIN OFF`	
Low Band	`:POW:GAIN ON` `:POW:GAIN:BAND LOW`	Sets the internal preamp to use only the low band. The frequency range of the installed (optional) low-band preamp is displayed in square brackets on the Low Band selection in the dropdown
Full Range	`:POW:GAIN ON` `:POW:GAIN:BAND FULL`	Sets the internal preamp to use its full range. The low band (0-3.6 GHz, 0-3.4 GHz, 0-3 GHz, depending on the model) is supplied by the low band preamp and the frequencies above low band are supplied by the high band preamp The frequency range of the installed (optional) low-band preamp is displayed in square brackets on the Full Range selection in the dropdown. If the high band option is not installed the Full Range selection does not appear

NOTE The maximum **Center Frequency** for Low Band, displayed in square brackets, can change based on the selected IFBW for measurements that support IFBW (for example, Waveform measurement across all Modes that support it). In certain models (such as N9042B & N9032B), IFBW values <= 40 MHz have a maximum Low Band frequency of 3.6 GHz, while 40 MHz < IFBW <= 1 GHz have a maximum of 3.3 GHz, and 1 GHz < IFBW <= 1.5 GHz have a maximum of 3.5 GHz. IFBW values > 1.5 GHz do not support a **Center Frequency** that can reach the Low Band maximum frequency. In these cases, **N/A** is displayed in the square brackets for Low Band.

Remote Command	`[:SENSe]:POWer[:RF]:GAIN:BAND LOW | FULL`
	`[:SENSe]:POWer[:RF]:GAIN:BAND?`
	`[:SENSe]:POWer[:RF]:GAIN[:STATe] OFF | ON | 0 | 1`
	`[:SENSe]:POWer[:RF]:GAIN[:STATe]?`

Example	`:POW:GAIN:BAND LOW`
	`:POW:GAIN:BAND?`
	`:POW:GAIN OFF`
	`:POW:GAIN?`

Dependencies	Not available on all hardware platforms. If the preamp is not present or is unlicensed, this control is not shown Does not appear in VXT Models M9410A/11A/15A/16A If `:POW:GAIN:BAND FULL` is sent when a low band preamp is available, the preamp band parameter is set to `LOW` instead of `FULL`, and an "Option not installed" message is generated Not available when the electronic/soft attenuator is enabled
Preset	`LOW`

	OFF
State Saved	Saved in instrument state
Annotation	When the USB Preamp is not connected to USB, the Preamp annotation in the Meas Bar says "Off" if the preamp is off and displays the frequency range of the low band or full range preamp depending on the setting. For example, if the Preamp is set to Low Band and the Low Band is 3.6 GHz the annotation says "3.6 GHz". If it is a 13.6 GHz preamp and it is set to Full Range the annotation says "13.6 GHz" When the USB Preamp is connected to USB, the Preamp annotation says "Preamp: USB" if the internal preamp is off or "Preamp: USB, Int" if the internal preamp is on (only for measurements that support the USB preamp)

LNA

Lets you turn the Low Noise Amplifier (**LNA**) on or off.

LNA is an additional preamplifier that provides superior DANL and frequency range compared to "Internal Preamp" on page 1959. LNA provides lower system noise figure, especially at frequencies above 100 MHz, and can be operated up to the full range of 50 GHz instruments.

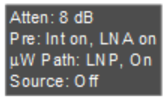
For best possible sensitivity, **LNA** can be turned on *together* with "Internal Preamp" on page 1959, although if you operate both preamps together, note that the TOI (distortion) specifications are impacted. The sensitivity improvement of this combination is substantial when operating in high band (frequencies above 3.6 GHz).

For more details about annotation, see "More Information" on page 750

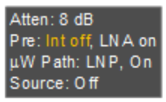
Remote Command	`[:SENSe]:POWer[:RF]:GAIN:LNA[:STATe] OFF | ON | 0 | 1` `[:SENSe]:POWer[:RF]:GAIN:LNA[:STATe]?`
Example	`:POW:GAIN:LNA ON`
Dependencies	Requires Option LNA, except for VXT models M9415A/16A Does not appear in VXT models M9421A/10A/11A May not appear in some measurements **LNA** is not available when the electronic/soft attenuator is enabled
Preset	OFF
State Saved	Saved in State

More Information

When **LNA** is installed, the preamp annotation changes to show the state of both **LNA** and **Internal Preamp**. Below is an example:



Note that when operating entirely in the low band (below about 3.6 GHz), if **LNA** is on, **Internal Preamp** is switched off (even if you have its switch set to ON). This is because the noise performance is actually degraded in low band if both preamps are on. In this case, the annotation reflects the actual state of the two preamps, but the **Internal Preamp** annotation displays in amber, to warn you that the actual state of **Internal Preamp** does not match its switch control display:



µW Path Control

Options for this control include **µW Preselector Bypass** (Option MPB), **Low Noise Path** (Option LNP) and **Full Bypass Enable** in the High Band path circuits.

When the µW Preselector is bypassed, flatness is improved, but will be subject to spurs from out of band interfering signals. When **Low Noise Path Enable** is selected, the instrument automatically bypasses certain circuitry in the high frequency bands that can contribute to noise, when it is appropriate based on other instrument settings.

For most applications, the preset state is **Standard Path**, which provides the best remote-control throughput, minimizes acoustic noise from switching and minimizes the risk of wear in the hardware switches, particularly in remote test scenarios where both low band and high band setups will follow in rapid succession. In this path, the bypass of the low band/high band switch and microwave preamp is never activated, which can cause some noise degradation but preserves the life of the bypass switch.

For applications that utilize the wideband IF paths, the preset state is **µW Preselector Bypass**, if option MPB is present. This is because, when using a wideband IF such as the 140 MHz IF, the µW Preselector's bandwidth can be narrower than the available IF bandwidth, causing degraded amplitude flatness and phase linearity, so it is desirable to bypass the preselector in the default case.

You may choose **Low Noise Path Enable** for a lower noise floor, especially in the 21-26.5 GHz region, though without improving many measures of dynamic range, and without giving the best possible noise floor. The preamp, if purchased and used, gives better noise floor than does **Low Noise Path Enable**, but the preamp's compression threshold and third-order intercept are much poorer than that of **Low Noise Path Enable**.

A fourth choice is **Full Bypass Enable**, which combines **µW Preselector Bypass** and **Low Noise Path Enable**. Because this can bypass most of the circuitry between the

input and the first mixer, care should be taken when using this setting to avoid damaging the mixer. **Full Bypass Enable** is only available if both options LNP and MPB are present, as well as option FBP.

Path	Example	Note
Standard Path	:POW:MW:PATH STD	Normal setting for most measurements. µW Preselector in circuit, Low Noise Path disabled
Low Noise Path Enable	:POW:MW:PATH LNP	See "Low Noise Path Enable" on page 755
µW Preselector Bypass	:POW:MW:PATH MPB	See "µW Preselector Bypass" on page 757
Full Bypass Enable	:POW:MW:PATH FULL	See "Full Bypass Enable" on page 758

Remote Command	`[:SENSe]:POWer[:RF]:MW:PATH STD | LNPath | MPBypass | FULL` `[:SENSe]:POWer[:RF]:MW:PATH?`

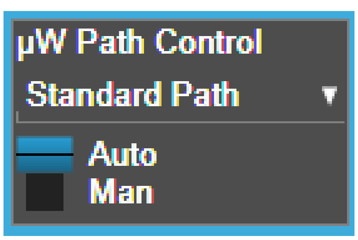
Example	`:POW:MW:PATH LNP`
	Enables the Low Noise path
	`:POW:MW:PATH?`

Notes	If "Presel Center" on page 1956 is performed, the instrument will momentarily switch to the Standard Path, regardless of the setting of **µW Path Control** The DC Block will always be switched in when the low noise path is switched in, to protect succeeding circuitry from DC. Note that this does not mean “when the low noise path is enabled” but when, based on the Low Noise Path rules, the path is actually switched in. This can happen when the selection is **Low Noise Path Enable** or **Full Bypass Enable**. In the case where the DC Block is switched in the instrument is now AC coupled. However, if you selected DC coupling, the UI would still behave as though it were DC coupled, including all annunciation, warnings, status bits, and responses to SCPI queries. This is because, based on other settings, the instrument could switch out the low noise path at any time and hence go back to being DC coupled Alignment switching ignores the settings in this menu, and restores them when finished
Dependencies	Does not appear in CXA-m, VXT Models M9410A/11A, nor in BBIQ and External Mixing – The **Low Noise Path Enable** selection does not appear unless Option LNP is present and licensed – The **µW Preselector Bypass** selection does not appear unless Option MPB is present and licensed – The **Full Bypass Enable** selection does not appear unless options LNP and MPB are both present as well as option FBP In any of these cases, if the required options are not present and the SCPI command is sent, error -241, "Hardware missing; Option not installed" is generated **Low Noise Path Enable** and **Full Bypass Enable** are grayed-out if the current measurement does not support them **Low Noise Path Enable** and **Full Bypass Enable** are not supported in Avionics and MMR Modes (non-modulation measurements). In any of these cases (that is, the feature is not supported in either measurement or Mode), if the SCPI command is sent, the following error is generated: -221, “Setting Conflict; Feature not supported for this measurement”

Preset	**Mode** / **Value** IQ Analyzer, Pulse, Avionics: MPB option present and licensed: `MPB` MPB option not present and licensed: `STD` All other Modes: `STD`
State Saved	Save in instrument state
Range	Standard Path | Low Noise Path Enable | µW Presel Bypass | Full Bypass Enable
Annotation	In the Meas Bar, if the Standard path is chosen: µW Path: Standard If Low Noise Path is enabled but the LNP switch is not thrown: µW Path: LNP,Off If the Low Noise Path is enabled and the LNP switch *is* thrown: µW Path: LNP,On If the preselector is bypassed: µW Path: Bypass If Full Bypass Enable is selected but the LNP switch is not thrown: µW Path: FByp,Off If Full Bypass Enable is selected and the LNP switch *is* thrown: µW Path: FByp,On

µW Path Control Auto

In VMA, WLAN, 5G NR, CQM Modes, an **Auto/Man** switch is added to **µW Path Control**:



This allows the function to automatically switch based on certain Auto Rules as shown below:

VMA Mode

Measurement	When µW Path Control is in Auto
Digital Demod	Use Standard Path unless tuned frequency > 3.6 GHz and IFBW > 15 MHz, in which case choose Preselector Bypass
Monitor Spectrum	Always Presel Bypass

Measurement	When µW Path Control is in Auto
IQ Waveform	Use Standard Path unless tuned frequency > 3.6 GHz and IFBW > 15 MHz, in which case choose Preselector Bypass
Custom OFDM	Use Standard Path unless tuned frequency > 3.6 GHz and IFBW > 15 MHz, in which case choose Preselector Bypass
Channel Power	Always Presel Bypass
Occupied BW	Always Presel Bypass
CCDF	Use Standard Path unless tuned frequency > 3.6 GHz and IFBW > 15 MHz, in which case choose Preselector Bypass
ACP	Always Presel Bypass
SEM	Always Presel Bypass
Spurious Emissions	Always Standard Path

WLAN Mode

Measurement	When µW Path Control is in Auto
Modulation Analysis	Always Presel Bypass
Spectral Flatness	Always Presel Bypasss
Power vs Time	Always Presel Bypass
Monitor Spectrum	Always Presel Bypass
IQ Waveform	Always Presel Bypass
Channel Power	Always Presel Bypass
Occupied BW	Always Presel Bypass
CCDF	Always Presel Bypass
SEM	For 11be 320M, when ‘Enabled Wideband IF for FFT’ is OFF or ‘Sweep Type Rule’ is Best Dynamic Range, auto µW path is standard For other cases, auto µW path is presel bypass if presel bypass is enabled, auto µW path is standard if presel bypass is not enabled
Spurious Emissions	Always Standard Path

5G NR Mode

Measurement	When µW Path Control is in Auto
Modulation Analysis	Use Standard Path unless tuned frequency > 3.6 GHz and IFBW > 15 MHz, in which case choose Full Bypass if conditions warrant(FBP Option is available and “Allow Full Bypass in Auto” is On), otherwise choose Preselector Bypass
Monitor Spectrum	Always Standard Path
IQ Waveform	Use Standard Path unless tuned frequency > 3.6 GHz and IFBW > 15 MHz, in which case choose Full Bypass if conditions warrant(FBP Option is available and

Measurement	When µW Path Control is in Auto
	"Allow Full Bypass in Auto" is On), otherwise choose Preselector Bypass
Channel Power	Always Standard Path
Occupied BW	Always Standard Path
CCDF	Use Standard Path unless tuned frequency > 3.6 GHz and IFBW > 15 MHz, in which case choose Preselector Bypass
ACP	Always Standard Path
SEM	Always Standard Path
Spurious Emissions	Always Standard Path
Transmit On|Off Power	Use Standard Path unless tuned frequency > 3.6 GHz and Info BW > 15 MHz, in which case choose Preselector Bypass

Channel Quality Mode

Measurement	When µW Path Control is in Auto
Group Delay	Use Standard Path unless tuned frequency > 3.6 GHz and IFBW > 15 MHz, in which case choose Full Bypass if conditions warrant(FBP Option is available and "Allow Full Bypass in Auto" is On), otherwise choose Preselector Bypass
Monitor Spectrum	Always Standard Path
IQ Waveform	Use Standard Path unless tuned frequency > 3.6 GHz and IFBW > 15 MHz, in which case choose Preselector Bypass
CCDF	Use Standard Path unless tuned frequency > 3.6 GHz and IFBW > 15 MHz, in which case choose Preselector Bypass

Remote Command	`[:SENSe]:POWer[:RF]:MW:PATH:AUTO ON | OFF | 1 | 0` `[:SENSe]:POWer[:RF]:MW:PATH:AUTO?`
Example	`:POW:MW:PATH:AUTO ON` `:POW:MW:PATH:AUTO?`
Dependencies	Only appears in VMA, WLAN, 5G NR and CQM Modes
Couplings	See the tables above
Preset	ON
Range	ON|OFF

Low Noise Path Enable

Low Noise Path Enable provides a lower noise floor under some circumstances, particularly when operating in the 21–26.5 GHz region. With the Low Noise Path enabled, the low band/high band switch and microwave preamp are bypassed whenever *all* the following are true:

- The instrument is not in the Low Band, meaning:
- the start frequency is above 3.5 GHz and
- the stop frequency is above 3.6 GHz
- The internal preamp is not installed, or if installed, is set to **Off** or **Low Band**

Note that this means that, when any part of a sweep is done in Low Band, the Low Noise Path is not used, whether or not the **Low Noise Path Enable** is selected in the user interface. Also, if the preamp is turned on, the Low Noise Path is not used, whether or not the **Low Noise Path Enable** is selected in the user interface. The only time the Low Noise Path is used is when **Low Noise Path Enable** is selected, the sweep is completely in High Band (> 3.6 GHz) and no preamp is in use.

For measurements that use IQ acquisition, the low noise path is used when **Center Frequency** is in High Band (> 3.6 GHz) and no preamp is in use. In other words, the rules above are modified to use only the center frequency to qualify which path to switch in. This is not the case for FFTs in the Swept SA measurement; they use the same rules as swept measurements.

Note that the Low Noise Path, while giving improved DANL, has the disadvantage of decreased TOI performance and decreased gain compression performance relative to the standard path.

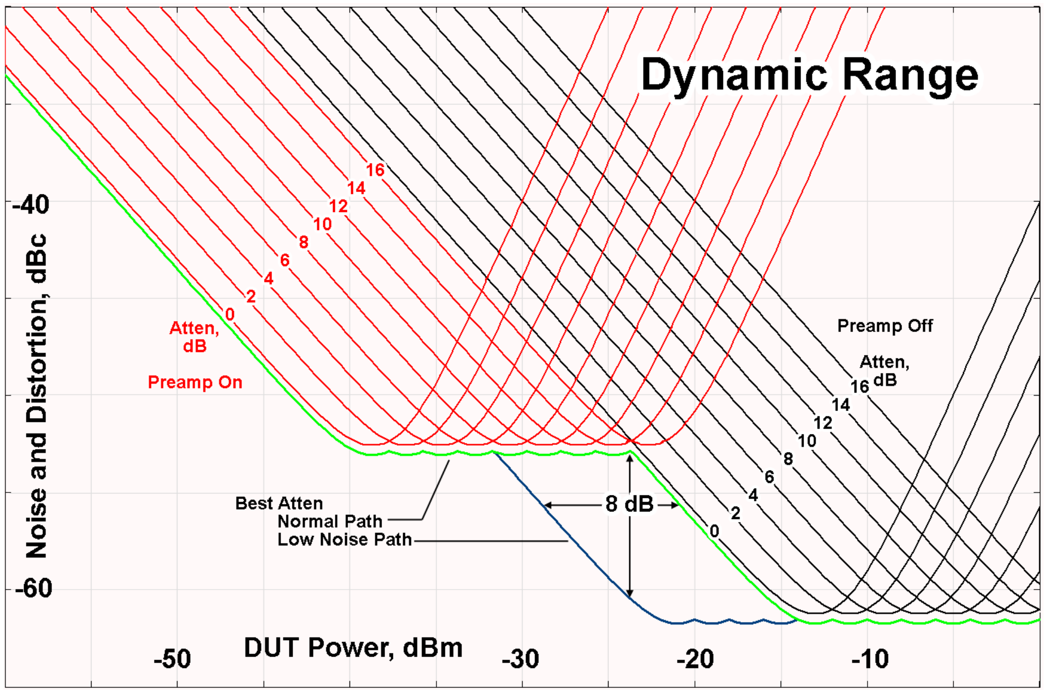
Note also that the bypass switch is a mechanical switch and has finite life, so if the **Low Noise Path Enable** is selected, it is possible to cause frequent cycling of this switch by frequently changing instrument settings such that the above conditions hold true only some of the time. A user making tests of this nature should consider opting for the **Standard Path**, which will never throw the bypass switch, at the expense of some degraded noise performance.

The low noise path is useful for situations where the signal level is so low that the instrument performance is dominated by noise even with 0 dB attenuation, but still high enough that the preamp option would have excessive third-order intermodulation or compression. The preamp, if purchased and used, gives better noise floor than does the “Low Noise Path.” However, its compression threshold and third-order intercept are much poorer than that of the non-preamp path.

There are some applications, typically for signals around –30 dBm, for which the third-order dynamic range of the standard path is good enough, but the noise floor is not low enough even with 0 dB input attenuation. When the third-order dynamic range of the preamp path is too little and the noise floor of the standard path is too high, the Low Noise Path can provide the best dynamic range

The graph below illustrates the concept. It shows, in red, the performance of an instrument at different attenuation settings, both with the preamp on and off, in a measurement that is affected by both instrument noise and instrument TOI. The green shows the best available dynamic range, offset by 0.5 dB for clarity. The blue

shows how the best available dynamic range improves for moderate signal levels with the low noise path switched in. In this illustration, the preamp improves the noise floor by 15 dB while degrading the third-order intercept by 30 dB, and the low noise path reduces loss by 8 dB. The attenuator step size is 2 dB.



There are other times where selecting the low noise path improves performance, too. Compression-limited measurements such as finding the nulls in a pulsed-RF spectrum can profit from the low noise path in a way similar to the TOI-limited measurement illustrated. Accuracy can be improved when the low noise path allows the optimum attenuation to increase from a small amount like 0, 2 or 4 dB to a larger amount, giving better return loss at the instrument input. Harmonic measurements, such as second and third harmonic levels, are much improved using the low noise path because of the superiority of that path for harmonic (though not intermodulation) distortion performance.

µW Preselector Bypass

Toggles the preselector bypass switch for band 1 and higher. When the microwave presel is on, the signal path is preselected. When the microwave preselector is off, the signal path is not preselected. The preselected path is the normal path for the instrument.

The preselector is a tunable bandpass filter which prevents signals away from the frequency of interest from combining in the mixer to generate in-band spurious

signals (images). The consequences of using a preselector filter are its limited bandwidth, the amplitude and phase ripple in its passband, and any amplitude and phase instability due to center frequency drift.

Option MPB or pre-selector bypass provides an unpreselected input mixer path for certain X-Series signal analyzers with frequency ranges above 3.6 GHz. This signal path allows a wider bandwidth and less amplitude variability, which is an advantage when doing modulation analysis and broadband signal analysis. The disadvantage is that, without the preselector, image signals will be displayed. Another disadvantage of bypassing the preselector is increased LO emission levels at the front panel input port.

Image responses are separated from the real signal by twice the 1st IF. For IF Paths of 10 MHz and 25 MHz, the 1st IF is 322.5 MHz, so the image response and the real signal will be separated by 645 MHz. The 1st IF will be different for other IF Path settings. When viewing a real signal and its corresponding image response in internal mixing, the image response will be to the left of the real signal.

Also, the image response and the real signal typically have the same amplitude and exhibit the same shape factor.

However, if Option FS1 (Fast Sweep Capability) is enabled, the image response in the Swept SA measurement appears lower in amplitude and has a much wider shape factor compared to the real signal.

Full Bypass Enable

With **Full Bypass Enable** selected, the microwave preselector is bypassed. In addition, the low band/high band switch and microwave preamp are bypassed whenever *all* the following are true:

- The instrument is not in the Low Band, meaning:
- the start frequency is above 3.5 GHz and
- the stop frequency is above 3.6 GHz.
- the internal preamp is not installed or if installed, is set to **Off** or **Low Band**

Note that this means that, when any part of a sweep is done in Low Band, the Low Noise Path is not used, whether or not the **Full Bypass Enable** is selected in the user interface. Also, if the preamp is turned on, the Low Noise Path is not used, whether or not the **Full Bypass Enable** is selected in the user interface. The only time the Low Noise Path is used is when **Full Bypass Enable** is selected, the sweep is completely in High Band (> 3.6 GHz) and no preamp is in use.

CAUTION When **Full Bypass Enable** is selected, and "Y Scale" on page 1929 is set to 0 dB, there will be a direct AC connection between the input and the first converter when the Low Noise Path switches in (when Start Freq >3.6 GHz and the Preamp is either not licensed, set to Low Band, or Off). This puts the first converter at considerable risk to be damaged by high AC power. Consequently, whenever **Full Bypass Enable** is selected, a warning message appears in the status bar:

"Full Bypass Enabled, maximum safe input power reduced"

Microwave Preselector Bypass Backwards Compatibility

Example	`:POW:MW:PRES OFF` Bypasses the microwave preselector
Notes	Included for Microwave Preselector Bypass backwards compatibility The `ON` parameter sets the `STD` path (`:POW:MW:PATH STD`) The `OFF` parameter sets path `MPB` (`:POW:MW:PATH MPB`)
Preset	`ON`
Backwards Compatibility SCPI	`[:SENSe]:POWer[:RF]:MW:PRESelector[:STATe] ON | OFF | 0 | 1` `[:SENSe]:POWer[:RF]:MW:PRESelector[:STATe]?`

Frequency Extender Preselection Bypass

Only applies to the high frequency path of the Frequency Extender, and only if the Frequency Extender allows it. For example, the V3050A high frequency path is 50 – 110 GHz and *does* allow control of the preselector bypass.

When the Frequency Extender's preselection is bypassed, flatness is improved, but will be subject to spurs from out-of-band interfering signals. For bandwidths greater than 2.5 [GHz], it is recommended that the signal bypass the Frequency Extender Preselector since the max bandwidth of the Preselector can be as narrow as 2.5 [GHz].

For most applications, the preset state is `OFF`, which gives the best remote-control throughput, minimizes acoustic noise from switching, minimizes out of band spurs, and minimizes the risk of wear in the hardware switches.

Preselector and Bandwidth Conflict

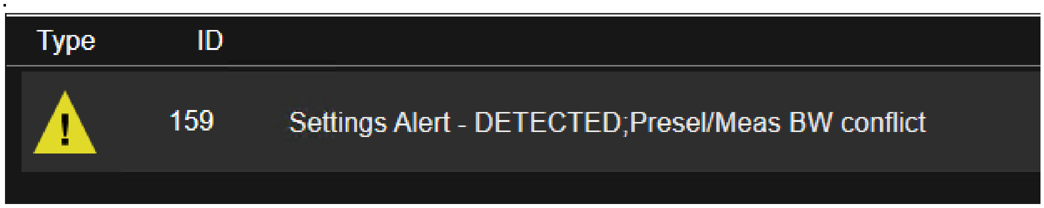
When the Frequency Extender Preselector is applied and the signal bandwidth is greater than 2.5 [GHz], then a settings alert message will show to warn the user that the signal may be distorted due to the limitation of the Frequency Extender Preselector bandwidth.

An example of the settings alert message is shown below.

Settings Alert message in the Status Bar at the bottom of the display.

Settings Alert message in the error queue

.



Software Preselection

Provided in some instruments, either to compensate for issues with provided hardware preselection or to provide the preselection function when there is no hardware preselector.

N9041B

Software Preselection compensates for the frequency range limit of the microwave preselector. Since the microwave preselector only goes up to 50 GHz, software preselection must be used to suppress and separate images above 50 GHz. The specific algorithm used for software preselection is specified by the SW Preselection Type selection – Normal or Advanced.

In N9041B, **Software Preselection** only applies for frequencies above 50 GHz, therefore it is only used for RF Input 2. Even if turned on, it is not used for other inputs, and never for frequencies below 50 GHz. This is why the label of this control contains the parenthetical note “(>~50 GHz)”.

Note that in N9041B, in Swept SA measurement, **Software Preselection** works even if the measurement is using an FFT Sweep Type. In measurements other than Swept SA, Software Preselection is not used if the measurement is using an FFT sweep type.

N9042B+V3050A

Software Preselection compensates for the frequency range limit of the microwave preselector. Since the microwave preselector only goes up to 50 GHz, software preselection must be used to suppress and separate images above 50 GHz. The specific algorithm used for software preselection is specified by the SW Preselection

Type selection – Normal or Advanced.

For N9042B+V3050A, Software Preselection only applies for frequencies above 50 GHz, therefore it is only used for External RF. Even if it is turned on, it will not be used for other inputs and never for frequencies below 50 GHz. This is why the label of this control contains the parenthetical note “(>~50 GHz)”.

Note that for N9042B+V3050A, in the Swept SA measurement, Software Preselection works even if the measurement is using an FFT Sweep Type. In measurements other than Swept SA, Software Preselection is not used if the measurement is using an FFT Sweep Type.

VXT models M9410A/11A

Software Preselection is used to provide the preselection function, as there is no hardware preselector in these models. Two background traces are taken and compared point by point, and the point with the lowest amplitude from the two traces is used. This provides a method to reduce spurs that are internally generated within the VXT, but you should note the following when using Software Preselection:

– There is some speed cost due to the need to take multiple captures

– Taking the point with the lowest amplitude in each trace will make the average noise level lower at all points that do not have a spur. This can reduce the accuracy of the measurement of noise and noise-like signals

Because of the difficulty in identifying spurs manually, you are recommended to leave Software Preselection ON at all times in VXT models M9410A/11A. If you turn it off in order to speed up your measurement or improve noise accuracy, be aware of unwanted onscreen spurs.

Remote Command	`[:SENSe]:POWer[:RF]:SWPResel:STATe 0 | 1 | ON | OFF` `[:SENSe]:POWer[:RF]:SWPresel:STAT?`
Example	`:POW:SWPR:STAT 1` `:POW:SWPR:STAT?`
Dependencies	Only appears in N9041B, N9042B+V2050A, and VXT models M9410A/11A. Does not appear in all measurements
Couplings	Affects **Sweep Time** **Auto Tune** supports **Software Preselection**, so **Auto Tune** should be performed after setting the **Software Preselection** state
Preset	N9041B: OFF N9042B+V3050A: ON M9410A/11A: ON
State Saved	Saved in instrument state

SW Preselection Type

Specifies the algorithm used for software preselection.

Two hidden sweeps occur in succession. The second sweep is offset in LO frequency by 2 * IF / N. For each point in each trace, the smaller amplitude from the two traces is taken and placed in that point in the selected trace. The Peak detector is auto-selected to improve the image suppression effectiveness. Responses of each trace that lie on top of one another will remain and are valid signals. Other signals are images, which are suppressed. The action of taking the smaller of the two traces will make the average noise level lower in all points that do not have an image, thus reducing the accuracy of the measurement of noise and noise-like signals.

– `NORMal` - mathematically removes all image and multiple responses of signals present at the input

– `ADVanced` - any trace processing (such as "max hold" or trace averaging) is performed on the points of both candidate traces before the "select minimum" operation occurs. This form of processing works better for non-stationary signals, such as pulsed-RF signals

Remote Command	`[:SENSe]:POWer[:RF]:SWPResel NORMal | ADVanced` `[:SENSe]:POWer[:RF]:SWPResel?`
Example	`:POW:SWPR NORM` `:POW:SWPR?`
Dependencies	Only appears in N9041B and N9042B+V3050A. Only appears in measurements that use the Swept method Grayed-out when "Software Preselection" on page 1971 is `OFF`. The grayout message is "Unavailable unless SW Presel enabled"
Preset	N9041B: `ADVanced` N9042B+V3050A: `NORMal`
State Saved	Saved in instrument state

SW Preselection BW

Specifies the effective bandwidth to be used for Software Preselection.

The options are:

– `NORMal` – when making Swept measurements, a software preselection algorithm is used which takes up to 4 background acquisitions, then post-processes the result. This algorithm can remove images from signals with an occupied

bandwidth up to around 3 GHz. (Default/Preset setting). When making FFT measurements, this algorithm is not used, instead the same algorithm is used as for NARRow (below)

– NARRow– a software preselection algorithm is used which takes two background acquisitions, then post-processes the result to detect and remove images from wideband signals with occupied bandwidths up to 2 GHz. This increases the risk of images failing to be rejected, but improves the measurement speed

Remote Command	`[:SENSe]:POWer[:RF]:SWPResel:BW NORMal | NARRow` `[:SENSe]:POWer[:RF]:SWPResel:BW?`
Example	`:POW:SWPR:BW NARR`
Dependencies	Only appears in N9041B and N9042B+V3050A. Only appears in measurements that use the Swept method Grayed-out when "Software Preselection" on page 1971 is OFF. The grayout message is "Unavailable unless SW Presel enabled" For N9042B+V3050A, the parameter is SCPI-only, and always set to NARRow when **Software Preselection** is enabled
Preset	N9041B: NORMal N9042B+V3050A: NARRow
State Saved	Saved in instrument state

High Freq Prefilter

Lets you set the state of Prefilter for center frequencies above 1310 MHz.

In VXT Models M9410A/11A, the Receiver RF path has a bank of filters that come after the RF Attenuator in the signal path. Since this bank of filters precedes the mixer they are known as the "Prefilter" bank. Their purpose is to eliminate unwanted in-band mixing products by filtering out all but the desired frequencies before the signals get to the mixer. There are 13 prefilter bands to cover the frequencies between 9 kHz and 6000 MHz. The Prefilter provides the necessary rejection of the unwanted signal.

Remote Command	`[:SENSe]:<measurement>:PFILter[:STATe] ON | OFF | 1 | 0` `[:SENSe]:<measurement>:PFILter[:STATe]?`

Example	Enable High Freq Prefilter for the Complex Spectrum Measurement in BASIC Mode:
	`:SPEC:PFIL ON`
	Enable High Freq Prefilter for the IQ Waveform Measurement, in multiple Modes:
	`:WAV:PFIL ON`
	Enable High Freq Prefilter for the Swept SA Measurement in SA Mode:

	`:SAN:PFIL ON`
Dependencies	Only appears in VXT models M9410A/11A with center frequency above 1310 MHz
Preset	See "Prefilter Presets" on page 764 below
State Saved	Saved in instrument state

Prefilter Presets

Meas	Mode	Preset
SPEC	BASIC	OFF
WAV	BASIC, WCDMA, WLAN, LTEAFDD, LTEATDD, 5GNR, VMA	OFF
MON	WCDMA, WLAN, LTEAFDD, LTEATDD, 5GNR, VMA	OFF
RHO	WCDMA	OFF
CDP	WCDMA	OFF
PCON	WCDMA	OFF
EVMQ	WCDMA	OFF
CHP	WCDMA, WLAN, LTEAFDD, LTEATDD, 5GNR, VMA, SA	OFF
OBW	WCDMA, WLAN, LTEAFDD, LTEATDD, 5GNR, VMA, SA	OFF
ACP	WCDMA, LTEAFDD, LTEATDD, 5GNR, VMA, SA	OFF
SEM	WCDMA, WLAN, LTEAFDD, LTEATDD, 5GNR, VMA, SA	OFF
PST	WCDMA, WLAN, LTEAFDD, LTEATDD, 5GNR, VMA, SA	OFF
PVT	WLAN, LTEAFDD, LTEATDD, 5GNR	OFF
EVM	WLAN, LTEAFDD, LTEATDD, 5GNR	OFF
FLAT	WLAN	OFF
EVMM	WLAN	OFF
CEVM	LTEAFDD, LTEATDD	OFF
PAVT	5GNR, VMA	OFF
DDEM	VMA	OFF
OFDM	VMA	OFF
SAN	SA	ON
HARM	SA	ON

3.4.4 BW

Opens the Bandwidth (**BW**) menu, which contains controls for "Res BW" on page 765 and "Video BW" on page 766.

The **Resolution BW** functions control filter bandwidth and filter type. There are two filter types, Gaussian and Flattop. The Gaussian filters have a response curve that is parabolic on a log scale. The Flattop filter shape is a close approximation of a rectangular filter.

3.4.4.1 Settings

Contains the basic bandwidth functions. In this measurement, it is the only tab under **BW**.

Res BW

Activates the resolution bandwidth active function, which allows you to manually set the resolution bandwidth (RBW) of the instrument.

Normally, **Res BW** (Auto) selects automatic coupling of the **Res BW** to "Span" on page 783 using the ratio set by **Span:3 dB RBW** (some measurements do not have a **Span:3 dB RBW** control, in which case the measurement chooses the optimal ratio). To decouple the resolution bandwidth, press the **Auto/Man** toggle on the **Res BW** control, or simply enter a different value for **Res BW**.

When the **Res BW** is manually selected, it may be returned to the coupled state by pressing the **Auto/Man** toggle on the **Res BW** control. This may also be done by pressing "Auto Couple" on page 1995 or by performing a **Preset**.

When **Res BW** is set to **Auto**, the bandwidth selected depends on "RBW Filter Type" on page 767.

Only certain discrete resolution bandwidths are available. The available bandwidths are dependent on **Filter Type** or **EMC Standard**. If an unavailable bandwidth is entered with the numeric keypad, the closest available bandwidth is selected.

Remote Command	`[:SENSe]:OBWidth:BANDwidth[:RESolution] <bandwidth>`
	`[:SENSe]:OBWidth:BANDwidth[:RESolution]?`
	`[:SENSe]:OBWidth:BANDwidth[:RESolution]:AUTO ON | OFF | 1 | 0`
	`[:SENSe]:OBWidth:BANDwidth[:RESolution]:AUTO?`

Example	`:OBW:BAND 5 MHz`
	`:OBW:BAND?`
	`:OBW:BAND:AUTO ON`
	`:OBW:BAND:AUTO?`

Notes	For numeric entries, all RBW Types choose the nearest (arithmetically, on a linear scale, rounding up) available RBW to the value entered The setting and querying of values depend on the current bandwidth type
Couplings	Sweep time is coupled to RBW. As RBW changes, the sweep time (if set to **Auto**) is changed to maintain amplitude calibration "Video BW" on page 766 is coupled to RBW. As the resolution bandwidth changes, the video bandwidth (if set to **Auto**) changes to maintain the ratio of VBW/RBW (10:1) When **Res BW** is set to **Auto**, the resolution bandwidth is auto-coupled to the span. The ratio of

	Span/RBW is approximately 106:1 when auto coupled. When **Res BW** is set to **Man**, and the bandwidths are entered manually, these bandwidths are used regardless of other instrument settings
Preset	**Auto**, unless noted in "RBW Presets" on page 766 below See table below
State Saved	Saved in instrument state
Min	1 Hz
Max	8 MHz is the max equivalent –3 dB RBW, which means that the named RBW (the one shown on the control etc.) can exceed 8 MHz if using a filter other than –3 dB Gaussian
Annotation	A "#" mark appears before "RBW" in the annotation when it is switched from Auto to Manual coupling
Backwards Compatibility Notes	For backwards compatibility, this command supports both `BANDwidth` and `BWIDth` forms For ESA, the maximum Res BW was 5 MHz; for X-Series it is 8 MHz

RBW Presets

Unless noted in the table below, the Preset value of RBW is **Auto**.

Mode	Preset Value
WCDMA	30 kHz
BT	10 kHz
WLAN	100 kHz
MSR	30 kHz
LTE, LTETDD, LTEAFDD, LTEATDD, 5G NR	30 kHz

Video BW

Lets you change the instrument post-detection filter (VBW or "video bandwidth") from 1 Hz to 8 MHz, in approximately 10% steps. In addition, a wide-open video filter bandwidth may be chosen by selecting 50 MHz. The VBW is annotated at the bottom of the display, in the center.

Video BW (Auto) selects automatic coupling of **Video BW** to "Res BW" on page 765. To decouple the resolution bandwidth, press the **Auto/Man** toggle on the **Video BW** control, or simply enter a different value for **Video BW**.

When **Video BW** is manually selected, it may be returned to the coupled state by pressing the **Auto/Man** toggle on **Video BW**. This may also be done by pressing "Auto Couple" on page 1995 or by performing a **Preset**.

Remote Command	`[:SENSe]:OBWidth:BANDwidth:VIDeo <bandwidth>`
	`[:SENSe]:OBWidth:BANDwidth:VIDeo?`
	`[:SENSe]:OBWidth:BANDwidth:VIDeo:AUTO ON | OFF | 1 | 0`
	`[:SENSe]:OBWidth:BANDwidth:VIDeo:AUTO?`

Example	`:OBW:BAND:VID 2.4 MHz`
	`:OBW:BAND:VID?`
	`:OBW:BAND:VID:AUTO ON`
	`:OBW:BAND:VID:AUTO?`

Notes	For numeric entries, the instrument chooses the nearest (arithmetically, on a linear scale, rounding up) available VBW to the value entered. The 50 MHz VBW is defined to mean “wide open” The values shown in this table reflect the conditions after a Mode Preset
Dependencies	Sometimes the displayed **Video BW** is not actually used to process the trace data: When the **Average** detector is selected, and **Sweep Type** is set to **Swept**, the video bandwidth filter cannot be used, because it uses the same hardware as the **Average** detector When the **Quasi-Peak**, **EMI Average**, or **RMS Average** detector is selected, **Video BW** is implemented by the digital IF as part of the detector In this case, **Video BW** still acts to change the Sweep Time, if Sweep Time is in **Auto**, and still affects the data on other traces for which this is not the case
Couplings	Normally coupled to **Res BW**. If **Video BW** is set to **Auto**, then video bandwidth is changed as **Res BW** changes, to maintain the preset ratio (normally 10:1)
Preset	**Auto**, unless noted in "Video BW Presets" on page 767 below `ON`
State Saved	Saved in instrument state
Min	1 Hz
Max	50 MHz
Annunciation	A “#” mark appears before “VBW” in the annotation when it is not coupled
Annotation	In the bottom center of the screen, “VBW <value> <units>” indicates the current video bandwidth value. Note that for some detectors this is not the value used for VBW (see above)
Backwards Compatibility Notes	For backwards compatibility, this command supports both `BANDwidth` and `BWIDth` forms

Video BW Presets

Unless noted in the table below, the Preset value is **Auto**.

Mode ID	Preset Value
WCDMA	300 kHz
BT	30 kHz

RBW Filter Type

Selects the type for the resolution bandwidth filters. Historically, the **Res BW** filters in HP/Agilent/Keysight spectrum analyzers were Gaussian filters, specified using the –3 dB bandwidth of the filter. That is, a 10 MHz **Res BW** filter was a Gaussian shape with its –3 dB points 10 MHz apart. In X-Series, you can choose between a Gaussian and Flat Top filter shape, for varying measurement conditions.

Filter Type	SCPI
Gaussian	GAUSsian
Flattop	FLATtop

Remote Command	[:SENSe]:OBWidth:BANDwidth:SHAPe GAUSsian | FLATtop [:SENSe]:OBWidth:BANDwidth:SHAPe?
Example	:OBW:BAND:SHAP GAUS :OBW:BAND:SHAP?
Preset	"Auto Couple" on page 1995 selects the preset value
State Saved	Saved in instrument state
Annotation	The annotation under RBW in the bottom left of the screen shows the type of filter or bandwidth that is being used. The following examples illustrate this:

–3 dB (Normal) filter BW	Res BW 300 Hz
–6 dB filter BW	Res BW (–6 dB) 422 Hz
Noise filter BW	Res BW (Noise) 317 Hz
Impulse filter BW	Res BW (Impulse) 444 Hz
CISPR filter BW	Res BW (CISPR) 200 Hz
MIL filter BW	Res BW (MIL) 1 kHz
Flattop filter type	Res BW (Flattop) 300 Hz

Backwards Compatibility SCPI	[:SENSe]:OBWidth:BWIDth:SHAPe

3.4.5 Display

Opens the **Display** menu, which lets you configure display items for the current Mode, Measurement View or Window.

3.4.5.1 Meas Display

Contains controls for setting the display for the current Measurement, View or Window.

x dB BW Boundaries On/Off

Turns the x dB BW Boundaries On or Off.

Remote Command	:DISPlay:OBWidth:WINDow[1]:XDB 0 | 1 | OFF | ON :DISPlay:OBWidth:WINDow[1]:XDB?
Example	:DISP:OBW:WIND:XDB 1 :DISP:OBW:WIND:XDB?
Preset	0
State Saved	Saved in instrument state
Range	OFF|ON
Backwards Compatibility SCPI	:DISPlay:OBWidth:VIEW:WINDow[1]:XDB

Boundary Frequency

Selects frequency display type:

– OFFSet: offsets from Center Freq to OBW boundary frequency are displayed

– ABSolute: absolute frequencies are displayed

Remote Command	:DISPlay:OBWidth:WINDow2:BOUNdaries:FREQuency OFFSet | ABSolute :DISPlay:OBWidth:WINDow2:BOUNdaries:FREQuency?
Example	:DISP:OBW:WIND2:BOUN:FREQ ABS :DISP:OBW:WIND2:BOUN:FREQ?
Preset	OFFSet
State Saved	Saved in instrument state
Range	OFFSet|ABSolute
Backwards Compatibility SCPI	:DISPlay:OBWidth:VIEW2:WINDow2:BOUNdaries:FREQuency

3.4.5.2 Annotation

Contains controls for setting up the annotation for the current Mode or Measurement.

Graticule

Turns the display graticule On or Off for all windows with graticules in all measurements in the current Mode. Also turns the graticule Y-Axis annotation on and off.

Remote Command	`:DISPlay:GRATicule[:STATe] OFF | ON | 0 | 1` `:DISPlay:GRATicule[:STATe]?`
Example	`:DISP:GRAT OFF`
Notes	The graticule is the set of horizontal and vertical lines that make up the grid/divisions for the X-Axis and Y-Axis
Preset	ON
State Saved	Saved in instrument state

Backwards Compatibility SCPI	`:DISPlay:WINDow[1]:TRACe:GRATicule:GRID[:STATe] OFF | ON | 0 | 1`
	`:DISPlay:WINDow[1]:TRACe:GRATicule:GRID[:STATe]?`
	This command is accepted for backwards compatibility with older instruments, but the `WINDow`, `TRACe` and `GRID` parameters are ignored

Screen Annotation

Controls the display of the annunciation and annotation around the graticule, including any annotation on lines (such as the display line, the threshold line, etc.) and the Y-Axis annotation, for all windows with screen annotation in all measurements in the current Mode.

This does *not* include marker annotation (or the N dB result). When OFF, the graticule expands to fill the entire graticule area, leaving only the 1.5% gap above the graticule, as described in the **Trace** section.

Remote Command	`:DISPlay:ANNotation:SCReen[:STATe] OFF | ON | 0 | 1` `:DISPlay:ANNotation:SCReen[:STATe]?`
Example	`:DISP:ANN:SCR OFF`
Dependencies	Grayed-out and forced to OFF when **System Display Settings**, **Annotation** is OFF
Preset	ON This remains OFF through a Preset when **System Display Settings**, **Annotation** is set to OFF
State Saved	Saved in instrument state

Trace Annotation

Turns on and off the labels on the traces, showing their detector (or their Math Mode) as described in the **Trace** section, for all windows in all measurements in the current Mode for which Trace Annotation on/off is supported.

If Trace Math is being performed on a trace, then the Trace Math annotation replaces the detector annotation.

For measurements that support limit lines, this key also turns on and off the labels on the Limit Lines. The label is the Limit number annotation and Limit Comment displayed on the graph. If the length of the comment is greater than 20 characters, the first 8 characters and the last 8 characters are displayed, joined with ....

Remote Command	`:DISPlay:ANNotation:TRACe[:STATe] ON | OFF | 1 | 0` `:DISPlay:ANNotation:TRACe[:STATe]?`
Example	`:DISP:ANN:TRAC OFF`
Preset	`OFF`
State Saved	Saved in instrument state

Control Annotation

Turns on and off the display of values on the Active Function controls for all measurements in the current Mode. This is a security feature.

Remote Command	`:DISPlay:ACTivefunc[:STATe] ON | OFF | 1 | 0` `:DISPlay:ACTivefunc[:STATe]?`
Example	`:DISP:ACT OFF`
Dependencies	Grayed out and forced to `OFF` when **System Display Settings**, **Annotation** is `OFF`
Preset	`ON` This remains `OFF` through a Preset when **System Display Settings**, **Annotation** is set to `OFF`
State Saved	Saved in instrument state

Frequency Annotation

Turns on and off the absolute frequency annotation in the main display for all windows in all measurements in the current Mode for which Frequency Annotation on/off is supported.

The affected annotations include Center Frequency, Start/Stop Frequency, Frequency Offset, Marker Frequency. Any relative frequency annotation such as Span and Marker Delta are not affected.

The frequency annotations in any other associated display, such as in Active Function, Softkey label, Limit Editor, Amp Corr Editor and Marker Table are not changed.

Frequency annotations that are not associated with the spectrum, such as RBW, IBW, Sweep Time, are excluded and they are shown regardless of this selection.

Remote Command	`:DISPlay:ANNotation:FREQuency[:STATe] ON | OFF | 1 | 0` `:DISPlay:ANNotation:FREQuency[:STATe]?`
Example	`:DISP:ANN:FREQ OFF`
Dependencies	Only appears in the Swept SA measurement in Spectrum Analyzer Mode
Preset	`ON`

Meas Bar

Turns the Measurement Bar at the top of the screen on and off for all measurements in the current Mode. When OFF, the graticule area expands to fill the area formerly occupied by the Measurement Bar.

Remote Command	:DISPlay:ANNotation:MBAR[:STATe] OFF | ON | 0 | 1 :DISPlay:ANNotation:MBAR[:STATe]?
Example	:DISP:ANN:MBAR OFF
Dependencies	Grayed out and forced to OFF when **System Display Settings**, **Annotation** is OFF
Preset	ON This remains OFF through a Preset when **System Display Settings**, **Annotation** is set to OFF
State Saved	Saved in instrument state

Display Enable (Remote Command Only)

Turns the display on/off, including the display drive circuitry. The backlight stays lit to confirm that the instrument is on. The display enable setting is mode global. Theare three reasons for turning the display off:

1. To increase speed as much as possible by freeing the instrument from having to update the display
2. To reduce emissions from the display, drive circuitry
3. For security purposes

If you have turned off the display:

– and you are in local operation, the display can be turned back on by pressing any key or by sending :SYSTem:DEFaults MISC or :DISPlay:ENABle ON (neither *RST nor :SYSTem:PRESet enable the display)

– and you are in remote operation, the display can be turned back on by pressing the **Local** or **Esc** keys, or by sending :SYSTem:DEFaults MISC or :DISPlay:ENABle ON (neither *RST nor :SYSTem:PRESet enable the display)

– and you are using either the :SYSTem:KLOCk command or GPIB local lockout, then *no* front-panel key press will turn the display back on. You must turn it back on remotely.

If the display is OFF, many SCPI commands related to User Views and Multiscreen functionality do not work, and return the error messages “-221, Settings conflict; Screen SCPI cannot be used when Display is disabled” or “221, Settings conflict; View SCPI cannot be used while Display is disabled”. These commands include:

Name	Command
Select User View	:DISPlay:VIEW:ADVanced:SELect
Rename User View	:DISPlay:VIEW:ADVanced:REName
Delete User View	:DISPlay:VIEW:ADVanced:DELete
Create User View	:DISPlay:VIEW:ADVanced:NAME
Select Screen	:INSTrument:SCReen:SELect
Delete Screen	:INSTrument:SCReen:DELete
Delete All But This Screen	:INSTrument:SCReen:DELete:ALL
Add Screen	:INSTrument:SCReen:CREate
Rename Screen	:INSTrument:SCReen:REName
Sequencer On/Off	:SYSTem:SEQuencer

Remote Command	`:DISPlay:ENABle OFF | ON | 0 | 1` `:DISPlay:ENABle?`
Example	`:DISP:ENAB OFF`
Couplings	`:DISP:ENAB OFF` turns Backlight `OFF` and `:DISP:ENAB ON` turns Backlight `ON`, but changing Backlight settings does *not* change the state of `:DISP:ENAB`
Preset	`ON` Set by `:SYST:DEF MISC`, but not affected by `*RST` or `:SYSTem:PRESet`
State Saved	Not saved in instrument state
Backwards Compatibility Notes	`:SYST:PRES` no longer turns on `:DISPlay:ENABle` as it did in legacy analyzers

3.4.5.3 View

Contains controls for selecting the current **View**, and for editing User Views.

View

See "Views" on page 711

User View

Lets you choose a View from the saved User Views for the current measurement. This panel only appears if a User View exists for the current measurement.

Remote	`:DISPlay:VIEW:ADVanced:SELect <alphanumeric>`

Command	`:DISPlay:VIEW:ADVanced:SELect?`
Example	Select Baseband as the current View `:DISP:VIEW:ADV:SEL “Baseband”`

Notes	You must be in the measurement whose View you are trying to set to send the command. You can only set Views for the current measurement using this command
	For predefined views, the parameter is derived from the view name that is shown in the View list in the user interface. For example, if you are trying to select the Trace Zoom view in the Swept SA measurement, you send:
	`:DISP:VIEW:ADV:SEL "Trace Zoom"`
	because “Trace Zoom” is the name of the View as seen in the Mode/Meas dialog or in the Display, View menu
	You *cannot* use the legacy View parameter (which in this case would be `TZOom`) with `:DISP:VIEW:ADV:SEL`
	`<alphanumeric>` is case insensitive; you can specify mixed case, however the name will be evaluated on a single case. Thus, both of the following forms work:
	`:DISP:VIEW:ADV:SEL "Trace Zoom"`
	`:DISP:VIEW:ADV:SEL "TRACE ZOOM"`
	If the specified view is not a valid View, the query returns the error message “-224, Illegal parameter value; View with the name <alphanumeric> does not exist”
	If the display is disabled (via `:DISP:ENAB OFF`) then the error message “-221, Settings conflict; View SCPI cannot be used while Display is disabled” is generated

Backwards Compatibility SCPI	The legacy node `:DISPlay:VIEW[:SELect]` is retained for backwards compatibility, but it only supports predefined views

Restore Layout to Default

Restores the Layout to the default for Basic.

Modified Views are very temporary; if you exit the current measurement they are discarded, and they are not saved in State. To retain this View for later use, and to be able to return easily to your original Basic View, you can save your edited View as a “User View”.

Save Layout as New View

Saves your new View as a User View. An alpha keyboard appears, which lets you name your new View; the default is the old View name plus a number.

Remote Command	`:DISPlay:VIEW:ADVanced:NAME <alphanumeric>`
Example	`:DISP:VIEW:ADV:NAME “Baseband”`

	Creates a new View named `Baseband` from the current View, and selects it as the current View
Notes	`<alphanumeric>` is case insensitive; you can specify mixed case, however the name will be evaluated on a single case If `<alphanumeric>` name already exists as a View, the error message "-224, Illegal parameter value; View <alphanumeric> already exists" is generated If the display is disabled (via `:DISP:ENAB OFF`) then the error message "-221, Settings conflict; User View SCPI cannot be used while Display is disabled" is generated

Re-Save User View

You can re-edit a User View; if you make changes, then an asterisk will appear next to the User View's name. You can then tap **Re-Save User View** to save it back to its existing name, or **Save Layout as New View** to add another, new User View.

This is a front panel function only, there is no remote command available to perform this function. To do this remotely, you must first perform **Save Layout as New View**, then delete the old User View and rename the new one with the name of the View you just deleted.

Rename User View

You can rename the current View by giving it a new unique name. Only User Views can be renamed, if the current View is a Predefined View, an error occurs.

Remote Command	`:DISPlay:VIEW:ADVanced:REName <alphanumeric>`
Example	`:DISP:VIEW:ADV:REN "Baseband"`
Notes	`<alphanumeric>` is case insensitive; you can specify mixed case, however the name will be evaluated on a single case If the `<alphanumeric>` specifying the new name is already present in the list of View names, the error message "-224, Illegal parameter value; View <alphanumeric> already exists" is generated If the current View is a Predefined View, the error message "-224, Illegal parameter value; Cannot rename a Predefined View" is generated If the display is disabled (via `:DISP:ENAB OFF`) then the error message "-221, Settings conflict; View SCPI cannot be used while Display is disabled" is generated

Delete User View

You can delete the current View if it is a User View. The default view becomes the current view for the Measurement.

Remote Command	`:DISPlay:VIEW:ADVanced:DELete`

Example	`:DISP:VIEW:ADV:DEL`
Notes	`<alphanumeric>` is case insensitive; you can specify mixed case, however the name will be evaluated on a single case If the `<alphanumeric>` is not present in the list of View names, the error message "-224, Illegal parameter value; View <alphanumeric> does not exist" is generated If the current View is a Predefined View, the error message "-224, Illegal parameter value; Cannot delete a Predefined View" is generated If the display is disabled (via `:DISP:ENAB OFF`) then the error message "-221, Settings conflict; View SCPI cannot be used while Display is disabled" is generated

Delete All User Views

Deletes all previously saved User Views. The default view becomes the current view for the Measurement if a User View was the current view when this command was executed.

Remote Command	`:DISPlay:VIEW:ADVanced:DELete:ALL`
Example	`:DISP:VIEW:ADV:DEL:ALL`
Notes	Disabled if there are no User Views

View Editor Remote Commands

The following remote commands help you manage Views and User Views. Note that the SCPI node for User Views handles both Predefined and User Views. The legacy nodes, `:DISPlay:VIEW[:SELect]` and `:DISPlay:VIEW:NSEL`, are retained for backwards compatibility, but they only support predefined views.

View Listing Query

Returns a string containing a comma-separated list of names for *all* the Views, including User Views, available for the current Measurement.

Remote Command	`:DISPlay:VIEW:ADVanced:CATalog?`
Example	`:DISP:VIEW:ADV:CAT?`
Notes	Returns a quoted string of the available Views for the current measurement, separated by commas. The list includes names for *all* the Views, including User Views, available for the current Measurement Example: `"Normal,Trace Zoom,Spectrogram,Baseband,myView1,yourView1"` No distinction is made between Predefined and User Views

If you switch measurements with the display disabled (via `:DISP:ENAB OFF`), then query the list of available Views, the result is undefined

User View Listing Query

Returns a string containing a comma-separated list of names for *only* the User Views available for the current Measurement.

Remote Command	`:DISPlay:VIEW:ADVanced:USER:CATalog?`
Example	`:DISP:VIEW:ADV:USER:CAT?`
Notes	Returns a quoted string of the available User Views for the current measurement, separated by commas. Example: `"Baseband,myView1,yourView1"` If you switch measurements with the display disabled (see "Display Enable (Remote Command Only)" on page 1983), then query the list of available Views, the result is undefined

3.4.6 Frequency

Opens the **Frequency** menu, which contains controls that allow you to control the Frequency and Channel parameters of the instrument.

Some features in the **Frequency** menu are the same for all measurements in the current Mode – they do not change as you change measurements. Settings like these are called “Meas Global” and are unaffected by Meas Preset. For example, the Center Freq setting is the same for all measurements - it does not change as you change measurements.

3.4.6.1 Settings

Contains controls that pertain to the X-Axis parameters of the measurement. These parameters control how data on the vertical (X) axis is displayed and control instrument settings that affect the horizontal axis.

Center Frequency

Sets the frequency that corresponds to the horizontal center of the graticule (when frequency Scale Type is set to linear). While adjusting **Center Frequency**, **Span** is held constant, which means that both **Start Freq** and **Stop Freq** will change.

In measurements that also have **Start Freq** and **Stop Freq** controls, pressing **Center Frequency** sets the frequency entry mode to Center/Span. In Center/Span mode, the center frequency and span values are displayed below the graticule, and the default active function in the **Frequency** menu is **Center Frequency**. In the Start/Stop annotation mode, **Start Freq** and **Stop Freq** are displayed below the graticule instead of **Center Frequency** and **Span**.

Pressing **Center Frequency** also sets the frequency entry mode to Center/Span. In Center/Span mode, the center frequency and span values are displayed below the graticule, and the default active function in the **Frequency** menu is **Center Frequency**.

When **Display Scale Type** is set to `LOG`, pressing **Center Frequency** sets the frequency that corresponds to the arithmetic mean of the start frequency and stop frequency, which is not at the horizontal center of the graticule.

The center frequency setting is the same for all measurements within a Mode, that is, it is Meas Global. Some Modes are also able to share a Mode Global center frequency value. If this is the case, the Mode has a **Global** tab in its **Meas Setup** menu.

Center Frequency sets (and queries) the center frequency for the currently selected input. If your instrument has multiple inputs, and you select another input, **Center Frequency** changes to the value for that input. SCPI commands are available to directly set **Center Frequency** for a specific input (see "RF Center Frequency" on page 781 and "Ext Mix Center Freq" on page 782).

Center Frequency is remembered as you go from input to input. Thus you can set a **Center Frequency** of 10 GHz with the RF Input selected, change to BBIQ and set a **Center Frequency** of 20 MHz, then switch to External Mixing and set a **Center Frequency** of 60 GHz. When you return to the RF Input, **Center Frequency** reverts to 10 GHz; back to BBIQ and it is 20 MHz; back to External Mixing and it is 60 GHz.

Remote Command	`[:SENSe]:FREQuency:CENTer <freq>` `[:SENSe]:FREQuency:CENTer?`

Example	Set Center Frequency to 50 MHz:
	`:FREQ:CENT 50 MHz`
	Increment **Center Frequency** by the value of **CF Step**:
	`:FREQ:CENT UP`
	Return the current value of **Center Frequency**:
	`:FREQ:CENT?`

Notes	Sets the RF, External Mixing or I/Q Center Frequency depending on the selected input: – For RF input it is equivalent to `:FREQ:RF:CENT` – For I/Q input it is equivalent to `:FREQ:IQ:CENT` – For External Mixer it is equivalent to `:FREQ:EMIX:CENT` Preset and Max values depend on Hardware Options

	If no terminator (for example, MHz) is sent, the terminator Hz is used. If a terminator with unit other than frequency is used, an invalid suffix error message is generated
Dependencies	**Center Frequency** can be limited by **Start Freq** or **Stop Freq** limits, if **Span** is so large that start or stop reach their limits
Couplings	When operating in "swept span", any value of **Center Frequency** or **Span** that is within the frequency range of the instrument is allowed, *if* the value is being set through the front panel numeric key pad or the SCPI command. The other parameter is forced to a different value if needed, to keep Start and Stop Frequencies within the instrument's frequency range Coupling between center frequency and span: numeric (keypad) entries are treated differently than changing the value using the step keys (**Up/Down Arrows**) or the knob. Similarly, for remote operation, sending a numeric frequency value is treated differently than the UP|DOWN keywords: – Numeric entries (keypad or remote): Any value of **Center Frequency** or **Span** (within the frequency range of the instrument) is allowed. The other parameter is changed, as necessary, to keep the Start Freq and Stop Freq within the instrument frequency range – Knob or Step keys (up/down arrows) or UP|DOWN keywords: The value of the parameter being changed (**Center Frequency** or **Span**) is limited so the other parameter is not forced to a new value. Thus, if only the step keys and knob are used, you can return to the initial **Center Frequency** and **Span** by changing only the current parameter Note that, since out-of-range **Start Freq** and **Stop Freq** are never allowed, markers and trace math work correctly without requiring any special handling for out-of-range conditions
Preset	Depends on instrument maximum frequency, mode, measurement, and selected input See "Center Frequency Presets" on page 779 and "Ext Mix Center Freq" on page 782
State Saved	Saved in instrument state
Min/Max	Depends on instrument maximum frequency, mode, measurement, and selected input See "Center Frequency Presets" on page 779 and "Ext Mix Center Freq" on page 782
Annotation	Center <value> appears in the lower left corner of the display
Status Bits/OPC dependencies	Non-overlapped

Center Frequency Presets

The following table provides the Center Frequency Presets for the Spectrum Analyzer mode, and the Max Freq, for the various frequency options:

Freq Option	CF after Mode Preset	Stop Freq after Mode Preset	Max Freq (can't tune above)
503 (all but CXA)	1.805 GHz	3.6 GHz	3.7 GHz
503 (CXA)	1.505 GHz	3.0 GHz	3.08 GHz
507 (all but CXA)	3.505 GHz	7.0 GHz	7.1 GHz
507 (CXA)	3.755 GHz	7.5 GHz	7.58 GHz

Freq Option	CF after Mode Preset	Stop Freq after Mode Preset	Max Freq (can't tune above)
508 (all but MXE)	1.805 GHz	3.6 GHz	8.5 GHz
508 (MXE)	4.205 GHz	8.4 GHz	8.5 GHz
513	6.805 GHz	13.6 GHz	13.8 GHz
526 (except CXA and MXE)	13.255 GHz	26.5 GHz	27.0 GHz*
526 (CXA)	13.255 GHz	26.5 GHz	26.55 GHz
526 (MXE)	1.805 GHz	3.6 GHz	27.0 GHz
532	16.005 GHz	32.0 GHz	32.5 GHz
540	20.005 GHz	40.0 GHz	40.5 GHz
543	21.505 GHz	43.0 GHz	43.0 GHz
544	22.005 GHz	44.0 GHz	45.0 GHz
550	25.005 GHz	50.0 GHz	52 GHz
F03 (CXA-m)	1.505 GHz	3.0 GHz	3.08 GHz
F07 (CXA-m)	3.755 GHz	7.5 GHz	7.575 GHz
F13 (CXA-m)	6.805 GHz	13.6 GHz	13.8 GHz
F26 (CXA-m)	13.255 GHz	26.5 GHz	26.55 GHz
504 (M9421A, M8920A)	2.145 GHz	3.88GHz	3.88 GHz
506 (M9421A, M8920A)	3.245 GHz	6.08GHz	6.08 GHz
F06 (M9410A/11A)	1.0 GHz	6.08 GHz	6.08 GHz
F06 (M9415A)	1 GHz	1.08 GHz	6.6 GHz
F08 (M9415A)	1 GHz	1.08 GHz	8.6 GHz
F12 (M9415A)	1 GHz	1.08 GHz	12.9 GHz

*For option 526, the Max CF in RTSA is 26.999999995 GHz.

N9041B Center Freq Presets

Input	CF after Mode Preset	Stop Freq after Mode Preset	Max Freq (can't tune above)
Input 1, all models	25.005 GHz	50.0 GHz	52 GHz
Input 2, opt 585	42.505 GHz	85.0 GHz	86 GHz
Input 2, opt 590	45.005 GHz	90.0 GHz	92 GHz
Input 2, opt 5CX	55.005 GHz	110.0 GHz	110 GHz

Input 2, CXA and MXE

Model	CF after Mode Preset	Stop Freq after Mode Preset	Max Freq (can't tune above)
CXA opt C75	0.7505 GHz	1.5 GHz	1.58 GHz
MXE	505 MHz	1 GHz	1.000025 GHz

Tracking Generator Frequency Limits (CXA only)

Tracking Generator Option	Min Freq (clips to this freq when turn TG on and can't tune below while TG on)	If above this Freq, Stop Freq clipped to this Freq when TG turned on	Max Freq (can't tune above) while TG on
T03	9 kHz	3.0 GHz	3.08 GHz
T06	9 kHz	6.0 GHz	6.05 GHz

Tracking Generator Frequency Limits(CXA-m only)

Tracking Generator Option	Min Freq (clips to this freq when turn TG on and can't tune below while TG on)	If above this Freq, Stop Freq clipped to this Freq when TG turned on	Max Freq (can't tune above) while TG on
T03	2 MHz	3.08 GHz	3.08 GHz
T07	2 MHz	7.575 GHz	7.575 GHz
T13	2 MHz	13.8 GHz	13.8 GHz
T26	2 MHz	26.55 GHz	26.55 GHz

RF Center Frequency

Specifies the RF Center Frequency. Sets the center frequency to use when the RF input is selected, even if the RF input is not the input that is selected at the time the command is sent. Note that **Center Frequency** in the **Frequency** menu on the front panel always applies to the currently selected input.

Remote Command	`[:SENSe]:FREQuency:RF:CENTer <freq>` `[:SENSe]:FREQuency:RF:CENTer?`
Example	`:FREQ:RF:CENT 30 MHz` `:FREQ:RF:CENT?`
Notes	This command is the same in all Modes, but the parameter is Measurement Global. So, the value is independent in each Mode and common across all the measurements in the Mode
Dependencies	If the electronic/soft attenuator is enabled, any attempt to set **Center Frequency** such that the Stop Frequency would be >3.6 GHz fails and results in an advisory message. If the equivalent SCPI command is sent, this same message is generated as part of a "-221, Settings conflict" warning If Source Mode is set to Tracking, and the Max or Min **Center Frequency** is therefore limited by the limits of the source, a warning message is generated, "Data out of range; clipped to source max/min" if these limits are exceeded. Note that for an external source, these limits can be affected by the

	settings of Source Numerator, Source Denominator, and Power Sweep
Preset	See "Center Frequency Presets" on page 779
State Saved	Saved in instrument state
Min	**Instrument Types** / **Value**: VXT model M9421A: 55.000005 MHz VXT models M9410A/11A: 6.505 kHz with Option LFE; 330.000005 MHz without Option LFE; 330.000005 MHz VXT model M9415A: 330.000005 MHz M8920A: 80.005 kHz All other instruments: –79.999995 MHz *Unless* Source Mode is set to Tracking, in which case it is limited by the minimum frequency of the Source
Max	See table above. Basically, instrument maximum frequency – 5 Hz. Note that, if the Source Mode is set to Tracking, the effective instrument maximum frequency may be limited by the source maximum frequency If the knob or step keys are being used, also depends on the value of the other three interdependent parameters: **Span**, **Start Frequency** and **Stop Frequency**

Min table:

Instrument Types	Value
VXT model M9421A	55.000005 MHz
VXT models M9410A/11A	6.505 kHz with Option LFE 330.000005 MHz without Option LFE 330.000005 MHz
VXT model M9415A	330.000005 MHz
M8920A	80.005 kHz
All other instruments *Unless* Source Mode is set to Tracking, in which case it is limited by the minimum frequency of the Source	–79.999995 MHz

Ext Mix Center Freq

Specifies the External Mixer Center Frequency. Sets the center frequency to use when the External Mixer is selected, even if the External Mixer input is not the input which is selected at the time the command is sent. Note that the **Center Frequency** function in the **Frequency** menu on the front panel always applies to the currently selected input.

Remote Command	`[:SENSe]:FREQuency:EMIXer:CENTer <freq>` `[:SENSe]:FREQuency:EMIXer:CENTer?`
Example	`:FREQ:EMIX:CENT 60 GHz` `:FREQ:EMIX:CENT?`
Notes	This command is the same in all Modes, but the parameter is Measurement Global. So, the value is independent in each Mode and common across all the measurements in the Mode
Couplings	When you return to External Mixing after using one of the other inputs (for example, RF), you return to the settings that you had when you left External Mixing. So, you return to the band you were in with the **Center Frequency** that you had. However, **Span** is *not* an input-dependent parameter, so it does not change. Therefore, the instrument comes back with the **Span** from the previous input, limited as necessary by the current mixer setup

Preset	When **Mode Preset** is performed while in External Mixing, the start frequency of the current Mode is set to the nominal Min frequency of the lowest harmonic range in the Harmonic Table for the current mixer setup. Similarly, the stop frequency of the current Mode is set to the nominal Max frequency of the highest harmonic range in the Harmonic Table. **Center Frequency** thus presets to the point arithmetically equidistant from these two frequencies Note that, if the current measurement has a limited **Span** available to it, and cannot achieve the span shown in the table (**Span** = **Stop Freq** – **Start Freq**), the instrument uses the maximum span that the measurement allows, and still sets **Center Frequency** to the midpoint of the **Start Freq** and **Stop Freq** values in the Harmonic Table When **Restore Input/Output Defaults** is performed, the mixer presets to the 11970A, whose Start and Stop frequencies are 26.5 and 40 GHz respectively. The center of these two frequencies is 33.25 GHz Therefore, after **Restore Input/Output Defaults**, if you switch to External Mixing and do a **Mode Preset** while in the Spectrum Analyzer Mode, the resulting **Center Frequency** is 33.25 GHz
State Saved	Yes
Min	The minimum frequency in the currently selected mixer band + 5 Hz
Max	The maximum frequency in the currently selected mixer band - 5 Hz If the knob or step keys are being used, also depends on the value of the other three interdependent parameters **Span**, **Start Freq** and **Stop Freq**

Span

Set the frequency of the occupied bandwidth span for the current measurement.

Remote Command	`[:SENSe]:OBWidth:FREQuency:SPAN <freq>`
	`[:SENSe]:OBWidth:FREQuency:SPAN?`
	`[:SENSe]:OBWidth:FREQuency:SPAN:AUTO ON | OFF | 0 | 1`
	`[:SENSe]:OBWidth:FREQuency:SPAN:AUTO?`

Example	`:OBW:FREQ:SPAN 2.4 MHz`
	`:OBW:FREQ:SPAN?`
	`:OBW:FREQ:SPAN:AUTO 0`
	`:OBW:FREQ:SPAN:AUTO?`

Notes	Span Auto Detector (`[:SENSe]:OBWidth:FREQuency:SPAN:AUTO`) is only available in the MSR, LTEAFDD/LTEATDD and 5GNR modes
Dependencies	The Auto Detect functionality is only available in the MSR, LTEAFDD/LTEATDD and 5GNR modes
Preset	see table below

Mode	Value
SA	3 MHz
WCDMA	10 MHz
LTEAFDD, LTEATDD	10 MHz

Mode	Value
BT	2 MHz
5GNR	Automatically calculated
RTS	27 kHz
MSR	10 MHz
WLAN	Radio Std: 802.11b = 30MHz; 802.11a/g/n/ac/ax/be (20MHz) = 25 MHz; 802.11n/ac/ax/be (40MHz) = 50 MHz; 802.11n/ac/ax/be (80MHz) = 100 MHz; 802.11ac/ax/be (160MHz) = 200 MHz; 802.11be (320MHz) = 400 MHz

WLAN:

Radio Std	Value
802.11b	30MHz
802.11a/g/n/ac/ax/be (20MHz)	25 MHz
802.11n/ac/ax/be (40MHz)	50 MHz
802.11n/ac/ax/be (80MHz)	100 MHz
802.11ac/ax/be (160MHz)	200 MHz
802.11be (320MHz)	400 MHz

State Saved	Yes
Min	100 Hz
Max	Hardware Maximum Span
Backwards Compatibility SCPI	[:SENSe]:EBWidth:FREQuency:SPAN

CF Step

Changes the step size for the center frequency and start and stop frequency functions. Once a step size has been selected, and the center frequency function is active, the step keys (and the UP|DOWN parameters for **Center Frequency** from remote commands) change the center frequency by the step-size value. The step size function is useful for finding harmonics and sidebands beyond the current frequency span of the instrument.

Note that Start Frequency and Stop Frequency also step by the **CF Step** value.

Remote Command	[:SENSe]:FREQuency:CENTer:STEP[:INCRement] <freq> [:SENSe]:FREQuency:CENTer:STEP[:INCRement]? [:SENSe]:FREQuency:CENTer:STEP:AUTO OFF | ON | 0 | 1 [:SENSe]:FREQuency:CENTer:STEP:AUTO?
Example	Increase the current center frequency value by 500 MHz: :FREQ:CENT:STEP 500 MHz :FREQ:CENT UP

	`:FREQ:CENT:STEP:AUTO ON` `:FREQ:CENT:STEP:AUTO?`
Notes	Preset and Max values depend on Hardware Options
Dependencies	Span, RBW, Center frequency If the electronic/soft attenuator is enabled, any attempt to change the value of the center frequency >3.6 GHz by pressing the **Up Arrow** key, fails and results in an advisory message. If the equivalent SCPI command is sent, this same message is generated as part of a "-221, Settings conflict" warning
Couplings	When auto-coupled in a non-zero span, the center frequency step size is set to 10% of the span When auto-coupled in zero span, the center frequency step size is set to the equivalent -3 dB RBW value
Preset	Auto `ON`
State Saved	Saved in instrument state
Min	– /+(the maximum frequency of the instrument). That is, 27 GHz max freq instrument has a CF step range of +/- 27 GHz. Note that this is the maximum frequency given the current settings of the instrument, so in External Mixing, for example, it is the maximum frequency of the current mixer band
Status Bits/OPC dependencies	non-overlapped

Freq Offset

Lets you set a frequency offset value to account for frequency conversions outside of the instrument. This value is added to the display readout of the marker frequency, center frequency, start frequency, stop frequency, and all other absolute frequency settings in the instrument, including frequency count. When a frequency offset is entered, the value appears below the center of the graticule. To eliminate an offset, perform a **Mode Preset**, or set the frequency offset to 0 Hz.

See "More Information" on page 786.

Remote Command	`[:SENSe]:FREQuency:OFFSet <freq>` `[:SENSe]:FREQuency:OFFSet?`
Example	`:FREQ:OFFS 10 MHz` `:FREQ:OFFS?`
Notes	Preset and Max values depend on Hardware Options
Dependencies	Appears only in Spectrum Analyzer Mode Not available in External Mixing. In this case, the control is grayed-out and shows a value of zero. However, the value of CF Offset that was set for the RF Input is retained and is restored when you switch back to the RF Input
Preset	See table under "Center Frequency" on page 777
State Saved	Saved in instrument state

Min	-500 GHz
Max	500 GHz
Annotation	If Frequency Offset is not zero, "Freq Offset <value>" appears on the upper line of the annotation, below the graticule, in the center
Status Bits/OPC dependencies	Non-overlapped
Backwards Compatibility SCPI	`:DISPlay:WINDow[1]:TRACe:X[:SCALe]:OFFSet` The `DISPlay` version of the command is in the instrument for compatibility across platforms and is not recommended for new development
Backwards Compatibility Notes	In pre-X-Series instruments, **Freq Offset** could not be adjusted by the knob or step keys. That is no longer the case Some previous spectrum analyzers did not adjust frequency counter results for **Freq Offset**. The X-Series does adjust the frequency counter for the offset

More Information

This command does not affect any bandwidths or the settings of relative frequency parameters such as delta markers or span. It does not affect the current hardware settings of the instrument, but only the displayed frequency values. Entering an offset does not affect the trace position or display, just the value of the start and stop frequency and the values represented by the trace data. The frequency values of exported trace data, queried trace data, markers, trace data used in calculations such as N dB points, trace math, etc., are all affected by **Freq Offset**. Changing the offset, even on a trace that is not updating will immediately change all the above, without taking new data.

NOTE If a trace is exported with a nonzero **Freq Offset**, the exported data will contain the trace data with the offset applied. Therefore, if that trace were to be imported back into the instrument, you would want **Freq Offset** to be 0, or the offset would be applied again to data that is already offset. No such care need be taken when saving a State+Trace file because the data and state are saved together.

Full Span (Remote Command Only)

Changes the Occupied Bandwidth Span to show the full frequency range of the instrument. It maximizes the span within a range but does not change **Center Frequency**. When using external mixing, it changes the displayed frequency span to the frequency range specified for the selected external mixing band.

Remote Command	`[:SENSe]:OBWidth:FREQuency:SPAN:FULL`
Example	`:OBW:FREQ:SPAN:FULL`
Couplings	Selecting full span changes the measurement span value

3.4.7 Marker

Accesses a menu that enables you to select, set up and control the markers for the current measurement. If there are no active markers, **Marker** selects marker 1, sets it to **Normal** mode (see "Marker Mode" on page 789), and places it at the center of the display. If the selected marker is **Off**, it is set to **Normal** and placed at the center of the screen, on the trace determined by the Marker Trace rules.

3.4.7.1 Select Marker

Specifies the selected marker. The term “selected marker” is used throughout this document to specify which marker will be affected when you change marker settings, perform a **Peak Search**, etc.

This control appears above the menu panel, indicating that it applies to all controls in the **Marker** menu panels. **Select Marker** is blanked if you select a tab whose controls do *not* depend on the selected marker (for example, **Counter**).

For any menu that includes **Select Marker**, the first control is always **Marker Frequency | Time**.

Notes	The selected marker is remembered even when not in the **Marker** menu and is used if a search is done, or a Band Function is turned on, or for Signal Track or Continuous Peak
Preset	Marker 1
State Saved	The number of the selected marker is saved in instrument state
Annunciation	Appears in the marker results block label for **Normal** and **Delta** markers

3.4.7.2 Settings

The controls on this tab include the Marker active function and a radio button selection for the marker control mode (**Normal**/`POSition`, **Delta** or **Off**; see "Marker Mode" on page 789) for the selected marker, as well as additional functions that help you use markers.

Marker Frequency

Sets the marker X-Axis value in the current marker X-Axis Scale unit. It has no effect if the control mode (see "Marker Mode" on page 789) is **Off,** but is the SCPI equivalent of entering an X value if the control mode is **Normal** or **Delta**.

Remote Command	`:CALCulate:OBWidth:MARKer[1]|2|…|12:X <freq>` `:CALCulate:OBWidth:MARKer[1]|2|…|12:X?`

Example	`:CALC:OBW:MARK3:X 0` `:CALC:OBW:MARK3:X?`
Notes	If no suffix is sent, uses the fundamental units for the current marker X Axis Scale. If a suffix is sent that does not match the current marker X Axis Scale unit, an error “Invalid suffix” is generated The query returns the marker’s absolute X Axis value if the control mode is **Normal**, or the offset from the marker’s reference marker if the control mode is **Delta**. The query is returned in the fundamental units for the current marker X Axis scale: Hz for **Frequency** and **Inverse Time**, seconds for **Period** and **Time**
Preset	After a preset, all markers are turned `OFF`, so Marker X Axis Value query returns Not a Number (NAN)
State Saved	Saved in instrument state
Min	-9.9E+37
Max	9.9E+37
Annotation	Mkr # <X value> and <Marker value> upper right on graph

Marker X Axis Position (Remote Command Only)

Sets the marker X-Axis Scale position in trace points. This setting has no effect if the control mode is **Off**, but is the SCPI equivalent of entering a value if the control mode is **Normal** or **Delta** - except in trace points rather than X-Axis Scale units. The entered value is immediately translated into the current X-Axis Scale units for setting the value of the marker.

Remote Command	`:CALCulate:OBWidth:MARKer[1]|2|…|12:X:POSition <real>` `:CALCulate:OBWidth:MARKer[1]|2|…|12:X:POSition?`
Example	`:CALC:OBW:MARK10:X:POS 0` `:CALC:OBW:MARK10:X:POS?`
Notes	The query returns the marker’s absolute X-Axis value in trace points if the control mode is **Normal**, or the offset from the marker’s reference marker in trace points if the control mode is **Delta**. The value is returned as a real number, not an integer, corresponding to the translation from X-Axis Scale units to trace points . When a marker is turned on, it is placed center of the screen on the trace. Therefore, the default value depends on instrument condition If the marker is **Off**, the query response is Not A Number
Preset	After a preset, all markers are turned **Off**, so the query returns Not A Number (NAN)
State Saved	Saved in instrument state
Min	-9.9E+37
Max	9.9E+37

Marker Y Axis Value (Remote Query only)

Returns the marker Y-Axis value in the current marker Y-Axis unit.

Remote	`:CALCulate:OBWidth:MARKer[1]|2|…|12:Y?`

Command	
Example	`:CALC:OBW:MARK11:Y?`
Notes	Returns the marker Y-Axis result, if the control mode is **Normal** or **Delta** If the marker is **Off**, the response is Not A Number
Preset	Result dependent on Markers setup and signal source
State Saved	No
Backwards Compatibility SCPI	`:CALCulate:OBWidth:MARKer[1]|2|…|12:FUNCtion:RESult?`

Marker Mode

Sets the marker control mode to **Normal** (`POSition`), **Delta**, or **Off**. All interactions and dependencies detailed under the control description are enforced when the remote command is sent. If the selected marker is `OFF`, pressing **Marker** sets it to **Normal** and places it at the center of the screen on the trace determined by the **Marker Trace** rules. At the same time, **Marker X Axis Value** appears on the Active Function area.

The default active function is the active function for the currently selected marker control mode. If the current control mode is **Off**, there is no active function, and the active function is turned off.

Remote Command	`:CALCulate:OBWidth:MARKer[1]|2|…|12:MODE POSition | DELTa | OFF` `:CALCulate:OBWidth:MARKer[1]|2|…|12:MODE?`
Example	`:CALC:OBW:MARK:MODE POS` `:CALC:OBW:MARK:MODE?`
Preset	`OFF`
State Saved	Saved in instrument state
Range	`POSition|DELTa|OFF`
Annotation	Mkr # <X value> and <Marker value> upper right on graph When Marker Trace is Polar in WCDMA mode: Mkr # <Chip Value (RHO & QPSKEVM)/Symbol Value (CDP)>, <X value> and <Y value> upper right on graph

Backwards Compatibility SCPI Command

Sets or queries the state of a marker. Setting a marker that is `OFF` to `ON` (1), puts it in **Normal** mode, and places it at the center of the screen.

Example	`:CALC:OBW:MARK3:STAT ON`

	`:CALC:OBW:MARK3:STAT?`
Preset	`OFF`
State Saved	Saved in instrument state
Range	`OFF|ON`
Backwards Compatibility SCPI	`:CALCulate:OBWidth:MARKer[1]|2|…|12:STATe OFF | ON | 0 | 1` `:CALCulate:OBWidth:MARKer[1]|2|…|12:STATe?`

Delta Marker (Reset Delta)

Pressing this button has the same effect as pressing **Delta** in **Marker Mode**. The selected marker becomes a **Delta** marker. If the selected marker is already a **Delta** marker, the reference marker is moved to the current position of the selected marker, thus resetting the delta to zero.

Marker Settings Diagram

Lets you configure the **Marker** system using a visual utility.

All Markers Off

Turns off all markers.

Remote Command	`:CALCulate:OBWidth:MARKer:AOFF`
Example	`:CALC:OBW:MARK:AOFF`

3.4.7.3 Peak Search

The controls on this tab allow you to move the marker to selected peaks of the signal, giving you enormous analysis capabilities, particularly when combined with "Marker Delta" on page 791.

NOTE: Pressing the **Peak Search** hardkey automatically moves you to the **Peak Search** page of the **Marker** menu *and* performs a peak search.

Pressing the **Peak Search** tab once you are already *in* the **Marker** menu does *not* perform a peak search.

Marker Frequency

This is the fundamental control that you use to move a marker around on the trace. It is the same as "Marker Frequency" on page 787 on the **Settings** tab.

Peak Search

Moves the selected marker to the trace point which has the maximum y-axis value for that marker's trace.

NOTE	Pressing the **Peak Search** hardkey automatically moves you to the **Peak Search** page of the **Marker** menu *and* performs a peak search.

Remote Command	`:CALCulate:OBWidth:MARKer[1]|2|…|12:MAXimum`

Example	`:CALC:OBW:MARK2:MAX`
	`:SYST:ERR?`
	can be used to query the errors to determine if a peak is found. The message "No peak found" (-200) will be returned after an unsuccessful search

Notes	Sending this command selects the subopcoded marker In WCDMA Mode, this command does not work when the selected marker is located on the polar trace. In this case, the command is ignored

Marker Delta

Pressing this button has the same effect as pressing **Delta** in "Marker Mode" on page 789 on the **Settings** tab. The selected marker becomes a **Delta** marker. If the selected marker is already a **Delta** marker, the reference marker is moved to the current position of the selected marker, thus resetting the delta to zero.

The control is duplicated here to allow you to conveniently perform a peak search and change the marker's control mode to **Delta** without having to access two separate menus.

3.4.7.4 Properties

The controls on this tab are used to set certain properties of the selected marker.

Marker Frequency

This is the fundamental control that you use to move a marker around on the trace. It is the same as "Marker Frequency" on page 787 on the **Settings** tab.

Relative To

Selects the marker to which the selected marker is relative (its reference marker).

Every marker has another marker to which it is relative. This marker is referred to as the "reference marker" for that marker. This attribute is set by the **Marker, Properties, Relative To** key. The marker must be a **Delta** marker to make this attribute relevant. If it is a **Delta** marker, the reference marker determines how the marker is controlled and how its value is displayed. A marker cannot be relative to itself.

Remote Command	`:CALCulate:OBWidth:MARKer[1]|2|…|12:REFerence <integer>` `:CALCulate:OBWidth:MARKer[1]|2|…|12:REFerence?`
Example	`:CALC:OBW:MARK:REF 2` `:CALC:OBW:MARK:REF?`
Notes	Causes the marker specified with the subopcode to become selected Range (for SCPI command): 1 to 12. If the range is exceeded, the value is clipped A marker cannot be relative to itself so that choice is not available, and if sent from SCPI generates error -221: "Settings conflict; marker cannot be relative to itself" The query returns a single value (the specified marker number's relative marker)
Couplings	The act of specifying the selected marker's reference marker makes the selected marker a **Delta** marker If the reference marker is **Off**, it is turned on in **Normal** mode at the **Delta** marker location
Preset	The preset default "Relative To" marker (reference marker) is the next higher numbered marker (current marker +1). For example, if marker 2 is selected, then it's default reference marker is marker 3. The exception is marker 12, which has a default reference of marker 1 Set to the defaults by using **Restore Mode Defaults**. This is not reset by **Marker Off**, **All Markers Off**, or **Preset**
State Saved	Saved in instrument state. Not affected by **Marker Off** and hence not affected by **Preset** or power cycle
Min	1
Max	12
Annunciation	Appears in the marker label of a **Delta** marker

Marker Trace

Selects the trace on which you want your marker placed. A marker is associated with one and only one trace. This trace is used to determine the placement, result, and X-

Axis Scale of the marker. All markers have an associated trace; it is from that trace that they determine their attributes and behaviors, and it is to that trace that they go when they become **Normal** or **Delta** markers (see "Marker Mode" on page 789).

Specifying a **Marker Trace** manually or with this command associates the marker with the specified trace. If the marker is not **Off**, it moves from the trace it was on to the new trace. If the marker is **Off**, it stays off, but is now associated with the specified trace.

The query returns the number of the trace on which the marker is currently placed.

Remote Command	`:CALCulate:OBWidth:MARKer[1]|2|…|12:TRACe 1 | 2 | 3` `:CALCulate:OBWidth:MARKer[1]|2|…|12:TRACe?`
Example	`:CALC:OBW:MARK2:TRAC 2` `:CALC:OBW:MARK2:TRAC?`
Notes	A marker may be placed on a blanked and/or inactive trace, even though the trace is not visible and/or updating An application may register a trace name to be displayed on the control instead of a trace number
Couplings	The state of **Marker Trace** is not affected by "Auto Couple" on page 1995 Sending the remote command causes the addressed marker to become selected
Preset	1
State Saved	Saved in instrument state

Marker Settings Diagram

Lets you configure the **Marker** system using a visual utility. It is the same as "Marker Settings Diagram" on page 790 on the **Settings** tab.

3.4.8 Meas Setup

Contains functions for setting up the measurement parameters and contains functions for setting up parameters global to all measurements in the mode.

3.4.8.1 Settings

Contains frequently used **Meas Setup** functions to which you will want the fastest access.

Avg/Hold Num

Specifies the number of measurement averages used when calculating the measurement result. The average is displayed at the end of each sweep.

Initiates an averaging routine that averages the sweep points in several successive sweeps, resulting in trace smoothing.

After the specified number of average counts, "Average Mode" on page 794 (termination control) determines the average action.

Remote Command	`[:SENSe]:OBWidth:AVERage:COUNt <integer>` `[:SENSe]:OBWidth:AVERage:COUNt?`
Example	`:OBW:AVER:COUN 1500` `:OBW:AVER:COUN?`
Preset	10
State Saved	Yes
Min/Max	1/10000
Annotation	The average count is displayed in the measurement bar on the front panel display. The annotation appears in the format n/N where n is the current average and N is the average count
Backwards Compatibility SCPI	`[:SENSe]:EBWidth:AVERage:COUNt`

Averaging On/Off

Turns averaging on or off.

NOTE In this measurement, **Average Type** is always preset to the `Log-Pwr Avg (Video)` method. Other averaging methods are not available.

Remote Command	`[:SENSe]:OBWidth:AVERage[:STATe] ON | OFF | 1 | 0` `[:SENSe]:OBWidth:AVERage[:STATe]?`
Example	`:OBW:AVER ON` `:OBW:AVER?`
Couplings	**Averaging** state is coupled to "Max Hold (Remote Command Only)" on page 800. If **Max Hold** is changed from `OFF` to `ON`, **Averaging** state is automatically set to `ON`
Preset	`ON`
State Saved	Yes
Range	`ON|OFF`
Backwards Compatibility SCPI	`[:SENSe]:EBWidth:AVERage[:STATe]`

Average Mode

Lets you set the averaging mode.

EXPonential	Measurement averaging continues using the specified number of averages to compute each averaged value. The average is displayed at the end of each sweep
REPeat	The measurement resets the average counter each time the specified number of averages is reached

Remote Command	`[:SENSe]:OBWidth:AVERage:TCONtrol EXPonential | REPeat` `[:SENSe]:OBWidth:AVERage:TCONtrol?`
Example	`:OBW:AVER:TCON REP` `:OBW:AVER:TCON?`
Preset	`EXP`
State Saved	Yes
Range	`EXPonential|REPeat`

% of OBW Power

Assigns the percentage of the total power that is measured within the Occupied Bandwidth for the current measurement. The resulting Occupied Bandwidth limits are displayed by markers placed on the frequencies of the specified percentage.

Remote Command	`[:SENSe]:OBWidth:PERCent <real>` `[:SENSe]:OBWidth:PERCent?`
Example	`:OBW:PERC 75` `:OBW:PERC?`
Preset	99.00
State Saved	Yes
Min/Max	10/99.99

Power Ref

Lets you select Power Ref type:

Total Power	TPOWer	Total power in the current span is displayed
OBW Power	OBWPower	Occupied power is displayed

When **Power Ref** type is changed, the annotation in the lower window and Remote Command SCPI Results also change.

Remote Command	`[:SENSe]:OBWidth:PREFerence | OBWPower` `[:SENSe]:OBWidth:PREFerence?`
Example	`:OBW:PREF TPOW`

	`:OBW:PREF?`
Preset	`TPOWer`
State Saved	Saved in instrument state
Range	`TPOWer|OBWPower`

x dB

Sets the x dB value used for the "x dB bandwidth" result that measures the bandwidth between two points on the signal that is x dB down from the highest signal point within the OBW Span.

Remote Command	`[:SENSe]:OBWidth:XDB <rel_ampl>` `[:SENSe]:OBWidth:XDB?`
Example	`:OBW:XDB -20` `:OBW:XDB?`
Preset	BT Mode: -20.0 dB All other Modes: -26.0 dB
State Saved	Yes
Min/Max	-100.0 dB/-0.1 dB
Backwards Compatibility SCPI	`[:SENSe]:EBWidth:XDB`

Power Integration Method

Selects the power integration method:

Normal	`NORMal`	By integrating the linear power bucket values from the lower edge of the trace, and interpolating to find the point where the integrated power equals (1 – [Occ BW % Pwr]) / 2 (0.5% if, for example, the 99% occupied bandwidth is to be found) of the total power, frequency f1 is obtained. This procedure is repeated from the upper trace edge to find frequency f2. This calculation uses linear interpolation to find the lower and upper carrier boundary point within the width of a sweep point (the span divided by the number of sweep points), f1 and f2
From Center	`ICENter`	Measures the power spectrum distribution within two times or more frequency range over the requirement for Occupied Bandwidth specification centering on the current carrier frequency

Remote Command	`[:SENSe]:OBWidth:INTegration[:METHod] NORMal	ICENter` `[:SENSe]:OBWidth:INTegration[:METHod]?`
Example	`:OBW:INT NORM`

	:OBW:INT?	
Preset	For 5GNR Mode, Uplink:	ICENter
	All other Modes	NORMal
State Saved	Yes	
Range	NORMal|ICENter	

Spur Avoidance

Because VXT models M9410A/11A/15A/16A and M9410E/11E/15E/16E are direct-conversion (zero-IF) receivers, feedthrough leakage from the local oscillator appears as a spurious signal (spur) at the center frequency. The **Spur Avoidance** function is provided to eliminate this spur, at the expense of some measurement speed.

When **Spur Avoidance** is enabled (the default), the instrument uses a software algorithm to remove this spur from the displayed measurement data, but the algorithm only operates under certain conditions. Specifically, it only operates in the multiple capture case.

You can disable this function to speed up your measurement by setting **Spur Avoidance** to "Disabled."

Note that when **Spur Avoidance** is not in effect, either because you have disabled it or because you are not in multiple capture, the following warning message will appear in the status bar:

`Settings Alert;Spur Avoidance Off`

This is to alert you that measurement accuracy might be impacted by the fact that **Spur Avoidance** is not in effect.

The spur avoidance function is not available for:

- M9410A/11A with EP6 option at frequency above 6 GHz
- M9415A/16A at frequency below 380 MHz and above 12.3 GHz
- M9410E/11E/15E/16E at frequency below 380 MHz and above 25.9 GHz

Remote Command	[:SENSe]:OBWidth:SAVoid[:STATe] OFF | ON | 0 | 1 [:SENSe]:OBWidth:SAVoid[:STATe]?
Example	:OBW:SAV ON :OBW:SAV?
Dependencies	Only appears in VXT models M9410A/11A/15A/16A and M9410E/11E/15E/16E
Preset	OFF

State Saved	Saved in instrument state
Range	OFF|ON

Meas Setup Summary Table

Lets you view and access many of the parameters in the **Meas Setup** menus on one screen.

Auto Couple

Immediately puts all **Auto/Man** functions into **Auto**. **Auto Couple** is confined to the current measurement only. It does not affect other measurements in the Mode.

In the **Auto** state, **Auto/Man** functions are said to be “coupled”, meaning their values change as you make changes to other values in the measurement. This helps ensure accurate measurements and optimum dynamic range. **Auto Couple** is an immediate action function, and when it is executed, all the **Auto/Man** controls for the current measurement are set to **Auto**, and all measurement settings coupled to the **Auto/Man** parameters are automatically set to their optimal values.

For further details of measurement-specific settings (if any), see "Measurement-Specific Details" on page 799 below.

Remote Command	`:COUPle ALL`
Example	`:COUP ALL`
Backwards Compatibility SCPI	`:COUPLE ALL | NONE`
Backwards Compatibility Notes	`:COUP:NONE` puts all Auto/Man parameters in manual mode, decoupling all the coupled instrument parameters. It is retained for backwards compatibility and is *not* recommended for making measurements or new designs

All **Auto/Man** parameter couplings in the measurement are set to **Auto**. This includes couplings that may be unavailable or grayed-out due to the current state. For example, in the Swept SA measurement, there is no **Auto/Man** coupling for **RBW** while in Zero Span. Nonetheless, if **Auto Couple** were executed while in Zero Span, it would set **RBW** to Auto "behind the scenes" so that, on exit from Zero Span, it would be in **Auto**.

Any **Auto/Man** selection specific (local) to the other measurements in the current Mode are not affected by **Auto Couple**. Any functions that are *not* coupled with other instrument parameters, such as ranging or leveling variables, such as **AutoRange** or **AutoScale**, are not affected.

Executing **Auto Couple** generates the informational message, "All Auto/Man functions have been set to Auto".

Each parameter, upon being set to **Auto**, selects and sets the appropriate auto-coupled value based on that parameter’s coupling rules. The Dependency Resolver orchestrates the couplings for parameters that depend on one or more other parameters. The coupling and dependency rules for each parameter are defined in the section describing that parameter.

Executing **Auto Couple***does not* affect markers, marker functions, trace or display attributes, or any other instrument setting other than those specifically mentioned above.

Measurement-Specific Details

TOI (SA Mode only)

Parameters affected by **Auto Couple** are:

- Center Frequency Step
- Resolution Bandwidth
- Span/RBW Ratio
- Sweep Time
- Video BANDwidth VBW/RBW ratio
- Upper and Lower Tone (set to Sense)
- Zero span measurement Resolution Bandwidth
- Zero span measurement Dwell Time

Harmonics (SA Mode only)

Parameters affected by **Auto Couple** are:

- Resolution Bandwidth
- Fundamental Frequency
- Dwell Time
- Range Table Resolution Bandwidths
- Range Table Dwell Times

Meas Preset

Restores all measurement parameters to their default values.

Remote Command	:CONFigure:OBWidth
Example	:CONF:OBW

Max Hold (Remote Command Only)

When ON, **Max Hold** displays and holds the maximum responses of the current measurement. Turn **Max Hold**OFF to disable the maximum hold feature.

Remote Command	[:SENSe]:OBWidth:MAXHold ON | OFF | 1 | 0 [:SENSe]:OBWidth:MAXHold?
Example	:OBW:MAXH ON :OBW:MAXH?
Couplings	**Max Hold** is coupled to "Averaging On/Off" on page 794. **Max Hold** is activated only if **Average** state is ON. If **Max Hold** is changed to ON when **Average** state is OFF, **Average** state is automatically set to ON
Preset	OFF
State Saved	Yes
Range	OFF|ON
Backwards Compatibility SCPI	[:SENSe]:EBWidth:MAXHold

3.4.8.2 Limits

Lets you set measurement limits and be alerted when they have been exceeded.

Limit

Enables you to turn on or off limit checking at the specified frequency. For results that fail the limit test, a red FAIL appears in the Meas Bar.

Remote Command	:CALCulate:OBWidth:LIMit:FBLimit <freq> :CALCulate:OBWidth:LIMit:FBLimit? :CALCulate:OBWidth:LIMit[:TEST] ON | OFF | 1 | 0 :CALCulate:OBWidth:LIMit[:TEST]?
Example	:CALC:OBW:LIM:FBL 50 kHz

<table>
<tr><td></td><td>:CALC:OBW:LIM:FBL?
:CALC:OBW:LIM OFF
:CALC:OBW:LIM?</td></tr>
<tr><td>Dependencies</td><td>Appears in all Modes except MSR, LTE-A and 5G NR</td></tr>
<tr><td>Preset</td><td>
<table>
<tr><th>Mode</th><th>Value</th></tr>
<tr><td>SA
WCDMA
MSR</td><td>5 MHz</td></tr>
<tr><td>WLAN</td><td>
<table>
<tr><th>Radio Std</th><th>Value</th></tr>
<tr><td>802.11a/g(OFDM/DSSS-OFDM)</td><td>20 MHz</td></tr>
<tr><td>802.11b</td><td>25 MHz</td></tr>
<tr><td>802.11n/ac/ax/be (20MHz)</td><td>20 MHz</td></tr>
<tr><td>802.11n/ac/ax/be (40MHz)</td><td>40 MHz</td></tr>
<tr><td>802.11n/ac/ax/be (80MHz)</td><td>80 MHz</td></tr>
<tr><td>802.11ac/ax/be (160MHz)</td><td>160 MHz</td></tr>
<tr><td>802.11be (320MHz)</td><td>320 MHz</td></tr>
</table>
</td></tr>
<tr><td>BT</td><td>1 MHz</td></tr>
<tr><td>RTS</td><td>25 kHz</td></tr>
</table>
<table>
<tr><th>Mode</th><th>Value</th></tr>
<tr><td>SA</td><td>OFF</td></tr>
<tr><td>All others</td><td>ON</td></tr>
</table>
</td></tr>
<tr><td>State Saved</td><td>Yes
Yes</td></tr>
<tr><td>Range</td><td>OFF | ON</td></tr>
<tr><td>Min/Max</td><td>1 kHz/Depends on instrument maximum frequency</td></tr>
</table>

3.4.8.3 Meas Standard

Contains controls that allow you to preset the PowerSuite measurements to conform to various communications standards.

Radio Standard Presets

Lets you specify the Radio Standard to be used. Spectrum Analyzer Mode supports many Radio Standards. You can select the desired Radio Standard using the **Radio Std Presets** dialog, which is a cascading list of standards. When you have the selected the desired Standard, press **OK** and the measurement settings will change to reflect that standard.

Remote Command	`[:SENSe]:RADio:STANdard[:SELect] NONE | JSTD | IS95a | IS97D | IS98D | GSM | W3GPP | C2000MC1 | C20001X | NADC | PDC | BLUEtooth | TETRa | WL802DOT11A | WL802DOT11B | WL802DOT11G | HIPERLAN2 | DVBTLSN | DVBTGPN | DVBTIPN | FCC15 | SDMBSE | UWBINDOOR | LTEB1M4 | LTEB3M | LTEB5M | LTEB10M | LTEB15M | LTEB20M | WL11N20M | WL11N40M | WL11AC20M | WL11AC40M | WL11AC80M | WL11AC160M | WL11AX20M | WL11AX40M | WL11AX80M | WL11AX160M | WL11BE20M | WL11BE40M | WL11BE80M | WL11BE160M | WL11BE320M | WL11AD2G | WL11AY2G16 | WL11AY4G32 | WL11AY6G48 | WL11AY8G64 | NR5GFR1B100M` `[:SENSe]:RADio:STANdard[:SELect]?`
Example	`:RAD:STAN NONE` `:RAD:STAN?`
Dependencies	Some selections appear only when support license is valid
Couplings	By changing the radio standard, the measurement parameters will be automatically set to an appropriate default value
State Saved	Saved in instrument state

The **Radio** column in the table lets you specify the device to be used. It is a global setting that affects the Device selection, between Mobile (MS) and Base Station (BTS) settings, for all relevant PowerSuite measurements. The Device SCPI command has the same effect as a selection in the **Radio** column:

Remote Command	`[:SENSe]:RADio:STANdard:DEVice BTS | MS` `[:SENSe]:RADio:STANdard:DEVice?`
Example	`:RAD:STAN:DEV MS` `:RAD:STAN:DEV?`
Preset	`BTS`
State Saved	Saved in instrument state
Range	`BTS|MS`

Chart for Standard and Available Measurements

Note that not every measurement in Spectrum Analyzer Mode is available for every standard. The chart below describes which measurements are available for each Radio Standard.

For TOI or Harmonics measurements, *no* Radio Standards are available.

	Swept SA	CHP	OBW	ACP	CCDF	Burst Power	Spurious Emission	SEM	List Sweep
None	X	X	X	X	X	X	X	X	(X)
3GPP 5G NR	(X)	X	X	X	X			X	(X)
3GPP LTE	(X)	X	X	X	X			X	(X)
3GPP W-CDMA	(X)	X	X	X	X	X		X	(X)
GSM/EDGE	(X)				X	X			(X)
cdma2000 1x	(X)	X	X	X	X	X			(X)
IS-95A	(X)	X	X	X	X	X			(X)
J-STD-008	(X)	X	X	X	X	X			(X)
IS-97D/98D	(X)	X	X	X	X				(X)
NADC	(X)	X	X	X	X	X			(X)
PDC	(X)	X	X	X	X	X			(X)
Bluetooth	(X)				X	X			(X)
W-LAN 802.11a	(X)							X	(X)
W-LAN 802.11b	(X)							X	(X)
W-LAN 802.11g	(X)							X	(X)
W-LAN 802.11n	(X)	X	X		X			X	(X)
W-LAN 802.11ac	(X)	X	X		X			X	(X)
W-LAN 802.11ax	(X)	X	X		X			X	(X)
W-LAN 802.11be	(X)	X	X		X			X	(X)
W-LAN 802.11ad	(X)	X	X		X			X	(X)
W-LAN 802.11ay	(X)	X	X		X			X	(X)
W-LAN HiperLAN/2	(X)							X	(X)
TETRA	(X)	X		X					(X)
DVB-T L/SECAM/NICAM	(X)	X			X				(X)
FCC Part 15 Subpart F	(X)	X			X				(X)
DVBT-T G/PAL/NICAM	(X)	X			X				(X)
DVB-T I/PAL/NICAM	(X)						X		(X)

	Swept SA	CHP	OBW	ACP	CCDF	Burst Power	Spurious Emission	SEM	List Sweep
S-DMB System E	(X)	X	X	X					(X)
UWB Indoor	(X)						X		(X)

General Radio Standards

The table below lists the settings and provides an example for each general Radio Standard.

None	Command Example	:RAD:STAN NONE
	IBW	2 MHz
	Span	3 MHz
	RBW	Auto rules
	VBW	Auto rules
TETRA	Command Example	:RAD:STAN TETR
	IBW	18 kHz
	Span	27 kHz
	RBW	1.2 kHz
	VBW	Auto rules
	RRC Filter	On
	RRC Filter Alpha	0.35
FCC Part15 Subpart F	Command Example	:RAD:STAN FCC15

Video Radio Standards

The table below lists the settings and provides an example for each video Radio Standard.

DVB-T L/SECAM/NICAM	Command Example	:RAD:STAN DVBTLSN
	IBW	7.61 MHz
	Span	24 MHz
	RBW	3.9 kHz
	VBW	Auto rules
	Sweep Points	8001

DVB-T G/PAL/NICAM	Command Example	:RAD:STAN DVBTGPN
	IBW	7.61 MHz
	Span	24 MHz
	RBW	3.9 kHz
	VBW	Auto rules
	Sweep Points	8001
DVB-T I/PAL/NICAM	Command Example	:RAD:STAN DVBTIPN
	IBW	7.61 MHz
	Span	24 MHz
	RBW	3.9 kHz
	VBW	Auto rules
	Sweep Points	8001
S-DMB System E	Command Example	:RAD:STAN SDMBSE
	IBW	25 MHz
	Span	37.5 MHz
	RBW	360 kHz
	VBW	Auto rules
	RRC Filter	Off
	RRC Filter Alpha	0.22

Cellular Radio Standards

The table below lists the CHP settings and provides an example for each cellular Radio Standard.

GSM/EDGE	Command Example	:RAD:STAN GSM
3GPP 5G NR	Command Example	:RAD:STAN NR5GFR1B100M
	IBW	100 MHz
	Span	150 MHz
	RBW	Auto rules
	VBW	Auto rules
3GPP W-CDMA	Command Example	:RAD:STAN W3GPP
	IBW	5 MHz
	Span	7.5 MHz
	RBW	240 kHz
	VBW	Auto rules
	RRC Filter	Off
	RRC Filter Alpha	0.22

3GPP LTE 1.4 MHz	Command Example	:RAD:STAN LTEB1M4
	IBW	1.4 MHz
	Span	2.1 MHz
	RBW	Auto rules
	VBW	Auto rules
3GPP LTE 3 MHz	Command Example	:RAD:STAN LTEB3M
	IBW	3 MHz
	Span	4.5 MHz
	RBW	Auto rules
	VBW	Auto rules
3GPP LTE 5 MHz	Command Example	:RAD:STAN LTEB5M
	IBW	5 MHz
	Span	7.5 MHz
	RBW	Auto rules
	VBW	Auto rules
3GPP LTE 10 MHz	Command Example	:RAD:STAN LTEB10M
	IBW	10 MHz
	Span	15 MHz
	RBW	Auto rules
	VBW	Auto rules
3GPP LTE 15 MHz	Command Example	:RAD:STAN LTEB15M
	IBW	15 MHz
	Span	22.5 MHz
	RBW	Auto rules
	VBW	Auto rules
3GPP LTE 20 MHz	Command Example	:RAD:STAN LTEB20M
	IBW	20 MHz
	Span	30 MHz
	RBW	Auto rules
	VBW	Auto rules
cdma2000	Command Example	:RAD:STAN C20001X :RAD:STAN C2000MC1 :RAD:STAN? (Query always returns C20001X)
	IBW	1.23 MHz
	Span	1.845 MHz

	RBW	24 kHz
	VBW	Auto rules
IS-95A	Command Example	:RAD:STAN IS95
	IBW	1.23 MHz
	Span	1.845 MHz
	RBW	24 kHz
	VBW	Auto rules
J-STD-008	Command Example	:RAD:STAN JSTD
	IBW	1.23 MHz
	Span	1.845 MHz
	RBW	24 kHz
	VBW	Auto rules
NADC	Command Example	:RAD:STAN NADC
	IBW	32.8 kHz
	Span	49.2 kHz
	RBW	1.2 kHz
	VBW	Auto rules
PDC	Command Example	:RAD:STAN PDC
	IBW	21 kHz
	Span	31.5 kHz
	RBW	6.2 kHz
	VBW	Auto rules
IS-97D/98D	Command Example	:RAD:STAN IS97D :RAD:STAN IS98D :RAD:STAN IS95C :RAD:STAN? Query always returns `IS97D`
	IBW	1.23 MHz
	Span	1.845 MHz
	RBW	24kHz
	VBW	Auto rules

Band Class (IS-97D/98D only)

The following function is only available when you have selected the standard: IS-97D/98D. It lets you select the band class.

Remote Command	`[:SENSe]:RADio:STANdard:BAND:CLASs BC0 | BC1` `[:SENSe]:RADio:STANdard:BAND:CLASs?`

Example	`:RAD:STAN:BAND:CLAS BC0` `:RAD:STAN:BAND:CLAS?`
Preset	`BC0`
State Saved	Saved in instrument state
Range	0 (800 MHz Band)|1 (1900 MHz Band)

Wireless Radio Standards

The table below lists the CHP settings and provides an example for each wireless Radio Standard.

WLAN 802.11a	Command Example	:RAD:STAN WL802DOT11A
	IBW	20 MHz
	Span	30 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11g	Command Example	:RAD:STAN WL802DOT11G
	IBW	20 MHz
	Span	30 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11b	Command Example	:RAD:STAN WL802DOT11B
	IBW	25 MHz
	Span	37.5 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11n 20 MHz	Command Example	:RAD:STAN WL11N20M
	IBW	20 MHz
	Span	30 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11n 40 MHz	Command Example	:RAD:STAN WL11N40M
	IBW	40 MHz
	Span	60 MHz
	RBW	100 kHz
	VBW	Auto rules

WLAN 802.11ac 20 MHz	Command Example	:RAD:STAN WL11AC20M
	IBW	20 MHz
	Span	30 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11ac 40 MHz	Command Example	:RAD:STAN WL11AC40M
	IBW	40 MHz
	Span	60 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11ac 80 MHz	Command Example	:RAD:STAN WL11AC80M
	IBW	80 MHz
	Span	120 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11ac 160 MHz	Command Example	:RAD:STAN WL11AC160M
	IBW	160 MHz
	Span	240 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11ax 20 MHz	Command Example	:RAD:STAN WL11AX20M
	IBW	20 MHz
	Span	30 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11ax 40 MHz	Command Example	:RAD:STAN WL11AX40M
	IBW	40 MHz
	Span	60 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11ax 80 MHz	Command Example	:RAD:STAN WL11AX80M
	IBW	80 MHz
	Span	120 MHz
	RBW	100 kHz
	VBW	Auto rules

WLAN 802.11ax 160 MHz	Command Example	:RAD:STAN WL11AX160M
	IBW	160 MHz
	Span	240 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11be 20 MHz	Command Example	:RAD:STAN WL11BE20M
	IBW	20 MHz
	Span	30 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11be 40 MHz	Command Example	:RAD:STAN WL11BE40M
	IBW	40 MHz
	Span	60 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11be 80 MHz	Command Example	:RAD:STAN WL11BE80M
	IBW	80 MHz
	Span	120 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11be 160 MHz	Command Example	:RAD:STAN WL11BE160M
	IBW	160 MHz
	Span	240 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11be 320 MHz	Command Example	:RAD:STAN WL11BE320M
	IBW	320 MHz
	Span	480 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11ad 2 GHz	Command Example	:RAD:STAN WL11AD2G
	IBW	2.16 GHz
	Span	3.24 GHz
	RBW	1 MHz
	VBW	Auto rules

WLAN 802.11ay 2.16 GHz	Command Example	:RAD:STAN WL11AY2G16
	IBW	2.16 GHz
	Span	3.24 GHz
	RBW	1 MHz
	VBW	Auto rules
WLAN 802.11ay 4.32 GHz	Command Example	:RAD:STAN WL11AY4G32
	IBW	4.32 GHz
	Span	6.48 GHz
	RBW	1 MHz
	VBW	Auto rules
WLAN 802.11ay 6.48 GHz	Command Example	:RAD:STAN WL11AY6G48
	IBW	6.48 GHz
	Span	9.72 GHz
	RBW	1 MHz
	VBW	Auto rules
WLAN 802.11ay 8.64 GHz	Command Example	:RAD:STAN WL11AY8G64
	IBW	8.64 GHz
	Span	12.96 GHz
	RBW	1 MHz
	VBW	Auto rules
3GPP 5G NR	Command Example	:RAD:STAN NR5GFR1B100M
5G NR FR1 100MHz	IBW	100 MHz
	Span	150 MHz
	RBW	Auto rules
	VBW	Auto rules

WLAN HiperLAN/2	Command Example	`:RAD:STAN HIPERLAN2`
	UWB Indoor	Command Example RAD:STAN UWBINDOOR
	Bluetooth	Command Example RAD:STAN BLUE

Packet Type (Bluetooth only)

The command below sets the packet type for the Bluetooth measurement

Remote Command	`[:SENSe]:RADio:STANdard:PACKet DH1 | DH3 | DH5` `[:SENSe]:RADio:STANdard:PACKet?`
Example	`:RAD:STAN:PACK DH1` `:RAD:STAN:PACK?`
Notes	The packet length is:

DH1	366 µs

	DH3	1622 µs
	DH5	2870 µs
Preset	DH1	
State Saved	Saved in instrument state	
Range	DH1 | DH3 | DH5	

Radio Standard Presets Hierarchy

General	None	
	TETRA	BTS
		MS
	FCC Part 15 Subpart F	
	APCO-25	
	DMR	
	dPMR	
Video	DVB-T	L/SECAM/NICAM
		G/PAL/NICAM
		I/PAL/NICAM
	S-DMB System E	

Cellular	3GPP 5G NR	BTS	FR1 100 MHz
		MS	FR1 100 MHz
	3GPP LTE	BTS	1.4 MHz (6 RB)
			3 MHz (15 RB)
			5 MHz (25 RB)
			10 MHz (50 RB)
			15 MHz (75 RB)
			20 MHz (100 RB)
		MS	1.4 MHz (6 RB)
			3 MHz (15 RB)
			5 MHz (25 RB)
			10 MHz (50 RB)
			15 MHz (75 RB)
			20 MHz (100 RB)
	3GPP W-CDMA	BTS	
		MS	
	GSM/EDGE	BTS	
		MS	
	cdma2000 1x	BTS	
		MS	
	IS-95A	BTS	
		MS	
	J-STD-008	BTS	
		MS	
	IS-97D/98D	BTS	Band Class 0
			Band Class 1
		MS	Band Class 0
			Band Class 1
	NADC	BTS	
		MS	
	PDC	BTS	
		MS	

Wireless	W-LAN	802.11a	
		802.11b	
		802.11g	
		802.11n	20 MHz
			40 MHz
		802.11ac	20 MHz
			40 MHz
			80 MHz
			160 MHz
		802.11ax	20 MHz
			40 MHz
			80 MHz
			160 MHz
		802.11be	20 MHz
			40 MHz
			80 MHz
			160 MHz
			320 MHz
		802.11ad	
		802.11ay	2.16 GHz
			4.32 GHz
			6.48 GHz
			8.64 GHz
		HiperLAN/2	
	Bluetooth	DH1	
		DH3	
		DH5	
	UWB Indoor		

Each Radio Standard has the preset parameter set for the measurement.

When a standard is selected, the default value of the measurement parameters are overwritten by those preset values.

When the standard is NONE, or the standard does not specify the firm RBW requirement, then the table displays “auto”, and the following definition is used to compute the proper RBW setting:

1. Compute the guard-band = [Offset Freq A] - 0.5*([Chan Integ BW] + [Ref BW])
2. Divide by 4.5. Call the result GuardbandGoalRBW

3. Compute the greater of the Reference and Offset A integration bandwidths. Divide that result by 100 and call it the ChannelWidthGoalRBW
4. Find the smallest integration bandwidth of any of the offsets; divide it by two and call the result IntegBWGoalRBW
5. Compute AutoRBWGoal = min(IntegBWGoal, max(GuardbandGoalRBW, ChannelWidthGoalRBW))
6. Compute the RBW to be selected to be the largest available RBW that is smaller than AutoRBWGoal

Measurements that are unavailable for a particular Radio Standard are grayed-out. Radio Standards that are unavailable for the current active measurement are also grayed-out.

However, remote operations, such as `:CONF` allow the measurement to be active even if it is not a supported format. In this case, the measurement configuration should be set to `NONE`.

Enable Non-Std Meas

Lets you specify whether all measurements and radio standards are enabled or not.

By default, **Enable Non-Std Measurements** is set to `NO`, so you can select only valid combinations of preset available standards and measurements. Combinations of measurement and standard that would have no valid preset value are grayed-out.

When **Enable Non-Std Measurements** is set to `YES`, all measurements and standard selections are enabled, so you can select any combination.

NOTE: If you select an unavailable measurement or unavailable radio standard using the **Enable Non-Std Meas** control, the measurement results may not conform to the selected standard.

Remote Command	`[:SENSe]:RADio:STANdard:EAMeas YES | NO` `[:SENSe]:RADio:STANdard:EAMeas?`
Example	`:RAD:STAN:EAM YES` `:RAD:STAN:EAM?`
Preset	`NO`
State Saved	Saved in instrument state
Range	`YES|NO`

3.4.8.4 Advanced

Contains controls for setting advanced functions of the instrument. This tab does not appear in EXM, nor in VXT models M9420A/10A/11A.

Noise Floor Extension

Lets you configure **Noise Floor Extension** (NFE). All Modes that support NFE let you set it on or off. Additionally, some Modes support *two* “on” states for NFE, **Full** and **Adaptive**, as described below.

Adaptive Option Support

At present (Release: X-Apps 2024), support for **Adaptive** NFE is as follows:

Mode	Measurements	Supports Adaptive NFE?
BT	ACP, IBEM, IBSP	No
CQM	MON	Yes
EDGEGSM	EORF, ETSP, MON	No
EMI	APD, DAN, FSC, MON, RTSC, SCH	Yes
LTEAFDD	PVT	No
LTEATDD	PVT	No
MSR	ACP, CHP, MON, OBW, SEM, SPUR	Yes
NR5G	PVT	No
PNOISE	LPL, MON, SFR	No
SA	SAN	Yes
SRCOMMS	ACP, CHP, MON, OBW, SEM, SPUR	Yes
VMA	ACP, CHP, OBW, SEM, SPUR	Yes
WCDMA	ACP, CHP, MON, OBW, SEM, SPUR	Yes
WLAN	CHP, MON, OBW, SEM, SPUR	Yes

The menus and command options are as follows:

NFE State	Modes with Adaptive NFE	Modes without Adaptive NFE	SCPI
Off	**Off**	**Off**	See "NFE On/Off Command" on page 819
On	**Full**	**On**	
Adaptive	**Adaptive**	n/a	See "Adaptive NFE Command" on page 819

As shown in the table above, the **On** state (in Modes that do not support **Adaptive** NFE) matches the **Full** state in Modes that *do* support **Adaptive** NFE.

To maintain SCPI backwards compatibility, the existing command to turn NFE on or off is retained, and a new command is added to set the state to turn **Adaptive**`ON` or `OFF`:

- `[:SENSe]:CORRection:NOISe:FLOor ON|OFF|1|0` is retained, with the default changed to `ON` for Modes that support **Adaptive** NFE
- `[:SENSe]:CORRection:NOISe:FLOor:ADAPtive ON|OFF|1|0` is added (for certain Modes), default = `ON`

When NFE is **On** or **Full**, the expected noise power of the instrument (derived from a factory calibration) is subtracted from the trace data. This will usually reduce the apparent noise level by about 10 dB in low band, and 8 dB in high band (>~3.6 GHz).

NFE works with any RBW, VBW, detector, any setting of **Average Type**, any amount of trace averaging, and any signal type. It is ineffective when the trace is not smoothed (smoothing processes include narrow VBWs, trace averaging, and long sweep times with the detector set to **Average** or **Peak**). It works best with extreme amounts of smoothing, and with the average detector, with the **Average Type** set to **Power**.

In those cases where the cancellation is ineffective, it nonetheless has no undesirable side-effects. There is no significant speed impact to having **Noise Floor Extension** on.

The best accuracy is achieved when substantial smoothing occurs in each point before trace averaging. Thus, when using the **Average** detector, results are better with long sweep times and fewer trace averages. When using the **Sample** detector, the VBW filter should be set narrow with less trace averaging, instead of a wide VBW filter with more trace averaging.

NOTE **Noise Floor Extension has no effect unless the RF Input is selected, so when External Mixing is selected, it does nothing.**

For more details, see "Optimal Detector & Averaging Selections" on page 820 and "Recalibration of Noise Floor" on page 821.

Pros & Cons of Adaptive NFE

Adaptive NFE provides an alternative to fully-on or fully-off NFE. Fully-on NFE can, notably in cases with little or no averaging of the spectrum, result in a display that is distractingly unfamiliar in the variability in response to low level signals. Fully-off NFE fails to achieve the potential improvement in dynamic range and associated accuracy of measurement of low-level signals. **Adaptive** NFE controls the degree of potential improvement in the noise floor to give more improvement for those instrument settings that can make good use of the potential improvement—those settings with high degrees of variance reduction through some variant of averaging. When the potential improvement is small, the display acts like the fully-off case, and when it is high, it acts like the fully-on case, and in-between, application is a compromise between attractiveness and effectiveness.

In **Adaptive** NFE, there is not the same dramatic visual impact on the noise floor as there is in **Full** NFE. **Adaptive** NFE controls the amount of correction that is applied based on other instrument settings like RBW, averaging and sweep time. **Adaptive** NFE controls the degree of potential improvement in the noise floor to give more improvement for those instrument settings that can make good use of the potential improvement, such as settings that provide more averaging. The result is that when not much averaging is being performed, the signal displays more like the fully-off case; and when lots of averaging is being performed, the signal displays more like the **Full** NFE case.

Adaptive NFE is recommended for general-purpose use. For fully-ATE (automatic test equipment) applications, where possible distraction of the instrument user is not a risk, **Full** NFE is recommended.

NFE On/Off Command

Remote Command	`[:SENSe]:CORRection:NOISe:FLOor ON | OFF | 1 | 0` `[:SENSe]:CORRection:NOISe:FLOor?`
Example	`:CORR:NOIS:FLO ON`
Dependencies	Only appears in instruments with the NFE or NF2 license installed. In all others, the control does not appear. In those cases, the SCPI command is accepted without error, but has no effect
Couplings	When NFE is enabled in any Mode manually, a prompt is displayed reminding you to perform the **Characterize Noise Floor** operation if it is needed When NFE is enabled through SCPI, and a **Characterize Noise Floor** operation is needed, an error is entered in the system error queue
Preset	Unaffected by **Mode Preset**. Turned `ON` at startup and by **Restore Mode Defaults** in Modes that support **Adaptive**. Turned `OFF` at startup and by **Restore Mode Defaults** in Modes that do *not* support **Adaptive** In Modes that support **Adaptive** NFE, the default (preset) state of NFE is **Adaptive**. In Modes that do not support **Adaptive** NFE, the default state of NFE is **Off**
State Saved	No

Adaptive NFE Command

Only effective in instruments with the NFE or NF2 license installed, and in Modes that support **Adaptive** NFE. For coverage, see "Adaptive Option Support" on page 817 above.

For all other cases, the SCPI command below is accepted without error, but has no effect.

Remote Command	`[:SENSe]:CORRection:NOISe:FLOor:ADAptive ON | OFF | 1 | 0` `[:SENSe]:CORRection:NOISe:FLOor:ADAptive?`

Example	First turn NFE on, this is **Full** mode
	`:CORR:NOIS:FLO ON`
	Then set it to **Adaptive**
	`:CORR:NOIS:FLO:ADAP ON`

Couplings	To maintain backwards compatibility, sending :`CORR:NOIS:FLO ON` turns NFE **Adaptive**`OFF`. To turn **Adaptive** on, you must issue the commands in the proper order, as shown in the example above
Preset	Not affected by **Mode Preset**, but set to `ON` at startup and by **Restore Mode Defaults**
State Saved	No

Optimal Detector & Averaging Selections

Note that some measurements do not allow you to switch the **Detector** type (which is set by default to **Average**), so the discussion of detector types here is irrelevant for those measurements. Similarly, some measurements do not allow you to set **Average Type** (set by default to `LOG`), so that discussion here is irrelevant in those cases.

The instrument is characterized in the factory (or during a field calibration) with a model of the noise, referred to the input mixer, versus frequency in each band and path combination. Bands are 0 (low band) and 1 through 4 (high band) in a 26.5 GHz instrument, for example. Paths include normal paths, preamp paths, the electronic attenuator, etc.

In most band/path combinations, the noise can be well characterized based on just two parameters and the instrument frequency response before compensation for frequency-dependent losses.

After the noise density at the input mixer is estimated, the effects of the input attenuator, RBW, detector, etc. are computed to obtain the estimated input-port-referred noise level.

In the simplest case, the measured power (signal plus analyzer noise) in each display point (bucket) is compensated by subtracting the estimated noise power, leaving just the signal power. This is the operation when **Detector** is **Average** and **Average Type** is set to **Power** (`RMS`).

For best operation, **AverageDetector** (default) and **Average Type**. = **Power** are recommended, as already stated. In other cases, operation is often not quite as good but still highly effective. Other **Detector** options, when available, behave as follows:

Positive Peak The noise floor is estimated based on the RBW and the duration of the bucket using

	the same equations used in the noise marker function. The voltage of the noise is subtracted from the voltage of the observed signal-plus-noise measurement to compute the estimated signal voltage **Positive Peak** is one example of processing that varies with detector to give good estimates of the signal level without the analyzer noise For pulsed-RF, **Positive Peak** can still give excellent effectiveness FFT analysis does not work well, and does not perform NFE well, with pulsed-RF signals, so this combination is *not* recommended
Negative Peak	Not very useful
Sample	Works well, but never better than **Average** , because it does not smooth as well
Normal	A combination of peak and negative peak behaviors, and works about as well as these

For best operation, extreme smoothing is desirable, as already stated. Using narrow VBWs works well, but using very long bucket durations and the average detector works best. Reducing the number of trace points makes the buckets longer.

For best operation, **Average Type** = **Power** (`RMS`) is optimal (when this option is available). When making CW measurements in the presence of noise without NFE, averaging on the decibel scale has the advantage of reducing the effect of noise. Using NFE with **Average Type** = **Log-Power** (`LOG`) is not synergistic, though; NFE with **Average Type** = **Power** (`RMS`) works a little better than NFE with `LOG`.

The results from NFE with internal preamp can often be lower than the theoretical noise in a signal source at room temperature, a noise density of -174 dBm/Hz. This is expected and useful behavior, because NFE is designed to report the amount of input signal that exceeds the thermal noise, not the amount that includes the thermal noise. This can be a useful behavior because thermal noise often interferes with what you want to measure, instead of being part of what you want to measure. Note that NFE is not adequately accurate to always be able to read below kTB.

Recalibration of Noise Floor

In instruments with the NF2 license installed, the calibrated noise floor used by **Noise Floor Extension** should be refreshed periodically. Keysight recommends that the **Characterize Noise Floor** operation be performed after the first 500 hours of operation, *and* once every calendar year. To do this, use "Characterize Noise Floor" on page 2128, under **System**, **Alignments**, **Advanced**. If you have not done this yourself at the recommended interval, then when you turn on **Noise Floor Extension**, the instrument will prompt you to do so with a dialog stating:

This action will take several minutes to perform. Please disconnect all cables from the RF input and press Enter to proceed. Press ESC to cancel, or Postpone to postpone for a week

If you cancel, you will be prompted again the next time you turn NFE on. If you postpone, you will be prompted again after a week passes and you then turn NFE on.

IF Gain

Sets the **IF Gain** function to one of:

Setting	SCPI	Comments
Auto	AUTO = ON	Auto
Low	OFF AUTO = OFF	Low Gain
High	ON AUTO = OFF	High Gain

This setting affects sensitivity and IF overloads. It only applies to the RF input; not to the baseband I/Q input.

Remote Command	`[:SENSe]:OBWidth:IF:GAIN[:STATe] ON | OFF | 1 | 0`
	`[:SENSe]:OBWidth:IF:GAIN[:STATe]?`
	`[:SENSe]:OBWidth:IF:GAIN:AUTO[:STATe] ON | OFF | 1 | 0`
	`[:SENSe]:OBWidth:IF:GAIN:AUTO[:STATe]?`

Example	`:OBW:IF:GAIN ON`
	`:OBW:IF:GAIN?`
	`:OBW:IF:GAIN:AUTO OFF`
	`:OBW:IF:GAIN:AUTO?`

Dependencies	Has no effect when the U7227A USB Preamplifier is connected. This is not annotated or reflected on any control; there are no controls grayed-out nor any SCPI locked out. The instrument simply behaves as though both IF Gain is set to Low regardless of the setting on the control Not available in VXT models M9420A/10A/11A, EXM, or UXM
Couplings	**Auto** sets **IF Gain** to High (ON) under any of the following conditions: – The input attenuator is set to 0 dB, or – The preamp is turned on and the frequency range is under 3.6 GHz For other conditions, **Auto** sets **IF Gain** to Low (OFF)
Preset	OFF OFF
State Saved	Saved in instrument state
Range	Low Gain | High Gain

3.4.8.5 Global

The controls in this menu apply to all Modes in the instrument.

Some controls (for example, "Global Center Freq" on page 2013) allow you to switch certain Meas Global parameters to a Mode Global state. These switches apply to all Modes that support global settings. For example, no matter what Mode you are in when you set **Global Center Freq** to `ON`, it applies to all Modes that support Global settings.

Other controls (for example, **Extend Low Band**) are actually set in this menu, but apply to all Modes.

Global Center Freq

The software maintains a Mode Global value called **Global Center Freq**.

When **Global Center Freq** is switched `ON`, the current Mode's center frequency is copied into the **Global Center Frequency**, and from then on all Modes that support global settings use the **Global Center Frequency**, so you can switch between any of these Modes and the **Center Frequency** remains unchanged.

Adjusting the **Center Frequency** of any Mode that supports Global Settings, while **Global Center Freq** is `ON`, modifies the **Global Center Freq**.

When **Global Center Freq** is switched `OFF`, the **Center Frequency** of the current Mode is unchanged, but now the **Center Frequency** of each Mode is once again independent.

When **Mode Preset** is pressed while **Global Center Freq** is `ON`, the **Global Center Freq** is preset to the preset **Center Frequency** of the current Mode.

This function resets to `OFF` when "Restore Defaults" on page 2016 is pressed, or when **System**, **Restore Defaults**, **All Modes** is pressed.

Remote Command	`:INSTrument:COUPle:FREQuency:CENTer ALL | NONE` `:INSTrument:COUPle:FREQuency:CENTer?`
Example	`:INST:COUP:FREQ:CENT ALL` `:INST:COUP:FREQ:CENT?`
Preset	Set to `OFF` on **Global** Settings, **Restore Defaults** and **System, Restore Defaults, All Modes**
Range	`ALL|NONE`

Preset	`OFF`
Backwards Compatibility SCPI	`:GLOBal:FREQuency:CENTer[:STATe] 1 | 0 | ON | OFF` `:GLOBal:FREQuency:CENTer[:STATe]?`

Global EMC Std

When this control is switched ON, the current Mode's EMC Std is copied into the **Global EMC Std**, and from then on all Modes that support global settings use the **Global EMC Std**, so you can switch between any of these Modes and the EMC Std remains unchanged.

Adjusting the EMC Std of any Mode that supports Global settings, while **Global EMC Std** is ON modifies the **Global EMC Std**.

When **Global EMC Std** is switched OFF, the EMC Std of the current Mode remains unchanged, but now the EMC Std of each Mode is once again independent. When **Mode Preset** is pressed while **Global EMC Std** is ON, **Global EMC Std** is preset to the preset EMC Std of the current Mode.

This function resets to OFF when "Restore Defaults" on page 2016 is pressed, or when **System, Restore Defaults, All Modes** is pressed.

Remote Command	`:INSTrument:COUPle:EMC:STANdard ALL | NONE` `:INSTrument:COUPle:EMC:STANdard?`
Example	`:INST:COUP:EMC:STAN ALL` `:INST:COUP:EMC:STAN?`
Dependencies	Only available if Option EMC is installed
Preset	Set to OFF on **Global** Settings, **Restore Defaults** and **System, Restore Defaults, All Modes**
Range	`ALL | NONE`

Global Limit Lines (Freq and Amptd)

When this control is set to ALL, the current Mode's Limit Line is copied into the **Global Limit Lines**, and from there to all Modes that support Global settings and use **Global Limit Lines**, so you can switch between any of these Modes and the Limit Lines remain unchanged.

Adjusting the Limit Lines of any Mode that supports **Global** Settings, while **Global Limit Lines** is ALL, modifies the **Global Limit Lines**.

When **Global Limit Lines** is set to NONE, the Limit Lines of the current Mode are unchanged, but now the Limit Lines of each Mode are once again independent. When **Mode Preset** is pressed while **Global Limit Lines** is ALL, **Global Limit Lines** is preset to the preset Limit Lines of the current Mode.

This function is reset to NONE when "Restore Defaults" on page 2016 is pressed, or when **System**, **Restore Defaults**, **All Modes** is pressed.

Remote	`:INSTrument:COUPle:LLINe ALL | NONE`

Command	`:INSTrument:COUPle:LLINe?`
Example	`:INST:COUP:LLIN ALL | NONE` `:INST:COUP:LLIN?`
Preset	Set to `OFF` on **Global** Settings, **Restore Defaults** and **System, Restore Defaults, All Modes**
Range	`ALL | NONE`

Extend Low Band

The software maintains a Mode Global value called **Extend Low Band**.

Under the current sweep configuration crossing over two bands, when **Extend Low Band** is turned `ON`, the instrument checks whether one band can cover the whole sweep frequency range or not. If it can, then the instrument locks the band; otherwise, it does nothing (the band crossover occurs).

This function does *not* work when **Band Lock** under **System** > **Service** > **Lock Functions** is not -1 (no Band Lock). In that case, **Band Lock** takes priority over **Extend Low Band**.

This function resets to `OFF` when "Restore Defaults" on page 2016 is pressed, or when **System**, **Restore Defaults**, **All Modes** is pressed.

Remote Command	`:INSTrument:COUPle:FREQuency:BAND:EXTend 0 | 1 | ON | OFF` `:INSTrument:COUPle:FREQuency:BAND:EXTend?`
Example	`:INST:COUP:FREQ:BAND:EXT 1` `:INST:COUP:FREQ:BAND:EXT?`
Preset	Set to `OFF` by **Global** Settings > **Restore Defaults** and **System** > **Restore Defaults** > **All Modes**
Range	`ON|OFF`

Restore Defaults

Resets all functions in the **Global** settings menu to `OFF`. Pressing **System**, **Restore Defaults**, **All Modes** has the same effect.

Remote Command	`:INSTrument:COUPle:DEFault`
Example	`:INST:COUP:DEF`
Backwards Compatibility SCPI	`:GLOBal:DEFault`

3.4.9 Sweep

Accesses controls to configure and control the acquisition of data, and the X-axis parameters of the instrument.

Depending on the selected mode and measurement, these controls might include: **Sweep Time**, **Continuous/Single**, **Pause/Resume**, **X Scale** and **Number of Points**.

3.4.9.1 Sweep/Control

Accesses controls that let you operate the sweep and control functions of the instrument, such as **Sweep Time** and **Continuous/Single**.

Sweep Time

Controls the time the instrument takes to sweep the current frequency span in swept measurements, displays the sweep time in swept measurements, and displays the equivalent Sweep Time in FFT measurements.

When **Sweep Time** is in Auto, the instrument computes a time that will give accurate measurements based on other settings, such as RBW and VBW.

You can select a shorter sweep time to improve the measurement throughput (with some potential unspecified accuracy reduction), but the **Meas Uncal** indicator will appear if the sweep time you set is less than the calculated Auto Sweep time.

You can also select a longer sweep time, which can be useful (for example) for obtaining accurate insertion loss measurements on very narrowband filters.

NOTE Significantly faster sweep times are available with Option FS1.

NOTE The **Meas Uncal** (measurement uncalibrated) warning is displayed in the Status Bar at the bottom of the screen when the manual Sweep time entered is faster than the time computed by the instrument's Sweep time equations, that is, the Auto Sweep Time. The instrument's computed Sweep time will provide accurate measurements; if you sweep faster than this your measurements may be inaccurate. A **Meas Uncal** condition may be corrected by returning the Sweep Time to Auto; by entering a longer Sweep Time; or by choosing a wider RBW and/or VBW.

NOTE On non-sweeping hardware, this control is grayed-out. The value shown on this control is an estimate. It is the measurement's turnaround time, which is the sum of signal acquisition time, FFT time, and other overhead time, to complete the entire span of the measurement. If you need to specify the same “Sweep Time” as you would for sweeping hardware, send `[:SENSe]:<meas>:SWEep:TIME <time>`. The measurement emulates the “Sweep Time” effect, but this emulation is not straightforward, and therefore the behavior is not specified. Instead, we recommend using Minimum Acquisition Time, which provides better control.

Remote Command	`[:SENSe]:<meas>:SWEep:TIME <time>` `[:SENSe]:<meas>:SWEep:TIME?`

Example	Channel Power measurement:
	`:CHP:SWE:TIME 25ms`
	`:CHP:SWE:TIME?`

Notes	In the ACP measurement in WCDMA Mode, this parameter is preset by **Meas Method** selection. Preset values are as follows: – IBW: 29 ms – IBWR: 108 ms – FAST 7.5 ms
Dependencies	On non-sweeping hardware, this control is grayed out, and the Auto/Man toggle disappears. The read-only control shows estimated sweep time In those instruments, "Minimum Acquisition Time" on page 1087 is available
Couplings	Coupled to **Span**, **RBW**, **VBW**, and **Sweep Time Rules** when **Sweep Time** is set to Auto; **Sweep Time** changes when these parameters are changed When you manually set a value when in the **Auto** state, the state automatically changes to **Man**
Preset	Automatically Calculated unless noted below WCDMA Mode – Channel Power: 1.0 msOBW: 32.6 ms – ACP: 29 ms
State Saved	Saved in instrument state
Min	Other than non-sweeping hardware: Typically, 1 ms Non-sweeping hardware: N/A In the ACP measurement, when **Meas Method** is **Fast Power**, the minimum sweep time is span-dependent and automatically calculated
Max	Other than non-sweeping hardware: 4000 s Non-sweeping hardware: N/A
Annotation	The sweep time is displayed in the lower-right corner of the screen. The number of points is displayed parenthetically, as: Sweep 13.3 ms (1001 points)

	A "#" mark appears before "Sweep" in the annotation when it is switched from Auto to Manual coupling
Status Bits/OPC dependencies	Meas Uncal is Bit 0 in the register: `STATus:QUEStionable:INTegrity:UNCalibrated`

Auto Function

Remote Command	`[:SENSe]:<meas>:SWEep:TIME:AUTO OFF | ON | 0 | 1` `[:SENSe]:<meas>:SWEep:TIME:AUTO?`

Example	Channel Power measurement:
	`:CHP:SWE:TIME:AUTO OFF`
	`:CHP:SWE:TIME:AUTO?`

Preset	WCDMA Mode: `OFF` All others: `ON`

Minimum Acquisition Time

Available on non-sweeping hardware.

Specifies the minimum acquisition time for each "chunk" of the measurement result. The instrument automatically divides Span into multiple chunks if needed. Therefore, the total signal acquisition time for the entire Span is:

~(>~Minimum Acquisition Time) * (The number of chunks)

When in Auto, this parameter's value is determined by other parameters, such as **Span**, **RBW** and **VBW**.

You can manually increase this parameter value from this Auto value.

If increased, the instrument acquires signal for the specified time duration for each chunk. It performs additional FFTs, and averages or peak-holds the FFT results for a chunk, depending on **Detector** settings.

Note that the actual acquisition time for each chunk may exceed the **Minimum Acquisition Time** value, in order to satisfy FFT time required by other parameters, and to perform an integer number of FFTs.

Remote Command	`[:SENSe]:<meas>:SWEep:ACQuisition:TIME <time>`
	`[:SENSe]:<meas>:SWEep:ACQuisition:TIME?`
	`<meas>` is the identifier for the current measurement; any one of `CHPower-|ACPower|OBWidth|MONitor`

Example	Channel Power measurement `:CHP:SWE:ACQ:TIME 500 ms`

	:CHP:SWE:ACQ:TIME?
Dependencies	Available only on non-sweeping hardware
Couplings	Coupled to **Span**, **RBW**, and **VBW** when in the Auto state When you manually set a value when in the **Auto** state, the state automatically changes to **Man**
Preset	Automatically calculated
State Saved	Saved in instrument state
Min	100 ns
Max	4.00 ks

Auto Function

Remote Command	[:SENSe]:<meas>:SWEep:ACQuisition:TIME:AUTO OFF | ON | 0 | 1 [:SENSe]:<meas>:SWEep:ACQuisition:TIME:AUTO? <meas> is the identifier for the current measurement; any one of CHPower-|ACPower|OBWidth|MONitor
Example	Channel Power measurement: :CHP:SWE:ACQ:TIME:AUTO OFF
Preset	ON

Sweep/Measure

Lets you toggle between **Continuous** and **Single** sweep or measurement operation. The single/continuous state is Meas Global, so the setting affects all measurements.

The front-panel key **Single/Cont** performs exactly the same function

See "More Information" on page 830

Remote Command	:INITiate:CONTinuous OFF | ON | 0 | 1 :INITiate:CONTinuous?
Example	Put instrument into **Single** measurement operation: :INIT:CONT 0 :INIT:CONT OFF Put instrument into **Continuous** measurement operation: :INIT:CONT 1 :INIT:CONT ON
Preset	ON Note that :SYST:PRES sets :INIT:CONT to ON, but *RST sets :INIT:CONT to OFF
State Saved	Saved in instrument state
Annunciation	The **Single/Continuous** icon in the Meas Bar changes depending on the setting:

	– A line with an arrow is **Single** – A loop with an arrow is **Continuous**
Backwards Compatibility Notes	X-Series A-models had **Single** and **Cont** hardkeys in place of the **SweepSingleCont** softkey. In the X-Series A-models, if in single measurement, the **Cont** hardkey (and `INIT:CONT ON`) switched to continuous measurement, but never restarted a measurement and never reset a sweep X-Series B-models have a **Cont/Single** toggle control instead of **Single** and **Cont** hardkeys, but it is still true that, if in single measurement, the **Cont/Single** toggle control never restarts a measurement and never resets a sweep

More Information

Continuous Mode	The instrument takes repetitive sweeps, averages, measurements, etc., when in continuous mode. If in average or Max/Min Hold, and the average/hold count reaches the **Average/Hold Num**, the count stops incrementing, but the instrument keeps sweeping See the **Trace** key description under **Trace Average** for the averaging formula used both before and after the **Average/Hold Num** is reached. The trigger condition must be met prior to each sweep The type of trace processing for multiple sweeps is set under the **Trace** key, with choices of **Trace Average**, **Max Hold**, or **Min Hold**
Single Mode	The instrument takes a single sweep when in **Single** mode, or if in average or Max/Min Hold, or if there is a **Waterfall** window displayed, it takes multiple sweeps until the average/hold count reaches the **Average/Hold Num**, then the count stops incrementing, and the instrument stops sweeping See the **Trace** key description under **Trace Average** for the averaging formula used. The trigger condition must be met prior to the sweep The type of trace processing for multiple sweeps is set under the **Trace** key, with choices of **Trace Average**, **Max Hold**, or **Min Hold**

If the instrument is in **Single** measurement mode, pressing the **Cont/Single** toggle control does not zero the count and does not cause the sweep to be reset; the only action is to put the instrument into Continuous measurement operation.

If the instrument is already in **Continuous** sweep:

– `:INIT:CONT 1` has no effect

– `:INIT:CONT 0` places the instrument in Single Sweep but has no effect on the current sequence until k = N, at which point the current sequence will stop and the instrument will go to the idle state

See "Restart" on page 2018 for details of `:INIT:IMMediate`.

If the instrument is already in **Single** sweep, `:INIT:CONT OFF` has no effect.

If the instrument is already in **Single** sweep, then pressing **Cont/Single** in the middle of a sweep does not restart the sweep or sequence. Similarly, pressing **Cont/Single** does not restart the sweep or sequence if the sweep is not in the idle state (for example, if you are taking a very slow sweep, or the instrument is waiting for a trigger). Even though pressing **Cont/Single** in the middle of a sweep does not restart the sweep, sending `:INIT:IMM` *does* reset it.

If the instrument is in **Single** sweep, and *not* Averaging/Holding, and you want to take one more sweep, press **Restart**.

If the instrument is in **Single** sweep, *and* Averaging/Holding, and you want to take one more sweep without resetting the Average trace or count, go to **Meas Setup** and increment the average count by 1 by pressing the **Step-Up** key while **Average/Hold Num** is the active function. You can also do this by sending `:CALC:AVER:TCON UP`.

Restart

Restarts the current sweep, or measurement, or set of averaged/held sweeps or measurements. If you are Paused, pressing **Restart** performs a Resume.

The front-panel key **Restart** performs exactly the same function.

The **Restart** function is accessed in several ways:

- Pressing the **Restart** key
- Sending `:INIT:IMM`
- Sending `:INIT:REST`

See "More Information" on page 832

Remote Command	`:INITiate[:IMMediate]` `:INITiate:RESTart`
Example	`:INIT:IMM` `:INIT:REST`
Notes	`:INIT:REST` and `:INIT:IMM` perform exactly the same function
Couplings	Resets average/hold count k. For the first sweep overwrites all active (update = on) traces with new current data. For application modes, it resets other parameters as required by the measurement
Status Bits/OPC dependencies	This is an Overlapped command The `STATus:OPERation` register bits 0 through 8 are cleared , *except* bit 6 (Waiting for Periodic Sync). Initiating a measurement and Waiting for Periodic Sync could be asynchronous The `STATus:QUEStionable` register bit 9 (`INTegrity` sum) is cleared The `SWEEPING` bit is set The `MEASURING` bit is set
Backwards	For Spectrum Analysis Mode in ESA and PSA, the **Restart** hardkey and the `:INIT:REST` command

Compatibility Notes	restarted trace averages (displayed average count reset to 1) for a trace in **Clear Write**, but did not restart **Max Hold** and **Min Hold** In X-Series, the **Restart** hardkey and the `:INIT:REST` command restart not only **Trace Average**, but **MaxHold** and **MinHold** traces as well

More Information

The **Restart** function first aborts the current sweep or measurement as quickly as possible. It then resets the sweep and trigger systems, sets up the measurement and initiates a new data measurement sequence with a new data acquisition (sweep) taken once the trigger condition is met.

If the instrument is in the process of aligning when a **Restart** is executed, the alignment finishes before the restart function is performed.

Even when set for **Single** operation, multiple sweeps may be taken when **Restart** is pressed (for example, when averaging/holding is on). Thus, when we say that **Restart** "restarts a measurement", depending on the current settings, we may mean that it:

- Restarts the current sweep
- Restarts the current measurement
- Restarts the current set of sweeps if any trace is in Trace Average, Max Hold or Min Hold
- Restarts the current set of measurements if Averaging, or Max Hold, or Min Hold is on for the measurement

If there is no Average or Max/Min Hold function (no trace in Trace Average or Hold, or **Average/Hold Num** set to 1), and no **Waterfall** window is being displayed, a single sweep is equivalent to a single measurement. A single sweep is taken after the trigger condition is met; and the instrument stops sweeping once that sweep has completed. However, with **Average/Hold Num** >1, and at least one trace set to Trace Average, Max Hold, or Min Hold, or a **Waterfall** window being displayed, multiple sweeps/data acquisitions are taken for a single measurement. The trigger condition must be met prior to each sweep. The sweep is stopped when the average count k equals the number N set for **Average/Hold Num**.

Once the full set of sweeps has been taken, the instrument goes to the idle state. To take one more sweep without resetting the average count, increment the average count by 1, by pressing the **Step-Up** key while **Average/Hold Number** is the active function, or by sending the remote command `:CALC:AVER:TCON UP`.

Trace Update

The numeric results are not blanked at any time during the restart cycle.

For slow sweeps (see **Trace Update** section in **Trace/Detector**), the traces are updated real-time during the sweep. There may be a special circumstance in application mode measurements where an exception is made and the traces and/or results need to be blanked before displaying the new results.

To summarize, the following list shows what happens to the trace data on various events:

Event	Trace Effect
Clear/Write pressed (even if already in Clear/Write)	Set to mintracevalue
Max Hold pressed (even if already in Max Hold)	Set to mintracevalue
Min Hold pressed (even if already in Min Hold)	Set to maxtracevalue
Trace Average pressed (even if already in Trace Average)	Trace data unaffected but start new sweep/avg/hold
Restart pressed	Trace data unaffected but start new sweep/avg/hold
Parameter requiring restart changed (e.g., RBW)	Trace data unaffected but start new sweep/avg/hold

Sweep and Trigger Reset

Resetting the sweep system resets the average/hold count k to 0. It also resets the set point counter to 0. Resetting the trigger system resets the internal auto trig timer to the value set by the **Auto Trig** control.

Averaging

The weighting factor used for averaging is k. This k is also the average/hold count for how many valid sweeps (data acquisitions) have been done. This k is used for comparisons with N, as those comparisons always needs to be based on valid completed sweeps.

The displayed average/hold, K, shows the count for the sweep (data acquisition) in progress. K = k + 1, with a limit of N. The displayed value K changes from its previous value to 1 as soon as the trigger condition for the first data acquisition (sweep) is met.

Pause/Resume

Pauses a measurement after the current data acquisition is complete.

When paused, the label on the control changes to **Resume**. Pressing **Resume** un-pauses the measurement. When paused, pressing **Restart** performs a Resume.

Remote Command	`:INITiate:PAUSe` `:INITiate:RESume`
Example	`:INIT:PAUS` `:INIT:RES`
Dependencies	Not displayed in Modes that do not support pausing
Annotation	Only on control

Abort (Remote Command Only)

Stops the current measurement. Aborts the current measurement as quickly as possible, resets the sweep and trigger systems, and puts the measurement into an "idle" state. If the instrument is in the process of aligning when `:ABORt` is sent, the alignment finishes *before* the abort function is performed, so `:ABORt` does not abort an alignment.

If the instrument is set for **Continuous** measurement, it sets up the measurement and initiates a new data measurement sequence with a new data acquisition (sweep) taken once the trigger condition is met.

If the instrument is set for **Single** measurement, it remains in the "idle" state until an `:INIT:IMM` command is received.

Remote Command	`:ABORt`
Example	`:ABOR`
Notes	If :`INIT:CONT` is `ON`, then a new continuous measurement will start immediately, with sweep (data acquisition) occurring once the trigger condition has been met If :`INIT:CONT` is `OFF`, then `:INIT:IMM` is used to start a single measurement, with sweep (data acquisition) occurring once the trigger condition has been met
Dependencies	For continuous measurement, `:ABORt` is equivalent to the **Restart** key Not all measurements support this command
Status Bits/OPC dependencies	The `STATus:OPERation` register bits 0 through 8 are cleared , *except* bit 6 (Waiting for Periodic Sync). Initiating a measurement and Waiting for Periodic Sync could be asynchronous The `STATus:QUEStionable` register bit 9 (`INTegrity` sum) is cleared Since all the bits that feed into OPC are cleared by `:ABORt`, the Abort command will cause the `*OPC` query to return true

Sweep Time Annotation (Remote Query Only)

Returns the **Sweep Time Annotation** value. Available only on non-sweeping hardware.

This value is also displayed in the result trace window.

The value returned is the estimated turnaround time of each measurement cycle, in seconds. The turnaround time is the sum of the signal acquisition time, FFT time, and other overhead time, to complete the entire span of each measurement cycle.

Remote Command	`[:SENSe]:<meas>:SWEep:ETIMe?` `<meas>` is the identifier for the current measurement; any one of `CHPower-|ACPower|OBWidth|MONitor`
Example	Channel Power measurement `:CHP:SWE:ETIMe?`
Dependencies	Available only on non-sweeping hardware
Preset	Automatically calculated

3.4.9.2 Sweep Config

Accesses controls that let you configure the sweep and control functions of the instrument, such as "Sweep Time Rules" on page 835.

Sweep Time Rules

Switches the instrument between normal and accuracy sweep states:

Accy	`ACCuracy`
Norm	`NORMal`

Setting **Auto Sweep Time** to **Accy** results in slower sweep times, usually about three times as long, but yields better amplitude accuracy for CW signals. The instrument amplitude accuracy specifications only apply when **Auto Sweep Time** is set to **Accy**.

Additional amplitude errors which occur when **Auto Sweep Time** is set to **Norm** are usually well under 0.1 dB, though this is not guaranteed. Because of the faster sweep times and still low errors, **Norm** is the preferred setting of **Auto Sweep Time**. **Auto Sweep Time** is set to **Norm** on a **Preset**. This means that in the Preset state, instrument amplitude accuracy specifications do not apply.

Remote Command	`[:SENSe]:OBWidth:SWEep:TIME:AUTO:RULes NORMal | ACCuracy` `[:SENSe]:OBWidth:SWEep:TIME:AUTO:RULes?`
Example	`:OBW:SWE:TIME:AUTO:RUL NORM`

	:OBW:SWE:TIME:AUTO:RUL?
Dependencies	Does not appear in Spectrum Analyzer Mode in VXT model M9420A
Preset	NORMal
State Saved	Saved in instrument state
Range	NORMal|ACCuracy

Points

Sets the number of points taken per sweep, and displayed in the traces. The current value of points is displayed parenthetically, next to the sweep time in the lower-right corner of the display. Using more points provides greater resolution. Using fewer points compacts the data and decreases the time required to access a trace over the remote interface.

Increasing the number of points does not increase the sweep time. However, it can slightly impact the trace processing time and therefore the overall measurement speed. Decreasing the number of points does not decrease the sweep time, but it may speed up the measurement, depending on the other sweep settings (for example, in FFT sweeps). Fewer points will always speed up the I/O.

Due to minimum sweep rate limitations of the hardware, the minimum sweep time available to the user will increase above its normal value of 1 ms as the number of sweep points increases above 15001.

Changing the number of sweep points has several effects on the instrument. Since markers are read at the point location, the marker reading may change. The sweep time resolution will change. Trace data for all the traces will be cleared and, if **Sweep** is in **Cont**, a new trace taken. If any trace is in average or hold, the averaging starts over.

Due to sweep time quantization issues, the knob and up/down keys *cannot* be used to adjust the number of points.

When in a split-screen display, each window may have its own value for points.

When sweep **Points** is changed, an informational message "Sweep points changed, all traces cleared" is displayed, and in 5G NR Mode, **Auto Sweep Point**s is set to OFF (0).

Remote Command	[:SENSe]:OBWidth:SWEep:POINts <integer> [:SENSe]:OBWidth:SWEep:POINts?
Example	:OBW:SWE:POIN 501 :OBW:SWE:POIN?
Dependencies	Not available when **Signal ID** is set to On in External Mixing Neither the knob nor the step keys can be used to change this value. If it is tried, a warning is given

	Not displayed in Modes that do not support Swept
Couplings	Whenever the number of sweep points change: – All trace data is erased – Any traces with **Update Off** will also go to **Display Off**Sweep time is re-quantized – Any limit lines that are on will be updated – If averaging/hold is on, averaging/hold starts over – **Auto Sweep Points** is set to `OFF` (5G NR Mode only) The resolution of setting the sweep time depends on the number of points selected
Preset	**Mode** / **Value**: MSR, LTEAFDD, LTEATDD: 2001 5GNR: Automatically calculated All Others: 1001
State Saved	Saved in instrument state
Min	101
Max	20001
Annotation	On second line of annotations, in lower right corner in parenthesis behind the sweep annotation

IF Dithering

Lets you turn IF Dithering on or off. This is a technique used in unpreselected instruments (such as Keysight's modular instruments) to enhance the rejection of images and internally-generated spurious signals.

Remote Command	`[:SENSe]:SWEep:IF:DITHer OFF | ON | 0 | 1` `[:SENSe]:SWEep:IF:DITHer?`
Dependencies	Only appears in Spectrum Analyzer Mode in VXT models
Preset	`OFF`
State Saved	Saved in instrument state

Image Protection

Lets you turn IF Protection on or off. This is a technique used in unpreselected instruments (such as Keysight's modular instruments) to detect and suppress images and spurs that may be present in non-preselected hardware.

IF Protection takes two sweeps and by correlating the data between them, provides a single, correct power-versus-frequency trace.

Remote Command	`[:SENSe]:SWEep:IMAGeprot OFF | ON | 0 | 1` `[:SENSe]:SWEep:IMAGeprot?`
Dependencies	Only appears in Spectrum Analyzer Mode in VXT models
Preset	`ON`
State Saved	Saved in instrument state

3.4.10 Trace

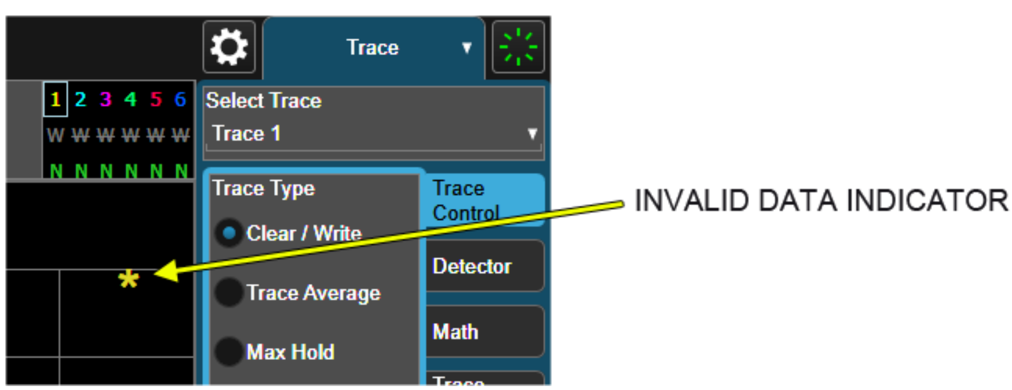
Lets you control the acquisition, display, storage, detection and manipulation of trace data for the available traces.

The "Trace Control" on page 1904 tab of this menu contains radio-button selections for the trace type (**Clear/Write, Trace Average, Max Hold, Min Hold**) and **View/Blank** setting for the selected trace.

A trace is a series of data points, each having an x and a y value. The x value is frequency (or time, in zero span) and the y value is amplitude. Each data point is referred to as a *trace point*. In any given trace, trace point 0 is the first point, and trace point (*sweep_points – 1*) is the last. For example, in a 1001 point trace, the first point is 0 and the last is 1000. Another term sometimes used to describe traces is *bucket*. A bucket is the frequency span of a trace point, equal to the point spacing. For swept analysis, the y value in each bucket is measured while the instrument is sweeping across the bucket. The selected detector determines how it is measured.

When in **Single** Mode, Measurements and their Views save the trace data from the last acquisition. This is true on multiple screens. The marker and trace data will be present whenever the measurement is brought back into focus. The measurement switches for these measurements do not clear the traces, so the data will be present until the next acquisition is completed.

Invalid Data Indicator



The Invalid Data Indicator is displayed whenever the data on the display does not match the settings of the instrument. The most common example of this is when instrument settings have changed in the time since the data in the traces on the display was taken. This means that the screen annotation cannot be guaranteed to match the trace data. For example, if you change **Center Frequency**, the Invalid Data Indicator will display until the trace has been retaken.

If any Trace is in View mode (displaying but not updating) and instrument settings are changed, the Invalid Data Indicator will display as long as that trace remains in View. Traces that are blanked do not turn on the Invalid Data Indicator.

Not all instrument settings require display of the invalid data indicator when they change; only changes that require a new acquisition will cause it to display. For example, changing the Y-Axis scale of the instrument does not cause the invalid data indicator to display, unless the attenuation changes.

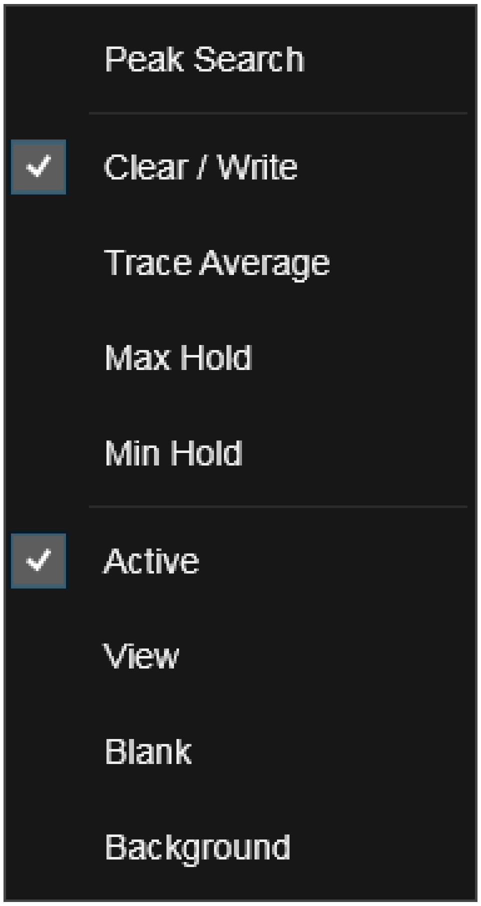
The Invalid Data Indicator is also turned on:

- When the counter is turned on, until the completion of the first count
- When a trace is imported from mass storage and the trace's parameters do not match the current instrument settings
- When a trace is sent to the instrument from a remote interface (since there is no way to know if its settings match)

NOTE **The Invalid Data Indicator has an associated status bit that can be checked at any time to determine whether the indicator is on.**

Trace right-click menu

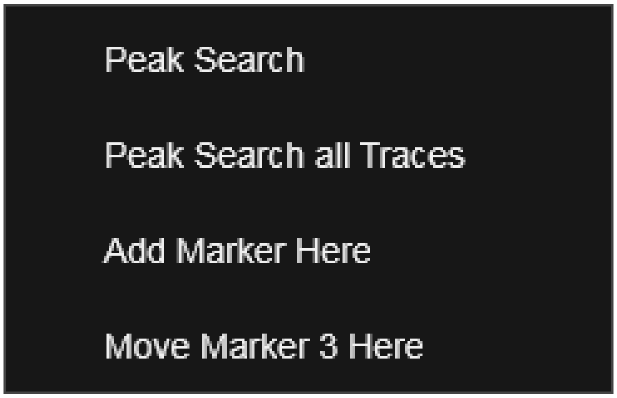
If you right-click on a trace (or touch and hold a trace and wait for the circle to close) you will see the Trace Right-Click Menu:



If you now tap or click on one of the items in this menu, the instrument will perform the corresponding function. **Peak Search** finds the highest peak on the selected Trace. **Clear/Write**, **Trace Average**, **Max Hold** and **Min Hold** set the "Trace Type" on page 1905. **Active**, **View**, **Blank**, and **Background** set the "View/Blank" on page 1721 type.

Waterfall Window

If you right-click on the trace (or touch and hold the trace and wait for the circle to close) in the **Waterfall** window (for example, in the Spectrogram View) you will see the Waterfall Trace Right-Click Menu:



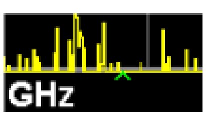
In this menu, **Peak Search** works as above. **Peak Search all Traces** finds the highest peak in the Waterfall window. **Add Marker Here** takes the lowest numbered Marker that is currently Off and turns it On as a **Normal** marker in the Waterfall window at the point where you right-clicked (or touched-and-held). **Move Marker n Here** moves the currently selected Marker to the point in the Waterfall window where you right-clicked (or touched-and-held).

Trace Update Indicator

Trace updates can take one of two forms:

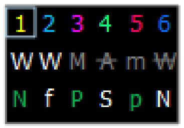
1. The trace is updated in a single operation that affects all of the points in the trace at once. This happens, for example, in the case of very fast (< 200 ms) sweeps, single-chunk FFT's, and the initial math operation after a math function is set for a trace
2. The trace is updated in a series of discrete steps, with measurement data being gathered between each step. This will be the case for slow sweeps, multi-chunk FFTs, gated sweeps, etc.

In the first case, no update indicator is required. In the second case, however, a visual indicator exists on the trace where the new data is being written. The indicator is a green caret (^) , which moves across the bottom of the graticule showing the current trace point.



Trace Annunciator Panel

This panel appears on the right hand side of the Meas Bar. Here is an explanation of the fields in this panel, as shown below:



Top Line

On the top line, each trace number is shown, in the trace color. A box is drawn around the currently selected trace.

Middle Line

Below each trace number, is a letter signifying the trace type for that trace number, where

W	Clear/Write
A	Trace Average
M	Max Hold
m	Min Hold

If the letter is white, it means the trace is being updated (**Update** = ON); if the letter is dimmed , it means the trace is not being updated (**Update** = OFF). A strikethrough indicates that the trace is blanked (**Display** = OFF). Note that it is possible for a trace to be updating *and* blanked, which is useful if the trace is a trace math component.

Bottom Line

The third line shows the detector type for each trace, or, if trace math is on for that trace, it shows “f” (for “math function”). It is not always possible to have a unique detector for each trace, but the instrument hardware provides the maximum flexibility of detector selection in order to maintain the highest accuracy. The letters used for this readout are

N	Normal
A	Average
P	peak
p	negative peak
S	Sample
Q	Quasi Peak
E	EMI Average
R	RMS Average
f	math function

If the letter is green, the detector is in Auto. If white, the detector has been manually selected.

In the example above, the panel is indicating the following:

- Trace 1: Visible, being updated, in Clear/Write, with Normal detector auto selected
- Trace 2: Visible, being updated, in Clear/Write, being written to with a math function
- Trace 3: Visible, not updating, data was taken in Max Hold, with the peak detector auto selected
- Trace 4: Blanked, not updating, data was taken with Averaging turned on, Sample detector manually selected
- Trace 5: Visible, not updating, data was taken in Min Hold with Negative Peak detector auto selected
- Trace 6: Blanked, not updating, in Clear/Write, with Normal detector manually selected

Trace Annotation

When **Trace Annotation** (see **Display**) is `ON`, each non-blanked trace is labeled on the trace with the detector used to take it, unless a Trace Math function is on for that trace, in which case it is labeled with the "Math Function" on page 1724.

The detector labels are:

`NORM`	Normal
`PEAK`	Peak
`SAMP`	Sample
`NPEAK`	Negative Peak
`RMS`	Average detector with Power Average (RMS)
`LG AVG`	Average detector with Log-Pwr Average
`VAVG`	Average detector with Voltage Average
`QPEAK`	Quasi Peak
`EMI AVG`	EMI Average
`RMS AVG`	RMS Average

The trace math labels are:

`PDIF`	Power Difference
`PSUM`	Power Sum
`LOFF`	Log Offset
`LDIF`	Log Difference

3.4.10.1 Select Trace

Specifies the *selected trace*, which is the trace that will be affected when you change trace settings.

Select Trace appears above the menu panel, indicating that it applies to *all* controls in the menu panel. **Select Trace** is blanked if you select a tab whose controls do *not* depend on the selected trace (for example, **Trace Function**).

Notes	The selected trace is remembered even when not in the **Trace** menu
Dependencies	For the Swept SA measurement: – In Image Suppress mode, when you select a trace it becomes the active trace, and the formerly active trace goes into View – When you turn on Image Suppress, Update turns off for all traces except the selected trace For the ACP measurement, when **Meas Method** is `RBW`, `FAST` or `FPOWer`, **Select Trace** is disabled
Preset	Trace 1
State Saved	Yes

3.4.10.2 Trace Control

The controls on this tab allow you to set the "Trace Type" on page 1905 and its update mode.

There are four Trace Types:

- **Clear/Write**
- **Trace Average**
- **Max Hold**
- **Min Hold**

Each type handles data in a different way.

Each trace also has two values that determine whether it is being written or not, and whether it is being displayed or not. These values, **Update** and **Display,** are described fully in the "View/Blank" on page 1721 control description. Essentially, when **Update** is `ON`, a trace is updating, and when **Update** is `OFF` it is not. When **Display** is `ON`, it is visible and when **Display** is `OFF` it is not. These terms are used throughout the descriptions in this section.

Trace Type

There are four trace Types:

Option	Parameter	SCPI Example	Details
Clear/Write	WRITe	:TRAC2:TYPE WRIT	See: "Clear/Write" on page 848
Trace Average	AVERage	:TRAC2:TYPE AVER	See: "Trace Average" on page 848
Maximum Hold	MAXHold	:TRAC3:TYPE MAXH	See: "Max Hold" on page 849
Minimum Hold	MINHold	:TRAC5:TYPE MINH	See: "Min Hold" on page 849

Full descriptions of each type are provided below. You may select one of these types for each trace. Re-selecting the current **Trace Type** initiates the same action that selecting it the first time did, even though it is already selected. For example, selecting **Clear/Write** while **Clear/Write** is already selected will nonetheless clear the trace and begin rewriting it.

Besides the **Trace Type**, the "View/Blank" on page 1721 state must be set to **Active** (**Update**: ON, **Display**: ON) for a trace to be updating and visible. Selecting any **Trace Type** automatically makes the trace **Active**.

See also: "Trace Mode Backwards Compatibility Commands" on page 846

Remote Command	For Swept SA Measurement (in SA Mode):
	`:TRACe[1]|2|…|6:TYPE WRITe | AVERage | MAXHold | MINHold`
	`:TRACe[1]|2|…|6:TYPE?`
	For all other measurements:
	`:TRACe[1]|2|3:<meas>:TYPE WRITe | AVERage | MAXHold | MINHold`
	`:TRACe[1]|2|3:<meas>:TYPE?`
	where `<meas>` is the identifier for the current measurement

Example	`:TRAC:TYPE WRIT` `:TRAC:TYPE?`
Couplings	Selecting a **Trace Type** (by pressing any of the Trace Type selections or sending `:TRAC:TYPE`) sets the Trace to **Active** (**Update**: ON, **Display**: OFF), even if the same trace type was already selected When Detector setting is “Auto” (`[:SENSe]:<meas>:DETector:AUTO?`), Detector (`[:SENSe]:<meas>:DETector[:FUNCtion]?`) switches aligning with the switch of this parameter: “NORMal” with WRITe (Clear Write), “AVERage” with AVERage, “POSitive (peak)” with MAXHold, and “NEGative (peak)” with MINHold
Preset	Swept SA and Monitor Spectrum: WRITe All other measurements: AVERage Following **Preset**, all traces are cleared (all trace points set to mintracevalue)
State Saved	The type of each trace is saved in instrument state
Annunciation	The type for each trace is indicated in the Trace annunciator panel on the Measurement Bar

Trace Mode Backwards Compatibility Commands

In earlier instruments, the “Trace Modes” were: Clear/Write, Max Hold, Min Hold, View and Blank. Averaging was global to all traces and was controlled under the **BW/Avg** menu.

In X-Series, trace averaging can be done on a per-trace basis. The Trace Modes (now called Trace Types) are Clear/Write, Trace Average, Max Hold and Min Hold. View and Blank are set separately under "View/Blank" on page 1721.

While this provides more flexibility, it also gives rise to potential backwards compatibility problems. To mitigate these, the old Trace Mode command has been retained and a new Trace Type command has been added. The :`TRACe:MODE` command is retained for backwards compatibility, and the :`TRACe:TYPE`, :`TRACe:UPDate` and :`TRACe:DISPlay` commands introduced for ongoing use. The old Trace Modes are selected using `:TRAC:MODE`, whose parameters are mapped into calls to `:TRACe:TYPE`, `:TRACe:UPDate` and `:TRACe:DISPlay`, and the old global Averaging command `[:SENSe]:AVERage[:STATe]` is provided for backwards compatibility. See the individual command descriptions for details.

When **Average/Hold** in the **Meas Setup**, **Legacy Compatibility** menu is `ON`, the following is true for traces in Max Hold and Min Hold:

- They ignore the **Average/Hold** number; **Single** for Max Hold causes one sweep only, so switching to **Single** stops after the current sweep, and switching to **Cont** starts again without clearing the accumulated result
- Max Hold is not cleared on a **Restart**, **Single** or `:INIT:IMM`, but changing a measurement parameter, like frequency or bandwidth etc., still restarts the Max Hold

Preset	`WRITe`
State Saved	The trace mode is an alias only
Backwards Compatibility SCPI	`:TRACe[1]|2|…|6:MODE WRITe | MAXHold | MINHold | VIEW | BLANk` `:TRACe[1]|2|…|6:MODE?`
Backwards Compatibility Notes	The legacy `:TRACe:MODE` command is retained for backwards compatibility. In conjunction with the legacy `:AVERage` command, it works as follows: – `:AVERage ON|OFF` sets/clears a variable that we will call average for the sake of this discussion. This variable is maintained by the instrument solely for backwards compatibility. See the `[:SENSe]:AVERage[:STATe]` command description below – `:TRACe:MODE WRITe` sets `:TRACe:TYPE WRITe` (Clear/Write) unless average is true, in which case it sets it to `:TRACe:TYPE AVERage`. It also sets `:TRACe:UPDate ON`, `:TRACe:DISPlay ON`, for the selected trace – `:TRACe:MODE MAXHold` sets `:TRACe:TYPE MAXHold` (Max Hold). It also sets `:TRACe:UPDate ON`, `:TRACe:DISPlay ON`, for the selected trace

	– `:TRACe:MODE MINHold` sets `:TRACe:TYPE MINHold` (Min Hold). It also sets `:TRACe:UPDate ON`, `:TRACe:DISPlay ON`, for the selected trace – `:TRACe:MODE VIEW` sets `:TRACe:UPDate OFF`, `:TRACe:DISPlay ON`, for the selected trace – `:TRACe:MODE BLANk` sets `:TRACe:UPDate OFF`, `:TRACe:DISPlay OFF`, for the selected trace The query returns the same value as `:TRACe:TYPE?`, meaning that if you set `:TRACe:MODE:VIEW` or `:TRACe:MODE:BLANk`, the query response will not be what you sent `:TRACe[n]:MODE` was formerly used to set the type or "writing mode" of the trace. At that time, View and Blank were writing modes. The new `:TRACe:TYPE` command should be used in the future, but `:TRACe:MODE` is retained to provide backwards compatibility In X-Series, unlike earlier instruments, Max Hold and Min Hold now obey the Average Number and counts up to a terminal value as Average always has As the **Average/Hold Number** now affects **Min Hold** and **Max Hold**, the operations that restart Averaging (for example, the **Restart** key) now also restart **Min Hold** and **Max Hold** As a result of these changes, legacy code that restarts averaging while retaining a running Max Hold will need to be rewritten, because the Max Hold will now restart when the Average does Also, previous to X-Series: – Pressing **Max Hold** while already in **Max Hold** (or doing so remotely) had no effect. Now it will clear the trace and restart the sweep and the Max Hold sequence – Changing the vertical scale (Log/Lin or dB/div) of the display restarted **Max Hold** and **Min Hold**. This is no longer the case
Preset	`OFF`
State Saved	The state of Average is saved in Instrument State for ghosting purposes
Backwards Compatibility SCPI	`[:SENSe]:AVERage[:STATe] ON | OFF | 1 | 0` `[:SENSe]:AVERage[:STATe]?`
Backwards Compatibility Notes	Previous to X-Series, Averaging (also sometimes known as trace averaging) was global to all traces, that is, it was either on or off for all active traces. The legacy command `[:SENSe]:AVERage[:STATe] ON|OFF|1|0` was used to turn Averaging on or off In X-Series, Averaging is turned on or off on a per-trace basis, so it can be on for one trace and off for another For backwards compatibility, the old global Average State variable is retained solely as a legacy variable, turned on and off and queried by the legacy command `[:SENSe]:AVERage[:STATe] OFF|ON|0|1.` When Average is turned on, any trace in Clear/Write will get put into Average. While Average is on, any trace put into Clear/Write by the old `:TRAC:MODE` command will instead get put into Average. When Average is turned off, any trace in Average will get put into Clear/Write

Trace Type Details

Clear/Write

Each trace update replaces the old data in the trace with new data.

Pressing **Clear/Write** for the selected trace, or sending `:TRAC:TYPE WRIT` for the specified trace, sets the trace type to **Clear/Write** and clears the trace, even if you are already in **Clear/Write**. Then a new sweep is initiated. Trigger conditions must be met before the sweep actually starts, and if in **Single** the sweep won't start until **Restart** is pressed.

Pressing **Clear/Write** stops the current sweep and initiates a new one, so **Trace Average, Max Hold** and **Min Hold** data may be interrupted in mid-sweep when **Clear/Write** is pressed, and therefore may not accurately reflect the displayed count. Therefore, when **Clear/Write** is pressed for one trace, **Trace Average, Max Hold** and **Min Hold** must restart for all traces.

When in **Clear/Write**, if a measurement-related instrument setting is changed (that is, one which requires new data to be taken, like **Center Frequency** or **Attenuation**), a new sweep is initiated but the trace is not cleared.

Trace Average

The instrument maintains and displays an average trace, which represents the cumulative average on a point-by-point basis of the new trace data and previous averaged trace data.

Pressing **Trace Average** (for the selected trace), or sending `:TRAC:TYPE AVER` (for the specified trace), sets the trace type to **Trace Average**, clears the trace, initiates a new sweep, and restarts the Average sequence.

Details of the count limiting behavior and the averaging calculations may be found under **Avg|Hold Number** and **Average Type** under **Meas Setup.**

When in **Trace Average**, if a measurement-related instrument setting is changed (that is, one which requires new data to be taken, like Center Frequency or Attenuation), the average restarts and a new sweep is initiated but the trace is not cleared.

Restarting the average means:

- The average/hold count k is set to 1, so that the next time the average trace is displayed it simply represents one trace of new data
- A new sweep is initiated

- Once the new sweep starts, the trace is overwritten with current trace data as the first trace of the new average

Remember that restarting averaging also restarts **Max Hold** and **Min Hold**, as there is only one count for Trace Average and Hold.

Max Hold

The instrument maintains and displays a max hold trace, which represents the maximum data value on a point-by-point basis of the new trace data and previous trace data. Details of the count limiting behavior may be found under **Avg|Hold Number** under **Meas Setup.**

Pressing **Max Hold** for the selected trace, or sending `:TRAC:TYPE MAXH` for the specified trace, sets the Trace Type to **Max Hold,** clears the trace , initiates a new sweep, and restarts the hold sequence, even if you are already in **Max Hold**.

When in **Max Hold**, if a measurement-related instrument setting is changed(that is, one which requires new data to be taken, like **Center Frequency** or **Attenuation**), the **Max Hold** sequence restarts and a new sweep is initiated but the trace is not cleared.

Restarting the **Max Hold** sequence means:

- The average/hold count k is set to 1, so that the next time the max hold trace is displayed it simply represents one trace of new data
- A new sweep is initiated.

Remember that restarting **Max Hold** also restarts averaging and **Min Hold**, as there is only one count for Trace Average and Hold.

Min Hold

The instrument maintains and displays a min hold trace, which represents the minimum data value on a point-point basis of the new trace data and previous trace data. Details of the count limiting behavior may be found under **Avg|Hold Number** under the **Meas Setup** functions.

Pressing **Min Hold** for the selected trace, or sending `:TRAC:TYPE MINH` for the specified trace, sets the Trace Type to **Min Hold,** clears the trace, initiates a new sweep, and restarts the hold sequence, even if you are already in **Min Hold**.

When in **Min Hold**, if a measurement-related instrument setting is changed(that is, one which requires new data to be taken, like **Center Frequency** or **Attenuation**), the **Min Hold** sequence restarts and a new sweep is initiated but the trace is not cleared.

Restarting the **Min Hold** sequence means:

– The average/hold count k is set to 1, so that the next time the min hold trace is displayed it simply represents one trace of new data

– A new sweep is initiated

Remember that restarting **Min Hold** also restarts **Max Hold** and averaging, because there is only one count for Trace Average and Hold.

Clear and Write | Restart Averaging | Restart Max/Min Hold

Starts the trace writing, as though the "Trace Type" on page 1905 had just been selected. The effect is exactly the same as reselecting the current **Trace Type** again – the control is provided because it may not be obvious that reselecting the same selection from a radio button menu will take any action.

This control displays different labels, depending on the selected Trace Type:

– **Clear/Write**: Clear and Write

– **Trace Average**: Restart Averaging

– **Max Hold**: Restart Max Hold

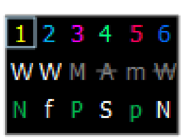
– **Min Hold**: Restart Min Hold

View/Blank

Lets you set the state of the two trace variables: **Update** and **Display**. The choices available in this dropdown menu are:

Active	Update and Display both ON
View	Update OFF; Display ON
Blank	Update OFF; Display OFF
Background	Update ON, Display OFF Allows a trace to be blanked *and* continue to update "in the background", which was not possible in the past

In the Swept SA measurement, a trace with **Display**OFF is indicated by a strikethrough of the type letter in the trace annotation panel in the Measurement Bar. A trace with **Update**OFF is indicated by dimming the type letter in the trace annotation panel in the Measurement Bar. In the example below, Traces 3, 4, 5 and 6 have **Update**OFF, and Traces 4 and 6 have **Display**OFF.



See: "More Information" on page 852

Notes	For the commands to control the two variables, Update and Display, see "Trace Update State On/Off" on page 851 and "Trace Display State On/Off" on page 851 below
Dependencies	When Signal ID is on, this key is grayed-out
Couplings	Selecting a Trace Type for a trace (pressing the key or sending the equivalent command) puts the trace in **Active** (Update ON and Display ON), even if that trace type was already selected Selecting a detector for a trace (pressing the key or sending [:SENS]:DET:TRAC) puts the trace in **Active** (**Update**ON and **Display**ON), even if that detector was already selected Selecting a "Math Function" on page 1724 other than OFF for a trace (pressing the key or sending the equivalent command) puts the trace in **Active** (**Update**ON and **Display**ON), even if that Math Mode was already selected Loading a trace from a file puts that trace in **View** regardless of the state it was in when it was saved; as does being the target of a **Copy** or a participant in an **Exchange**

Trace Update State On/Off

Remote Command	For Swept SA Measurement (in SA Mode):
	`:TRACe[1]|2|…|6:UPDate[:STATe] ON | OFF | 1 | 0`
	`:TRACe[1]|2|…|6:UPDate[:STATe]?`
	For all other measurements:
	`:TRACe[1]|2|3:<meas>:UPDate[:STATe] ON | OFF | 1 | 0`
	`:TRACe[1]|2|3:<meas>:UPDate[:STATe]?`
	where <meas> is the identifier for the current measurement

Example	Make trace 2 inactive (stop updating): `:TRAC2:UPD 0`
Couplings	Whenever you set **Update** to ON for any trace**,** the **Display** is set to ON for that trace

Preset	For Swept SA Measurement (in SA Mode):
	`1|0|0|0|0|0`
	ON for Trace 1; OFF for 2–6
	For all other measurements:
	`1|0|0`
	ON for Trace 1; OFF for 2 &3

State Saved	Saved in instrument state

Trace Display State On/Off

Remote Command	For Swept SA Measurement (in SA Mode):
	`:TRACe[1]|2|…|6:DISPlay[:STATe] ON | OFF | 1 | 0`
	`:TRACe[1]|2|…|6:DISPlay[:STATe]?`
	For all other measurements:

	`:TRACe[1]|2|3:<meas>:DISPlay[:STATe] ON | OFF | 1 | 0`
	`:TRACe[1]|2|3:<meas>:DISPlay[:STATe]?`
	where <meas> is the identifier for the current measurement

Example	Make trace 1 visible:
	`:TRAC2:DISP 1`
	Blank trace 3:
	`:TRAC3:DISP 3`

Couplings	Whenever you set **Update** to ON for any trace, the **Display** is set to ON for that trace

Preset	For Swept SA Measurement (in SA Mode):
	`1|0|0|0|0|0`
	ON for Trace 1; OFF for 2–6
	For all other measurements:
	`1|0|0`
	ON for Trace 1; OFF for 2 &3

State Saved	Saved in instrument state

More Information

When a trace becomes inactive, any update from the `:SENSe` system (detectors) immediately stops, without waiting for the end of the sweep. The trace data remains unchanged, but stops updating. If the trace is blanked, this still does not affect the data in the trace. Traces that are blanked (**Display**=OFF) do not display nor appear on printouts, but their data stays intact, they may be queried, and markers may be placed on them

In most cases, inactive traces are static and unchanging; however, there are cases when an inactive trace will update, specifically:

- if data is written to that trace from remote
- if trace data is loaded from mass storage
- if the trace is the target of a **Copy** or participant in an **Exchange**
- if the trace is cleared using **Clear Trace**

Inactive traces that are also being displayed (traces in **View**) are displayed at half intensity. Traces in **View** display across the entire X-Axis of the instrument. Their horizontal placement does not change, even if X-Axis settings subsequently are changed, although Y-Axis settings do affect the vertical placement of data.

When a trace becomes active (**Update**=ON), the trace is cleared, the average count is reset, and a new sweep is initiated.

Note that putting a trace into **Display**=OFF and/or **Update**=OFF does *not* restart the sweep and does *not* restart Averaging or Hold functions for any traces.

3.4.10.3 Math

Lets you turn on and configure Trace Math functions.

Math Function

Trace Math functions perform mathematical operations between traces and, in some cases, user-specified offsets. When in a Trace Math function, the indicated function is performed during the sweep with the math function used in place of a detector. The trace operands for the math function are set using the "Operand 1 / Operand 2" on page 1730 controls.

– See "How trace math is processed" on page 857

Remote Command	For option details, see "Trace Math Options" on page 855
	For Swept SA Measurement (in SA Mode):
	`:CALCulate:MATH <trace_num>, PDIFference | PSUM | LOFFset | LDIFference | OFF, <trace_num>, <trace_num>, <real>,<real>`
	`:CALCulate:MATH? <trace_num>`
	where `<trace_num>` is any one of:
	`TRACE1|…|TRACE6`
	For all other measurements:
	`:CALCulate:<meas>:MATH <trace_num>, PDIFference | PSUM | LOFFset | LDIFference | OFF, <trace_num>, <trace_num>, <real>,<real>`
	`:CALCulate[:<meas>]:MATH? <trace_num>`
	where:
	`<meas>` is the identifier for the current measurement, and
	`<trace_num>` is any one of:
	`TRACe1|TRACe2|TRACe3`
	Note that the format of the `TRACe<n>` parameter differs from that for the Swept SA Measurement

Example	`:CALC:MATH TRACE3,PDIF,TRACE1,TRACE2,0,0`
	Sets Trace 3 to Power Diff trace math function, and sets the First Trace operand (for Trace 3) to Trace 1 and the Second Trace operand (for Trace 3) to Trace 2
	`:CALC:MATH TRACE3,PSUM,TRACE1,TRACE2,0,0`
	Sets Trace 3 to Power Sum trace math function and sets the First Trace operand (for Trace 3) to Trace 1 and the Second Trace operand (for Trace 3) to Trace 2
	`:CALC:MATH TRACE3,LOFF,TRACE1,TRACE2,-6.00,0`

	Sets Trace 3 to Log Offset trace math function, sets the First Trace operand (for Trace 3) to Trace 1, leaves the Second Trace operand (for Trace 3) unchanged (it is irrelevant for this function) and sets the Log Offset (for Trace 3) to -6 dB
	`:CALC:MATH TRACE3,LDIF,TRACE1,TRACE2,0,-6.00`
	Sets Trace 3 to Log Diff trace math function, sets the First Trace operand (for Trace 3) to Trace 1, sets the Second Trace operand (for Trace 3) to Trace 2, and sets the Log Difference reference (for Trace 3) to -6 dBm
	`:CALC:MATH TRACE1,OFF,TRACE2,TRACE3,0,0`
	Turns off trace math for trace 1

Notes	The Trace Math Function command has 6 main set of parameters:
	- Set 1 defines the "result trace":
	`TRACE1|…|TRACE6`
	-Set 2 defines the "function":
	`PDIFference|PSUM|LOFFset|LDIFference|OFF`
	- Set 3 is a "trace operand" (1):
	`TRACE1|…|TRACE6`
	- Set 4 is a "trace operand" (2):
	`TRACE1|…|TRACE6`
	- Set 5 defines the "Log Offset" (in dB)
	- Set 6 defines the "Log Difference Reference" (in dBm)
	Note that the trace math mode is an enumeration; that is, when a math function is set for a trace, it turns off any math function that is on for that trace, then sets the new math function
	The parameters sent in the command are reflected in the values in the control menu. There is no default for any parameter; all 6 parameters must be sent to satisfy the parser. Failure to specify a parameter will result in a missing parameter message
	The query returns the math mode, the operand traces, the offset and the reference for the specified trace, all separated by commas

Dependencies	Trace Math is not available if **Normalize** is on Trace Math is not available if Signal ID is on None of the trace operands can be the destination trace. If any of the three trace math commands is sent with a destination trace number matching one of the operands, a warning is generated and the function does not turn on
Couplings	When a math function is changed for a trace, that trace is set to Display = ON; and Update = ON

Preset	For Swept SA Measurement (in SA Mode):
	`OFF,TRACE5,TRACE6,0,0 | OFF,TRACE6,TRACE1,0,0 | OFF,TRACE1,TRACE2,0,0 | OFF,TRACE2,TRACE3,0,0 | OFF,TRACE3,TRACE4,0,0 | OFF,TRACE4,TRACE5,0,0`
	For all other measurements:
	`OFF,TRACE2,TRACE3,0,0 | OFF,TRACE3,TRACE1,0,0 | OFF,TRACE1,TRACE2,0,0`

State Saved	The trace math function for each trace is saved in instrument state
Annunciation	An "f" is shown on the trace annunciation panel in the Measurement Bar when a math function is on;

	and the function is annotated on the trace if Trace Annotation is on
Status Bits/OPC dependencies	*OPC can be used to detect the completion of a sweep, which will also correspond to the completion of the math operation, since all math takes place during the sweep

Trace Math Options

IMPORTANT To generate a trace math result, *you must take a sweep*. The trace math engine, described below, operates in concert with the sweep engine in the instrument. Until a sweep has been taken, even if the constituent traces are not in Update mode, no result is generated.

Note that certain events can affect the trace in ways that affects all points at once. This can happen in any number of ways, including:

- A trace clear taking place
- A trace being loaded from the file system
- Trace data being sent in from the remote interface
- A copy or exchange of trace data

You should try to avoid these occurrences during a sweep, as they will tend to invalidate the math result being accumulated.

The Trace Math functions are:

Power Diff (Op1 - Op2)

Calculates a power difference between the First Trace operand and the Second Trace operand and puts the result in the destination trace.

During the sweep, the following formula is executed for each point in the trace operands, and the corresponding point is generated for the destination trace:

```
DestinationTrace = 10 log(10(1/10)(FirstTrace) – 10(1/10)(SecondTrace))
```

The values of the trace points are assumed to be in a decibel scale, as they are internally stored.

If a point in FirstTrace is equal to maxtracevalue, the resultant point is also maxtracevalue.

Otherwise, if the result of the subtraction is less than or equal to 0, the resultant point is mintracevalue.

Power Sum (Op1 + Op2)

Calculates a power sum between the `First Trace` operand and the `Second Trace` operand and puts the result in the destination trace.

During the sweep, the following formula is executed for each point in the trace operands, and the corresponding point is generated for the destination trace.

```
DestinationTrace = 10 log(10(1/10)(FirstTrace) + 10(1/10)(SecondTrace))
```

The values of the trace points are assumed to be in a decibel scale, as they are internally stored.

If a point in either trace operand is equal to `maxtracevalue`, the resultant point is also `maxtracevalue`.

Log Offset (Op1 + Offset)

Calculates a log offset from the `First Trace` operand and puts the result in the destination trace. This is like the B-DL function in some older instruments. The offset is entered on the `Offset` control, which only appears when this math function is in force for the selected trace. Each destination trace has its own offset.

During the sweep, the following formula is executed for each point in the trace operand, and the corresponding point is generated for the destination trace.

```
DestinationTrace = FirstTrace + Offset
```

The values of the trace points are assumed to be in dBm (as they are internally stored) and the offset is in dB.

If a point in the trace operand is equal to `maxtracevalue`, the resultant point is also `maxtracevalue`.

If a point in the trace operand is equal to `mintracevalue`, the resultant point is also `mintracevalue`.

Example: If offset is 25 dB, then our destination trace will be higher than the operand trace by 25 dB.

Note that the `Second Trace` operand is not used for this function.

Log Diff (Op1 - Op2 + Ref)

Offsets the difference between the `First Trace` operand and the `Second Trace` operand by a reference and puts the result in the destination trace. This is like the A-B+DL function in some older instruments. The Reference is entered on the **Reference** control, which only appears when this math function is in force for the selected trace. Each destination trace has its own reference.

Offsets the difference between the `First Trace` operand and the `Second Trace` operand by a reference and puts the result in the destination trace. This is like the A-

B+DL function in some older instruments. The Reference is entered on the **Reference** control, which only appears when this math function is in force for the selected trace. Each destination trace has its own reference.

During the sweep, the following formula is executed for each point in the trace operands, and the corresponding point is generated for the destination trace.

```
DestinationTrace = (FirstTrace - SecondTrace) + Reference
```

The values of the operand trace points are assumed to be in decibel units (as they are internally stored) and the reference is in dBm so the result is in dBm.

Example: If the first operand trace 1 is at 5 dBm, the second operand trace 2 is at –5 dBm, and the reference is –25 dBm, then the destination trace will be –15 dBm.

Example: If the first operand trace1 is at 60 dBuV, the second operand trace 2 is at 50 dBuV, and the reference is 35 dBuV, then the destination trace will be 45 dBuV.

If a point in `FirstTrace` is equal to `maxtracevalue`, the resultant point is also `maxtracevalue`.

If a point in `FirstTrace` is equal to `mintracevalue`, the resultant point is also `mintracevalue`.

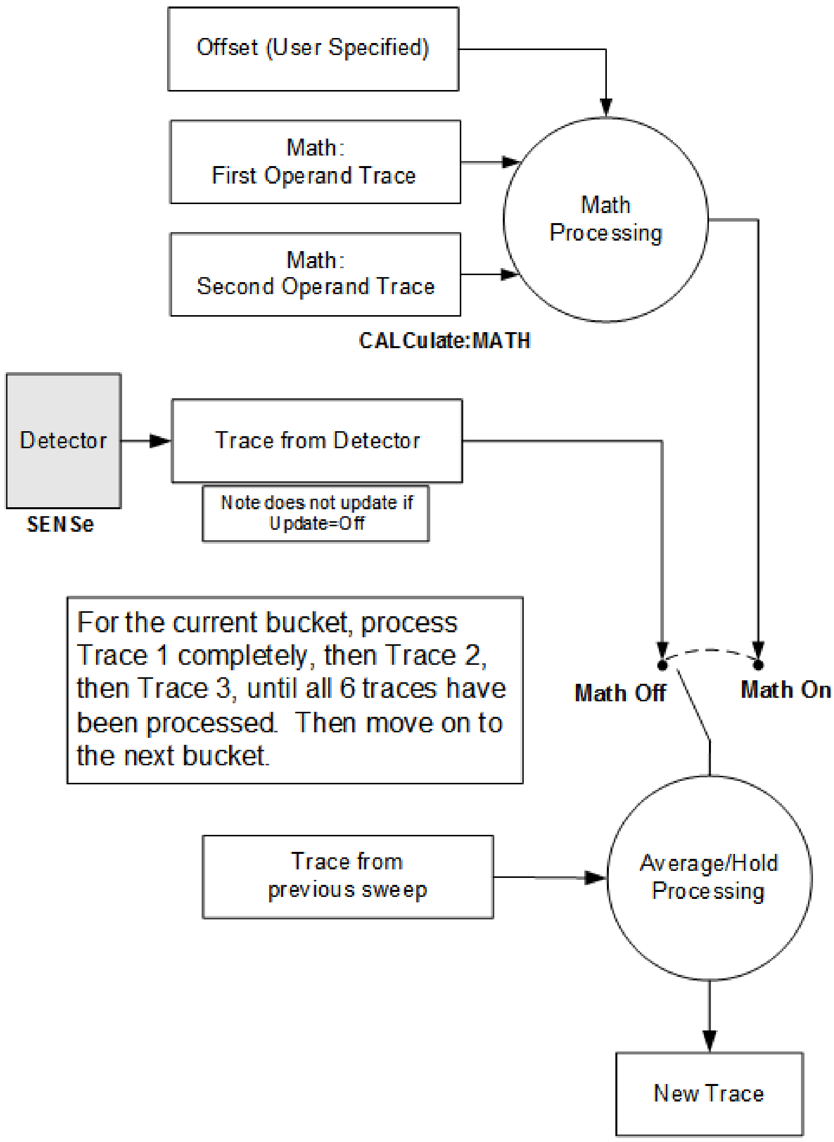
If neither of the above is true for a given point, then:

- If that point in `SecondTrace` is equal to `maxtracevalue`, the resultant point is `mintracevalue`.
- If that point in `SecondTrace` is equal to `mintracevalue`, the resultant point is `maxtracevalue`.

How trace math is processed

Whenever a trace math function is turned on, or the parameters and/or operands of an existing trace math function are changed, the destination trace is cleared. After the trace is cleared, all x-axis values in the trace, and the domain of the trace, are set to match the X-Axis settings of the first trace operand. When this is complete, a new sweep is initiated.

The process of acquiring data, processing it using the math and Average/Hold functions, and presenting it as trace data, consists of several functional blocks, as shown below:



NOTE ABOUT OFFSETS: When either External Gain or Ref Level Offset is on, an offset is applied to the trace operands, and when Trace Math is on this offset is applied before any math processing is performed. Since the operands have already been offset the result trace should NOT be offset. Therefore when any Trace Math operation is performed, the sum of (External Gain - Ref Level Offset) is added to the result before it is stored in the result trace.

For each active trace, the current trace point is processed for `Trace 1`, then `Trace 2`, then `Trace 3`, etc. Trace data is taken from either the detector for that trace, or

from the mathematical result of up to two other traces and an offset, depending on whether trace math is on or not. The resultant data is then fed to the Average/Hold processing block, where (if the trace type is **Average**, **Max Hold**, or **Min Hold**) it is processed with previous trace data. The new trace data resulting from this process is then available for display, storage or remote output.

When the processing is complete for `Trace 1`, `Trace 2` is processed, and so on until all six traces have been processed. This allows a downstream trace to use as one of its math components a fully processed upstream trace. In other words, if math is `ON` for `Trace 4`, and its operand traces are `Trace 2` and `Trace 3`, then all detector, math, average and hold processing for Traces 2 and 3 is completed before the math is performed for `Trace 4`. When the current trace point is completed for all traces, the instrument moves on to the next trace point.

This allows very flexible and powerful math functions to be configured. For example, `Trace 1` can be an average trace, which can be fed with an offset to `Trace 2`, which can also be in **Max Hold**, allowing you to obtain the **Max Hold** of an Average trace.

Note that none of this processing is performed on inactive traces.

Note also that for any active trace with math `ON`, the Operand traces should have *lower* numbers than the trace (for example, using `Trace 4` as an operand for `Trace 1` will cause the data coming from `Trace 4` to be delayed by one sweep).

Operand 1 / Operand 2

These two controls select the first and second trace operands to be used for the trace math functions for the destination trace. The operands are common to all math functions for a given trace. The most recently sent `:CALCulate:MATH` command for a given trace sets the operands for that trace. Those settings are displayed on the trace operand controls for that trace.

Example	The following examples are for the Swept SA measurement
	Set Trace 3 to Power Diff trace math function. Set the First Trace operand (for Trace 3) to Trace 1 and the Second Trace operand (for Trace 3) to Trace 2:
	`:CALC:MATH TRACE3,PDIF,TRACE1,TRACE2,0,0`
	Set Trace 3 to Log Offset trace math function. Set the First Trace operand (for Trace 3) to Trace 1, leave the Second Trace operand (for Trace 3) unchanged (it is irrelevant for this function) and set the Log Offset (for Trace 3) to -6 dB:
	`:CALC:MATH TRACE3,LOFF,TRACE1,TRACE2,-6.00,0`

Notes	See "Math Function" on page 1724 for how to specify Operands 1 and 2 using `:CALCulate:MATH`
Dependencies	The destination trace cannot be an operand. The destination trace number is grayed-out on the dropdown
Preset	Operand 1: Trace number minus 2 (wraps at 1). For example, for Trace 1, Operand 1 presets to Trace

	5; for Trace 6, it presets to Trace 4 Operand 2: Trace number minus 1 (wraps at 1). For example, for Trace 1, Operand 2 presets to Trace 6; for Trace 6, it presets to Trace 5
State Saved	Operands 1 and 2 for each trace are stored in instrument state

Offset

Used by the Log Offset math function.

Example	The following example is for the Swept SA measurement Set Trace 3 to Log Offset trace math function, set the First Trace operand (for Trace 3) to Trace 1, leave the Second Trace operand (for Trace 3) unchanged (it is irrelevant for this function) and set the Log Offset (for Trace 3) to -6 dB: `:CALC:MATH TRACE3,LOFF,TRACE1,TRACE2,-6.00,0`
State Saved	The Log Offset value for each trace is saved in Instrument State
Min	–100 dB
Max	100 dB

Reference

Used by the Log Diff math function.

Example	The following example is for the Swept SA measurement Set Trace 3 to Log Diff trace math function, set the First Trace operand (for Trace 3) to Trace 1, set the Second Trace operand (for Trace 3) to Trace 2, and set the Log Difference reference (for Trace 3) to -6 dBm: `:CALC:MATH TRACE3,LDIF,TRACE1,TRACE2,0,-6.00`
State Saved	The Log Difference reference value for each trace is saved in instrument state
Min/Max	Same as reference level

3.4.10.4 Detector

Lets you select and configure detectors for the specified trace.

Detector

Selects a detector to be used by the instrument for the current measurement. The following selections are available:

Option	Behavior
AUTO	The detector selected depends on marker functions, trace functions, average type,

Option	Behavior
	and the trace averaging function For details, see "Detector Select Auto/Man" on page 862
NORMal	The detector determines the peak of the CW-like signals, and it yields alternating maximums and minimums of noise-like signals. This is also referred to as Rosenfell detection
AVERage	The detector determines the average of the signal within the sweep points, using RMS averaging
POSitive Peak	The detector determines the maximum of the signal within the sweep points
SAMPle	The detector indicates the instantaneous level of the signal at the center of the sweep points represented by each display point
NEGative Peak	The detector determines the minimum of the signal within the sweep points
RMS	Equivalent to AVERage

Because they may not find a spectral component's true peak, neither AVERage nor SAMPle detectors measure amplitudes of CW signals as accurately as POSitivePeak or NORMal, but they do measure noise without the biases of peak detection.

Remote Command	[:SENSe]:OBWidth:DETector[:FUNCtion] NORMal | AVERage | POSitive | SAMPle | NEGative | RMS [:SENSe]:OBWidth:DETector[:FUNCtion]?
Example	:OBW:DET NORM :OBW:DET? Set the detector to **Average**. **Average** uses RMS averaging, so this is equivalent to selecting an RMS detector: :OBW:DET RMS
Notes	The query returns a name that corresponds to the detector type, as follows The RMS selection sets the detector type to AVERage, with RMS averaging. Therefore, if RMS had been selected, the query returns AVER

String Returned	Definition
NORM	Normal
AVER	Average (RMS)
POS	Peak
SAMP	Sample
NEG	Negative Peak

Couplings: When "Detector Select Auto/Man" on page 862 is ON, the values returned by the query depend on the setting of "Trace Type" on page 1905 as follows:

	Trace Type / **Query Returns:** WRITe → NORMal AVERage → AVERage MAXHold → POSitive MINHold → NEGative
Preset	AVERage
State Saved	Saved in instrument state
Range	NORMal|AVERage|POSitive|SAMPle|NEGative|RMS

Trace Type	Query Returns:
WRITe	NORMal
AVERage	AVERage
MAXHold	POSitive
MINHold	NEGative

Detector Select Auto/Man

Sets the Detector mode to **Auto** (ON) or **Man** (OFF). In **Auto**, the proper detector is chosen based on rules that take into account the measurement settings and other instrument settings.

When you select any "Detector" on page 860 manually, this setting reverts automatically to **Man** (manual).

Remote Command	`[:SENSe]:OBWidth:DETector:AUTO ON | OFF | 1 | 0` `[:SENSe]:OBWidth:DETector:AUTO?`
Example	`:OBW:DET:AUTO ON` `:OBW:DET:AUTO?`
Couplings	When ON, the query "Detector" on page 860 returns values that depend on the setting of "Trace Type" on page 1905 as follows:
Preset	ON
State Saved	Yes

Trace Type	Query Returns:
WRITe	NORMal
AVERage	AVERage
MAXHold	POSitive
MINHold	NEGative

3.4.10.5 Trace Function

Contains controls to:

– Copy and Exchange traces

– Preset or Clear all traces

From Trace

Selects the trace to be copied to or exchanged with the "To Trace" on page 1732 when a "Copy" on page 1732 or "Exchange" on page 1733 is performed

Preset	1

To Trace

Selects the trace to be copied from or exchanged with the "From Trace" on page 1732 when a "Copy" on page 1732 or "Exchange" on page 1733 is performed

Preset	2

Copy

Executes a Trace Copy based on the "From Trace" on page 1732 and "To Trace" on page 1732 parameters. The copy operation is from the **From Trace** to the **To Trace**. The action is performed once.

The X-Axis settings and domain of a trace are also copied.

Remote Command	For Swept SA Measurement (in SA Mode):
	`:TRACe:COPY TRACE1 | … | TRACE6, TRACE1 | … | TRACE6`
	For all other measurements:
	`:TRACe:<meas>:COPY TRACe1 | TRACe2 | TRACe3, TRACe1 | TRACe2 | TRACe3`
	where `<meas>` is the identifier for the current measurement
	Note that the format of the `TRACe<n>` parameter differs from that for the Swept SA Measurement

Example	Copy Trace 1 to Trace 3 and put Trace 3 in Update=Off, Display=On `:TRAC:COPY TRACE1,TRACE3`
Notes	The command is of the form: `:TRACe:COPY <source_trace>,<dest_trace>`
Dependencies	When Signal ID is on, this key is grayed-out
Couplings	The destination trace is put in **View** (Update = Off, Display = On) after the copy

Preset	For Swept SA Measurement (in SA Mode):
	`TRACE1, TRACE2`
	For all other measurements:
	`TRACe1, TRACe2`

Exchange

Executes a Trace Exchange based on the "From Trace" on page 1732 and "To Trace" on page 1732 parameters. The **From Trace** and **To Trace** values are exchanged with each other. The action is performed once.

The X-Axis settings and domain of a trace are also copied when it is exchanged with another trace.

Remote Command	For Swept SA Measurement (in SA Mode):
	`:TRACe:EXCHange TRACE1 | … | TRACE6, TRACE1 | … | TRACE6`
	For all other measurements:
	`:TRACe:<meas>:EXCHange TRACe1 | TRACe2 | TRACe3, TRACe1 | TRACe2 | TRACe3`
	where `<meas>` is the identifier for the current measurement
	Note that the format of the `:TRACe<n>` parameter differs from that for the Swept SA Measurement

Example	Exchange Trace 1 and Trace 2 and put both traces in Update=OFF, Display=ON: `:TRAC:EXCH TRACE1,TRACE2`
Notes	The command is of the form: `:TRACe:EXCHange <trace_1>,<trace_2>`
Couplings	Both traces are put in **View** (Update=Off, Display=On) after the exchange

Preset All Traces

Turns on Trace 1 and blanks all other traces. This is useful when you have many traces on and you want to return to having only Trace 1 on the display. Does not affect the trace type, detector or any other aspect of the trace system.

Remote Command	`:TRACe[:<meas>]:PRESet:ALL`
Example	`:TRAC:PRES:ALL`
Dependencies	When Signal ID is on, this key is grayed-out

Clear All Traces

Clears all traces. Does not affect the state of any function or variable in the instrument. Loads `mintracevalue` into all of the points for all traces, except traces in **Min Hold**, in which case it loads `maxtracevalue`, even if **Update** = OFF.

Remote Command	`:TRACe[:<meas>]:CLEar:ALL`
Example	`:TRAC:CLE:ALL`
Dependencies	When Signal ID is on, this key is grayed-out

3.4.10.6 Advanced

Contains controls for setting advanced trace functions of the instrument.

Measure Trace

Specifies which trace's scalar results are displayed in the **Metrics** window, and retrieved by sending a `:READ` or `:FETCh` query:

- Trace 1
- Trace 2
- Trace 3

Remote Command	`:CALCulate:<meas>:MTRace TRACe1 | TRACe2 | TRACe3`
	`:CALCulate:<meas>:MTRace?`
	`<meas>` is the identifier for the current measurement; any one of `CHPower | ACPower | OBWidth | SEMask | SPURious | PVTime`

Example	Channel Power
	`:CALC:CHP:MTR TRAC1`
	`:CALC:CHP:MTR?`

Dependencies	In the ACP measurement, this control is grayed-out when **Meas Method** is set to `RBW` or `FAST`, and only Trace 1 is enabled
Preset	`TRACe1`
State Saved	No
Range	Trace 1 | Trace 2 | Trace 3

3.5 ACP Measurement

ACP is a measurement of the amount of interference, or power, in an adjacent frequency channel. The results are displayed as a bar graph or as spectrum data, with measurement data at specified offsets.

Measurement Commands

The general functionality of "CONFigure" on page 2732, "INITiate" on page 2733, "FETCh" on page 2733, "MEASure" on page 2735, and "READ" on page 2734 are described in the section **SCPI Operation and Results Query** in the topic **Programming the Instrument**.

The following measurement commands and queries are used to configure the measurement:

`:INITiate:ACPower`	Initiates a trigger cycle for the `ACPower` measurement, but does not return any data. You must then use `:FETC:ACP[n]?` to retrieve data Does not change any measurement settings
`:CONFigure?`	Returns the long form name of current measurement, in this case, `ACPower`
`:CONFigure:ACPower`	Selects ACP measurement with Meas Setup settings in preset state – same as "Meas Preset" on page 1004
`:CONFigure:ACPower:NDEFault`	Selects ACP measurement *without* affecting settings

The following queries are used to retrieve the results:

`:FETCh:ACPower?`	Retrieves the data specified by n
`:MEASure:ACPower[n]?`	Switches to ACP measurement, restores default values, starts the measurement, then retrieves the data specified by n
`:READ:ACPower[n]?`	Starts the measurement, then retrieves the data specified by n

Remote Command Results

The following table describes the results returned by the `:FETCh`, `:MEASure`, and `:READ` queries listed above, according to the index value `n`.

n	Results Returned
1, or not specified	Dependent on **Mode**, "Meas Method" on page 963, "Power Ref" on page 1045 , and "Measurement Type" on page 1045 See "Measurement Results for n = 1, or no Index Specified" on page 868
2	Dependent on "Measurement Type" on page 1045. See "Measurement Results for n = 2" on page 872
3	Dependent on **Mode** and "Measurement Type" on page 1045. See "Measurement Results for n = 3" on page

n	Results Returned
	873
4	Returns `<Num Pts>` comma-separated scalar values representing the Y values in Trace 1
5	Returns `<Num Pts>` comma-separated scalar values representing the Y values in Trace 2
6	Returns `<Num Pts>` comma-separated scalar values representing the Y values in Trace 3
7	Dependent on **Mode** and "Measurement Type" on page 1045. See "Measurement Results for n = 7" on page 874
8	Only available in LTEAFDD, LTEATDD, 5GNR, MSR Modes Dependent on "Measurement Type" on page 1045, "PSD Unit" on page 1053, and "Power Ref" on page 1045. See "Measurement Results for n = 8" on page 875
9	Only available in LTEAFDD, LTEATDD, 5GNR, MSR Modes Returns scalar pass/fail values (0 = passed, or 1 = failed) for the trace specified by "Measure Trace" on page 1734, determined by comparing the relative to the reference carrier and by testing the absolute power limit of the offset frequencies

#	Item
1	Inner Lower offset A - relative limit result
2	Inner Lower offset A - absolute limit result
3	Inner Upper offset A - relative limit result
4	Inner Upper offset A - absolute limit result
5	Inner Lower offset B - relative limit result
6	Inner Lower offset B - absolute limit result
7	Inner Upper offset B - relative limit result
8	Inner Upper offset B - absolute limit result
...	...

When "Max Num of Offsets" on page 1000 is 6, returns 24 results (Offset A-F: 24 = 4*6) and when set to 12, returns 48 results (Offset A-L: 48 = 4 * 12)

n	Results Returned
10	Only available in LTEAFDD, LTEATDD, 5GNR, MSR Modes Returns scalar values of offset results for the trace specified by "Measure Trace" on page 1734 Numbers returned in this trace are 10 x the actual measured offsets. Note that upper and lower sides of an offset are returned separately. For example, when only outer offset A is measured with offset side both, 10 x 2 = 20 values are returned In the table below, f is the Number of Offsets. See "Max Num of Offsets" on page 1000

#	Measurement Type	Item	Unit, if any
1		Inner = 1 or Outer = 2	
2		Offset A~L. (A = 1, B = 2, ... L = 12)	
3		Offset Side. Lower = 1 or Upper = 2	

n	Results Returned			
	#	**Measurement Type**	**Item**	**Unit, if any**
	4	TPRef	Relative power or	dBc
		PSDRef	Relative PSD	dB
	5	TPRef	Absolute power	dBm
		PSDRef	Absolute PSD	dBm/Hz, dBm/MHz*
	6	TPRef	Reference power	dBm
		PSDRef	Reference PSD	dBm/Hz, dBm/MHz*
	7		Reference Index 1	
	8		Reference Index 2	
	9		0 (Reserved)	
	10		0 (Reserved)	
	…			
	10(f - 1) + 1		Inner = 1 or Outer = 2	
	10(f - 1) + 2		Offset A~L. (A = 1, B = 2, … L = 12)	
	10(f - 1) + 3		Offset Side. Lower = 1 or Upper = 2	
	10(f - 1) + 4	TPRef	Relative power	dBc
		PSDRef	Relative PSD	dB
	10(f - 1) + 5	TPRef	Absolute power	dBm
		PSDRef	Absolute PSD	dBm/Hz, dBm/MHz*
	10(f - 1) + 6	TPRef	Reference power	dBm
		PSDRef	Reference PSD	dBm/Hz, dBm/MHz*
	10(f - 1) + 7		Reference Index 1	
	10(f - 1) + 8		Reference Index 2	
	10(f - 1) + 9		0 (Reserved)	
	10(f - 1) + 10		0 (Reserved)	
	"Measurement Type" on page 1045 determines which type of power result is returned: Total Pwr Ref (TPRef) or PSD Ref (PSDRef)			
	*For PSD results, the unit is determined by "PSD Unit" on page 1053: DBMHZ or DBMMHZ			
	If any result is not available, 9.91E+37 (NaN) is returned			

3.5.1 Measurement Results for n = 1, or no Index Specified

Mode = SA, Radio Std = None, Number of carriers = 1, Only Offset A is On

Returns 3 comma-separated values that correspond to:

#	Item	Unit, if any
1	Reference carrier power	
2	Lower-adjacent channel power of the trace specified by "Measure Trace" on page 1734	dBc
3	Upper-adjacent channel power of the trace specified by "Measure Trace" on page 1734	dBc

The values are in the current Y Axis Unit of the instrument

Meas Method = FAST

See also "Meas Method" on page 963

For the trace specified by "Measure Trace" on page 1734, returns 5 comma-separated scalar results in the following order:

#	Item	Result	Unit, if any
1	Reference carrier	Absolute power	dBm
2	Lower offset A	Absolute power	dBm
3	Upper offset A	Absolute power	dBm
4	Lower offset B	Absolute power	dBm
5	Upper offset B	Absolute power	dBm

Measurement Type = Total Power Reference

<table>
<tr><th>Conditions</th><th>Results</th></tr>
<tr><td>Mode: LTEAFDD, LTEATDD, 5GNR, MSR
"Power Ref" on page 1045:
<code>LRCarriers</code>
<code>LRSubblocks</code>
<code>MPCSubblock</code>
<code>MINSubbloc</code>
For all other Power Ref settings, see All other Modes row below</td><td>For the trace specified by "Measure Trace" on page 1734, returns comma-separated scalar results in the following order:
<table>
<tr><th>#</th><th>Item</th><th>Unit, if any</th></tr>
<tr><td>1</td><td>0.0</td><td></td></tr>
<tr><td>2</td><td>Total carrier power</td><td>dBm</td></tr>
<tr><td>3</td><td>Left Reference power</td><td>dBm</td></tr>
<tr><td>4</td><td>Right Reference power</td><td>dBm</td></tr>
<tr><td>5</td><td>Lower offset A - relative power</td><td>dB</td></tr>
<tr><td>6</td><td>Lower offset A - absolute power</td><td>dBm</td></tr>
<tr><td>7</td><td>Upper offset A - relative power</td><td>dB</td></tr>
<tr><td>8</td><td>Upper offset A - absolute power</td><td>dBm</td></tr>
<tr><td>9</td><td>Lower offset B - relative power</td><td>dB</td></tr>
<tr><td>10</td><td>Lower offset B - absolute power</td><td>dBm</td></tr>
</table></td></tr>
</table>

Conditions	Results		
	#	**Item**	**Unit, if any**
	11	Upper offset B - relative power	dB
	12	Upper offset B - absolute power	dBm
	...	...	
	When "Max Num of Offsets" on page 1000 is 6, returns 28 results (Offset A-F: 28 = 4 + 4*6) and when set to 12, returns 52 results (Offset A-L: 52 = 4 + 4 * 12)		
	If any result is not available, -999.0 is returned		
	This trace includes only outer offset results and their reference value(s)		
All other Modes and **Power Ref** settings	For the trace specified by "Measure Trace" on page 1734, returns comma-separated scalar results in the following order:		
	#	**Item**	**Unit, if any**
	1	0.0	
	2	Total carrier power	dBm
	3	0.0	
	4	Reference power	dBm
	5	Lower offset A - relative power	dB
	6	Lower offset A - absolute power	dBm
	7	Upper offset A - relative power	dB
	8	Upper offset A - absolute power	dBm
	9	Lower offset B - relative power	dB
	10	Lower offset B - absolute power	dBm
	11	Upper offset B - relative power	dB
	12	Upper offset B - absolute power	dBm
	...	...	
	When "Max Num of Offsets" on page 1000 is 6, returns 28 results (Offset A-F: 28 = 4 + 4*6) and when set to 12, returns 52 results (Offset A-L: 52 = 4 + 4 * 12)		
	If any result is not available, -999.0 is returned		
	For SA Mode, the values are in the current Y Axis Unit of the instrument		

Measurement Type = Power Spectral Density Reference

Conditions	Results
Mode: LTEAFDD, LTEATDD, 5GNR, MSR "Power Ref" on page 1045: `LRCarriers`	For the trace specified by "Measure Trace" on page 1734, returns comma-separated scalar results in the following order:

Conditions	Results		
`LRSubblocks` `MPCSubblock` `MINSubbloc`	**#**	**Item**	**Unit, if any**
	1	0.0	
	2	Total carrier power	dBm/Hz or dBm/MHz*
	3	Left reference power	dBm/Hz or dBm/MHz*
	4	Right reference power	dBm/Hz or dBm/MHz*
	5	Lower offset A - relative power	dB
	6	Lower offset A - absolute power	dBm/Hz or dBm/MHz*
	7	Upper offset A - relative power	dB
	8	Upper offset A - absolute power	dBm/Hz or dBm/MHz*
	9	Lower offset B - relative power	dB
	10	Lower offset B - absolute power	dBm/Hz or dBm/MHz*
	11	Upper offset B - relative power	dB
	12	Upper offset B - absolute power	dBm/Hz or dBm/MHz*
	When "Max Num of Offsets" on page 1000 is 6, returns 28 results (Offset A-F: 28 = 4 + 4*6) and when set to 12, returns 52 results (Offset A-L: 52 = 4 + 4 * 12) *The unit is determined by "PSD Unit" on page 1053: DBMHZ or DBMMHZ If any result is not available, -999.0 is returned This trace includes only outer offset results and their reference value(s)		
All other Modes and **Power Ref** settings	For the trace specified by "Measure Trace" on page 1734, returns comma-separated scalar results in the following order:		
	#	**Item**	**Unit, if any**
	1	0.0	
	2	Total carrier power	dBm/Hz or dBm/MHz*
	3	0.0	
	4	Reference power	dBm/Hz or dBm/MHz*
	5	Lower offset A - relative power	dB
	6	Lower offset A - absolute power	dBm/Hz or dBm/MHz*
	7	Upper offset A - relative power	dB
	8	Upper offset A - absolute power	dBm/Hz or dBm/MHz*
	9	Lower offset B - relative power	dB
	10	Lower offset B - absolute power	dBm/Hz or dBm/MHz*
	11	Upper offset B - relative power	dB
	12	Upper offset B - absolute power	dBm/Hz or dBm/MHz*
	...	...	...
	When "Max Num of Offsets" on page 1000 is 6, returns 28 results (Offset A-F: 28 = 4 + 4*6) and when set to 12, returns 52 results (Offset A-L: 52 = 4 + 4 * 12)		

Conditions	Results
	*The unit is determined by "PSD Unit" on page 1053: DBMHZ or DBMMHZ If any result is not available, -999.0 is returned For SA Mode, the values are in the current Y Axis Unit of the instrument

3.5.2 Measurement Results for n = 2

- For SA Mode, the values are in the current Y Axis Unit of the instrument
- For MSR, LTE Advanced FDD/TDD, and 5G NR Modes, this trace includes only outer offset results and their reference value(s)

Measurement Type = Total power reference

For the trace specified by "Measure Trace" on page 1734, returns comma-separated scalar results in the following order:

#	Item	Result	Unit, if any
1	Channel (1)	Relative power	dB
2	Channel (1)	Absolute power	dBm
3	Channel (2)	Relative power	dB
4	Channel (2)	Absolute power	dBm
...	...	...	
23	Channel (12)	Relative power	dB
24	Channel (12)	Absolute power	dBm
25	Lower offset A	Relative power	dB
26	Lower offset A	Absolute power	dBm
27	Upper offset A	Relative power	dB
28	Upper offset A	Absolute power	dBm
29	Lower offset B	Relative power	dB
30	Lower offset B	Absolute power	dBm
31	Upper offset B	Relative power	dB
32	Upper offset B	Absolute power	dBm
...	...	...	

When "Max Num of Offsets" on page 1000 is 6, returns 48 results (Offset A-F: 48 = 24 + 4*6) and when set to 12, returns 72 results (Offset A-L: 72 = 24 + 4 * 12)

If any result is not available, -999.0 is returned

Measurement Type = Power spectral density reference

For the trace specified by "Measure Trace" on page 1734, returns comma-separated scalar results in the following order:

#	Channel	Item	Unit, if any
1	Channel (1)	Relative power	dB
2	Channel (1)	Absolute power	dBm/Hz or dBm/MHz*
3	Channel (2)	Relative power	dB
4	Channel (2)	Absolute power	dBm/Hz or dBm/MHz*
...	...	...	
23	Channel (12)	Relative power	dB
24	Channel (12)	Absolute power	dBm/Hz or dBm/MHz*
25	Lower offset A	Relative power	dB
26	Lower offset A	Absolute power	dBm/Hz or dBm/MHz*
27	Upper offset A	Relative power	dB
28	Upper offset A	Absolute power	dBm/Hz or dBm/MHz*
29	Lower offset B	Relative power	dB
30	Lower offset B	Absolute power	dBm/Hz or dBm/MHz*
31	Upper offset B	Relative power	dB
32	Upper offset B	Absolute power	dBm/Hz or dBm/MHz*
...	...	...	

When "Max Num of Offsets" on page 1000 is 6, returns 48 results (Offset A-F: 48 = 24 + 4*6) and when set to 12, returns 72 results (Offset A-L: 72 = 24 + 4 * 12)

*The unit is determined by "PSD Unit" on page 1053: DBMHZ or DBMMHZ

If any result is not available, -999.0 is returned

3.5.3 Measurement Results for n = 3

For the trace specified by "Measure Trace" on page 1734, returns scalar pass/fail values (0 = passed, or 1 = failed) determined by comparing the relative to the reference carrier and by testing the absolute power limit of the offset frequencies (measured as total power in dB if "Measurement Type" on page 1045 is **Total Pwr Ref**, or as power spectral density in dB if **Measurement Type** is **PSD Ref**).

When "Max Num of Offsets" on page 1000 is 6, returns 24 results (Offset A-F: 24 = 4*6). When set to 12, returns 48 results (Offset A-L: 48 = 4 * 12).

For MSR, LTE-Advanced FDD/TDD, and 5G NR Modes, this trace includes only outer offset results.

#	Item
1	Lower offset A - relative limit result
2	Lower offset A - absolute limit result
3	Upper offset A - relative limit result
4	Upper offset A - absolute limit result
5	Lower offset B - relative limit result
6	Lower offset B - absolute limit result
7	Upper offset B - relative limit result
8	Upper offset B - absolute limit result
...	...

If any result is not available, 1 is returned.

3.5.4 Measurement Results for n = 7

In all cases below:

– for SA Mode, the values are in the current Y Axis Unit of the instrument

– if any result is not available, 9.91E+37 (NaN) is returned

Mode	Max Number of Carriers
MSR	100
LTEAFDD, LTEATDD	5
5GNR	16
All Others	18

Measurement Type = Total power reference

For the trace specified by "Measure Trace" on page 1734, returns (2 * Number of Carriers) comma-separated scalar results in the following order:

#	Channel	Result	Unit, if any
1	Channel (1)	Relative power	dB
2	Channel (1)	Absolute power	dBm
3	Channel (2)	Relative power	dB
4	Channel (2)	Absolute power	dBm
...	...		
2 * Number of Carriers – 1	Channel (Number of Carriers)	Relative power	dB
2 * Number of Carriers	Channel (Number of Carriers)	Absolute power	dBm

Measurement Type = Power spectral density reference

For the trace specified by "Measure Trace" on page 1734, returns (2 * Number of Carriers) comma-separated scalar results in the following order:

#	Channel	Result	Unit, if any
1	Channel (1)	Relative power	dB
2	Channel (1)	Absolute power	dBm/Hz or dBm/MHz*
3	Channel (2)	Relative power	dB
4	Channel (2)	Absolute power	dBm/Hz or dBm/MHz*
...	...		
2 * Number of Carriers - 1	Channel (Number of Carriers)	Relative power	dB
2 * Number of Carriers	Channel (Number of Carriers)	Absolute power	dBm/Hz or dBm/MHz*

*The unit is determined by "PSD Unit" on page 1053: DBMHZ or DBMMHZ

3.5.5 Measurement Results for n = 8

Only available in LTEAFDD, LTEATDD, 5GNR, MSR Modes

For the trace specified by "Measure Trace" on page 1734, returns scalar results in the following order:

#	Item	Unit, if any
1	0.0	
2	Total carrier power	dBm
3	Reference Power #1 (See "Reference Power Result Details" on page 876)	
4	Reference Power #2 (See "Reference Power Result Details" on page 876)	
5	Inner Lower offset A - relative power	dB
6	Inner Lower offset A - absolute power	dBm, dBm/Hz or dBm/MHz*
7	Inner Upper offset A - relative power	dB
8	Inner Upper offset A - absolute power	dBm, dBm/Hz or dBm/MHz*
9	Inner Lower offset B - relative power	dB
10	Inner Lower offset B - absolute power	dBm, dBm/Hz or dBm/MHz*
11	Inner Upper offset B - relative power	dB
12	Inner Upper offset B - absolute power	dBm, dBm/Hz or dBm/MHz*
...	...	

This trace includes only inner offset results

When "Max Num of Offsets" on page 1000 is 6, returns 28 results (Offset A-F: 24 = 4 + 4*6) and when set to 12, returns 52 results (Offset A-L: 52 = 4 + 4 * 12)

Absolute Power Units

*For Absolute power results, the units depend on the "Measurement Type" on page 1045 and "PSD Unit" on page 1053 settings as follows:

Measurement Type	PSD Unit	Unit
Total Pwr Ref	All	dBm
PSD Reference	dBm/Hz, DBMHZ	dBm/Hz
	dBm/MHz, DBMMHZ	dBm/MHz

Reference Power Result Details

The values returned as Reference Power #1 and Reference Power #2 depend on "Power Ref" on page 1045:

Power Ref Setting	Option	Reference Power #1	Reference Power #2
Left & Right Carriers	LRCarriers	Left or Max Power Carrier in the lower sub-block dBm, dBm/Hz or dBm/MHz*	Right or Max Power Carrier in the upper sub-block dBm, dBm/Hz or dBm/MHz*
Max Power Carriers in Sub-block	MPCSubblock		
Left & Right Sub-blocks	LRSubblocks	Integrated Power of the lower sub-block dBm, dBm/Hz or dBm/MHz*	Integrated Power of the upper sub-block dBm, dBm/Hz or dBm/MHz*
Others		0.0	Reference carrier power dBm, dBm/Hz or dBm/MHz*

*For PSD results, the unit is determined by "PSD Unit" on page 1053. See "Absolute Power Units" on page 876 above

If any result is not available, 9.91E+37 (NaN) is returned

3.5.6 Views

The ACP measurement has two views: "Normal" on page 877 and "Carrier Info" on page 878.

These are multiple-window Views. When in a multiple-window View, you select a window by touching it. The menu controls may sometimes change depending on which window is selected.

Whenever the View changes, the default menu is **Frequency**, unless otherwise specified in the View description.

NOTE: **Y Scale/Div, Y Ref Position, Y Auto Scale, Y Ref Value and Bar Graph affect both views. For example, power bars on the traces in both views appear or disappear when Bar Graph is toggled.**

View Selection by Name

Selects the results view. The following command allows you to select the desired measurement view by enumeration.

Remote Command	`:DISPlay:ACPower:VIEW[:SELect] PRESult | CINFormation` `:DISPlay:ACPower:VIEW[:SELect]?`
Example	`:DISP:ACP:VIEW PRES` `:DISP:ACP:VIEW?`
Preset	`PRESult`
State Saved	Saved in instrument state
Range	`PRESult|CINFormation`

View Selection by Number (Remote Command Only)

Selects the results view. The following command allows you to select the desired measurement view by enumeration.

Remote Command	`:DISPlay:ACPower:VIEW:NSELect <integer>` `:DISPlay:ACPower:VIEW:NSELect?`
Example	`:DISP:ACP:VIEW:NSEL 1` `:DISP:ACP:VIEW:NSEL?`
Dependencies	Available only for LTEAFDD, LTEATDD and 5G NR Modes
Preset	1
State Saved	Saved in instrument state
Min/Max	1/2

3.5.6.1 Normal

Windows: "Graph" on page 878, "Metrics" on page 879,

Dual window view of the graph and the metrics.

Example	`:DISP:ACP:VIEW PRES`

3.5.6.2 Carrier Info

Windows: "Graph" on page 878, "Metrics" on page 879,

Dual window view of the graph and the metrics.

Example	`:DISP:ACP:VIEW CINF`

3.5.7 Windows

This section describes the Windows that are available in the ACP measurement.

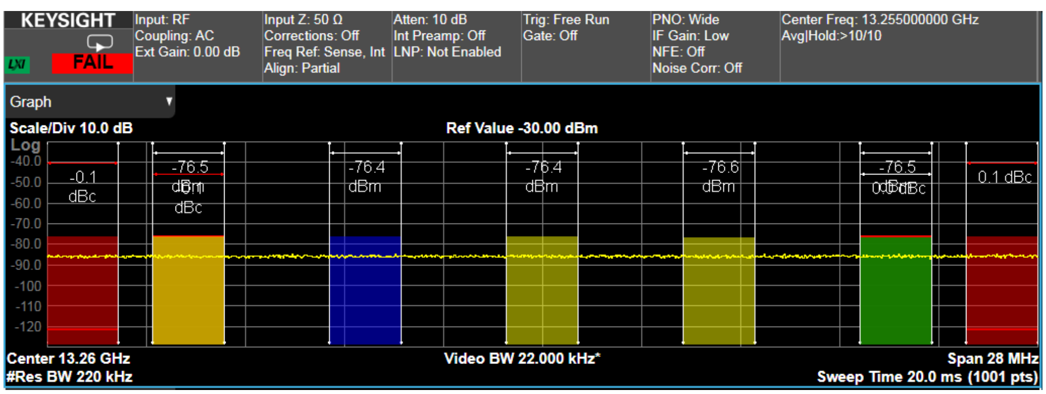
3.5.7.1 Graph

The Graph window is used to display the spectrum being measured by the ACP measurement.

The results of the measurement can be displayed as a single spectrum trace view or displayed with a Bar Graph trace on the spectrum trace.

The Graph window appears in several Views, as follows:

View	Size	Position
Normal	Half, full width	Top
Carrier Info	Half, full width	Top
Gate View	One third, full width	Middle



When the Bar Graph is ON and Limit Test is ON, the color of each bar graph reflects the limit test result. When the limit test fails, the bar color is red, and when limit test passes, the bar color is green.

When RBW is selected as the measurement method, the spectrum trace is not displayed, only the bar graph is displayed. In addition, the Bar Graph control (under the Display front-panel key) is set to ON and is grayed-out.

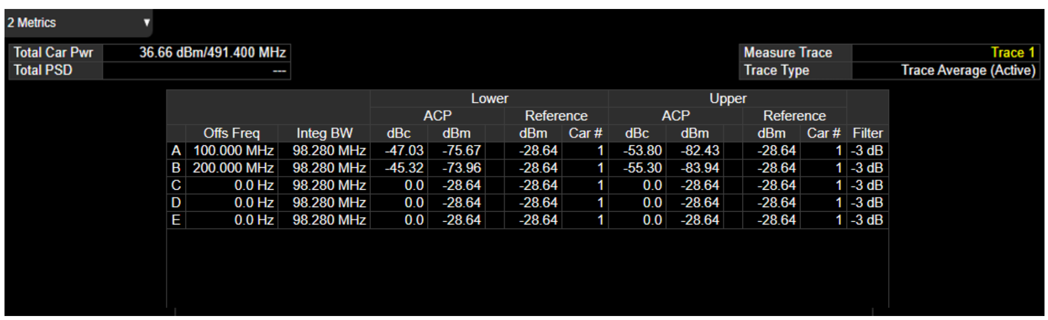
3.5.7.2 Metrics

The Metrics window displays the textual results of the ACP measurement.

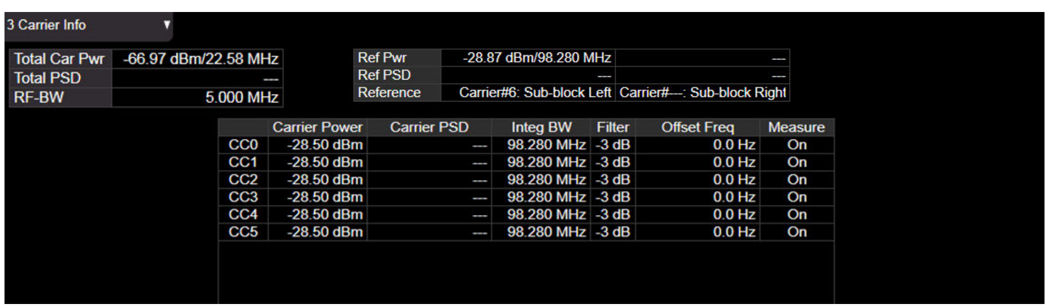
Views in which the Metrics window appears:

View	Size	Position
Normal	Half, full width	Bottom
Carrier Info	Half, full width	Bottom
Gate View	One Third, full width	Bottom

Metrics Window in Normal view:



Metrics Window in Carrier Info view:



The text window displays the following results:

Total Carrier Power

This is the total power of all the carriers with carrier power present set to yes. The power is calculated by integrating across the bandwidth declared by the Carrier Integ BW parameter for each carrier and then totaling the sums. The total integration bandwidth is shown as part of the result. This will be the total of the Carrier Integ Bw of the carriers used in calculating the total carrier power. If the RRC

Filter is on, then the integration bandwidth used is (1 + alpha)/T where T = 1/(Carrier Integ BW) multiplied by the number of carriers with carrier power present set to yes.

Ref Power

This is the power of the reference. The power is calculated by integrating across the bandwidth defined by the Reference Type. The integration bandwidth is shown as a part of the result. For some Power Reference Type, this is the value of the Carrier Integ BW for that carrier unless the RRC Filter is on, then the integration bandwidth used is the displayed value, which is (1 + alpha)/T where T = 1/(Carrier Integ BW).

Reference

In multi-carrier applications, this row displays what is used as a reference power.

Carrier Power

This is the power in all the currently defined carriers. If the carrier has carrier power present, the power will be absolute. If the carrier is defined as not having power present, the power will be relative to the reference carrier. The power is calculated by integrating across the bandwidth declared by the Carrier Integ BW parameter. The integration bandwidth is shown as part of the result. This is the value of the Carrier Integ BW for the carrier unless the RRC Filter is on, then the integration bandwidth used is the displayed value, which is (1 + alpha)/T where T = 1/(Carrier Integ BW).

Offset Relative Power

This is the power in the offsets relative to the reference carrier. The power is calculated by integrating across the bandwidth declared by the Offset Integ BW parameter. The offset integration bandwidth is shown as part of the result. This is the value on the Offset Integ BW menu unless the RRC Filter is on, then the integration bandwidth used is the displayed value, which is (1 + alpha)/T where T = 1/(Offset Integ BW).

Offset Absolute Power

This is the absolute power in the offsets. The power is calculated by integrating across the bandwidth declared by the Offset Integ BW parameter. The offset integration bandwidth is shown as part of the result. This is the value on the Offset Integ BW menu unless the RRC Filter is on, then the integration bandwidth used is the displayed value, which is (1 + alpha)/T where T = 1/(Offset Integ BW).

RF-BW

Displays the total bandwidth from the lowest carrier to the highest carrier whatever their measurement states are on or off.

Integration Bandwidth

Displays the noise bandwidth of each carrier to be measured in the ACP measurement

Measure Trace

See "Measure Trace" on page 1734.

Trace Type

This is the trace type (and view/blank parameter) of a trace specified by Measure Trace.

Measure Trace and Trace Type are displayed only when Meas Method is set to “Integration BW”, “Filtered IBW”, or “Fast Power”

Filter

Indicates whether RRC filter is used for ACP measurement or not.

Offset Frequency

Shows the offset frequency from the carrier reference frequency in multi-carrier measurements. The carrier frequency display type determines whether the relative frequency or absolute frequency will be displayed.

Sub-block

For intra-band non-contiguous spectrum operation, the sub-block concept is introduced, which refers to one contiguous allocated block of spectrum for transmission and reception in the intra-band non-contiguous aggregation mode. So far we support the two sub-blocks. It displays which sub-block the carrier belongs to in the intra-band non-contiguous aggregation mode. The column will be displayed when the carrier allocation mode is non-contiguous.

Measure

Shows whether the carrier power presents or not.

3.5.7.3 Gate

Turning on Gate View displays the Gate Window, which allows you to see your Gating signal at the same time as the measured data. See the description under Gate View in the Trigger, Gate Settings section.

View	Size	Position
Gate View	One third, full width	Top

3.5.8 Amplitude

Activates the **Amplitude** menu and selects **Reference Level** or **Reference Value** as the active function, depending on the measurement.

Some features in this menu apply to multiple measurements. Some other features apply only to specific measurements and their controls are blanked or grayed-out in measurements that do not support the feature.

3.5.8.1 Y Scale

Contains controls that pertain to the Y axis parameters of the measurement. These parameters control how data on the vertical (Y) axis is displayed and control instrument settings that affect the vertical axis.

Ref Value

Sets the value for the absolute power reference. The reference line is at the top, center, or bottom of the graticule, depending on the value of the **Ref Position** function.

Remote Command	`:DISPlay:ACPower:WINDow[1]:TRACe:Y[:SCALe]:RLEVel <real>` `:DISPlay:ACPower:WINDow[1]:TRACe:Y[:SCALe]:RLEVel?`
Example	`:DISP:ACP:WIND:TRAC:Y:RLEV 100` `:DISP:ACP:WIND:TRAC:Y:RLEV?`
Couplings	When "Auto Scaling" on page 890 is ON (default), this value is automatically determined by the measurement result. When you set a value manually, **Auto Scaling** changes to OFF "Attenuation" on page 1932 is not coupled to **Ref Value**
Preset	10.00 dBm
State Saved	Saved in instrument state
Min/Max	-250.00 dBm / 250.00 dBm
Annotation	Ref <value> top left of graph
Backwards Compatibility SCPI	`:DISPlay:ACPower:VIEW[1]:WINDow[1]:TRACe:Y[:SCALe]:RLEVel`

Scale/Div

For measurements that support a logarithmic Y-Axis, **Scale/Div** sets the height of one division of the graticule in the current Y-Axis unit.

Scale/Div also determines the displayed amplitude range in the log plot graph. Since there are usually 10 vertical graticule division on the display, the total amplitude range of the graph is typically 10x this amount. For example, if Scale/Div is 10 dB, then the total range of the graph is 100 dB.

Remote Command	`:DISPlay:ACPower:WINDow[1]:TRACe:Y[:SCALe]:PDIVision <rel_ampl>` `:DISPlay:ACPower:WINDow[1]:TRACe:Y[:SCALe]:PDIVision?`
Example	`:DISP:ACP:WIND:TRAC:Y:PDIV 5` `:DISP:ACP:WIND:TRAC:Y:PDIV?`

Couplings	Coupled to "Scale Range" on page 1538 as follows: **Scale/Div** = **Scale Range**/10 (number of divisions) When "Auto Scaling" on page 890 is ON, this value is automatically determined by the measurement result When you change a value, **Auto Scaling** automatically changes to Off
Preset	10.00 dB / Div
State Saved	Saved in instrument state
Min	0.10 dB
Max	20 dB
Annotation	<value> dB/ left upper of graph
Backwards Compatibility SCPI	`:DISPlay:ACPower:VIEW[1]:WINDow[1]:TRACe:Y[:SCALe]:PDIVision`

Scale Range

Sets the Y-Axis scale range.

Remote Command	Replace `<meas>` with the identifier for the current measurement
	`:DISPlay:<meas>:WINDow[1]:TRACe:Y[:SCALe]:RANGe <rel_ampl>`
	`:DISPlay:<meas>:WINDow[1]:TRACe:Y[:SCALe]:RANGe?`

Example	`:DISP:CHP:WIND:TRAC:Y:RANG 100` `:DISP:CHP:WIND:TRAC:Y:RANG?`
Couplings	Coupled to **Scale/Div** as follows **Scale Range** = **Scale/Div** * 10 (number of divisions) When you change this value, **Auto Scaling** automatically changes to `OFF`
Preset	100 dB
State Saved	Saved in instrument state
Min	1
Max	200

Y Axis Unit

Displays a dropdown menu that enables you to change the vertical (Y) axis amplitude unit. This setting affects how the data is read over the remote interface. When using the remote interface, only numerical values are returned, so you must know what the Y Axis Unit is to interpret the results. This is described in more detail in "Amplitude Data Query and Y Axis Unit" on page 886 below.

For measurements that support both Log and Lin scales, the instrument retains the entered Y Axis Unit separately for both Log and Lin amplitude Display Scales. For example, if Display Scale has been set to Log, and you set Y Axis Unit to dBm, pressing **Display Scale (Log)** sets the Y Axis Unit to dBm. If Display Scale has been set to Lin and you set Y Axis Unit to V, pressing **Display Scale (Lin)** sets the Y Axis Unit to V. Pressing **Display Scale (Log)** again sets the Y Axis Unit back to dBm.

If an Amplitude Correction is being applied that has an associated Transducer Unit, all selections but **Xducer Unit** are grayed-out. For more information, see "Transducer Unit" on page 887 below.

Remote Command	`:UNIT:POWer DBM | DBMV | DBMA | V | W | A | DBUV | DBUA | DBPW | DBUVM | DBUAM | DBPT | DBG` `:UNIT:POWer?`

Example	`:UNIT:POW dBmV`
	`:UNIT:POW?`
	See also "Remote Interface Examples" on page 885 below

Notes	The Y axis unit has either logarithmic or linear characteristics. The set of units that is logarithmic consists of dBm, dBmV, dBmA, dBmV, dBmA, dBmV/m, dBmA/m, dBpT, and dBG. The set of units that are linear consists of V, W, and A. The chosen unit will determine how the reference level and all the amplitude-related outputs like trace data, marker data, etc., read out
Dependencies	Appears only in Spectrum Analyzer Mode If an amplitude correction with a Transducer Unit other than None is applied and enabled: – The Transducer Unit selection is forced, and is the only Y Axis Unit available. The specific Transducer Unit is shown in square brackets in the dropdown, and all other Y Axis Unit choices are grayed-out – If you turn off that correction or set Apply Corrections to NO, the Y Axis Unit that existed before the Transducer Unit was applied is restored When Normalize is ON (in the **Trace**, **Normalize** menu), Y Axis Unit is grayed-out, and forced to dBm
Couplings	The instrument retains the entered Y Axis Unit separately for both Log and Lin amplitude Display Scales
Preset	dBm for log scale, V for linear. The true 'preset' value is dBm, since at preset the Y Display Scale is set to logarithmic
State Saved	Saved in instrument state
Annotation	The Y Axis Unit is shown after Ref Level value at the top of the graticule

Unit	Example	Notes
dBm	`:UNIT:POW DBM`	Y Axis Unit is set to dBm
dBmV	`:UNIT:POW DBMV`	Y Axis Unit is set to dBmV
dBmA	`:UNIT:POW DBMA`	Y Axis Unit is set to dBmA
W	`:UNIT:POW W`	Y Axis Unit is set to W

Unit	Example	Notes
V	:UNIT:POW V	Y Axis Unit is set to V
A	:UNIT:POW A	Y Axis Unit is set to A
dBmV	:UNIT:POW DBUV	Y Axis Unit is set to dBmV
dBmA	:UNIT:POW DBUA	Y Axis Unit is dBmA. The unit dBuA can also appear as a Transducer Unit
dBpW	:UNIT:POW DBPW	Y Axis Unit is set to dBpW

Remote Interface Examples

Command examples and details appear in the table below. Note that each of the commands below sets the amplitude unit only for the *selected* amplitude scale (Log or Lin), the other scale is unaffected.

Unit	Example	Notes
dBm	:UNIT:POW DBM	dB relative to one milliwatt
dBmV	:UNIT:POW DBMV	dB relative to one millivolt
dBmA	:UNIT:POW DBMA	dB relative to one milliamp
W	:UNIT:POW W	Watts
V	:UNIT:POW V	Volts
A	:UNIT:POW A	Amperes
dBmV	:UNIT:POW DBUV	dB relative to one microvolt
dBmA	:UNIT:POW DBUA	dB relative to one microamp The unit dBuA can also appear as a "Transducer Unit" on page 887 When querying the Y-Axis unit, you can query the Transducer Unit to distinguish between regular dBuA and the dBuA transducer unit. If :CORR:CSET:ANT? returns NOC (for No Conversion), you are using a normal Y Axis dBuA. If it returns UA, you are using a Transducer Unit dBuA
dBpW	:UNIT:POW DBPW	dB relative to one picowatt
dBmV/m (Transducer Unit)	:UNIT:POW DBUVM	Sets the amplitude unit for the selected amplitude scale (log/lin) to dBmV/meter. This selection is only available if a Correction is turned on, and the Transducer Unit for that Correction is not None See "Transducer Unit" on page 887
dBmA/m (Transducer Unit)	:UNIT:POW DBUAM	Sets the amplitude unit for the selected amplitude scale (log/lin) to dBmA/meter. This selection is only available if a Correction is turned on, and the Transducer Unit for that Correction is not None See "Transducer Unit" on page 887

Unit	Example	Notes
dBpT (Transducer Unit)	`:UNIT:POW DBPT`	Sets the amplitude unit for the selected amplitude scale (log/lin) to dBpT (dB relative to one picotesla). This selection is only available if a Correction is turned on, and the Transducer Unit for that Correction is not None See "Transducer Unit" on page 887
dBG (Transducer Unit)	`:UNIT:POW DBG`	Sets the amplitude unit for the selected amplitude scale (log/lin) to dBG (dB relative to one Gauss). This selection is only available if a Correction is turned on, and the Transducer Unit for that Correction is not None See "Transducer Unit" on page 887
dBmA (Transducer Unit)	`:UNIT:POW DBUA`	Sets the amplitude unit for the selected amplitude scale (log/lin) to dBmA. This selection is only available as a Transducer Unit if a Correction is turned on, and the Transducer Unit for that Correction is not None See "Transducer Unit" on page 887 The unit dBuA can also appear as a normal Y Axis Unit (see above) dBuA as a Transducer Unit is used when using current probes, because current probes are often supplied with conversion tables that provide the transducer factors. When dBuA is used as a Transducer Unit, the normal conversion from power to amps for dBuA (based on the instrument input impedance) is not done, but instead the conversion is based solely on the Correction that contains the transducer factors. This is what distinguishes dBuA as a normal unit from dBuA as a transducer unit When querying the Y-Axis unit, you can query the Transducer Unit to distinguish between regular dBuA and the dBuA Transducer Unit. If `:CORR:CSET:ANT?` returns `NOC` (for No Conversion), you are using a normal Y-Axis dBuA. If it returns `UA`, you are using a Transducer Unit dBuA

Amplitude Data Query and Y Axis Unit

The settings of Y-Axis Unit and Display Scale affect how the data is returned over the remote interface in response to a query. When using the remote interface, no unit is returned, so you must know what the Y-Axis unit is to interpret the results:

Example 1

Set the following:

- Display Scale (Log)
- Y Axis Unit, dBm
- Scale/Div, 1 dB
- Ref Level, 10 dBm

This sets the top line to 10 dBm with each vertical division representing 1 dB. Thus, if a point on trace 1 is on the fifth graticule line from the top, it represents 5 dBm and will read out remotely as 5.

Example 2

Set the following:

- Display Scale (Lin)
- Y Axis Unit, Volts
- Ref Level, 100 mV (10 mV/div)

This sets the top line to 100 mV and the bottom line to 0 V, so each vertical division represents 10 mV. Thus, if a point on trace 1 is on the fifth graticule line from the top, it represents 50 mV and will read out remotely as 50.

NOTE **The units of current (A, dBmA, dBuA) are calculated based on 50 Ω input impedance.**

Transducer Unit

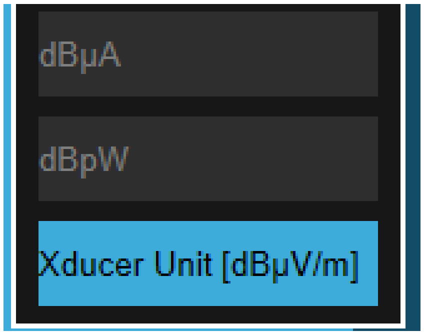
Transducer Units (formerly called Antenna Units) are units of field strength rather than amplitude, and are used when correcting the response of device such as antennas whose amplitude characteristics are measured in units of field strength. All five of the Transducer Units (dBmA/m, dBmV/m, dBG, dBpT, dBmA) are treated by the instrument exactly as though they were dBmV, when uncorrected. You must load an appropriate correction factor using Input/Output, Corrections for accurate and meaningful results.

If a remote command is sent to the instrument that uses one of the Transducer Units as a terminator, the instrument treats it as though DBUV had been sent as the terminator.

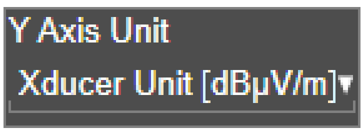
When a Correction is turned on that uses a Transducer Unit, the Y Axis Unit changes to that Transducer Unit. All of the selections in the **Y-Axis Unit** dropdown are then grayed-out, except the Transducer Unit selection. The unit being used is shown on this selection in square brackets, and appears on the control in square brackets preceded by **Xducer Unit**.

Example:

If the Transducer Unit in the Correction is dBmV/m, then the selection in the dropdown looks like this:



And on the control it looks like this:



NOTE

If a Transducer Unit is set, it is displayed as **Xducer Unit** in the **Y Axis Unit** dropdown. However, you can only *change* the Transducer Unit via the **Edit Correction** dialog in the **Input/Output**, **Corrections** menu. In that dialog, tap **Settings** then **Transducer Unit**. You can also turn off Transducer Unit from the same menu, by selecting **None**.

If a Transducer Unit is set, it is displayed as **Xducer Unit** in the **Y Axis Unit** dropdown. However, you can only *change* the Transducer Unit via the **Edit Correction** dialog in the **Input/Output**, **Corrections** menu. In that dialog, tap **Settings** then **Transducer Unit**. You can also turn off Transducer Unit from the same menu, by selecting **None**.

The Transducer Units are:

Units	Example
dBmV/m	`:UNIT:POW DBUVM`
dBmA/m	`:UNIT:POW DBUAM`
dBpT	`:UNIT:POW DBPT`
dBG	`:UNIT:POW DBG`
dBmA	`:UNIT:POW DBUA`
None	n/a

Ref Level Offset

Adds an offset value to the displayed reference level. The reference level is the absolute amplitude represented by the top graticule line on the display.

The on/off switch turns **Ref Level Offset** on and off. Setting a value for Ref Level Offset turns **Ref Level Offset**ON.

For more on using offsets, see the Ref Level Offset control description for the Swept SA measurement.

Remote Command	`:DISPlay:WINDow[1]:TRACe:Y[:SCALe]:RLEVel:OFFSet <rel_ampl>` `:DISPlay:WINDow[1]:TRACe:Y[:SCALe]:RLEVel:OFFSet?`

Example	Set **Ref Level Offset** to 12.7 dB. The only valid suffix is dB. If no suffix is sent, dB will be assumed:
	`:DISP:WIND:TRAC:Y:RLEV:OFFS 12.7`
	`:DISP:WIND:TRAC:Y:RLEV:OFFS?`

Dependencies	Appears only in SA Mode
Preset	0 dBm
State Saved	Saved in instrument state
Min	The range for **Ref Level Offset** is variable. It is limited to values that keep the reference level within the range of -327.6 dB to 327.6 dB
Max	327.6 dB
Annotation	The offset is displayed as "Ref Lvl Offset <value>" above the reference value annotation if nonzero. When the offset is zero, no annotation is shown

Auto Function

Remote Command	`:DISPlay:WINDow[1]:TRACe:Y[:SCALe]:RLEVel:OFFSet:STATe OFF | ON | 0 | 1` `:DISPlay:WINDow[1]:TRACe:Y[:SCALe]:RLEVel:OFFSet:STATe?`
Example	Turn on **Ref Level Offset**: `:DISP:WIND:TRAC:Y:RLEV:OFFS:STAT ON`
Preset	OFF

Ref Position

Positions the reference level at the top, center, or bottom of the Y Scale display. Changing the reference position does not change the reference level value.

Remote Command	`:DISPlay:ACPower:WINDow[1]:TRACe:Y[:SCALe]:RPOSition TOP | CENTer | BOTTom` `:DISPlay:ACPower:WINDow[1]:TRACe:Y[:SCALe]:RPOSition?`
Example	`:DISP:ACP:WIND:TRAC:Y:RPOS CENT` `:DISP:ACP:WIND:TRAC:Y:RPOS?`
Preset	TOP
State Saved	Saved in instrument state
Range	TOP|CENTer|BOTTom
Annotation	The greater than (>) and less than (<) symbols are displayed on both sides of the graph to indicate the Reference Position

Backwards Compatibility SCPI	`:DISPlay:ACPower:VIEW[1]:WINDow[1]:TRACe:Y[:SCALe]:RPOSition`

Auto Scaling

Toggles **Auto Scaling** On or Off.

Remote Command	`:DISPlay:ACPower:WINDow[1]:TRACe:Y[:SCALe]:COUPle 0 | 1 | OFF | ON` `:DISPlay:ACPower:WINDow[1]:TRACe:Y[:SCALe]:COUPle?`
Example	`:DISP:ACP:WIND:TRAC:Y:COUP OFF` `:DISP:ACP:WIND:TRAC:Y:COUP?`
Couplings	When **Auto Scaling** is ON, and the **Restart** front-panel key is pressed, this function automatically sets the scale per division to 10 dB and determines the reference values based on the measurement results When you change a value of "Scale/Div" on page 882, "Ref Value" on page 882, or "Scale Range" on page 1538, **Auto Scaling** automatically changes to OFF
Preset	1
State Saved	Saved in instrument state
Range	OFF|ON
Backwards Compatibility SCPI	`:DISPlay:ACPower:VIEW[1]:WINDow[1]:TRACe:Y[:SCALe]:COUPle`

3.5.8.2 Attenuation

Controls the attenuator functions and interactions between the attenuation system components.

There are two attenuator configurations in the X-Series. One is a Dual-Attenuator configuration consisting of a mechanical attenuator and an optional electronic attenuator. The other configuration uses a single attenuator with combined mechanical and electronic sections that controls all the attenuation functions. Different models in the X-Series come with different configurations.

- See "Dual-Attenuator Configurations" on page 891
- See "Single-Attenuator Configuration" on page 891

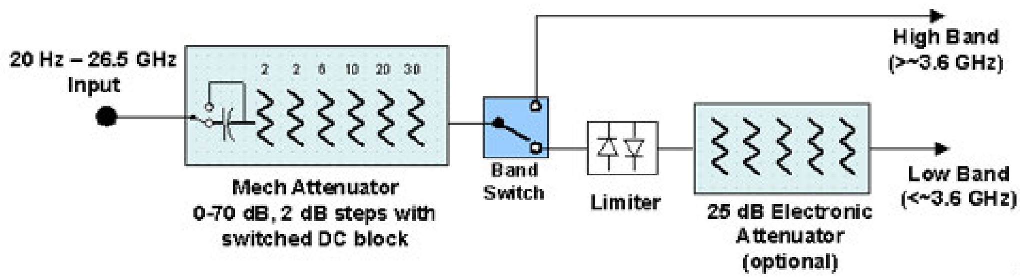
Most attenuation settings are the same for all measurements – they do not change as you change measurements. Settings like these are called “Meas Global” and are unaffected by **Meas Preset**.

Only available when the hardware set includes an input attenuator, which is typically only the case for Keysight’s benchtop instruments. For example, this tab does *not* appear in VXT models M9421A/10A/11A, nor in UXM. In UXM, all **Attenuation** and **Range** settings are disabled, as the expected input power level is handled by the Call Processing App that drives the DUT power control.

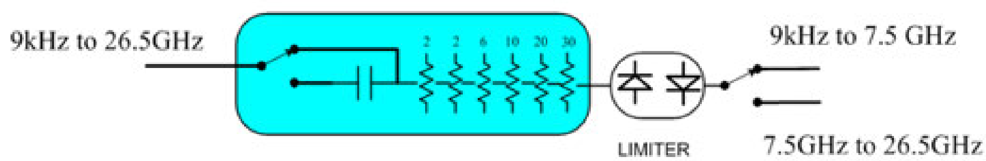
Dependencies	In measurements that support the I/Q inputs, unavailable when I/Q is the selected input. Replaced by the **Range** tab in that case

Dual-Attenuator Configurations

Configuration 1: Mechanical attenuator + optional electronic attenuator

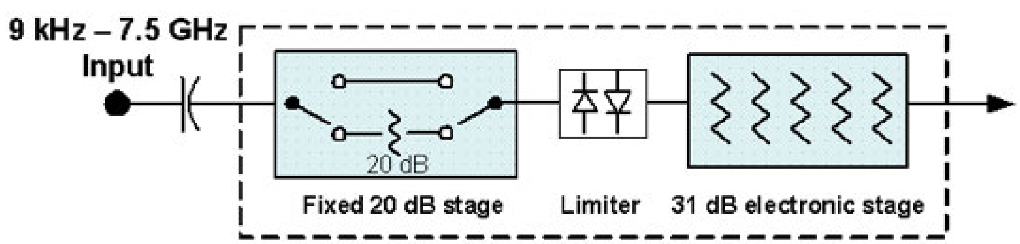


Configuration 2: Mechanical attenuator, no optional electronic attenuator



Note that Configuration 2 is not strictly speaking a dual-section attenuator, since there is no electronic section available. However, it behaves exactly like Configuration 1 without the Electronic Attenuator Option EA3, therefore for the sake of this document it is grouped into the “Dual-Attenuator” configuration.

Single-Attenuator Configuration



You can tell which attenuator configuration you have by pressing the Attenuation tab, which (in most Modes) opens the Attenuation menu. If the first control in the

Attenuation menu says **Mech Atten** you have the Dual-Attenuator configuration. If the first control says **Atten** you have the Single-Attenuator configuration.

Dual Attenuator **Single Attenuator**

(Note that depending on the measurement, there may be no Auto/Man functionality on the Mech Atten control.)

In the Single-Attenuator configuration, you control the attenuation with a single control, as the fixed stage has only two states. In the Dual-Attenuator configuration, both stages have significant range, so you are given separate control of the mechanical and electronic attenuator stages.

When you have the Dual-Attenuator configuration, you may still have only a Single-Attenuator, because unless Option EA3 (the Electronic Attenuator option) is available, and you purchase it, you will have only the mechanical attenuator.

Full Range Atten

This control and **Attenuator Summary** only appear in N9041B, when the RF input is selected, the RF Input Port is set to RF Input 2, and the Full Range Attenuator is installed. The Full Range Attenuator adds a second input attenuator in front of RF Input 2, which enhances the protection and optimizes the performance of the extra internal mixers used by RF Input 2.

Remote Command	`[:SENSe]:POWer[:RF]:FRATten <rel_ampl>` `[:SENSe]:POWer[:RF]:FRATten?`
Example	`:POW:FRAT 14` `:POW:FRAT?`
Notes	When you enter an amplitude value that falls between valid values, the value will be incremented to the next smallest valid value
Dependencies	Only appears if input RF is selected, RF Input Port 2 is selected, and the Full Range Attenuator exists
Couplings	This value is never changed by any coupling, but other couplings use this value. See **Reference Level** and "Mech Atten" on page 1935 command descriptions
Preset	20 dB
State Saved	Saved in instrument state
Min	0 dB

Max	Only valid values are 0, 6, 14, 20 dB
Annotation	When the **Input** is **RF**, and the **Input Port** is **RF Input 2**, and the Full Range Attenuator is installed: On the Meas Bar, the field "Atten" displays as follows: – If the sweep is entirely < 50 GHz, the value shown after "Atten:" is equal to Mech Atten + Elec Atten + Full Range Atten – If the sweep is entirely > 50 GHz, the value shown after "Atten:" is equal to Full Range Atten – If the sweep straddles 50 GHz, the value shown after "Atten:" is preceded by the symbol ">=" and is equal to Full Range Atten In the **Amplitude**, "Y Scale" on page 1929 menu, and the Atten **Meas Bar** dropdown menu panel, a summary is displayed as follows: "Total Atten below 50 GHz" followed by the value of Full Range Atten + Mech Atten + Elec Atten "Total Atten above 50 GHz" followed by the value of Full Range Atten For example, if Mech Atten = 6 dB, Elec Atten = 4 dB, and Full Range Atten = 20 dB, the summary below is shown: – Attenuator summary: – Total Atten below 50 GHz: 30 dB – Total Atten above 50 GHz: 20 dB

Mech Atten

Labeled **Mech Atten** in Dual-Attenuator models and **Atten** in Single-Attenuator models. In the Dual-Attenuator configuration, this control only affects the mechanical attenuator.

Lets you modify the attenuation applied to the RF input signal path. This value is normally auto-coupled to the Ref Level, the Internal Preamp Gain, any External Gain that is entered, and the Max Mixer Level, as described in the table below.

See "Attenuator Configurations and Auto/Man" on page 895

Remote Command	`[:SENSe]:POWer[:RF]:ATTenuation <rel_ampl>`
	`[:SENSe]:POWer[:RF]:ATTenuation?`
	`[:SENSe]:POWer[:RF]:ATTenuation:AUTO OFF | ON | 0 | 1`
	`[:SENSe]:POWer[:RF]:ATTenuation:AUTO?`

Example	`:POW:ATT 20` Dual-Attenuator configuration: sets the mechanical attenuator to 20 dB Single-Attenuator mode: sets the main attenuation to 20 dB (see below for definition of "main" attenuation) In either case, if the attenuator was in Auto, it is set to Manual

	`:POW:ATT:AUTO ON` Turn Auto Mech Atten `ON`
Dependencies	Some measurements do not support Auto setting of "Mech Atten" on page 893. In these measurements, the **Auto/Man** selection is not available, and the Auto/Man toggle function is not available In Dual-Attenuator configurations, when the electronic attenuator is enabled, the mechanical attenuator has no auto setting, and the Auto/Man toggle function is not available. The state of Auto/Man is remembered and restored when the electronic attenuator is once again disabled. This is described in more detail in "Elec Atten" on page 1937 See "Attenuator Configurations and Auto/Man" on page 895 for more information on the Auto/Man functionality `:POW:ATT:AUTO` is only available in measurements that support Mech Atten Auto, such as Swept SA
Couplings	If the RF Input Port is the RF Input: – If the USB Preamp is connected to USB, use 0 dB for Mech Atten – Otherwise compute the auto-selected value of Mech Atten based on **Reference Level**, Int Preamp, External Gain, Ref Level Offset, Max Mixer Level, µW Path Control and IF Gain settings. Limit this value to be no less than 6 dB (total attenuation below 6 dB can never be chosen by Auto) – In the N9041B, if the RF Input Port is RF Input 2, use the formula above and subtract the Full Range Atten value from the result to determine the Mech Atten. Limit the value so that it is never lower than 0 dB and so that total attenuation, including Full Range Atten, is never less than 6 dB (total attenuation, including Full Range Atten below 6 dB, can never be chosen by Auto) In External Mixing and BBIQ, where the Attenuator is not in the signal path, the Attenuator setting changes as described above when "Mech Atten" on page 893 is in Auto, but no changes are made to the actual attenuator hardware setting until the input is changed back to the RF Input For CXA-m with option FSA (Fine-Step Attenuator or 2 dB steps), the FSA-like behavior is only available when the frequency setting is <= 7.5 GHz. So, when the frequency is changed from below 7.5 GHz to above 7.5 GHz, the attenuation setting will be changed to a multiple of 10 dB which will be no smaller than the previous setting. For example, 4 dB attenuation will be changed to 10 dB
Preset	The preset for Mech Attenuation is “Auto” The Auto value of attenuation is 10 dB `ON`
State Saved	Saved in instrument state
Min	0 dB The attenuation set by this control cannot be decreased below 6 dB with the knob or step keys. Values below 6 dB must be directly entered from the keypad or via SCPI. This protects against setting a dangerously small attenuation value, which can put the instrument at risk of damage to input circuitry. If the current mechanical attenuation is below 6 dB, it can be increased with the knob and step keys, but not decreased
Max	CXA Option 503 or 507: 50 dB EXA: 60 dB

	All other models: 70 dB Note that in the Single-Attenuator configuration, the total of ATT and EATT cannot exceed 50 dB. So, if the EATT is set to 24 dB first, the main attenuation cannot be greater than 26 dB and will be reduced accordingly; if the main attenuator is set to 40 dB first, EATT cannot be greater than 10 dB
Annotation	The current value for Total Atten is displayed in the Measurement Bar at the top of the display. A value appears for Electronic Attenuation only if the Electronic Attenuator is enabled. The annotation appears as Atten: <total> dB (e<elec>) The e letter is in amber in Single-Attenuator configurations For example: Dual-Attenuator configuration: Atten: 24 dB (e14) Indicating the total attenuation is at 24 dB and the electronic attenuation is at 14 dB Single-Attenuator configuration: A: 24 dB (e14) Indicating the total attenuation is at 24 dB and the “soft” attenuation is at 14 dB (see below for definition of “soft” attenuation) When in Manual, a # sign appears in front of Atten in the annotation

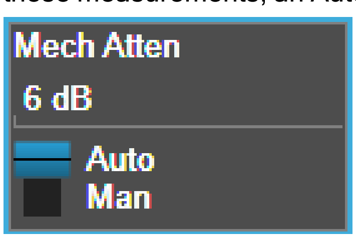
Attenuator Configurations and Auto/Man

As described under "Y Scale" on page 1929, there are two distinct attenuator configurations available in the X-Series, the single attenuator and Dual-Attenuator configurations. In Dual-Attenuator configurations, we have the mechanical attenuation and the electronic attenuation, and the current total attenuation is the sum of the electronic + mechanical attenuation. In Single-Attenuator configurations, we refer to the attenuation set using "Mech Atten" on page 893 (or `:POW:ATT`) as the “main” attenuation; and the attenuation that is set by `:POW:EATT` as the “soft” attenuation (`:POW:EATT` is honored even in the Single-Attenuator configuration, for compatibility purposes). Then the current total attenuation is the sum of the main + soft attenuation.

See "Elec Atten" on page 1937 for more about “soft” attenuation.

NOTE

In some measurements, the **Mech Atten** control has an Auto/Man function. In these measurements, an Auto/Man switch is shown on the **Mech Atten** control:



Note that in configurations that include an Electronic Attenuator, this switch is only shown when the Electronic Attenuator is disabled.

In other measurements, **Mech Atten** has no Auto/Man function. In these measurements, no switch is shown on the **Mech Atten** control:

Mech Atten also appears with no switch, as above, in configurations that include an Electronic Attenuator but when the Electronic Attenuator is enabled.

Elec Atten

Controls the Electronic Attenuator in Dual-Attenuator configurations. Does not appear in Single-Attenuator configurations, because the control of both the mechanical and electronic stages of the Single-Attenuator is integrated into the single **Atten** control.

This control includes an **Enable/Disable** toggle switch; it is only possible to enter a value for the Electronic Attenuator when this switch is in the **Enable** position.

For more details about the Electronic Attenuator, see "More Information" on page 897

Remote Command	`[:SENSe]:POWer[:RF]:EATTenuation <rel_ampl>`
	`[:SENSe]:POWer[:RF]:EATTenuation?`
	`[:SENSe]:POWer[:RF]:EATTenuation:STATe OFF | ON | 0 | 1`
	`[:SENSe]:POWer[:RF]:EATTenuation:STATe?`

Example	`:POW:EATT 10`
	`:POW:EATT?`
	`:POW:EATT:STAT ON`
	`:POW:EATT:STAT?`

Notes	Electronic Attenuation’s specification is defined only when Mechanical Attenuation is 6 dB
Dependencies	Only appears in Dual-Attenuator models with an Electronic Attenuator installed and licensed. Does not appear in models with the Single-Attenuator configuration, because in the Single-Attenuator configuration there is no “electronic attenuator”; there is only a single integrated attenuator (which has both a mechanical and electronic stage). However, in the Single-Attenuator configuration, EATT SCPI commands are accepted for compatibility with other X-series instruments, and set a “soft” attenuation. The “soft” attenuation is treated as an addition to the “main” attenuation value set by the **Attenuation** control or `:POW:ATT`, and affects the total attenuation displayed on the **Attenuation** control and the Meas Bar

	The electronic attenuator, and the "soft" attenuation function provided in Single-Attenuator configurations, are unavailable above the low band (0-3.6 GHz, 0-3.4 GHz, 0-3 GHz, depending on the model). If the low band range is from 0-3.6 GHz, and Stop Frequency of the instrument is > 3.6 GHz, then the **Enabled/Disabled** section of the **Elec Atten** control will be OFF and grayed-out If "Internal Preamp" on page 1959 is ON (that is, set to Low Band or Full), the electronic attenuator (and the "soft" attenuation function provided in Single-Attenuator configurations) is unavailable. In this case the **Enabled/Disabled** section of the **Elec Atten** control will be OFF and grayed-out If either of the above is true, and the SCPI command is sent, an error indicating that the electronic attenuator is unavailable is returned If both the above are true, pressing the control generates error message -221, in other words, the frequency range lockout takes precedence If the electronic/soft Attenuator is enabled, then the **Stop Freq** of the instrument is limited to 3.6 GHz and **Internal Preamp** is unavailable If "LNA" on page 1960 is ON, the electronic attenuator (and the "soft" attenuation function provided in Single-Attenuator configurations) is unavailable. In this case the **Enabled/Disabled** section of the **Elec Atten** control will be OFF and grayed-out. This coupling works in the following modes/measurements: – Channel Power, Occupied BW, ACP, SEM, Spurious Emissions, Power Stat CCDF measurements in all Modes – Transmit On|Off Power measurement in 5GNR Mode – Power vs. Time and Transmit Power measurement in GSM/EDGE Mode – Burst Power measurement in Spectrum Analyzer Mode The SCPI-only "soft" electronic attenuation for the single-attenuator configuration is not available in all measurements; in particular, it is not available in the Swept SA measurement
Couplings	Enabling and disabling the Electronic Attenuator affects the setting of the Mechanical Attenuator (in Dual-Attenuator configurations). This is described in more detail below and in "Mechanical Attenuator Transition Rules" on page 898
Preset	0 dB OFF (Disabled) for Swept SA measurement ON (Enabled) for all other measurements that support the electronic attenuator
State Saved	Saved in instrument state
Min	0 dB
Max	Dual-Attenuator configuration: 24 dB Single-Attenuator configuration: the total of ATT and EATT cannot exceed 50 dB. So, if the EATT is set to 24 dB first, the main attenuation cannot be greater than 26 dB and will be reduced accordingly; if the main attenuator is set to 40 dB first, EATT cannot be greater than 10 dB
Annotation	See Annotation under the **Mech Atten** control description

More Information

The electronic attenuator offers finer steps than the mechanical attenuator, has no acoustical noise, is faster, and is less subject to wear. These advantages primarily aid in remote operation and are negligible for front panel use. See "Using the Electronic Attenuator: Pros and Cons" on page 899 for a detailed discussion of the pros and cons of using the electronic attenuator.

For the Single-Attenuator configuration, for SCPI backwards compatibility, the “soft” attenuation feature replaces the Dual-Attenuator configuration’s electronic attenuator. All the same couplings and limitations apply. See "Attenuator Configurations and Auto/Man" on page 1937

Mechanical Attenuator Transition Rules

When the Electronic Attenuator is enabled, the Mechanical Attenuator transitions to a state that has no Auto function. Below are the rules for transitioning the Mechanical Attenuator. Note that the information below *only* applies to the Dual-Attenuator configurations, and *only* when the Electronic Attenuator is installed:

When the Electronic Attenuation is enabled from a disabled state:

- The Mechanical Attenuator is initialized to 10 dB (this is its optimal performance setting). You can then set it as desired with SCPI, numeric keypad, step keys, or knob, and it behaves as it normally would in manual mode
- The Auto/Man state of (Mech) Atten is saved
- The Auto/Man toggle on the (Mech) Atten control disappears, and the auto rules are disabled
- The Electronic Attenuator is set to 10 dB less than the previous value of the Mechanical Attenuator, within the limitation that it must stay within the range of 0 to 24 dB of attenuation

Examples in the Dual-Attenuator configuration:

- Mech Atten at 20 dB. Elec Atten enabled, Mech Atten set to 10 dB, and Elec Atten set to 10 dB. New total attenuation equals the value before Elec Atten enabled
- Mech Atten at 0 dB. Elec Atten enabled, Mech Atten set to 10 dB, and Elec Atten set to 0 dB. New total attenuation does not equal the value before Elec Atten enabled
- Mech Atten at 40 dB. Elec Atten enabled, Mech Atten set to 10 dB, and Elec Atten set to 24 dB. New total attenuation does not equal the value before Elec Atten enabled

When the Electronic Attenuation is disabled from an enabled state:

- The Elec Atten control is grayed out
- The Auto/Man state of (Mech) Atten is restored
- If now in Auto, (Mech) Atten recouples
- If now in Man, (Mech) Atten is set to the value of total attenuation that existed before the Elec Atten was disabled. The resulting value is rounded up to the smallest value possible given the (Mech) Atten Step setting - (That is, 57 dB changes to 58 dB when (Mech) Atten Step is 2 dB)

Using the Electronic Attenuator: Pros and Cons

The electronic attenuator offers finer steps than the mechanical attenuator, has no acoustical noise, is faster, and is less subject to wear.

The “finer steps” advantage of the electronic attenuator is beneficial in optimizing the alignment of the instrument dynamic range to the signal power in the front panel as well as remote use. Thus, you can achieve improved relative signal measurement accuracy. Compared to a mechanical attenuator with 2 dB steps, the 1 dB resolution of the electronic attenuator only gives better resolution when the odd-decibel steps are used. Those odd-decibel steps are less accurately calibrated than the even-decibel steps, so one tradeoff for this superior relative accuracy is reduced absolute amplitude accuracy.

Another disadvantage of the electronic attenuator is that the spectrum analyzer loses its “Auto” setting, making operation less convenient.

Also, the relationship between the dynamic range specifications (TOI, SHI, compression, and noise) and instrument performance are less well-known with the electrical attenuator. With the mechanical attenuator, TOI, SHI, and compression threshold levels increase dB-for-dB with increasing attenuation, and the noise floor does as well. With the electronic attenuator, there is an excess attenuation of about 1 to 3 dB between 0 and 3.6 GHz, making the effective TOI, SHI, and so forth, less well known. Excess attenuation is the actual attenuation relative to stated attenuation. Excess attenuation is accounted for in the instrument calibration.

Adjust Atten for Min Clipping

Sets the combination of mechanical and electronic attenuation and gain based on the current measured signal level so that clipping will be at a minimum.

This is an immediate action function, that is, it executes once, when the control is pressed.

The algorithms that are used for the adjustment are documented under "Pre-Adjust for Min Clipping" on page 1942.

Remote Command	`[:SENSe]:POWer[:RF]:RANGe:OPTimize IMMediate`
Example	`:POW:RANG:OPT IMM`
Notes	Executing **Adjust Atten for Min Clipping** initiates the measurement
Dependencies	Does not appear in the Swept SA, RTSA, Monitor Spectrum and Complex Spectrum measurements Appears in the Waveform measurement in 5G NR Mode only

Adjust Atten

Allows you to select;

- Electric attenuator only
- Combination of Electric attenuator and Mechanical attenuator

when `[:SENSe]:POWer[:RF]:RANGe:OPTimize IMMediate` is executed.

Remote Command	`[:SENSe]:POWer[:RF]:RANGe:OPTimize:TYPE EONLy | COMBined` `[:SENSe]:POWer[:RF]:RANGe:OPTimize:TYPE?`
Example	`:POW:RANG:OPT:TYPE EONL` `:POW:RANG:OPT:TYPE?`
Dependencies	Does not appear in the Swept SA, RTSA, Monitor Spectrum and Complex Spectrum measurements Appears in the Waveform measurement in 5G NR Mode only
Preset	`COMBined`
State Saved	Saved in instrument state

Pre-Adjust for Min Clipping

If this function is `ON`, it applies the adjustment described under "Adjust Atten for Min Clipping" on page 1941 each time a measurement restarts. Therefore, in Continuous measurement mode, it only executes before the first measurement.

In Dual-Attenuator models, you can set **Elec+Mech Atten**, in which case both attenuators participate in the autoranging, or **Elec Atten Only**, in which case the mechanical attenuator does not participate in the autoranging. This latter case results in less wear on the mechanical attenuator and is usually faster.

See "Adjustment Algorithm" on page 901

Selection	SCPI	Note
Off	`OFF`	This is the default setting
On	`ON`	Available in Single-Attenuator instruments. For compatibility with models that do not have an input attenuator, the `ON` parameter is supported and mapped to `COMBined`

Selection	SCPI	Note
Elec Atten Only	ELECtrical	Selects only the electric attenuator to participate in auto ranging. This offers less wear on the mechanical attenuator and is usually faster
Elec+Mech Atten	COMBined	In Dual-Attenuator models, this selects both attenuators to participate in the autoranging

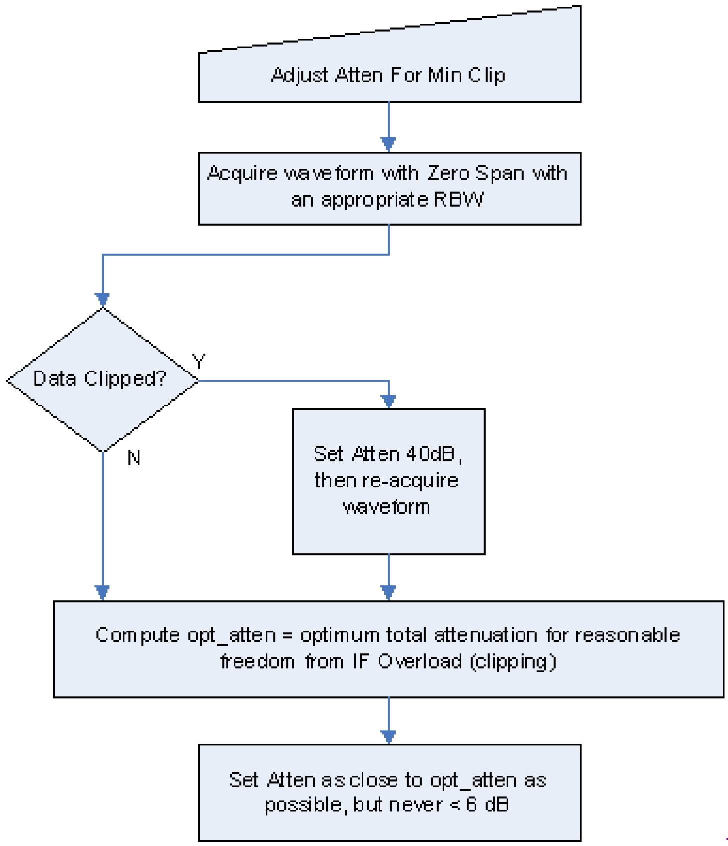
Remote Command	[:SENSe]:POWer[:RF]:RANGe:OPTimize:ATTenuation OFF | ON | ELECtrical | COMBined [:SENSe]:POWer[:RF]:RANGe:OPTimize:ATTenuation?
Example	:POW:RANG:OPT:ATT OFF :POW:RANG:OPT:ATT?
Notes	The parameter option ELECtrical sets this function to ON in Single-Attenuator models The parameter option COMBined is mapped to ELECtrical in Single-Attenuator models. If you send COMBined, it sets the function to ON and returns ELEC to a query For SCPI compatibility with models that do not have an input attenuator, the ON parameter is honored and mapped to COMBined
Dependencies	Only appears in Dual-Attenuator models with an Electronic Attenuator installed In instruments with Dual-Attenuator model, when "Elec Atten" on page 1937 is OFF or grayed-out, "Pre-Adjust for Min Clipping" on page 900 is grayed-out Does not appear in the Swept SA, RTSA, Monitor Spectrum and Complex Spectrum measurements For the Waveform measurement, available only in 5G NR Mode
Preset	OFF when Elec Atten is Disabled at preset, otherwise ELEC
State Saved	Saved in instrument state
Range	Dual-Attenuator models: Off | Elec Atten Only | Mech + Elec Atten Single-Attenuator models: Off | On

Notes	ON aliases to "Elec Atten Only" (:POW:RANG:OPT:ATT ELEC) OFF aliases to "Off" (:POW:RANG:OPT:ATT OFF) :POW:RANG:AUTO? returns true if :POW:RANG:OPT:ATT is not OFF
Backwards Compatibility SCPI	[:SENSe]:POWer[:RF]:RANGe:AUTO ON | OFF | 1 | 0 [:SENSe]:POWer[:RF]:RANGe:AUTO?

Adjustment Algorithm

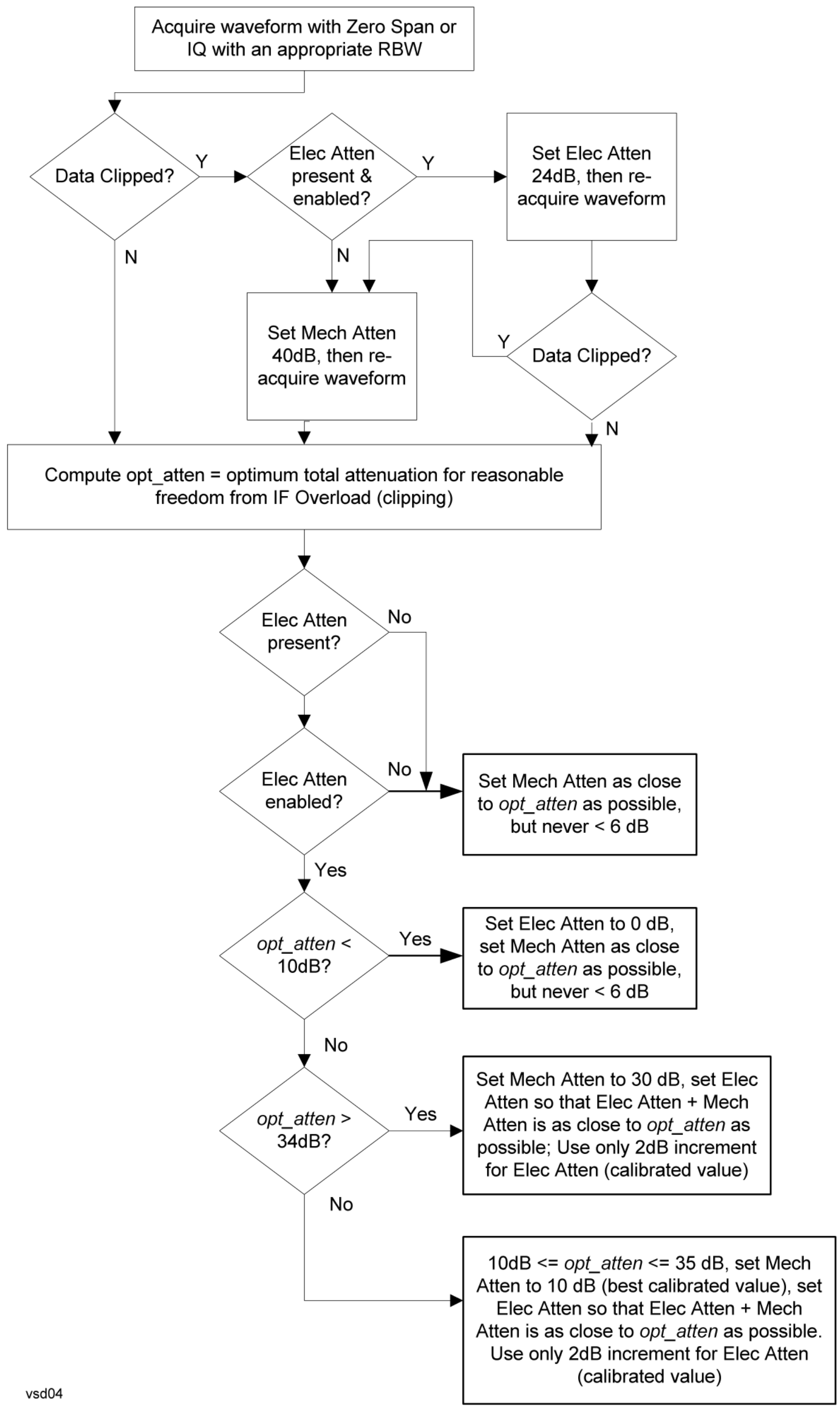
The algorithms for the adjustment are documented below:

Single-Attenuator Models



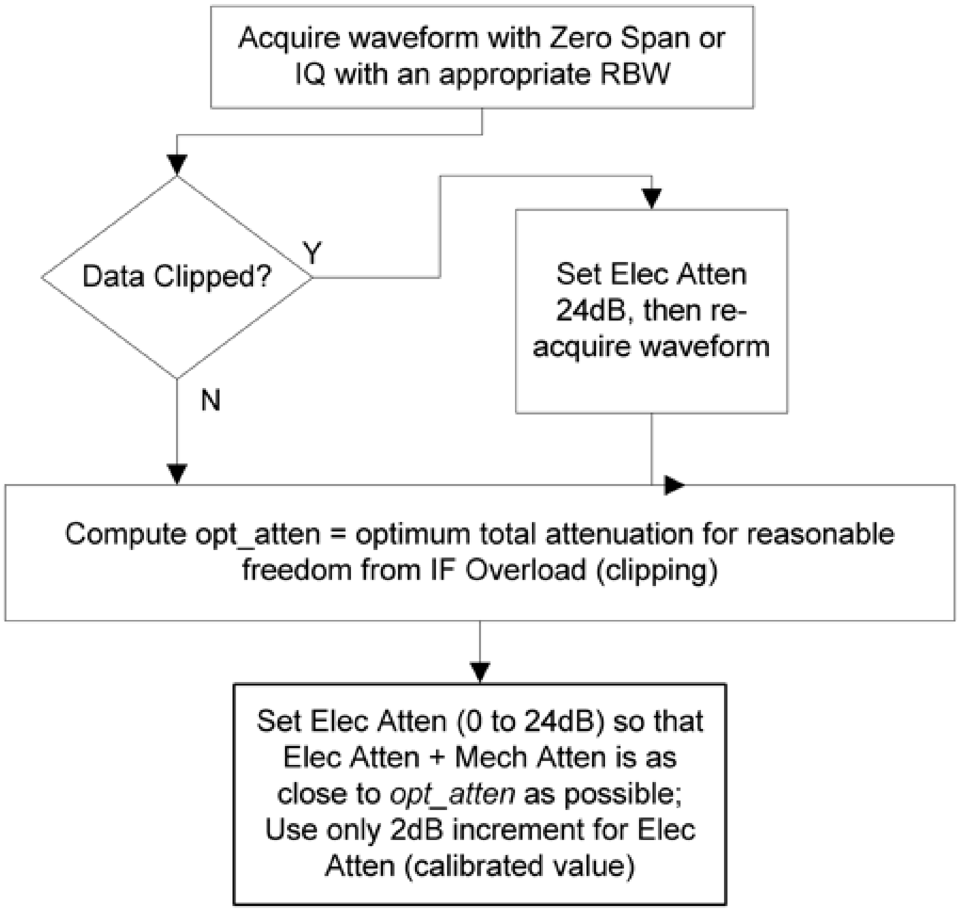
Dual-Attenuator models

"Adjust Atten for Min Clipping" on page 1941 or "Pre-Adjust for Min Clipping" on page 900 selection is Mech + Elec Atten:


Acquire waveform with Zero Span or IQ with an appropriate RBW
Data Clipped?
Y
N
Elec Atten present & enabled?
Y
N
Set Elec Atten 24dB, then re-acquire waveform
Set Mech Atten 40dB, then re-acquire waveform
Y
Data Clipped?
N
Compute opt_atten = optimum total attenuation for reasonable freedom from IF Overload (clipping)
Elec Atten present?
No
Elec Atten enabled?
No
Set Mech Atten as close to opt_atten as possible, but never < 6 dB
Yes
opt_atten < 10dB?
Yes
Set Elec Atten to 0 dB, set Mech Atten as close to opt_atten as possible, but never < 6 dB
No
opt_atten > 34dB?
Yes
Set Mech Atten to 30 dB, set Elec Atten so that Elec Atten + Mech Atten is as close to opt_atten as possible; Use only 2dB increment for Elec Atten (calibrated value)
No
10dB <= opt_atten <= 35 dB, set Mech Atten to 10 dB (best calibrated value), set Elec Atten so that Elec Atten + Mech Atten is as close to opt_atten as possible. Use only 2dB increment for Elec Atten (calibrated value)
vsd04

"Pre-Adjust for Min Clipping" on page 900 selection is Elec Only.

Note that the **Mech Atten** value is not adjusted, and the value previously set is used. Therefore, there is a case that IF Overload is still observed depending on the input signal level and the Mech Atten setting.



Mech Atten Step

Controls the step size used when making adjustments to the input attenuation.

Labeled **Mech Atten Step** in Dual-Attenuator models and **Atten Step** in Single-Attenuator models. In the Dual-Attenuator configuration, only affects the step size of the mechanical attenuator.

Remote Command	`[:SENSe]:POWer[:RF]:ATTenuation:STEP[:INCRement] 10 dB | 2 dB`

	`[:SENSe]:POWer[:RF]:ATTenuation:STEP[:INCRement]?`
Example	`:POW:ATT:STEP 2` `:POW:ATT:STEP?`
Notes	Has a toggle control on the front panel, but takes a specific value (in dB) when used remotely. The only valid values are 2 and 10
Dependencies	Blanked in EXA, CXA and CXA-m if option FSA (2 dB steps) is not present. If blanked, attempts to set it via SCPI yield an error
Couplings	When the attenuation step size changes, the current mechanical attenuation value is adjusted (if necessary) to be quantized to the new step size. That is, if step is set to 10 dB, mech atten is increased if necessary so it is a multiple of 10 dB
Preset	EXA, CXA and CXA-m: 10 dB (2 dB with option FSA) All other models: 2 dB
State Saved	Saved in instrument state

Max Mixer Level

Allows you to set the maximum level to be applied to the mixer for a signal at the top of the screen. By setting this value up or down you can allow more or less signal through the system.

The major impact of changes to **Max Mixer Level** is seen in changes to the value to which **Reference Level** is limited. Max Ref Level depends on Max Mixer Level and Attenuation, and therefore a higher Max Mixer Level may let you set Ref Level higher. However, changing this value can impact your TOI, compression, or dynamic range. The preset value of this function is best for most measurements.

See also "Max Mixer Lvl Rules" on page 1948.

Remote Command	`[:SENSe]:POWer[:RF]:MIXer:RANGe[:UPPer] <real>` `[:SENSe]:POWer[:RF]:MIXer:RANGe[:UPPer]?`
Example	`:POW:MIX:RANG -15 dBm` `:POW:MIX:RANG?`
Dependencies	Only appears in Swept SA and RTSA measurements
Preset	-10 dBm
State Saved	Saved in instrument state
Min	-50 dBm
Max	0 dBm

Max Mixer Lvl Rules

Allows you to optimize the Max Mixer Level setting for certain kinds of measurements.

NORMal	The historical, and thus backwards compatible, setting range (–50 to 0 dBm) and default setting (–10 dBm). The instrument has been designed so that, at the default setting, any signal below the Reference Level is extremely unlikely to create ADC overloads. At this mixer level the scale fidelity will be within specifications, thus compression with be negligible
TOI	Allows a range of settings of the "Max Mixer Level" on page 1947, –50 to –10 dBm, that can be optimum for measurements limited by the instrument third-order dynamic range. The default setting, –25 dBm, is commonly appropriate but RBW affects this. A good setting for Max Mixer Level would be higher than the optimum mixer level by half of the attenuator step size
COMPression	Allows a range of settings of the Max Mixer Level, –10 to +10 dBm or more, that can be optimum for measurements limited by the tradeoffs between instrument accuracy due to compression, and dynamic range due to the noise floor. The default setting, –3 dBm, is commonly appropriate, representing mixer drive levels that cause 1 dB or less compression at most carrier frequencies Typical measurements that would be optimized by this setting are the measurement of low sideband levels, including nulls, in angle-modulated signals (FM and PM). Also pulsed-RF measurements, including finding nulls to estimate pulse width, which are often best done with significant overdrive (compression) of the front end

Setting Name (readback)	Setting Name (verbose)	Max Mixer Level Preset Value, dBm	Max Mixer Level minimum value, dBm	Max Mixer Level maximum value, dBm
NORMal	Normal – balance TOI, noise, and compression	–10	–50	0
TOI	TOI-limited dynamic range	–25	–50	–10
COMPression	Compression-limited dynamic range	–3	–10	+30

Remote Command	[:SENSe]:POWer[:RF]:MIXer:RULEs NORMal | TOI | COMPression [:SENSe]:POWer[:RF]:MIXer:RULEs?
Example	:POW:MIX:RULE:COMP
Dependencies	Only appears in the Swept SA and RTSA measurements
Preset	NORM

3.5.8.3 Range (Non-attenuator models)

Only available for Keysight's modular signal analyzers and certain other Keysight products, such as VXT

State Saved	No

Range

Represents the amplitude of the largest sinusoidal signal that could be present within the IF without being clipped by the ADC. For signals with high peak-to-average ratios, the range may need to exceed the rms signal power by a significant amount to avoid clipping.

This is a measurement global setting.

Remote Command	`[:SENSe]:POWer[:RF]:RANGe <real>` `[:SENSe]:POWer[:RF]:RANGe?`
Example	`:POW:RANG 10 dBm` `:POW:RANG?`
Notes	The MIN and MAX values are affected by the External Gain parameters, and by the **Center Frequency** The hardware compensates for frequency response and alters the Range setting
Preset	0 dBm
State Saved	Yes
Min	-100
Max	100
Annotation	Meas Bar

Adjust Range for Min Clipping

Sets the combination of attenuation and gain based on the current measured signal level so that clipping will be at a minimum.

This is an "immediate action" function, that is, it executes once, when the key is pressed.

This key does not appear in measurements that do not support this functionality.

Remote Command	`[:SENSe]:POWer[:RF]:RANGe:OPTimize IMMediate`
Notes	Executing Adjust Range for Min Clipping initiates the measurement
Dependencies	Does not appear in the Swept SA and Monitor Spectrum measurements

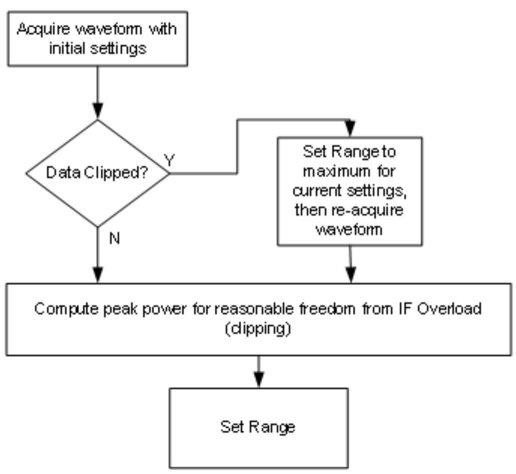
Pre-Adjust for Min Clipping

If this function is ON, it applies the adjustment described under Adjust Range For Min Clipping each time a measurement restarts. Therefore, in Continuous measurement mode, it only executes before the first measurement.

Remote Command	`[:SENSe]:POWer[:RF]:RANGe:OPTimize:ATTenuation OFF | ON | ELECtrical | COMBined` `[:SENSe]:POWer[:RF]:RANGe:OPTimize:ATTenuation?`
Notes	Because there is no attenuator control available in these models, the control displays only ON and OFF choices. However, for SCPI compatibility with other platforms, all three parameters (`ELECtrical`, `COMBined`, and ON) are honored and all are mapped to `ELECtrical`, so if any of these three parameters is sent, a subsequent query will return ELEC
Dependencies	Does not appear in the Swept SA and Monitor Spectrum measurements
Preset	OFF for Swept SA measurement; ON for all other measurements that support **Pre-Adjust for Min Clipping**
State Saved	Saved in instrument state

Adjustment Algorithm

The algorithm for the adjustment is documented below:



Peak-to-Average Ratio

Used with "Range (Non-attenuator models)" on page 1953 to optimize the level control in the instrument. The value is the ratio, in dB, of the peak power to the average power of the signal to be measured. A ratio of 0 should be used for sinusoidal signals; for 802.11g OFDM signals use 9 dB.

All Modes show the current value of Peak-to-Average ratio on the control. However, some Modes do not permit changing the value. In these situations, the control is grayed-out.

Remote Command	`[:SENSe]:POWer[:RF]:RANGe:PARatio <real>` `[:SENSe]:POWer[:RF]:RANGe:PARatio?`
Example	`:POW:RANG:PAR 12 dB`
Notes	In some Modes, this parameter is read-only; meaning the value will appear on the control and query via SCPI, but is not changeable. In such applications the control is grayed-out. Attempting to change the value via SCPI will be ignored but no error message will be generated
Dependencies	Does not appear in Spectrum Analyzer Mode
Preset	10 dB VXT Models M9410A/11A: 0 dB
State Saved	Saved in instrument state
Min	0 dB
Max	20 dB VXT Models M9410A/11A: 50 dB

Mixer Lvl Offset

This is an advanced setting to adjust target Range at the input mixer, which in turn affects the signal level in the instrument's IF. This setting can be used when additional optimization is needed after setting "Peak-to-Average Ratio" on page 1955. Positive values of offset optimize noise performance over distortion, negative values optimize distortion performance over noise.

Remote Command	`[:SENSe]:POWer[:RF]:RANGe:MIXer:OFFSet <real>` `[:SENSe]:POWer[:RF]:RANGe:MIXer:OFFSet?`
Example	`:POW:RANG:MIX:OFFS -5 dB`
Preset	0 dB
State Saved	Saved in instrument state
Min	-35 dB VXT Models M9410A/11A: -34 dB
Max	30 dB

3.5.8.4 Signal Path

Contains controls that pertain to the routing of the signal through the frontend of the instrument.

In general, only appears in instruments whose hardware supports this signal routing. For example, this tab does not appear in many of the modular instrument products, including VXT Model M9421A, or UXM.

This tab *does* appear in VXT Models M9410A/11A, because "Software Preselection" on page 1971 is under this tab, and VXT Models M9410A/11A implement a version of Software Preselection.

Presel Center

Adjusts the centering of the preselector filter to optimize the amplitude accuracy at the frequency of the selected marker. If the selected marker is not on when **Presel Center** is pressed, the instrument turns on the selected marker, performs a peak search, and then performs centering on the marker's center frequency. If the selected marker is already on and between the start and stop frequencies of the instrument, the instrument performs the preselector calibration on that marker's frequency. If the selected marker is already on, but outside the frequency range between **Start Freq** and **Stop Freq**, the instrument first performs a peak search, and then performs centering on the marker's center frequency.

The value displayed on "Preselector Adjust" on page 1958 changes to reflect the new preselector tuning.

Certain considerations should be observed to ensure proper operation, as detailed in "Proper Preselector Operation" on page 911.

Remote Command	`[:SENSe]:POWer[:RF]:PCENter`
Example	`:POW:PCEN`
Notes	The rules outlined above under the control description apply for the remote command as well as the key. The result of the command depends on marker position, etc. Any message generated by the control press is also generated in response to the remote command
Dependencies	Does not appear in CXA-m, nor in VXT Models M9410A/11A Grayed-out if the microwave preselector is off – If the selected marker's frequency is below Band 1, an advisory message is generated "Preselector not used in this frequency range" and no action is taken – Grayed-out if entirely in Band 0, that is, if **Stop Freq** is below about 3.6 GHz Grayed-out if entirely above 50 GHz, that is, if **Start Freq** is above 50 GHz – Blanked in models that do not include a preselector, such as Option 503. If the remote command is sent in these instruments, accepted without error, and the query always returns 0 – Grayed-out in the Spectrogram View
Couplings	The active marker position determines where the centering will be attempted If the instrument is in a measurement such as averaging when centering is initiated, the act of centering the preselector restarts averaging, but the first average trace will not be taken until the centering is completed

	The offset applied to do the centering appears in "Preselector Adjust" on page 1958
Status Bits/OPC dependencies	When centering the preselector, `*OPC` does not return true until the process is complete and a subsequent measurement has completed, nor are results returned in response to `:READ` or `:MEASure` queries The `Measuring` bit remains set (true) while this command is operating, and does not go false until the subsequent sweep/measurement has completed

Proper Preselector Operation

Certain considerations should be observed to ensure proper operation:

1. If the selected marker is **Off**, the instrument turns on a marker, performs a peak search, and adjusts the preselector using the selected marker's frequency. It uses the "highest peak" peak search method unqualified by threshold or excursion, so that there is no chance of a 'no peak found' error. It continues with that peak, even if it is the peak of just noise. Therefore, for this operation to work properly, there should be a signal on-screen in a preselected range for the peak search to find
2. If the selected marker is already **On**, the instrument attempts the centering at that marker's frequency. There is no preselector for signals below about 3.6 GHz, so if the marker is on a signal below 3.6 GHz, no centering is attempted, and an advisory message is generated
3. In some models, the preselector can be bypassed. If it is bypassed, no centering is attempted in that range and a message is generated

Preselector Adjust

Lets you manually adjust the preselector filter frequency to optimize its response to the signal of interest. Only available when "Presel Center" on page 1956 is available.

For general purpose signal analysis, using **Presel Center** is recommended. Centering the filter minimizes the impact of long-term preselector drift. **Preselector Adjust** can be used instead to manually optimize the preselector. One application of manual optimization would be to peak the preselector response, which both optimizes the signal-to-noise ratio and minimizes amplitude variations due to small (short-term) preselector drifting.

When **Presel Center** is performed, the offset applied to do the centering becomes the new value of **Preselector Adjust**.

Remote Command	`[:SENSe]:POWer[:RF]:PADJust <freq>` `[:SENSe]:POWer[:RF]:PADJust?`
Example	`:POW:PADJ 100KHz` `:POW:PADJ?`

Notes	The value on the control is displayed to 0.1 MHz resolution
Dependencies	– Does not appear in CXA-m – Does not appear in VXT Models M9410A/11A – Grayed-out if microwave preselector is off – Grayed-out if entirely in Band 0, that is, if Stop Freq is lower than about 3.6 GHz – Grayed-out if entirely above 50 GHz, that is, if Start Freq is higher than 50 GHz – Blank in models that do not include a preselector, such as Option 503. If the command is sent in these instruments, it is accepted without error, and the query always returns 0 – Grayed-out in the Spectrogram View
Preset	0 MHz
State Saved	The **Preselector Adjust** value set by "Presel Center" on page 1956, or by manually adjusting **Preselector Adjust** Not saved in instrument state, and does not survive a Preset or power cycle
Min	-500 MHz
Max	500 MHz
Backwards Compatibility SCPI	`[:SENSe]:POWer[:RF]:MW:PADJust` `[:SENSe]:POWer[:RF]:MMW:PADJust`

Notes	The command has no effect, and the query always returns `MWAVe`
Backwards Compatibility SCPI	`[:SENSe]:POWer[:RF]:PADJust:PRESelector MWAVe | MMWave | EXTernal` `[:SENSe]:POWer[:RF]:PADJust:PRESelector?`

Internal Preamp

Accesses a menu of controls for the internal preamps. Turning on the preamp gives a better noise figure, but a poorer inter-modulation distortion (TOI) to noise floor dynamic range. You can optimize this setting for your measurement.

The instrument takes the preamp gain into account as it sweeps. If you sweep outside of the range of the preamp, the instrument will also account for that. The displayed result always reflects the correct gain.

For some measurements, when the preamp is on and any part of the displayed frequency range is below the lowest frequency for which the preamp has specifications, a warning condition message appears in the status line. For example, for a preamp with a 9 kHz lowest specified frequency: "Preamp: Accy unspec’d below 9 kHz".

Selection	Example	Note
Off	`:POW:GAIN OFF`	
Low Band	`:POW:GAIN ON` `:POW:GAIN:BAND LOW`	Sets the internal preamp to use only the low band. The frequency range of the installed (optional) low-band preamp is displayed in square brackets on the Low Band selection in the dropdown
Full Range	`:POW:GAIN ON` `:POW:GAIN:BAND FULL`	Sets the internal preamp to use its full range. The low band (0-3.6 GHz, 0-3.4 GHz, 0-3 GHz, depending on the model) is supplied by the low band preamp and the frequencies above low band are supplied by the high band preamp The frequency range of the installed (optional) low-band preamp is displayed in square brackets on the Full Range selection in the dropdown. If the high band option is not installed the Full Range selection does not appear

NOTE The maximum **Center Frequency** for Low Band, displayed in square brackets, can change based on the selected IFBW for measurements that support IFBW (for example, Waveform measurement across all Modes that support it). In certain models (such as N9042B & N9032B), IFBW values <= 40 MHz have a maximum Low Band frequency of 3.6 GHz, while 40 MHz < IFBW <= 1 GHz have a maximum of 3.3 GHz, and 1 GHz < IFBW <= 1.5 GHz have a maximum of 3.5 GHz. IFBW values > 1.5 GHz do not support a **Center Frequency** that can reach the Low Band maximum frequency. In these cases, **N/A** is displayed in the square brackets for Low Band.

Remote Command	`[:SENSe]:POWer[:RF]:GAIN:BAND LOW | FULL`
	`[:SENSe]:POWer[:RF]:GAIN:BAND?`
	`[:SENSe]:POWer[:RF]:GAIN[:STATe] OFF | ON | 0 | 1`
	`[:SENSe]:POWer[:RF]:GAIN[:STATe]?`

Example	`:POW:GAIN:BAND LOW`
	`:POW:GAIN:BAND?`
	`:POW:GAIN OFF`
	`:POW:GAIN?`

Dependencies	Not available on all hardware platforms. If the preamp is not present or is unlicensed, this control is not shown Does not appear in VXT Models M9410A/11A/15A/16A If `:POW:GAIN:BAND FULL` is sent when a low band preamp is available, the preamp band parameter is set to `LOW` instead of `FULL`, and an "Option not installed" message is generated Not available when the electronic/soft attenuator is enabled
Preset	`LOW`

	OFF
State Saved	Saved in instrument state
Annotation	When the USB Preamp is not connected to USB, the Preamp annotation in the Meas Bar says "Off" if the preamp is off and displays the frequency range of the low band or full range preamp depending on the setting. For example, if the Preamp is set to Low Band and the Low Band is 3.6 GHz the annotation says "3.6 GHz". If it is a 13.6 GHz preamp and it is set to Full Range the annotation says "13.6 GHz" When the USB Preamp is connected to USB, the Preamp annotation says "Preamp: USB" if the internal preamp is off or "Preamp: USB, Int" if the internal preamp is on (only for measurements that support the USB preamp)

LNA

Lets you turn the Low Noise Amplifier (**LNA**) on or off.

LNA is an additional preamplifier that provides superior DANL and frequency range compared to "Internal Preamp" on page 1959. LNA provides lower system noise figure, especially at frequencies above 100 MHz, and can be operated up to the full range of 50 GHz instruments.

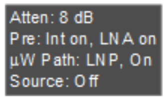
For best possible sensitivity, **LNA** can be turned on *together* with "Internal Preamp" on page 1959, although if you operate both preamps together, note that the TOI (distortion) specifications are impacted. The sensitivity improvement of this combination is substantial when operating in high band (frequencies above 3.6 GHz).

For more details about annotation, see "More Information" on page 914

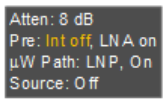
Remote Command	`[:SENSe]:POWer[:RF]:GAIN:LNA[:STATe] OFF | ON | 0 | 1` `[:SENSe]:POWer[:RF]:GAIN:LNA[:STATe]?`
Example	`:POW:GAIN:LNA ON`
Dependencies	Requires Option LNA, except for VXT models M9415A/16A Does not appear in VXT models M9421A/10A/11A May not appear in some measurements **LNA** is not available when the electronic/soft attenuator is enabled
Preset	OFF
State Saved	Saved in State

More Information

When **LNA** is installed, the preamp annotation changes to show the state of both **LNA** and **Internal Preamp**. Below is an example:



Note that when operating entirely in the low band (below about 3.6 GHz), if **LNA** is on, **Internal Preamp** is switched off (even if you have its switch set to ON). This is because the noise performance is actually degraded in low band if both preamps are on. In this case, the annotation reflects the actual state of the two preamps, but the **Internal Preamp** annotation displays in amber, to warn you that the actual state of **Internal Preamp** does not match its switch control display:



µW Path Control

Options for this control include **µW Preselector Bypass** (Option MPB), **Low Noise Path** (Option LNP) and **Full Bypass Enable** in the High Band path circuits.

When the µW Preselector is bypassed, flatness is improved, but will be subject to spurs from out of band interfering signals. When **Low Noise Path Enable** is selected, the instrument automatically bypasses certain circuitry in the high frequency bands that can contribute to noise, when it is appropriate based on other instrument settings.

For most applications, the preset state is **Standard Path**, which provides the best remote-control throughput, minimizes acoustic noise from switching and minimizes the risk of wear in the hardware switches, particularly in remote test scenarios where both low band and high band setups will follow in rapid succession. In this path, the bypass of the low band/high band switch and microwave preamp is never activated, which can cause some noise degradation but preserves the life of the bypass switch.

For applications that utilize the wideband IF paths, the preset state is **µW Preselector Bypas**s, if option MPB is present. This is because, when using a wideband IF such as the 140 MHz IF, the µW Preselector's bandwidth can be narrower than the available IF bandwidth, causing degraded amplitude flatness and phase linearity, so it is desirable to bypass the preselector in the default case.

You may choose **Low Noise Path Enable** for a lower noise floor, especially in the 21-26.5 GHz region, though without improving many measures of dynamic range, and without giving the best possible noise floor. The preamp, if purchased and used, gives better noise floor than does **Low Noise Path Enable**, but the preamp's compression threshold and third-order intercept are much poorer than that of **Low Noise Path Enable**.

A fourth choice is **Full Bypass Enable**, which combines **µW Preselector Bypass** and **Low Noise Path Enable**. Because this can bypass most of the circuitry between the

input and the first mixer, care should be taken when using this setting to avoid damaging the mixer. **Full Bypass Enable** is only available if both options LNP and MPB are present, as well as option FBP.

Path	Example	Note
Standard Path	`:POW:MW:PATH STD`	Normal setting for most measurements. µW Preselector in circuit, Low Noise Path disabled
Low Noise Path Enable	`:POW:MW:PATH LNP`	See "Low Noise Path Enable" on page 919
µW Preselector Bypass	`:POW:MW:PATH MPB`	See "µW Preselector Bypass" on page 921
Full Bypass Enable	`:POW:MW:PATH FULL`	See "Full Bypass Enable" on page 922

Remote Command	`[:SENSe]:POWer[:RF]:MW:PATH STD | LNPath | MPBypass | FULL` `[:SENSe]:POWer[:RF]:MW:PATH?`

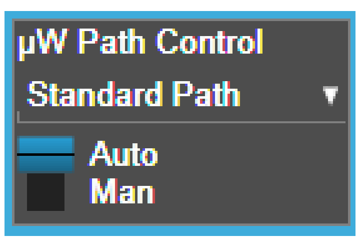
Example	`:POW:MW:PATH LNP`
	Enables the Low Noise path
	`:POW:MW:PATH?`

Notes	If "Presel Center" on page 1956 is performed, the instrument will momentarily switch to the Standard Path, regardless of the setting of **µW Path Control** The DC Block will always be switched in when the low noise path is switched in, to protect succeeding circuitry from DC. Note that this does not mean “when the low noise path is enabled” but when, based on the Low Noise Path rules, the path is actually switched in. This can happen when the selection is **Low Noise Path Enable** or **Full Bypass Enable**. In the case where the DC Block is switched in the instrument is now AC coupled. However, if you selected DC coupling, the UI would still behave as though it were DC coupled, including all annunciation, warnings, status bits, and responses to SCPI queries. This is because, based on other settings, the instrument could switch out the low noise path at any time and hence go back to being DC coupled Alignment switching ignores the settings in this menu, and restores them when finished
Dependencies	Does not appear in CXA-m, VXT Models M9410A/11A, nor in BBIQ and External Mixing – The **Low Noise Path Enable** selection does not appear unless Option LNP is present and licensed – The **µW Preselector Bypass** selection does not appear unless Option MPB is present and licensed – The **Full Bypass Enable** selection does not appear unless options LNP and MPB are both present as well as option FBP In any of these cases, if the required options are not present and the SCPI command is sent, error -241, "Hardware missing; Option not installed" is generated **Low Noise Path Enable** and **Full Bypass Enable** are grayed-out if the current measurement does not support them **Low Noise Path Enable** and **Full Bypass Enable** are not supported in Avionics and MMR Modes (non-modulation measurements). In any of these cases (that is, the feature is not supported in either measurement or Mode), if the SCPI command is sent, the following error is generated: -221, “Setting Conflict; Feature not supported for this measurement”

<table>
<tr><td>Preset</td><td><table><tr><th>Mode</th><th>Value</th></tr><tr><td>IQ Analyzer
Pulse
Avionics</td><td>MPB option present and licensed: <code>MPB</code>
MPB option not present and licensed: <code>STD</code></td></tr><tr><td>All other Modes</td><td><code>STD</code></td></tr></table></td></tr>
<tr><td>State Saved</td><td>Save in instrument state</td></tr>
<tr><td>Range</td><td>Standard Path | Low Noise Path Enable | µW Presel Bypass | Full Bypass Enable</td></tr>
<tr><td>Annotation</td><td>In the Meas Bar, if the Standard path is chosen:
µW Path: Standard
If Low Noise Path is enabled but the LNP switch is not thrown:
µW Path: LNP,Off
If the Low Noise Path is enabled and the LNP switch is thrown:
µW Path: LNP,On
If the preselector is bypassed:
µW Path: Bypass
If Full Bypass Enable is selected but the LNP switch is not thrown:
µW Path: FByp,Off
If Full Bypass Enable is selected and the LNP switch is thrown:
µW Path: FByp,On</td></tr>
</table>

µW Path Control Auto

In VMA, WLAN, 5G NR, CQM Modes, an **Auto/Man** switch is added to **µW Path Control**:



This allows the function to automatically switch based on certain Auto Rules as shown below:

VMA Mode

Measurement	When µW Path Control is in Auto
Digital Demod	Use Standard Path unless tuned frequency > 3.6 GHz and IFBW > 15 MHz, in which case choose Preselector Bypass
Monitor Spectrum	Always Presel Bypass

Measurement	When µW Path Control is in Auto
IQ Waveform	Use Standard Path unless tuned frequency > 3.6 GHz and IFBW > 15 MHz, in which case choose Preselector Bypass
Custom OFDM	Use Standard Path unless tuned frequency > 3.6 GHz and IFBW > 15 MHz, in which case choose Preselector Bypass
Channel Power	Always Presel Bypass
Occupied BW	Always Presel Bypass
CCDF	Use Standard Path unless tuned frequency > 3.6 GHz and IFBW > 15 MHz, in which case choose Preselector Bypass
ACP	Always Presel Bypass
SEM	Always Presel Bypass
Spurious Emissions	Always Standard Path

WLAN Mode

Measurement	When µW Path Control is in Auto
Modulation Analysis	Always Presel Bypass
Spectral Flatness	Always Presel Bypasss
Power vs Time	Always Presel Bypass
Monitor Spectrum	Always Presel Bypass
IQ Waveform	Always Presel Bypass
Channel Power	Always Presel Bypass
Occupied BW	Always Presel Bypass
CCDF	Always Presel Bypass
SEM	For 11be 320M, when ‘Enabled Wideband IF for FFT’ is OFF or ‘Sweep Type Rule’ is Best Dynamic Range, auto µW path is standard For other cases, auto µW path is presel bypass if presel bypass is enabled, auto µW path is standard if presel bypass is not enabled
Spurious Emissions	Always Standard Path

5G NR Mode

Measurement	When µW Path Control is in Auto
Modulation Analysis	Use Standard Path unless tuned frequency > 3.6 GHz and IFBW > 15 MHz, in which case choose Full Bypass if conditions warrant(FBP Option is available and “Allow Full Bypass in Auto” is On), otherwise choose Preselector Bypass
Monitor Spectrum	Always Standard Path
IQ Waveform	Use Standard Path unless tuned frequency > 3.6 GHz and IFBW > 15 MHz, in which case choose Full Bypass if conditions warrant(FBP Option is available and

Measurement	When µW Path Control is in Auto
	"Allow Full Bypass in Auto" is On), otherwise choose Preselector Bypass
Channel Power	Always Standard Path
Occupied BW	Always Standard Path
CCDF	Use Standard Path unless tuned frequency > 3.6 GHz and IFBW > 15 MHz, in which case choose Preselector Bypass
ACP	Always Standard Path
SEM	Always Standard Path
Spurious Emissions	Always Standard Path
Transmit On|Off Power	Use Standard Path unless tuned frequency > 3.6 GHz and Info BW > 15 MHz, in which case choose Preselector Bypass

Channel Quality Mode

Measurement	When µW Path Control is in Auto
Group Delay	Use Standard Path unless tuned frequency > 3.6 GHz and IFBW > 15 MHz, in which case choose Full Bypass if conditions warrant(FBP Option is available and "Allow Full Bypass in Auto" is On), otherwise choose Preselector Bypass
Monitor Spectrum	Always Standard Path
IQ Waveform	Use Standard Path unless tuned frequency > 3.6 GHz and IFBW > 15 MHz, in which case choose Preselector Bypass
CCDF	Use Standard Path unless tuned frequency > 3.6 GHz and IFBW > 15 MHz, in which case choose Preselector Bypass

Remote Command	`[:SENSe]:POWer[:RF]:MW:PATH:AUTO ON | OFF | 1 | 0` `[:SENSe]:POWer[:RF]:MW:PATH:AUTO?`
Example	`:POW:MW:PATH:AUTO ON` `:POW:MW:PATH:AUTO?`
Dependencies	Only appears in VMA, WLAN, 5G NR and CQM Modes
Couplings	See the tables above
Preset	`ON`
Range	`ON|OFF`

Low Noise Path Enable

Low Noise Path Enable provides a lower noise floor under some circumstances, particularly when operating in the 21–26.5 GHz region. With the Low Noise Path enabled, the low band/high band switch and microwave preamp are bypassed whenever *all* the following are true:

- The instrument is not in the Low Band, meaning:
- the start frequency is above 3.5 GHz and
- the stop frequency is above 3.6 GHz
- The internal preamp is not installed, or if installed, is set to **Off** or **Low Band**

Note that this means that, when any part of a sweep is done in Low Band, the Low Noise Path is not used, whether or not the **Low Noise Path Enable** is selected in the user interface. Also, if the preamp is turned on, the Low Noise Path is not used, whether or not the **Low Noise Path Enable** is selected in the user interface. The only time the Low Noise Path is used is when **Low Noise Path Enable** is selected, the sweep is completely in High Band (> 3.6 GHz) and no preamp is in use.

For measurements that use IQ acquisition, the low noise path is used when **Center Frequency** is in High Band (> 3.6 GHz) and no preamp is in use. In other words, the rules above are modified to use only the center frequency to qualify which path to switch in. This is not the case for FFTs in the Swept SA measurement; they use the same rules as swept measurements.

Note that the Low Noise Path, while giving improved DANL, has the disadvantage of decreased TOI performance and decreased gain compression performance relative to the standard path.

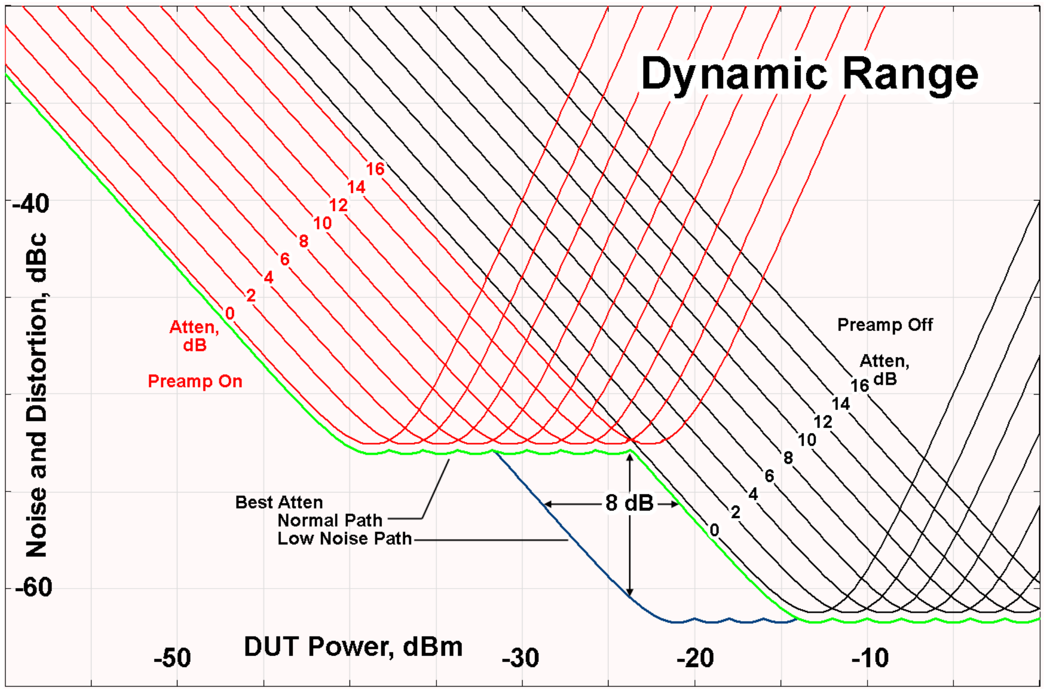
Note also that the bypass switch is a mechanical switch and has finite life, so if the **Low Noise Path Enable** is selected, it is possible to cause frequent cycling of this switch by frequently changing instrument settings such that the above conditions hold true only some of the time. A user making tests of this nature should consider opting for the **Standard Path**, which will never throw the bypass switch, at the expense of some degraded noise performance.

The low noise path is useful for situations where the signal level is so low that the instrument performance is dominated by noise even with 0 dB attenuation, but still high enough that the preamp option would have excessive third-order intermodulation or compression. The preamp, if purchased and used, gives better noise floor than does the “Low Noise Path.” However, its compression threshold and third-order intercept are much poorer than that of the non-preamp path.

There are some applications, typically for signals around –30 dBm, for which the third-order dynamic range of the standard path is good enough, but the noise floor is not low enough even with 0 dB input attenuation. When the third-order dynamic range of the preamp path is too little and the noise floor of the standard path is too high, the Low Noise Path can provide the best dynamic range

The graph below illustrates the concept. It shows, in red, the performance of an instrument at different attenuation settings, both with the preamp on and off, in a measurement that is affected by both instrument noise and instrument TOI. The green shows the best available dynamic range, offset by 0.5 dB for clarity. The blue

shows how the best available dynamic range improves for moderate signal levels with the low noise path switched in. In this illustration, the preamp improves the noise floor by 15 dB while degrading the third-order intercept by 30 dB, and the low noise path reduces loss by 8 dB. The attenuator step size is 2 dB.



There are other times where selecting the low noise path improves performance, too. Compression-limited measurements such as finding the nulls in a pulsed-RF spectrum can profit from the low noise path in a way similar to the TOI-limited measurement illustrated. Accuracy can be improved when the low noise path allows the optimum attenuation to increase from a small amount like 0, 2 or 4 dB to a larger amount, giving better return loss at the instrument input. Harmonic measurements, such as second and third harmonic levels, are much improved using the low noise path because of the superiority of that path for harmonic (though not intermodulation) distortion performance.

µW Preselector Bypass

Toggles the preselector bypass switch for band 1 and higher. When the microwave presel is on, the signal path is preselected. When the microwave preselector is off, the signal path is not preselected. The preselected path is the normal path for the instrument.

The preselector is a tunable bandpass filter which prevents signals away from the frequency of interest from combining in the mixer to generate in-band spurious

signals (images). The consequences of using a preselector filter are its limited bandwidth, the amplitude and phase ripple in its passband, and any amplitude and phase instability due to center frequency drift.

Option MPB or pre-selector bypass provides an unpreselected input mixer path for certain X-Series signal analyzers with frequency ranges above 3.6 GHz. This signal path allows a wider bandwidth and less amplitude variability, which is an advantage when doing modulation analysis and broadband signal analysis. The disadvantage is that, without the preselector, image signals will be displayed. Another disadvantage of bypassing the preselector is increased LO emission levels at the front panel input port.

Image responses are separated from the real signal by twice the 1st IF. For IF Paths of 10 MHz and 25 MHz, the 1st IF is 322.5 MHz, so the image response and the real signal will be separated by 645 MHz. The 1st IF will be different for other IF Path settings. When viewing a real signal and its corresponding image response in internal mixing, the image response will be to the left of the real signal.

Also, the image response and the real signal typically have the same amplitude and exhibit the same shape factor.

However, if Option FS1 (Fast Sweep Capability) is enabled, the image response in the Swept SA measurement appears lower in amplitude and has a much wider shape factor compared to the real signal.

Full Bypass Enable

With **Full Bypass Enable** selected, the microwave preselector is bypassed. In addition, the low band/high band switch and microwave preamp are bypassed whenever *all* the following are true:

- The instrument is not in the Low Band, meaning:
- the start frequency is above 3.5 GHz and
- the stop frequency is above 3.6 GHz.
- the internal preamp is not installed or if installed, is set to **Off** or **Low Band**

Note that this means that, when any part of a sweep is done in Low Band, the Low Noise Path is not used, whether or not the **Full Bypass Enable** is selected in the user interface. Also, if the preamp is turned on, the Low Noise Path is not used, whether or not the **Full Bypass Enable** is selected in the user interface. The only time the Low Noise Path is used is when **Full Bypass Enable** is selected, the sweep is completely in High Band (> 3.6 GHz) and no preamp is in use.

CAUTION When **Full Bypass Enable** is selected, and "Y Scale" on page 1929 is set to 0 dB, there will be a direct AC connection between the input and the first converter when the Low Noise Path switches in (when Start Freq >3.6 GHz and the Preamp is either not licensed, set to Low Band, or Off). This puts the first converter at considerable risk to be damaged by high AC power. Consequently, whenever **Full Bypass Enable** is selected, a warning message appears in the status bar:

"Full Bypass Enabled, maximum safe input power reduced"

Microwave Preselector Bypass Backwards Compatibility

Example	`:POW:MW:PRES OFF` Bypasses the microwave preselector
Notes	Included for Microwave Preselector Bypass backwards compatibility The `ON` parameter sets the `STD` path (`:POW:MW:PATH STD`) The `OFF` parameter sets path `MPB` (`:POW:MW:PATH MPB`)
Preset	`ON`
Backwards Compatibility SCPI	`[:SENSe]:POWer[:RF]:MW:PRESelector[:STATe] ON | OFF | 0 | 1` `[:SENSe]:POWer[:RF]:MW:PRESelector[:STATe]?`

Frequency Extender Preselection Bypass

Only applies to the high frequency path of the Frequency Extender, and only if the Frequency Extender allows it. For example, the V3050A high frequency path is 50 – 110 GHz and *does* allow control of the preselector bypass.

When the Frequency Extender's preselection is bypassed, flatness is improved, but will be subject to spurs from out-of-band interfering signals. For bandwidths greater than 2.5 [GHz], it is recommended that the signal bypass the Frequency Extender Preselector since the max bandwidth of the Preselector can be as narrow as 2.5 [GHz].

For most applications, the preset state is `OFF`, which gives the best remote-control throughput, minimizes acoustic noise from switching, minimizes out of band spurs, and minimizes the risk of wear in the hardware switches.

Preselector and Bandwidth Conflict

When the Frequency Extender Preselector is applied and the signal bandwidth is greater than 2.5 [GHz], then a settings alert message will show to warn the user that the signal may be distorted due to the limitation of the Frequency Extender Preselector bandwidth.

An example of the settings alert message is shown below.

Settings Alert message in the Status Bar at the bottom of the display.

Settings Alert message in the error queue

.

Software Preselection

Provided in some instruments, either to compensate for issues with provided hardware preselection or to provide the preselection function when there is no hardware preselector.

N9041B

Software Preselection compensates for the frequency range limit of the microwave preselector. Since the microwave preselector only goes up to 50 GHz, software preselection must be used to suppress and separate images above 50 GHz. The specific algorithm used for software preselection is specified by the SW Preselection Type selection – Normal or Advanced.

In N9041B, **Software Preselection** only applies for frequencies above 50 GHz, therefore it is only used for RF Input 2. Even if turned on, it is not used for other inputs, and never for frequencies below 50 GHz. This is why the label of this control contains the parenthetical note “(>~50 GHz)”.

Note that in N9041B, in Swept SA measurement, **Software Preselection** works even if the measurement is using an FFT Sweep Type. In measurements other than Swept SA, Software Preselection is not used if the measurement is using an FFT sweep type.

N9042B+V3050A

Software Preselection compensates for the frequency range limit of the microwave preselector. Since the microwave preselector only goes up to 50 GHz, software preselection must be used to suppress and separate images above 50 GHz. The specific algorithm used for software preselection is specified by the SW Preselection

Type selection – Normal or Advanced.

For N9042B+V3050A, Software Preselection only applies for frequencies above 50 GHz, therefore it is only used for External RF. Even if it is turned on, it will not be used for other inputs and never for frequencies below 50 GHz. This is why the label of this control contains the parenthetical note “(>~50 GHz)”.

Note that for N9042B+V3050A, in the Swept SA measurement, Software Preselection works even if the measurement is using an FFT Sweep Type. In measurements other than Swept SA, Software Preselection is not used if the measurement is using an FFT Sweep Type.

VXT models M9410A/11A

Software Preselection is used to provide the preselection function, as there is no hardware preselector in these models. Two background traces are taken and compared point by point, and the point with the lowest amplitude from the two traces is used. This provides a method to reduce spurs that are internally generated within the VXT, but you should note the following when using Software Preselection:

– There is some speed cost due to the need to take multiple captures

– Taking the point with the lowest amplitude in each trace will make the average noise level lower at all points that do not have a spur. This can reduce the accuracy of the measurement of noise and noise-like signals

Because of the difficulty in identifying spurs manually, you are recommended to leave Software Preselection ON at all times in VXT models M9410A/11A. If you turn it off in order to speed up your measurement or improve noise accuracy, be aware of unwanted onscreen spurs.

Remote Command	`[:SENSe]:POWer[:RF]:SWPResel:STATe 0 | 1 | ON | OFF` `[:SENSe]:POWer[:RF]:SWPresel:STAT?`
Example	`:POW:SWPR:STAT 1` `:POW:SWPR:STAT?`
Dependencies	Only appears in N9041B, N9042B+V2050A, and VXT models M9410A/11A. Does not appear in all measurements
Couplings	Affects **Sweep Time** **Auto Tune** supports **Software Preselection**, so **Auto Tune** should be performed after setting the **Software Preselection** state
Preset	N9041B: OFF N9042B+V3050A: ON M9410A/11A: ON
State Saved	Saved in instrument state

SW Preselection Type

Specifies the algorithm used for software preselection.

Two hidden sweeps occur in succession. The second sweep is offset in LO frequency by 2 * IF / N. For each point in each trace, the smaller amplitude from the two traces is taken and placed in that point in the selected trace. The Peak detector is auto-selected to improve the image suppression effectiveness. Responses of each trace that lie on top of one another will remain and are valid signals. Other signals are images, which are suppressed. The action of taking the smaller of the two traces will make the average noise level lower in all points that do not have an image, thus reducing the accuracy of the measurement of noise and noise-like signals.

- `NORMal` - mathematically removes all image and multiple responses of signals present at the input
- `ADVanced` - any trace processing (such as “max hold” or trace averaging) is performed on the points of both candidate traces before the “select minimum” operation occurs. This form of processing works better for non-stationary signals, such as pulsed-RF signals

Remote Command	`[:SENSe]:POWer[:RF]:SWPResel NORMal | ADVanced` `[:SENSe]:POWer[:RF]:SWPResel?`
Example	`:POW:SWPR NORM` `:POW:SWPR?`
Dependencies	Only appears in N9041B and N9042B+V3050A. Only appears in measurements that use the Swept method Grayed-out when "Software Preselection" on page 1971 is `OFF`. The grayout message is “Unavailable unless SW Presel enabled”
Preset	N9041B: `ADVanced` N9042B+V3050A: `NORMal`
State Saved	Saved in instrument state

SW Preselection BW

Specifies the effective bandwidth to be used for Software Preselection.

The options are:

- `NORMal` – when making Swept measurements, a software preselection algorithm is used which takes up to 4 background acquisitions, then post-processes the result. This algorithm can remove images from signals with an occupied

bandwidth up to around 3 GHz. (Default/Preset setting). When making FFT measurements, this algorithm is not used, instead the same algorithm is used as for NARRow (below)

– NARRow– a software preselection algorithm is used which takes two background acquisitions, then post-processes the result to detect and remove images from wideband signals with occupied bandwidths up to 2 GHz. This increases the risk of images failing to be rejected, but improves the measurement speed

Remote Command	`[:SENSe]:POWer[:RF]:SWPResel:BW NORMal | NARRow` `[:SENSe]:POWer[:RF]:SWPResel:BW?`
Example	`:POW:SWPR:BW NARR`
Dependencies	Only appears in N9041B and N9042B+V3050A. Only appears in measurements that use the Swept method Grayed-out when "Software Preselection" on page 1971 is OFF. The grayout message is “Unavailable unless SW Presel enabled” For N9042B+V3050A, the parameter is SCPI-only, and always set to NARRow when **Software Preselection** is enabled
Preset	N9041B: NORMal N9042B+V3050A: NARRow
State Saved	Saved in instrument state

High Freq Prefilter

Lets you set the state of Prefilter for center frequencies above 1310 MHz.

In VXT Models M9410A/11A, the Receiver RF path has a bank of filters that come after the RF Attenuator in the signal path. Since this bank of filters precedes the mixer they are known as the “Prefilter” bank. Their purpose is to eliminate unwanted in-band mixing products by filtering out all but the desired frequencies before the signals get to the mixer. There are 13 prefilter bands to cover the frequencies between 9 kHz and 6000 MHz. The Prefilter provides the necessary rejection of the unwanted signal.

Remote Command	`[:SENSe]:<measurement>:PFILter[:STATe] ON | OFF | 1 | 0` `[:SENSe]:<measurement>:PFILter[:STATe]?`

Example	Enable High Freq Prefilter for the Complex Spectrum Measurement in BASIC Mode:
	`:SPEC:PFIL ON`
	Enable High Freq Prefilter for the IQ Waveform Measurement, in multiple Modes:
	`:WAV:PFIL ON`
	Enable High Freq Prefilter for the Swept SA Measurement in SA Mode:

	`:SAN:PFIL ON`
Dependencies	Only appears in VXT models M9410A/11A with center frequency above 1310 MHz
Preset	See "Prefilter Presets" on page 928 below
State Saved	Saved in instrument state

Prefilter Presets

Meas	Mode	Preset
SPEC	BASIC	OFF
WAV	BASIC, WCDMA, WLAN, LTEAFDD, LTEATDD, 5GNR, VMA	OFF
MON	WCDMA, WLAN, LTEAFDD, LTEATDD, 5GNR, VMA	OFF
RHO	WCDMA	OFF
CDP	WCDMA	OFF
PCON	WCDMA	OFF
EVMQ	WCDMA	OFF
CHP	WCDMA, WLAN, LTEAFDD, LTEATDD, 5GNR, VMA, SA	OFF
OBW	WCDMA, WLAN, LTEAFDD, LTEATDD, 5GNR, VMA, SA	OFF
ACP	WCDMA, LTEAFDD, LTEATDD, 5GNR, VMA, SA	OFF
SEM	WCDMA, WLAN, LTEAFDD, LTEATDD, 5GNR, VMA, SA	OFF
PST	WCDMA, WLAN, LTEAFDD, LTEATDD, 5GNR, VMA, SA	OFF
PVT	WLAN, LTEAFDD, LTEATDD, 5GNR	OFF
EVM	WLAN, LTEAFDD, LTEATDD, 5GNR	OFF
FLAT	WLAN	OFF
EVMM	WLAN	OFF
CEVM	LTEAFDD, LTEATDD	OFF
PAVT	5GNR, VMA	OFF
DDEM	VMA	OFF
OFDM	VMA	OFF
SAN	SA	ON
HARM	SA	ON

3.5.9 BW

Opens the **BW** menu, which contains controls for the Resolution Bandwidth and Video Bandwidth functions of the instrument.

The Resolution BW functions control filter bandwidth and filter type. There are two filter types, Gaussian and Flattop. The Gaussian filters have a response curve that is parabolic on a log scale. The Flattop filter shape is a close approximation of a rectangular filter.

3.5.9.1 Settings

Contains the basic Bandwidth functions. In most measurements it is the only tab under Bandwidth.

Res BW

Activates the resolution bandwidth active function, which allows you to manually set the resolution bandwidth (RBW) of the instrument.

Normally, **Res BW** (Auto) selects automatic coupling of **Res BW** to "Span" on page 948. To decouple the resolution bandwidth, press the **Auto/Man** toggle on the **Res BW** control, or simply enter a different value for **Res BW**.

When **Res BW** is manually selected, it may be returned to the coupled state by pressing the **Auto/Man** toggle on the **Res BW** control. This may also be done by pressing "Auto Couple" on page 1995 or by performing a **Preset**.

For more Mode-specific details, see: "More Information" on page 930

Remote Command	`[:SENSe]:ACPower:BANDwidth[:RESolution] <bandwidth>` `[:SENSe]:ACPower:BANDwidth[:RESolution]?`
Example	`:ACP:BAND 5 MHz` `:ACP:BAND?`
Notes	For numeric entries, all **Res BW** Types choose the nearest (arithmetically, on a linear scale, rounding up) available **Res BW** to the value entered The setting and querying of values depend on the current bandwidth type This parameter is preset by "Meas Method" on page 963. Preset values are: **Modes** / **Values**: 5GNR, LTEAFDD/TDD, MSR, VMA, SRCOMM: IBW 100 kHz, IBWR 30 kHz SA: IBW 220 kHz, IBWR 30 kHz WCDMA: IBW 100 kHz, IBWR 27 kHz, FAST 390 kHz When **Meas Method** is “Fast Power” and Fast Power RBW mode is “Best Speed,” RBW is calculated as follows: RBW = Span × 2.442 × 10^{-3}
Dependencies	Disabled when **Meas Method** is RBW, FAST, or Fast Power and Fast Power RBW mode is Best Speed If pressed, an advisory message is generated. If the equivalent SCPI command is sent, a "Setting

	conflict" warning is generated
Couplings	Sweep time is coupled to the RBW. As RBW changes, the sweep time (if set to **Auto**) is changed to maintain amplitude calibration "Video BW" on page 931 is coupled to **Res BW**. As the resolution bandwidth changes, the video bandwidth (if set to Auto) changes to maintain the ratio of VBW/RBW (10:1) When **Res BW** is set to **Auto**, the resolution bandwidth is auto-coupled to the span. The ratio of Span/RBW is approximately 106:1 when auto coupled. When **Res BW** is set to **Man**, and the bandwidths are entered manually, these bandwidths are used regardless of other instrument settings
Preset	Auto, unless noted in "RBW Presets" on page 930
State Saved	Saved in instrument state
Min	1 Hz
Max	8 MHz is the max equivalent –3 dB RBW, which means that the named RBW (the one shown on the control etc.) can actually exceed 8 MHz if using a filter other than –3 dB Gaussian
Annotation	A “#” mark appears before “RBW” in the annotation when it is switched from Auto to Manual coupling
Backwards Compatibility Notes	For backwards compatibility this command accepts both the `BANDwidth` and `BWIDth` forms For ESA, the maximum Res BW was 5 MHz; for X-Series it is 8 MHz The following command is supported [:SENSe]:ACP:SWEep:BANDwidth|BWIDth[:RESolution]

Auto Function

Remote Command	`[:SENSe]:ACPower:BANDwidth[:RESolution]:AUTO ON | OFF | 1 | 0` `[:SENSe]:ACPower:BANDwidth[:RESolution]:AUTO?`
Example	`:ACP:BAND:AUTO ON` `:ACP:BAND:AUTO?`
Preset	See "RBW Presets" on page 930

RBW Presets

Unless noted in the table below, the Preset value of **Res BW** is **Auto**.

Mode	Preset Value
WCDMA	100 kHz
MSR	100 kHz
SA	220 kHz
5GNR	100 kHz

More Information

When **Res BW** is set to **Auto**, the bandwidth selected depends on "RBW Filter Type" on page 933.

Only certain discrete resolution bandwidths are available. The available bandwidths are dependent on the **RBW Filter Type** or the **EMC Standard**. If an unavailable bandwidth is entered with the numeric keypad, the closest available bandwidth is selected.

In some PowerSuite measurements, in the LTE-Advanced (both FDD and TDD) Modes, when **Res BW** is **Auto**, the resolution bandwidth is predefined based on the corresponding bandwidth of the single LTE carrier, as shown in the table below. In the Multi-carrier case, the narrowest **Res BW** among the active carriers is used.

LTEAFDD, LTEATDD Modes

Carrier BW	Auto Res BW, kHz
1.4 MHz	51
3 MHz	51
5 MHz	100
10 MHz	100
15 MHz	100
20 MHz	100
200 kHz (NB-IoT in FDD)	10

5G NR Mode

100 kHz for all carrier bandwidths.

Video BW

Lets you change the instrument post-detection filter (VBW or “video bandwidth”) from 1 Hz to 8 MHz in approximately 10% steps. In addition, a wide-open video filter bandwidth may be chosen by selecting 50 MHz. The VBW is annotated at the bottom of the display, in the center.

Normally, **Video BW (Auto)** selects automatic coupling of the Video BW to "Res BW" on page 929. To decouple the resolution bandwidth, press the **Auto/Man** toggle on the **Video BW** control, or simply enter a different value for **Video BW**.

When the **Video BW** is manually selected, it may be returned to the coupled state by pressing the **Auto/Man** toggle on the **Video BW** control. This may also be done by pressing "Auto Couple" on page 1995 or by performing a **Preset**.

For more information, see "VBW Presets" on page 932

Remote Command	`[:SENSe]:ACPower:BANDwidth:VIDeo <bandwidth>`
	`[:SENSe]:ACPower:BANDwidth:VIDeo?`
	`[:SENSe]:ACPower:BANDwidth:VIDeo:AUTO ON | OFF | 1 | 0`
	`[:SENSe]:ACPower:BANDwidth:VIDeo:AUTO?`

Example	`:ACP:BAND:VID 2.4 MHz`
	`:ACP:BAND:VID?`
	`:ACP:BAND:VID:AUTO ON`
	`:ACP:BAND:VID:AUTO?`

Notes	For numeric entries, the instrument chooses the nearest (arithmetically, on a linear scale, rounding up) available VBW to the value entered. The 50 MHz VBW is defined to mean “wide open” The values shown in this table reflect the conditions after **Mode Preset**
Dependencies	Sometimes the displayed **Video BW** is not actually used to process the trace data: – When the Average Detector is selected and **Sweep Type** is set to **Swept**, the video bandwidth filter cannot be used, because it uses the same hardware as the Average Detector – When the Quasi-Peak, EMI Average or RMS Average detector is selected the VBW is implemented by the digital IF as part of the detector When this is the case, the VBW still acts to change the sweep time, if **Sweep Time** is in **Auto**, and still affects the data on other traces for which this is not the case Disabled when **Meas Method** is RBW, FAST, or Fast Power If pressed, an advisory message is generated. If the equivalent command is sent, a "Setting conflict" warning is generated
Couplings	Video bandwidth (VBW) is normally coupled to RBW. If **VBW** is set to Auto, then the VBW is changed as the RBW changes, to maintain the ratio (usually 10:1)
Preset	See "VBW Presets" on page 932 below
State Saved	Saved in instrument state
Min	1 Hz
Max	50 MHz
Annunciation	A “#” mark appears before “VBW” in the annotation when it is not coupled
Annotation	In the bottom center of the screen, “VBW <value> <units>” indicates the current video bandwidth value. Note that for some detectors this is not the value actually used for VBW (see above)
Backwards Compatibility Notes	For backwards compatibility this command accepts both the `BANDwidth` and `BWIDth` forms

VBW Presets

Unless noted in the table below, the Preset value of **Video BW** is **Auto**.

Mode	Preset Value
WCDMA	1 MHz

RBW Filter Type

Selects the type for the resolution bandwidth filters. Historically, the Res BW filters in HP/Agilent/Keysight spectrum analyzers were Gaussian filters, specified using the –3 dB bandwidth of the filter. That is, a 10 MHz Res BW filter was a Gaussian shape with its –3 dB points 10 MHz apart. In X-Series, the **RBW Filter BW** menu lets you choose between a Gaussian and Flat Top filter shape, for varying measurement conditions.

Filter Type	SCPI Example
Gaussian	:BAND:SHAP GAUS
Flattop	:BAND:SHAP FLAT

Remote Command	`[:SENSe]:ACPower:BANDwidth:SHAPe GAUSsian | FLATtop` `[:SENSe]:ACPower:BANDwidth:SHAPe?`
Example	`:ACP:BAND:SHAP GAUS` `:ACP:BAND:SHAP?`
Notes	`GAUSsian`= Gaussian `FLATtop` = Flattop
Dependencies	Disabled when "Meas Method" on page 963 is FAST or Fast Power If pressed, an advisory message is generated. If the equivalent command is sent, a "Setting conflict" warning is generated
Preset	"Auto Couple" on page 1995 selects the preset value
State Saved	Saved in instrument state
Annotation	The annotation under RBW in the bottom left of the screen shows the type of filter or bandwidth that is being used
Backwards Compatibility SCPI	`[:SENSe]:ACPower:BWIDth:SHAPe`

RBW Filter BW

Selects a Gaussian filter based on its –3 dB (Normal) bandwidth or its –6 dB bandwidth.

Remote Command	`[:SENSe]:ACPower:BANDwidth:TYPE DB3 | DB6` `[:SENSe]:ACPower:BANDwidth:TYPE?`
Example	`:ACP:BAND:TYPE DB3` `:ACP:BAND:TYPE?`
Dependencies	Disabled when "RBW Filter Type" on page 933 is `FLATtop` or "Meas Method" on page 963 is RBW, FAST, or Fast Power

	If pressed, an advisory message is generated. If the equivalent command is sent, a "Setting conflict" warning is generated
Preset	DB3
State Saved	Saved in instrument state
Range	–3 dB (Normal)|–6 dB
Backwards Compatibility SCPI	[:SENSe]:ACPower:BWIDth:TYPE

3.5.10 Display

Lets you configure display items for the current Mode, Measurement View or Window.

3.5.10.1 Meas Display

Contains controls for setting up the display for the current Measurement, View or Window.

Bar Graph On/Off

Turns the Bar Graph On or Off.

Remote Command	:DISPlay:ACPower:WINDow[1]:BGRaph OFF | ON | 0 | 1 :DISPlay:ACPower:WINDow[1]:BGRaph?
Example	:DISP:ACP:WIND:BGR OFF :DISP:ACP:WIND:BGR?
Dependencies	Always set to ON and grayed-out when the method is RBW
Preset	ON
State Saved	Saved in instrument state
Range	OFF|ON
Backwards Compatibility SCPI	:DISPlay:ACPower:VIEW[1]:WINDow[1]:BGRaph

3.5.10.2 Annotation

Contains controls for setting up the annotation for the current Mode or Measurement.

Graticule

Turns the display graticule On or Off for all windows with graticules in all measurements in the current Mode. Also turns the graticule Y-Axis annotation on and off.

Remote Command	`:DISPlay:GRATicule[:STATe] OFF | ON | 0 | 1` `:DISPlay:GRATicule[:STATe]?`
Example	`:DISP:GRAT OFF`
Notes	The graticule is the set of horizontal and vertical lines that make up the grid/divisions for the X-Axis and Y-Axis
Preset	`ON`
State Saved	Saved in instrument state

Backwards Compatibility SCPI	`:DISPlay:WINDow[1]:TRACe:GRATicule:GRID[:STATe] OFF | ON | 0 | 1`
	`:DISPlay:WINDow[1]:TRACe:GRATicule:GRID[:STATe]?`
	This command is accepted for backwards compatibility with older instruments, but the `WINDow`, `TRACe` and `GRID` parameters are ignored

Screen Annotation

Controls the display of the annunciation and annotation around the graticule, including any annotation on lines (such as the display line, the threshold line, etc.) and the Y-Axis annotation, for all windows with screen annotation in all measurements in the current Mode.

This does *not* include marker annotation (or the N dB result). When `OFF`, the graticule expands to fill the entire graticule area, leaving only the 1.5% gap above the graticule, as described in the **Trace** section.

Remote Command	`:DISPlay:ANNotation:SCReen[:STATe] OFF | ON | 0 | 1` `:DISPlay:ANNotation:SCReen[:STATe]?`
Example	`:DISP:ANN:SCR OFF`
Dependencies	Grayed-out and forced to `OFF` when **System Display Settings**, **Annotation** is `OFF`
Preset	`ON` This remains `OFF` through a Preset when **System Display Settings**, **Annotation** is set to `OFF`
State Saved	Saved in instrument state

Trace Annotation

Turns on and off the labels on the traces, showing their detector (or their Math Mode) as described in the **Trace** section, for all windows in all measurements in the current Mode for which Trace Annotation on/off is supported.

If Trace Math is being performed on a trace, then the Trace Math annotation replaces the detector annotation.

For measurements that support limit lines, this key also turns on and off the labels on the Limit Lines. The label is the Limit number annotation and Limit Comment displayed on the graph. If the length of the comment is greater than 20 characters, the first 8 characters and the last 8 characters are displayed, joined with ....

Remote Command	`:DISPlay:ANNotation:TRACe[:STATe] ON | OFF | 1 | 0` `:DISPlay:ANNotation:TRACe[:STATe]?`
Example	`:DISP:ANN:TRAC OFF`
Preset	`OFF`
State Saved	Saved in instrument state

Control Annotation

Turns on and off the display of values on the Active Function controls for all measurements in the current Mode. This is a security feature.

Remote Command	`:DISPlay:ACTivefunc[:STATe] ON | OFF | 1 | 0` `:DISPlay:ACTivefunc[:STATe]?`
Example	`:DISP:ACT OFF`
Dependencies	Grayed out and forced to `OFF` when **System Display Settings**, **Annotation** is `OFF`
Preset	`ON` This remains `OFF` through a Preset when **System Display Settings**, **Annotation** is set to `OFF`
State Saved	Saved in instrument state

Frequency Annotation

Turns on and off the absolute frequency annotation in the main display for all windows in all measurements in the current Mode for which Frequency Annotation on/off is supported.

The affected annotations include Center Frequency, Start/Stop Frequency, Frequency Offset, Marker Frequency. Any relative frequency annotation such as Span and Marker Delta are not affected.

The frequency annotations in any other associated display, such as in Active Function, Softkey label, Limit Editor, Amp Corr Editor and Marker Table are not changed.

Frequency annotations that are not associated with the spectrum, such as RBW, IBW, Sweep Time, are excluded and they are shown regardless of this selection.

Remote Command	`:DISPlay:ANNotation:FREQuency[:STATe] ON | OFF | 1 | 0` `:DISPlay:ANNotation:FREQuency[:STATe]?`
Example	`:DISP:ANN:FREQ OFF`
Dependencies	Only appears in the Swept SA measurement in Spectrum Analyzer Mode
Preset	`ON`

Meas Bar

Turns the Measurement Bar at the top of the screen on and off for all measurements in the current Mode. When `OFF`, the graticule area expands to fill the area formerly occupied by the Measurement Bar.

Remote Command	`:DISPlay:ANNotation:MBAR[:STATe] OFF | ON | 0 | 1` `:DISPlay:ANNotation:MBAR[:STATe]?`
Example	`:DISP:ANN:MBAR OFF`
Dependencies	Grayed out and forced to `OFF` when **System Display Settings**, **Annotation** is `OFF`
Preset	`ON` This remains `OFF` through a Preset when **System Display Settings**, **Annotation** is set to `OFF`
State Saved	Saved in instrument state

Display Enable (Remote Command Only)

Turns the display on/off, including the display drive circuitry. The backlight stays lit to confirm that the instrument is on. The display enable setting is mode global. Theare three reasons for turning the display off:

1. To increase speed as much as possible by freeing the instrument from having to update the display
2. To reduce emissions from the display, drive circuitry
3. For security purposes

If you have turned off the display:

– and you are in local operation, the display can be turned back on by pressing any key or by sending `:SYSTem:DEFaults MISC` or `:DISPlay:ENABle ON` (neither

*RST nor :SYSTem:PRESet enable the display)

– and you are in remote operation, the display can be turned back on by pressing the **Local** or **Esc** keys, or by sending :SYSTem:DEFaults MISC or :DISPlay:ENABle ON (neither *RST nor :SYSTem:PRESet enable the display)

– and you are using either the :SYSTem:KLOCk command or GPIB local lockout, then *no* front-panel key press will turn the display back on. You must turn it back on remotely.

If the display is OFF, many SCPI commands related to User Views and Multiscreen functionality do not work, and return the error messages “-221, Settings conflict; Screen SCPI cannot be used when Display is disabled” or “221, Settings conflict; View SCPI cannot be used while Display is disabled”. These commands include:

Name	Command
Select User View	:DISPlay:VIEW:ADVanced:SELect
Rename User View	:DISPlay:VIEW:ADVanced:REName
Delete User View	:DISPlay:VIEW:ADVanced:DELete
Create User View	:DISPlay:VIEW:ADVanced:NAME
Select Screen	:INSTrument:SCReen:SELect
Delete Screen	:INSTrument:SCReen:DELete
Delete All But This Screen	:INSTrument:SCReen:DELete:ALL
Add Screen	:INSTrument:SCReen:CREate
Rename Screen	:INSTrument:SCReen:REName
Sequencer On/Off	:SYSTem:SEQuencer

Remote Command	:DISPlay:ENABle OFF | ON | 0 | 1 :DISPlay:ENABle?
Example	:DISP:ENAB OFF
Couplings	:DISP:ENAB OFF turns Backlight OFF and :DISP:ENAB ON turns Backlight ON, but changing Backlight settings does *not* change the state of :DISP:ENAB
Preset	ON Set by :SYST:DEF MISC, but not affected by *RST or :SYSTem:PRESet
State Saved	Not saved in instrument state
Backwards Compatibility Notes	:SYST:PRES no longer turns on :DISPlay:ENABle as it did in legacy analyzers

3.5.10.3 View

Contains controls for selecting the current **View**, and for editing User Views.

View

See "Views" on page 876.

User View

Lets you choose a View from the saved User Views for the current measurement. This panel only appears if a User View exists for the current measurement.

Remote Command	`:DISPlay:VIEW:ADVanced:SELect <alphanumeric>` `:DISPlay:VIEW:ADVanced:SELect?`
Example	Select Baseband as the current View `:DISP:VIEW:ADV:SEL “Baseband”`

Notes	You must be in the measurement whose View you are trying to set to send the command. You can only set Views for the current measurement using this command
	For predefined views, the parameter is derived from the view name that is shown in the View list in the user interface. For example, if you are trying to select the Trace Zoom view in the Swept SA measurement, you send:
	`:DISP:VIEW:ADV:SEL "Trace Zoom"`
	because “Trace Zoom” is the name of the View as seen in the Mode/Meas dialog or in the Display, View menu
	You *cannot* use the legacy View parameter (which in this case would be `TZOom`) with `:DISP:VIEW:ADV:SEL`
	`<alphanumeric>` is case insensitive; you can specify mixed case, however the name will be evaluated on a single case. Thus, both of the following forms work:
	`:DISP:VIEW:ADV:SEL "Trace Zoom"`
	`:DISP:VIEW:ADV:SEL "TRACE ZOOM"`
	If the specified view is not a valid View, the query returns the error message “-224, Illegal parameter value; View with the name <alphanumeric> does not exist”
	If the display is disabled (via `:DISP:ENAB OFF`) then the error message “-221, Settings conflict; View SCPI cannot be used while Display is disabled” is generated

Backwards Compatibility SCPI	The legacy node `:DISPlay:VIEW[:SELect]` is retained for backwards compatibility, but it only supports predefined views

Restore Layout to Default

Restores the Layout to the default for Basic.

Modified Views are very temporary; if you exit the current measurement they are discarded, and they are not saved in State. To retain this View for later use, and to be able to return easily to your original Basic View, you can save your edited View as a “User View”.

Save Layout as New View

Saves your new View as a User View. An alpha keyboard appears, which lets you name your new View; the default is the old View name plus a number.

Remote Command	`:DISPlay:VIEW:ADVanced:NAME <alphanumeric>`
Example	`:DISP:VIEW:ADV:NAME “Baseband”` Creates a new View named `Baseband` from the current View, and selects it as the current View
Notes	`<alphanumeric>` is case insensitive; you can specify mixed case, however the name will be evaluated on a single case If `<alphanumeric>` name already exists as a View, the error message “-224, Illegal parameter value; View <alphanumeric> already exists” is generated If the display is disabled (via `:DISP:ENAB OFF`) then the error message “-221, Settings conflict; User View SCPI cannot be used while Display is disabled” is generated

Re-Save User View

You can re-edit a User View; if you make changes, then an asterisk will appear next to the User View’s name. You can then tap **Re-Save User View** to save it back to its existing name, or **Save Layout as New View** to add another, new User View.

This is a front panel function only, there is no remote command available to perform this function. To do this remotely, you must first perform **Save Layout as New View**, then delete the old User View and rename the new one with the name of the View you just deleted.

Rename User View

You can rename the current View by giving it a new unique name. Only User Views can be renamed, if the current View is a Predefined View, an error occurs.

Remote Command	`:DISPlay:VIEW:ADVanced:REName <alphanumeric>`
Example	`:DISP:VIEW:ADV:REN “Baseband”`
Notes	`<alphanumeric>` is case insensitive; you can specify mixed case, however the name will be evaluated on a single case If the `<alphanumeric>` specifying the new name is already present in the list of View names, the error message “-224, Illegal parameter value; View <alphanumeric> already exists” is generated If the current View is a Predefined View, the error message “-224, Illegal parameter value; Cannot

	rename a Predefined View" is generated If the display is disabled (via `:DISP:ENAB OFF`) then the error message "-221, Settings conflict; View SCPI cannot be used while Display is disabled" is generated

Delete User View

You can delete the current View if it is a User View. The default view becomes the current view for the Measurement.

Remote Command	`:DISPlay:VIEW:ADVanced:DELete`
Example	`:DISP:VIEW:ADV:DEL`
Notes	`<alphanumeric>` is case insensitive; you can specify mixed case, however the name will be evaluated on a single case If the `<alphanumeric>` is not present in the list of View names, the error message "-224, Illegal parameter value; View <alphanumeric> does not exist" is generated If the current View is a Predefined View, the error message "-224, Illegal parameter value; Cannot delete a Predefined View" is generated If the display is disabled (via `:DISP:ENAB OFF`) then the error message "-221, Settings conflict; View SCPI cannot be used while Display is disabled" is generated

Delete All User Views

Deletes all previously saved User Views. The default view becomes the current view for the Measurement if a User View was the current view when this command was executed.

Remote Command	`:DISPlay:VIEW:ADVanced:DELete:ALL`
Example	`:DISP:VIEW:ADV:DEL:ALL`
Notes	Disabled if there are no User Views

View Editor Remote Commands

The following remote commands help you manage Views and User Views. Note that the SCPI node for User Views handles both Predefined and User Views. The legacy nodes, `:DISPlay:VIEW[:SELect]` and `:DISPlay:VIEW:NSEL`, are retained for backwards compatibility, but they only support predefined views.

View Listing Query

Returns a string containing a comma-separated list of names for *all* the Views, including User Views, available for the current Measurement.

Remote Command	`:DISPlay:VIEW:ADVanced:CATalog?`
Example	`:DISP:VIEW:ADV:CAT?`
Notes	Returns a quoted string of the available Views for the current measurement, separated by commas. The list includes names for *all* the Views, including User Views, available for the current Measurement Example: `"Normal,Trace Zoom,Spectrogram,Baseband,myView1,yourView1"` No distinction is made between Predefined and User Views If you switch measurements with the display disabled (via `:DISP:ENAB OFF`), then query the list of available Views, the result is undefined

User View Listing Query

Returns a string containing a comma-separated list of names for *only* the User Views available for the current Measurement.

Remote Command	`:DISPlay:VIEW:ADVanced:USER:CATalog?`
Example	`:DISP:VIEW:ADV:USER:CAT?`
Notes	Returns a quoted string of the available User Views for the current measurement, separated by commas. Example: `"Baseband,myView1,yourView1"` If you switch measurements with the display disabled (see "Display Enable (Remote Command Only)" on page 1983), then query the list of available Views, the result is undefined

3.5.11 Frequency

Contains controls that allow you to control the Frequency and Channel parameters of the instrument.

Some features in the **Frequency** menu are the same for all measurements in the current Mode – they do not change as you change measurements. Settings like these are called “Meas Global” and are unaffected by Meas Preset. For example, the **Center Frequency** setting is the same for all measurements - it does not change as you change measurements.

3.5.11.1 Settings

Contains controls that pertain to the X-Axis parameters of the measurement. These parameters control how data on the vertical (X) axis is displayed and control instrument settings that affect the horizontal axis.

Center Frequency

Sets the frequency that corresponds to the horizontal center of the graticule. While adjusting the Center Frequency the Span is held constant.

The **Center Frequency** setting is the same for all measurements within a mode, that is, it is Meas Global. Some Modes are also able to share a Mode Global center frequency value. If this is the case, the Mode has a **Global** tab in its **Meas Setup** menu.

Center Frequency sets (and queries) the center frequency for the currently selected input. If your instrument has multiple inputs, and you select another input, **Center Frequency** changes to the value for that input. SCPI commands are available to directly set **Center Frequency** for a specific input.

Center Frequency is remembered as you go from input to input. Thus, you can set a **Center Frequency** of 10 GHz with the RF Input selected, change to BBIQ and set a **Center Frequency** of 20 MHz, then switch to External Mixing and set a **Center Frequency** of 60 GHz. When you go back to the RF Input, **Center Frequency** returns to 10 GHz; back to BBIQ and it is 20 MHz; back to External Mixing and it is 60 GHz.

See:

– "RF Center Freq" on page 946

– "Ext Mix Center Freq" on page 947

– "I/Q Center Freq" on page 948

Remote Command	`[:SENSe]:FREQuency:CENTer <freq>` `[:SENSe]:FREQuency:CENTer?`

Example	Set Center Frequency to 50 MHz:
	`:FREQ:CENT 50 MHz`
	Increment the Center Frequency by the value of CF Step:
	`:FREQ:CENT UP`
	Return the current value of Center Frequency:
	`:FREQ:CENT?`

Notes	Sets the RF, External Mixing or I/Q Center Frequency depending on the selected input

	– For RF input it is equivalent to `:FREQ:RF:CENT` – For I/Q input it is equivalent to `:FREQ:IQ:CENT` – For External Mixer it is equivalent to `:FREQ:EMIX:CENT` Preset and Max values are dependent on Hardware Options (5xx) If no terminator (e.g., MHz) is sent the terminator Hz is used. If a terminator with unit other than Frequency is used, an invalid suffix error message is generated
Dependencies	Not available in the MSR, LTEAFDD, LTEATDD and 5G NR modes
Preset	Depends on instrument maximum frequency, mode, measurement, and selected input See "Center Frequency Presets" on page 944, "RF Center Freq" on page 946, "Ext Mix Center Freq" on page 947, "I/Q Center Freq" on page 948 and "VXT Models with Radio Heads/CIU Frequency Range" on page 946
State Saved	Saved in instrument state
Min/Max	Depends on instrument maximum frequency, mode, measurement, and selected input See "Center Frequency Presets" on page 944, "RF Center Freq" on page 946, "I/Q Center Freq" on page 948 and "VXT Models with Radio Heads/CIU Frequency Range" on page 946
Annotation	Center <value> appears in the lower left corner of the display
Status Bits/OPC dependencies	Non-overlapped

Center Frequency Presets

The following table provides the Center Frequency Presets for the Spectrum Analyzer mode, and the Max Freq, for the various frequency options:

Freq Option	CF after Mode Preset	Stop Freq after Mode Preset	Max Freq (can't tune above)
503 (all but CXA)	1.805 GHz	3.6 GHz	3.7 GHz
503 (CXA)	1.505 GHz	3.0 GHz	3.08 GHz
507 (all but CXA)	3.505 GHz	7.0 GHz	7.1 GHz
507 (CXA)	3.755 GHz	7.5 GHz	7.58 GHz
508 (all but MXE)	1.805 GHz	3.6 GHz	8.5 GHz
508 (MXE)	4.205 GHz	8.4 GHz	8.5 GHz
513	6.805 GHz	13.6 GHz	13.8 GHz
526 (except CXA and MXE)	13.255 GHz	26.5 GHz	27.0 GHz*
526 (CXA)	13.255 GHz	26.5 GHz	26.55 GHz
526 (MXE)	1.805 GHz	3.6 GHz	27.0 GHz
532	16.005 GHz	32.0 GHz	32.5 GHz

Freq Option	CF after Mode Preset	Stop Freq after Mode Preset	Max Freq (can't tune above)
540	20.005 GHz	40.0 GHz	40.5 GHz
543	21.505 GHz	43.0 GHz	43.0 GHz
544	22.005 GHz	44.0 GHz	45.0 GHz
550	25.005 GHz	50.0 GHz	52 GHz
F03 (CXA-m)	1.505 GHz	3.0 GHz	3.08 GHz
F07 (CXA-m)	3.755 GHz	7.5 GHz	7.575 GHz
F13 (CXA-m)	6.805 GHz	13.6 GHz	13.8 GHz
F26 (CXA-m)	13.255 GHz	26.5 GHz	26.55 GHz
504 (M9421A, M8920A)	2.145 GHz	3.88GHz	3.88 GHz
506 (M9421A, M8920A)	3.245 GHz	6.08GHz	6.08 GHz
F06 (M9410A/11A)	1.0 GHz	6.08 GHz	6.08 GHz
F06 (M9415A)	1 GHz	1.08 GHz	6.6 GHz
F08 (M9415A)	1 GHz	1.08 GHz	8.6 GHz
F12 (M9415A)	1 GHz	1.08 GHz	12.9 GHz

*For option 526, the Max CF in RTSA is 26.999999995 GHz.

N9041B Center Freq Presets

Input	CF after Mode Preset	Stop Freq after Mode Preset	Max Freq (can't tune above)
Input 1, all models	25.005 GHz	50.0 GHz	52 GHz
Input 2, opt 585	42.505 GHz	85.0 GHz	86 GHz
Input 2, opt 590	45.005 GHz	90.0 GHz	92 GHz
Input 2, opt 5CX	55.005 GHz	110.0 GHz	110 GHz

Input 2, CXA and MXE

Model	CF after Mode Preset	Stop Freq after Mode Preset	Max Freq (can't tune above)
CXA opt C75	0.7505 GHz	1.5 GHz	1.58 GHz
MXE	505 MHz	1 GHz	1.000025 GHz

Tracking Generator Frequency Limits (CXA only)

Tracking Generator Option	Min Freq (clips to this freq when turn TG on and can't tune below while TG on)	If above this Freq, Stop Freq clipped to this Freq when TG turned on	Max Freq (can't tune above) while TG on
T03	9 kHz	3.0 GHz	3.08 GHz
T06	9 kHz	6.0 GHz	6.05 GHz

Tracking Generator Frequency Limits(CXA-m only)

Tracking Generator Option	Min Freq (clips to this freq when turn TG on and can't tune below while TG on)	If above this Freq, Stop Freq clipped to this Freq when TG turned on	Max Freq (can't tune above) while TG on
T03	2 MHz	3.08 GHz	3.08 GHz
T07	2 MHz	7.575 GHz	7.575 GHz
T13	2 MHz	13.8 GHz	13.8 GHz
T26	2 MHz	26.55 GHz	26.55 GHz

VXT Models with Radio Heads/CIU Frequency Range

The following table shows the Center Frequency Presets and Range for VXT modes with Radio Heads/CIU.

Products with Radio Heads/CIU	Preset	Start frequency	Stop frequency
M9421A + CIU	6 GHz	5.9 GHz	12 GHz
M9410A + CIU	6 GHz	5.9 GHz	12 GHz
M9410A + CIU + RRH	25 GHz	24.25 GHz	43.5 GHz

RF Center Freq

Specifies the RF Center Frequency. Sets the center frequency to use when the RF input is selected, even if the RF input is not the input that is selected at the time the command is sent. Note that the **Center Frequency** function in the **Frequency** menu on the front panel always applies to the currently selected input.

Remote Command	`[:SENSe]:FREQuency:RF:CENTer <freq>` `[:SENSe]:FREQuency:RF:CENTer?`
Example	`:FREQ:RF:CENT 30 MHz` `:FREQ:RF:CENT?`
Notes	This command is the same in all Modes, but the parameter is Measurement Global. So, the value is independent in each Mode and common across all the measurements in the Mode
Dependencies	If the electronic/soft attenuator is enabled, any attempt to set Center Frequency such that the Stop Frequency would be >3.6 GHz fails and results in an advisory message. If the equivalent SCPI command is sent, this same message is generated as part of a "-221, Settings conflict" warning

Preset	See table above
State Saved	Saved in instrument state
Min	-79.999995 MHz
Max	See "Center Frequency Presets" on page 944 above. Basically, instrument maximum frequency - 5 Hz If the knob or step keys are being used, also depends on the value of **Span**

Ext Mix Center Freq

Specifies the External Mixer Center Frequency. Sets the center frequency to use when the External Mixer is selected, even if the External Mixer input is not the input which is selected at the time the command is sent. Note that the **Center Frequency** function in the **Frequency** menu on the front panel always applies to the currently selected input.

Remote Command	`[:SENSe]:FREQuency:EMIXer:CENTer <freq>` `[:SENSe]:FREQuency:EMIXer:CENTer?`
Example	`:FREQ:EMIX:CENT 60 GHz` `:FREQ:EMIX:CENT?`
Notes	This command is the same in all Modes, but the parameter is Measurement Global. So, the value is independent in each Mode and common across all the measurements in the Mode
Couplings	When returning to External Mixing after having switched to one of the other inputs (for example, RF), you return to the settings that you had when you left External Mixing. So, you return to the band you were in with the **Center Frequency** that you had. However, **Span** is not an input-dependent parameter, so the instrument retains the span from the previous input, limited as necessary by the current mixer setup
Preset	When a **Mode Preset** is performed while in External Mixing, the start frequency of the current Mode is set to the nominal Min Freq of the lowest harmonic range in the Harmonic Table for the current mixer setup. Similarly, the stop frequency of the current Mode is set to the nominal Max Freq of the highest harmonic range in the Harmonic Table. **Center Frequency** thus presets to the point arithmetically equidistant from these two frequencies Note that, if the current measurement has a limited **Span** available to it, and cannot achieve the span shown in the table (**Span** = Stop Freq – Start Freq), then the instrument uses the maximum Span the measurement allows, and still sets **Center Frequency** to the midpoint of the start and stop freq values in the Harmonic Table When **Restore Input/Output Defaults** is performed, the mixer presets to the 11970A, whose Start and Stop frequencies are 26.5 and 40 GHz respectively. The center of these two frequencies is 33.25 GHz Therefore, after **Restore Input/Output Defaults**, if you go to External Mixing and do a **Mode Preset** while in Spectrum Analyzer Mode, the resulting **Center Frequency** is 33.25 GHz
State Saved	Yes
Min	The minimum frequency in the currently selected mixer band + 5 Hz If the knob or step keys are being used, also depends on **Span**
Max	The maximum frequency in the currently selected mixer band – 5 Hz If the knob or step keys are being used, also depends on **Span**

I/Q Center Freq

Specifies the I/Q Center Frequency. Sets the center frequency to use when the I/Q input is selected, even if the I/Q input is not the input which is selected at the time the command is sent. Note that the **Center Frequency** function in the **Frequency** menu on the front panel always applies to the currently selected input.

Remote Command	`[:SENSe]:FREQuency:IQ:CENTer <freq>` `[:SENSe]:FREQuency:IQ:CENTer?`
Example	`:FREQ:IQ:CENT 30 MHz`
Notes	This command is the same in all Modes, but the parameter is Measurement Global. So, the value is independent in each Mode and common across all the measurements in the Mode
Preset	0 Hz
State Saved	Saved in instrument state
Min/Max	–/+40.049995 MHz

Span

Changes the displayed frequency range symmetrically about **Center Frequency**. While adjusting **Span**, **Center Frequency** is held constant, which means that both start and stop frequencies will change.

If **Span** is set to a value greater than the maximum allowable span of the instrument, an error message is generated indicating the data is out of range and was clipped to upper limit.The default (and minimum) **Span** is calculated using the number of carriers and the carrier width where;

Span = (Upper Carrier Freq + (max offset IBW * (1 + alpha)) / 2) – (Lower Carrier Freq – (max offset IBW * (1 + alpha)) / 2)

Span is increased by a factor of 1 + Filter Alpha if the RRC Filter in on.

Remote Command	`[:SENSe]:ACPower:FREQuency:SPAN <freq>` `[:SENSe]:ACPower:FREQuency:SPAN?`
Example	`:ACP:FREQ:SPAN 10 MHz` `:ACP:FREQ:SPAN?`
Notes	In Bluetooth Mode, the value of **Span** has to be an odd MHz
Dependencies	If the electrical attenuator is enabled, any attempt to set **Span** such that the Stop Frequency would be >3.6 GHz results in an error In instruments with an RF Preselector, such as MXE, you cannot sweep across the band break at 3.6 GHz while the RF Preselector is on in **Continuous** sweep, as there is a mechanical switch that bypasses the RF Preselector above 3.6 GHz
Couplings	**Span** affects RBW, sweeptime, FFT & Sweep choice (including FFT Width, Phase Noise Optimization and ADC Dither auto couplings)

	– Any value of **Center Frequency** or **Span** that is within the frequency range of the instrument is allowed *when* the value is being set through the front panel numeric keypad or the SCPI command. The other parameter is forced to a different value if needed, to keep the start and stop frequencies within the instrument's frequency range – When using the knob or the step up/down keys or the UP |DOWN keywords in SCPI, the value that is being changed, that is, **Center Frequency** or **Span**, is limited so that the other parameter is not forced to a new value – In Bluetooth Mode, if **Meas Method** is FFT, the max value of **Span** is coupled to the MAX IFBW of the platform The **Span** value is clipped when the carrier settings and/or the offset settings are changed. The value is changed to satisfy following formula: **Span** = (Upper Carrier Freq + (max offset IBW * (1 + alpha)) / 2) - (Lower Carrier Freq - (max offset IBW * (1 + alpha)) / 2) This parameter is unavailable when **Meas Method** is Fast Power. In that case, the span is fixed by the formula above
Preset	Depends on instrument maximum frequency, mode, measurement, and selected input See "Span Presets" on page 949
State Saved	Saved in instrument state
Min/Max	Depends on instrument maximum frequency, mode, measurement, and selected input. See "Span Presets" on page 949
Annotation	Span <value> appears on the first line of the annotation in the lower right corner of display

Span Presets

The following table provides the Max Span, for the various frequency options:

Freq Option	Max Span (can't set higher than this)
503 (all but CXA)	3.7 GHz
503, F03 (CXA, CXA-m)	3.08 GHz
507 (all but CXA)	7.1 GHz
507 (CXA, CXA-m)	7.575 GHz
508 (all but MXE)	8.5 GHz
508 (MXE)	8.5 GHz
513, F13	13.8 GHz
526 (all but CXA and MXE)	27.0 GHz
526 (MXE)	27.0 GHz
526, F26 (CXA, CXA-m)	26.55 GHz
544	44.5 GHz
550	52 GHz

Freq Option	Max Span (can't set higher than this)
F06 & EP6 (VXT models M9410A/11A)	6.27 GHz
F06 & LFE & EP6 (VXT models M9411A)	6.5999935 GHz
M9415A-F06	6.27 GHz
M9415A-F08	8.27 GHz
M9415A-F12	12.57 GHz

Input 2:

Model	Max Span (can't set higher than this)
CXA opt C75	1.58 GHz
MXE	1.000025 GHz

Note that if you are in External Mixing, the maximum Span will be equal to the Maximum Stop Frequency – Minimum Start Frequency for the currently selected mixer.

Span Presets by Mode

Mode	Preset Value
SA	8 MHz
WCDMA	24.6848 MHz
LTE, LTETDD, LTEAFDD, LTEATDD, MSR	25 MHz
5G NR	500 MHz
Radio Test	175 kHz

CF Step

Changes the step size for the center frequency and start and stop frequency functions. Once a step size has been selected and the center frequency function is active, the step keys (and the UP|DOWN parameters for **Center Frequency** from remote commands) change the center frequency by the step-size value. The step size function is useful for finding harmonics and sidebands beyond the current frequency span of the instrument.

Note that the start and stop frequencies also step by the **CF Step** value.

Remote Command	`[:SENSe]:FREQuency:CENTer:STEP[:INCRement] <freq>` `[:SENSe]:FREQuency:CENTer:STEP[:INCRement]?`
Example	Increase the current center frequency value by 500 MHz: `:FREQ:CENT:STEP 500 MHz`

	`:FREQ:CENT UP`
Notes	Preset and Max values depend on Hardware Options
Dependencies	If the electronic/soft attenuator is enabled, any attempt to change the value of the center frequency >3.6 GHz by pressing the Up-arrow key, fails and results in an advisory message. If the equivalent SCPI command is sent, this same message is generated as part of a "-221, Settings conflict" warning Not available in MSR, LTEAFDD, LTEATDD and 5G NR Modes
Couplings	When auto-coupled, the center frequency step size is set to 10% of the span
Preset	Auto
State Saved	Saved in instrument state
Min/Max	– /+(the maximum frequency of the instrument). That is, 27 GHz max freq instrument has a CF step range of +/- 27 GHz. Note that this is the maximum frequency given the current settings of the instrument, so in External Mixing, for example, it is the maximum frequency of the current mixer band
Status Bits/OPC dependencies	non-overlapped

Auto Function

Remote Command	`[:SENSe]:FREQuency:CENTer:STEP:AUTO OFF | ON | 0 | 1` `[:SENSe]:FREQuency:CENTer:STEP:AUTO?`
Example	`:FREQ:CENT:STEP:AUTO ON` `:FREQ:CENT:STEP:AUTO?`
Preset	`ON`

Freq Offset

Lets you set a frequency offset value to account for frequency conversions outside of the instrument. This value is added to the display readout of the marker frequency, center frequency, start frequency, stop frequency, and all other absolute frequency settings in the instrument including frequency count. When a frequency offset is entered, the value appears below the center of the graticule. To eliminate an offset, perform a **Mode Preset**, or set the frequency offset to 0 Hz.

See "More Information" on page 952

Remote Command	`[:SENSe]:FREQuency:OFFSet <freq>` `[:SENSe]:FREQuency:OFFSet?`
Example	`:FREQ:OFFS 10 MHz` `:FREQ:OFFS?`
Notes	Preset and Max values depend on Hardware Option
Dependencies	Appears only in SA Mode **Freq Offset** is not available in External Mixing. In this case the **Freq Offset** control is grayed out and shows a value of zero. However, the value of CF Offset that was set for the RF Input is retained and

	restored when you switch back to the RF Input
Preset	See "Center Frequency Presets" on page 944
State Saved	Saved in instrument state
Min	-500 GHz
Max	500 GHz
Annotation	If **Freq Offset** is not zero, "Freq Offset <value>" appears on the upper line of the annotation, below the graticule, in the center
Status Bits/OPC dependencies	Non-overlapped
Backwards Compatibility SCPI	`:DISPlay:WINDow[1]:TRACe:X[:SCALe]:OFFSet` This version of the command is in the instrument for compatibility across platforms and is not recommended for new development

More Information

This command does not affect any bandwidths or the settings of relative frequency parameters such as delta markers or span. It does not affect the current hardware settings of the instrument, but only the displayed frequency values. Entering an offset does not affect the trace position or display, just the value of the start and stop frequency and the values represented by the trace data. The frequency values of exported trace data, queried trace data, markers, trace data used in calculations such as N dB points, trace math, etc., are all affected by Freq Offset. Changing the offset, even on a trace that is not updating will immediately change all of the above, without taking new data.

NOTE If a trace is exported with a nonzero **Freq Offset**, the exported data contains the trace data with the offset applied. Therefore, if that trace were to be imported back into the instrument, you would want **Freq Offset** to be 0, or the offset would be applied again to data that is already offset. No such care need be taken when saving a State+Trace file, because the data and state are saved together.

3.5.12 Marker

Accesses a menu that enables you to select, set up and control the markers for the current measurement. If there are no active markers, **Marker** selects marker 1, sets it to `POSition` (Normal) and places it at the center of the display. If the selected marker is `OFF`, it is set to `POSition` and placed at the center of the screen on the trace determined by the **Marker Trace** rules.

Note that this hard key and all sub keys are unavailable when "Meas Method" on page 963 is RBW.

3.5.12.1 Select Marker

Specifies the selected marker. The term “selected marker” is used throughout this document to specify which marker will be affected when you change marker settings, perform a Peak Search, etc.

The **Select Marker** control appears above the menu panel, indicating that it applies to all controls in the **Marker** menu panels. **Select Marker** is blanked if you select a tab whose controls do *not* depend on the selected marker (for example, **Counter**).

On any menu tab in which **Select Marker** appears, the first control is always **Marker Frequency | Time**.

Notes	The selected marker is remembered even when not in the Marker menu and is used if a Search is done or a Band Function is turned on or for Signal Track or Continuous Peak
Preset	Marker 1
State Saved	The number of the selected marker is saved in instrument state
Annunciation	Appears in the marker results block label for **Normal, Delta** and **Fixed** markers

3.5.12.2 Settings

The controls on this tab include the **Marker** active function and a radio button selection of the marker control mode (`POSition`, `DELTa`, or `OFF`) for the selected marker, as well as additional functions that help you use markers.

Marker Frequency

Sets the marker X-Axis value in the current marker X-Axis Scale unit. Has no effect if the control mode is `OFF`, but is the SCPI equivalent of entering an X value if the control mode is `POSition` or `DELTa`.

Remote Command	`:CALCulate:ACPower:MARKer[1]|2|…|12:X <freq>` `:CALCulate:ACPower:MARKer[1]|2|…|12:X?`
Example	`:CALC:ACP:MARK3:X 0` `:CALC:ACP:MARK3:X?`
Notes	If no suffix is sent, uses the fundamental units for the current marker X-Axis Scale. If a suffix is sent that does not match the current marker X-Axis Scale unit, an error “Invalid suffix” is generated The query returns the marker’s absolute X Axis value if the control mode is `POSition`, or the offset from the marker’s reference marker if the control mode is `DELTa`. The query is returned in the fundamental units for the current marker X-Axis scale: Hz for **Frequency and Inverse Time**, seconds for **Period and Time**
Dependencies	Unavailable when "Meas Method" on page 963 is `RBW`

Preset	After a preset, all markers are turned OFF, so Marker X-Axis Value query returns Not A Number (NAN)
State Saved	Saved in instrument state
Min/Max	–/+9.9E+37
Annotation	Mkr # <X value> and <Marker value> upper right on graph

Marker X Axis Position (Remote Command Only)

Sets the marker X-Axis Scale position in trace points. This setting has no effect if the control mode is OFF, but is the SCPI equivalent of entering a value if the control mode is POSition or DELTa, except in trace points rather than X-Axis Scale units. The entered value is immediately translated into the current X-Axis Scale units for setting the value of the marker.

Remote Command	`:CALCulate:ACPower:MARKer[1]|2|…|12:X:POSition <real>` `:CALCulate:ACPower:MARKer[1]|2|…|12:X:POSition?`
Example	`:CALC:ACP:MARK10:X:POS 0` `:CALC:ACP:MARK10:X:POS?`
Notes	The query returns the marker's absolute X-Axis value in trace points if the control mode is POSition, or the offset from the marker's reference marker in trace points if the control mode is DELTa. The value is returned as a real number, not an integer, corresponding to the translation from X-Axis Scale units to trace points. When a Marker is turned on, it is placed center of the screen on the trace. Therefore, the default value depends on instrument condition. If the marker is OFF, the response is Not A Number
Dependencies	Unavailable when **Meas Method** is RBW
Preset	After a preset, all markers are turned OFF, so Marker X-Axis Value query returns a Not A Number (NAN)
State Saved	Saved in instrument state
Min/Max	–/+9.9E+37

Marker Y Axis Value (Remote Query only)

Returns the marker Y-Axis value in the current marker Y-Axis unit.

Remote Command	`:CALCulate:ACPower:MARKer[1]|2|…|12:Y?`
Example	`:CALC:ACP:MARK11:Y?`
Notes	Returns the marker Y-axis result, if the control mode is POSition or DELTa. If the marker is OFF, the response is Not A Number
Dependencies	Unavailable when "Meas Method" on page 963 is RBW
Preset	Depends on Markers setup and signal source
State Saved	No
Backwards Compatibility SCPI	`:CALCulate:ACPower:MARKer[1]|2|…|12:FUNCtion:RESult?`

Marker Mode

Sets the marker control mode to POSition (**Normal**), DELTa, or OFF. All interactions and dependencies detailed under the control description are enforced when the remote command is sent. If the selected marker is OFF, pressing **Marker** sets it to POSition, and places it at the center of the screen on the trace determined by the **Marker Trace** rules. At the same time, **Marker X Axis Value** appears on the Active Function area.

The default active function is the active function for the currently selected marker control mode. If the current control mode is OFF, there is no active function, and the active function is turned off.

Remote Command	`:CALCulate:ACPower:MARKer[1]|2|…|12:MODE POSition | DELTa | OFF` `:CALCulate:ACPower:MARKer[1]|2|…|12:MODE?`
Example	`:CALC:ACP:MARK3:MODE POS` `:CALC:ACP:MARK3:MODE?`
Dependencies	Unavailable when **Meas Method** is RBW
Preset	OFF
State Saved	Saved in instrument state
Range	POSition|DELTa|OFF
Annotation	Mkr # <X value> and <Marker value> upper right on graph

Backwards Compatibility SCPI Commands

Sets or queries the state of a marker. Setting a marker that is OFF to ON (1) puts it in POSition mode and places it at the center of the screen.

Example	`:CALC:ACP:MARK2:STAT ON` `:CALC:ACP:MARK2:STAT?`
Preset	OFF
State Saved	Saved in instrument state
Range	OFF|ON
Backwards Compatibility SCPI	`:CALCulate:ACPower:MARKer[1]|2|…|12:STATe OFF | ON | 0 | 1` `:CALCulate:ACPower:MARKer[1]|2|…|12:STATe?`

Delta Marker (Reset Delta)

Pressing this button has exactly the same effect as pressing `DELTa` in **Marker Mode**. The selected marker becomes a **Delta** marker. If the selected marker is already a **Delta** marker, the reference marker is moved to the current position of the selected marker, thus resetting the delta to zero.

Marker Settings Diagram

Lets you configure the **Marker** system using a visual utility.

All Markers Off

Turns off all markers.

Remote Command	`:CALCulate:ACPower:MARKer:AOFF`
Example	`:CALC:ACP:MARK:AOFF`
Dependencies	Unavailable when "Meas Method" on page 963 is `RBW`

Couple Markers

When this function is `ON`, moving any marker causes an equal X-Axis movement of every other marker that is not `OFF`. By "equal X-Axis movement" we mean that we preserve the difference between each marker's X-Axis value (in the fundamental X-Axis units of the trace that marker is on), and the X-Axis value of the marker being moved (in the same fundamental X-Axis units).

This may result in markers going off screen.

Remote Command	`:CALCulate:ACPower:MARKer:COUPle[:STATe] ON | OFF | 1 | 0` `:CALCulate:ACPower:MARKer:COUPle[:STATe]?`
Example	`:CALC:ACP:MARK:COUP ON` `:CALC:ACP:MARK:COUP?`
Dependencies	Unavailable when "Meas Method" on page 963 is `RBW`
Preset	`OFF` Presets on **Mode Preset** and **All Markers Off**
State Saved	Saved in instrument state

3.5.12.3 Peak Search

The controls on this tab allow you to move the marker to selected peaks of the signal, giving you enormous analysis capabilities, particularly when combined with the Delta Marker function.

NOTE Pressing the **Peak Search** hardkey automatically moves you to the Peak Search page of the **Marker** menu *and* performs a Peak Search.

Pressing the **Peak Search** tab once you are already *in* the **Marker** menu does *not* perform a Peak Search.

Marker Frequency

This is the fundamental control that you use to move a marker around on the trace. It is the same as "Marker Frequency" on page 953on the **Settings** tab.

Peak Search

Pressing the **Peak Search** control moves the selected marker to the trace point which has the maximum Y-Axis value for that marker's trace.

NOTE Pressing the **Peak Search** hardkey automatically moves you to the **Peak Search** page of the **Marker** menu *and* performs a peak search.

Remote Command	:CALCulate:ACPower:MARKer[1]|2|…|12:MAXimum
Example	:CALC:ACP:MARK2:MAX :SYST:ERR? can be used to query the errors to determine if a peak is found. The message "No peak found" will be returned after an unsuccessful search
Notes	Sending this command selects the subopcoded marker

Next Peak

Moves the selected marker to the peak that is next lower in amplitude than the current marker value.

If the selected marker was `OFF`, then it is turned on as a normal marker and a peak search is performed.

Remote Command	`:CALCulate:ACPower:MARKer[1]|2|…|12:MAXimum:NEXT`
Example	`:CALC:ACP:MARK2:MAX:NEXT`
Notes	Sending this command selects the subopcoded marker
State Saved	Not part of saved state

Next Pk Right

Moves the selected marker to the nearest peak right of the current marker.

If the selected marker was `OFF`, then it is turned on as a normal marker and a peak search is performed.

Remote Command	`:CALCulate:ACPower:MARKer[1]|2|…|12:MAXimum:RIGHt`
Example	`:CALC:ACP:MARK2:MAX:RIGH`
Notes	Sending this command selects the subopcoded marker
State Saved	Not part of saved state

Next Pk Left

Moves the selected marker to the nearest peak left of the current marker.

If the selected marker was `OFF`, then it is turned on as a normal marker and a peak search is performed.

Remote Command	`:CALCulate:ACPower:MARKer[1]|2|…|12:MAXimum:LEFT`
Example	`:CALC:ACP:MARK2:MAX:LEFT`
State Saved	Not part of saved state

Minimum Peak

Moves the selected marker to the minimum Y-Axis value on the current trace.

If the selected marker is `OFF`, it is turned on before the minimum search is performed.

Remote Command	`:CALCulate:ACPower:MARKer[1]|2|…|12:MINimum`
Example	`:CALC:ACP:MARK:MIN`
Notes	Sending this command selects the subopcoded marker
State Saved	Not part of saved state

Pk-Pk Search

Finds and displays the amplitude and frequency (or time, if in zero span) differences between the highest and lowest Y-Axis value. It places the selected marker on the minimum value on its selected trace, and places that marker's reference marker on the peak of its selected trace.

This function turns on the reference marker and sets its mode to `POSition` if it is not already on. (These markers may be on two different traces.)

If the selected marker is `OFF`, a delta type marker is turned on and the peak-to-peak search is done. If the selected marker is on, but it is not a delta marker, then it is changed to delta, which turns on the reference marker if needed, and then it performs the peak-to-peak function.

Remote Command	`:CALCulate:ACPower:MARKer[1]|2|…|12:PTPeak`
Example	`:CALC:ACP:MARK:PTP`
Notes	Turns on the Marker D active function Sending this command selects the subopcoded marker
Dependencies	**Pk-Pk Search** is not available when **Coupled Markers** is on
Couplings	The selected marker becomes a delta marker if not already in delta mode
State Saved	Not part of saved state

Marker Delta

Pressing this button has exactly the same effect as pressing `DELTa` in **Marker Mode** on the **Settings** tab. The selected marker becomes a **Delta** marker. If the selected marker is already a **Delta** marker, the reference marker is moved to the current position of the selected marker, thus resetting the delta to zero.

The control is duplicated here to allow you to conveniently perform a peak search and change the marker's control mode to **Delta** without having to access two separate menus.

3.5.12.4 Properties

The controls on this tab are used to set certain properties of the selected marker.

Marker Frequency

This is the fundamental control that you use to move a marker around on the trace. It is the same as "Marker Frequency" on page 953 on the **Settings** tab.

Relative To

Selects the marker to which the selected marker is relative (its reference marker).

Every marker has another marker to which it is relative. This marker is referred to as the “reference marker” for that marker. This attribute is set by the **Marker, Properties, Relative To** key. The marker must be a **Delta** marker to make this attribute relevant. If it is a **Delta** marker, the reference marker determines how the marker is controlled and how its value is displayed. A marker cannot be relative to itself.

Remote Command	`:CALCulate:ACPower:MARKer[1]|2|…|12:REFerence <integer>` `:CALCulate:ACPower:MARKer[1]|2|…|12:REFerence?`
Example	`:CALC:ACP:MARK2:REF 6` `:CALC:ACP:MARK2:REF?`
Notes	Causes the marker specified with the subopcode to become selected Range (for SCPI command): 1 to 12. If the range is exceeded the value is clipped A marker cannot be relative to itself so that choice is not available, and if sent from SCPI generates error -221: “Settings conflict; marker cannot be relative to itself” When queried a single value is returned (the specified marker numbers relative marker)
Dependencies	Unavailable when "Meas Method" on page 963 is `RBW`
Couplings	The act of specifying the selected marker’s reference marker makes the selected marker a **Delta** marker If the reference marker is `OFF`, it is turned on in `POSition` mode at the delta marker location
Preset	The preset default “Relative To” marker (reference marker) is the next higher numbered marker (current marker +1). For example, if marker 2 is selected, then its default reference marker is marker 3. The exception is marker 12, which has a default reference of marker 1 Set to the defaults by using **Restore Mode Defaults**. This is not reset by **Marker Off**, **All Markers Off**, or **Preset**
State Saved	Saved in instrument state. Not affected by **Marker Off** and hence not affected by **Preset** or power cycle
Min	1
Max	12
Annunciation	Appears in the marker label of a **Delta** marker

Marker Trace

Selects the trace on which you want your marker placed. A marker is associated with one and only one trace. This trace is used to determine the placement, result, and X-Axis Scale of the marker. All markers have an associated trace; it is from that trace that they determine their attributes and behaviors, and it is to that trace that they go when they become Normal markers.

Specifying a **Marker Trace** manually or with this command associates the marker with the specified trace. If the marker is not `OFF`, it moves the marker from the trace it was on to the new trace. If the marker is `OFF`, it stays off but is now associated with the specified trace.

The query returns the number of the trace on which the marker is currently placed.

Remote Command	`:CALCulate:ACPower:MARKer[1]|2|…|12:TRACe 1 | 2 | 3` `:CALCulate:ACPower:MARKer[1]|2|…|12:TRACe?`
Example	`:CALC:ACP:MARK2:TRAC 2` `:CALC:ACP:MARK2:TRAC?`
Notes	A marker may be placed on a blanked and/or inactive trace, even though the trace is not visible and/or updating An application may register a trace name to be displayed on the control instead of a trace number
Couplings	The state of **Marker Trace** is not affected by "Auto Couple" on page 1995 Sending the remote command causes the addressed marker to become selected
Preset	1
State Saved	Saved in instrument state
Min	1
Max	3

Marker Settings Diagram

Lets you configure the **Marker** system using a visual utility. It is the same as "Marker Settings Diagram" on page 956 on the **Settings** tab.

3.5.13 Meas Setup

Contains functions for setting up the measurement parameters and also contains functions for setting up parameters global to all measurements in the mode.

3.5.13.1 Settings

Contains frequently-used functions to which you will want the fastest access.

Avg | Hold Number

Specifies the number of measurement averages used to calculate the measurement result. The average will be displayed at the end of each sweep. After the specified number of average counts, the average mode (termination control) setting determines the average action.

Remote Command	`[:SENSe]:ACPower:AVERage:COUNt <integer>` `[:SENSe]:ACPower:AVERage:COUNt?`
Example	`:ACP:AVER:COUN 250` `:ACP:AVER:COUN?`
Notes	The BAF backwards Compatibility SCPI command, `[:SENSe]:ACPR:AVERage[:STATe]`, is provided to support same functionality as `[:SENSe]:ACPr:AVERage[:STATe]` (PSA W-CDMA, PSA cdma2000 and PSA 1xEVDO) due to ACPr node conflicts with ACPower node
Preset	10
State Saved	Saved in instrument state
Min/Max	1/1000
Annotation	Avg Number is displayed in the Measurement Bar

Backwards Compatibility SCPI	`[:SENSe]:ACPR:AVERage:COUNt`
	`[:SENSe]:MCPower:AVERage:COUNt`
	Power Suite, W-CDMA

Averaging On/Off

Turns averaging on or off.

NOTE In this measurement, the **Average Type** is preset to the `Log-Pwr Avg (Video)` method. Other averaging methods are not available.

Remote Command	`[:SENSe]:ACPower:AVERage[:STATe] OFF | ON | 0 | 1` `[:SENSe]:ACPower:AVERage[:STATe]?`
Example	`:ACP:AVER OFF` `:ACP:AVER?`
Preset	`ON`
State Saved	Yes
Range	`OFF|ON`

Backwards Compatibility SCPI	`[:SENSe]:ACPR:AVERage[:STATe]`
	`[:SENSe]:MCPower:AVERage[:STATe]`
	Power Suite, W-CDMA

Avg Mode

Sets the Averaging Mode. This determines the averaging action after the specified number of data acquisitions (average count) is reached.

– When set to `EXPonential`, the measurement averaging continues using the specified number of averages to compute each averaged value. The average will be displayed at the end of each sweep

– When set to `REPeat`, the measurement resets the average counter each time the specified number of averages is reached

Remote Command	`[:SENSe]:ACPower:AVERage:TCONtrol EXPonential | REPeat` `[:SENSe]:ACPower:AVERage:TCONtrol?`
Example	`:ACP:AVER:TCON EXP` `:ACP:AVER:TCON?`
Notes	The backwards-compatibility SCPI command, `[:SENSe]:ACPR:AVERage:TCONtrol`, is provided to support same functionality as `[:SENSe]:ACPr:AVERage:TCONtrol` (PSA W-CDMA, PSA cdma2000 and PSA 1xEVDO) due to `ACPr` node conflicts with `ACPower` node
Preset	`EXPonential`
State Saved	Saved in instrument state
Range	`EXPonential|REPeat`

Backwards Compatibility SCPI	`[:SENSe]:ACPR:AVERage:TCONtrol`
	Power Suite, W-CDMA:
	`[:SENSe]:MCPower:AVERage:TCONtrol`

Meas Method

Sets the desired method to measure ACP. The options are:

Integration BW `IBW`	One sweep of the trace is taken, and the band power for each offset is computed. Depending on "Measurement Type" on page 1045 (Total Power Reference or PSD Reference), results are displayed relative to the total power or the power spectral density. The display reflects either the current trace or a bar graph view
Filtered IBW `IBWRange` (max dynamic range)	The ACP Path is used to compute ACP when an ACP path is available. This method increases dynamic range, but increases measurement time as it limits the resolution bandwidth. This method is useful for improving dynamic range on a W-CDMA signal because a sharp cutoff bandpass filter is used. The accuracy of the adjacent channel power ratio is not degraded by this method, but the absolute accuracy of both adjacent channel power and carrier power are degraded by up to about 0.5 dB
RBW `RBW`	The algorithm uses zero-span and an appropriate RBW setting to capture all of the power in the carrier channel and the offsets. The zero-span algorithm (RBW method) is slower than the IBW method, but greatly improves repeatability
Fast `FAST`	WCDMA Mode or SA Mode with 3GPP WCDMA radio standard selected: Provides the same method as the Integration BW method, but is optimized for speed to measure a W-CDMA signal SA Mode with CDMA2K radio standard selected: Provides faster measurement using the FFT method with a limited parameter flexibility. When this is selected, CDMA2K preset offsets are given and control of the following are unavailable:

- BW menu
- Sweep/Control menu except Pause/Resume
- Trace/Detector menu
- Carrier Setup, Offset Limit, RRC Weighting, Filter Alpha, and Noise Correction in Meas Setup menu

Fast Power
`FPOWer`
(Option FP2 required)
	This provides faster measurement using the Hardware accelerated FFT method with a limited parameter flexibility. When this is selected, the following parameters are not available:
	– Points and Auto Sweep Points under Sweep
	  – When changing Meas Method to Fast Power, Auto Sweep Points is turned on and grayed-out (Sweep Points will change according to the Fast Power setting)
	  – When returning Meas Method to any setting other than Fast Power, Auto Sweep Points stays on and becomes available (Sweep Points will change according to the auto sweep points calculation algorithm)
	– Trace Type, Restart Averaging and View/Blank under Trace when Select Trace is Trace 2 or Trace3
	– Span under Frequency
	– Res BW, Video BW, Filter Type and Filter BW of Offset > Advanced dialog of Carr/Offset/Limits Config control under Meas Setup
	– For Trigger, only Free Run, External 1 and External 2 are supported
	When in microwave frequency and measurement span is > 40MHz, RF preselector must be turned off

Remote Command	`[:SENSe]:ACPower:METHod IBW | IBWRange | FAST | RBW | FPOWer` `[:SENSe]:ACPower:METHod?`
Example	`:ACP:METH IBW` `:ACP:METH?`
Notes	`FAST` mode is only supported for WCDMA and C2K signals. You must be in WCDMA or SA Modes, with 3GPP WCDMA or CDMA2K radio standard. Otherwise, a setting conflict error message is reported MSR, LTEAFDD, LTEATDD and 5G NR Modes support only Integration BW, Filtered IBW and Fast Power methods
Dependencies	When `RBW`, `FAST` or `FPOWer` is selected, **Gate** function is not available. If you try to turn **Gate**`ON` while **Meas Method** is `RBW`, `FAST` or `FPOWer`, an error is generated When **Gate** function is `ON`, `RBW`, `FAST` and `FPOWer` are not available. If you try to change **Meas Method** to `RBW`, `FAST` or `FPOWer`, an error is generated VXT Models M9420A/10A/11A support only the Integration BW method
Couplings	IBW (Range) restricts the **Res BW** available for making this measurement to 30 kHz. When selected, **Res BW** is clipped to this value if required and an error number displayed
Preset	`IBW`
State Saved	Saved in instrument state

Range	IBW|IBWRange|FAST|RBW|FPOWer
Backwards Compatibility SCPI	[:SENSe]:ACPR:SWEep:TYPE (Power Suite, WCDMA) [:SENSe]:MCPower:METHod

Carrier/Offset/Limits Config

Opens a dialog that lets you set Carriers, Offset, and Limits parameters.

Carrier

Lets you configure your carriers, carrier spacing, noise bandwidth and measurement method.

Dependencies	Appears in all Modes except MSR, LTEAFDD, LTEATDD and 5G NR

Number of Carriers

This is the same as "Number of Carriers" on page 1005 under **Reference**.

Couple to #1

Couples carrier settings to carrier #1. The coupled parameters are:

- "Carrier Pwr Present" on page 1006
- "Carrier Spacing" on page 1007
- "Measurement Noise Bandwidth" on page 1008
- "Method for Carrier " on page 1009
- "Filter Alpha for Carrier" on page 1010

Remote Command	[:SENSe]:ACPower:CARRier[1]|2:LIST:COUPle OFF | ON | 0 | 1, … [:SENSe]:ACPower:CARRier[1]|2:LIST:COUPle?
Example	:ACP:CARR:LIST:COUP OFF :ACP:CARR:LIST:COUP?
Notes	Carrier subopcode: 1 for BTS (Downlink), 2 for MS (Uplink). Default is BTS Some modes do not support Carrier subopcode 2. In those cases, commands with subopcode 2 are accepted without error but ignored For LTEAFDD or LTEATDD Modes, this control is not shown. In order to maintain backwards compat-

	ibility with legacy LTE FDD/TDD, the SCPI command is supported in LTE & LTE-A converged applications
Couplings	When ON, the carrier settings are coupled to carrier #1. Coupled parameters are: Carrier Power Present, Carrier Spacing, Measurement Noise Bandwidth, Method and Filter Alpha When a setting is changed, coupling is switched off automatically Carrier #1 is always set to ON and cannot be changed
Preset	ON
State Saved	Saved in instrument state

Carrier Pwr Present

Configures the carriers for this measurement. Allows spaces to be inserted between carriers. Carriers with the power present parameter set to YES are carriers, and those with the power present parameter set to NO are spaces. Each carrier power present is set to YES or NO. The individual carrier can be set by selecting the desired carrier.

The query returns the current values for all of the carriers. If a carrier is defined as having no power present, the power displayed is relative to the reference carrier, otherwise the absolute power is displayed.

If you change the carrier power present to NO, and that carrier is currently configured as the reference carrier, the next carrier to the left (or the right if there are no carriers to the left) is assigned as the reference carrier. This also applies to the scenario where there are only two carriers configured as having power present, and you configure only one carrier to have no power present.

Remote Command	`[:SENSe]:ACPower:CARRier[1]|2:LIST:PPResent YES	NO, …` `[:SENSe]:ACPower:CARRier[1]|2:LIST:PPResent?`
Example	`:ACP:CARR2:LIST:PPR YES` `:ACP:CARR2:LIST:PPR?`
Notes	Carrier subopcode: 1 for BTS (Downlink), 2 for MS (Uplink). Default is BTS Some Modes do not support Carrier subopcode 2. In those cases, commands with subopcode 2 are accepted without error but ignored When setting these values remotely, the position in the list sent corresponds to the carrier. Missing values are not permitted, so if you want to change values 2 and 6, you must send all values up to 6. Subsequent values remain unchanged, unless the number of values sent is greater than the number of carriers, then subsequent values are ignored For LTEAFDD or LTEATDD Modes, this control is not shown. To maintain backwards compatibility with legacy LTE FDD/TDD Modes, the SCPI command is supported in the LTE & LTE-A converged applications
Couplings	Coupled to number of carriers. When the SCPI command is sent, the number of carriers is set to the number of entries in the parameter list

Preset	YES
State Saved	Saved in instrument state
Backwards Compatibility SCPI	[:SENSe]:MCPower:CARRier[1]|2:LIST:PPResent

Carrier Spacing

Sets the width of the carrier spacing. This is the value applied to all the current slots, whether they are carriers or spaces.

Enter each carrier spacing value individually by selecting the desired carrier, and then enter the carrier width.

Remote Command	[:SENSe]:ACPower:CARRier[1]|2:LIST:WIDTh <freq>, … [:SENSe]:ACPower:CARRier[1]|2:LIST:WIDTh?
Example	:ACP:CARR2:LIST:WIDT 25kHz :ACP:CARR2:LIST:WIDT?
Notes	Carrier subopcode: 1 for BTS (Downlink), 2 for MS (Uplink). Default is BTS Some Modes do not support Carrier subopcode 2. In those cases, commands with subopcode 2 are accepted without error but ignored When setting these values remotely, the position in the list sent corresponds to the carrier. Missing values are not permitted, so if you want to change values 2 and 6, you must send all values up to 6. Subsequent values remain unchanged, unless the number of values sent is greater than the number of carriers, then subsequent values are ignored For LTEAFDD or LTEATDD Modes, this control is not shown. To maintain backwards compatibility with legacy LTE FDD/TDD Modes, the SCPI command is supported in the LTE & LTE-A converged applications
Couplings	Coupled to number of carriers. When the SCPI command is sent, the number of carriers is set to the number of entries in the parameter list Changing Carrier Spacing might affect "Span" on page 948
Preset	SA, WCDMA, LTE, LTETDD Modes: 5 MHz Radio Test Mode: 25 kHz
State Saved	Saved in instrument state
Min/Max	0 Hz/Depends on instrument maximum frequency. Same as the Max Span of Swept SA Measurement
Backwards Compatibility SCPI	[:SENSe]:MCPower:CARRier[1]|2:LIST:WIDTh

Measurement Noise Bandwidth

Specifies the **Measurement Noise Bandwidth** used to calculate the power in the carriers.

Each **Measurement Noise Bandwidth** value is entered individually by selecting the desired carrier. Enter the measurement noise bandwidth on the **Carrier** page of the **Carr/Offset/Limits Config** dialog.

Remote Command	`[:SENSe]:ACPower:CARRier[1]|2:LIST:BANDwidth[:INTegration] <freq>, …` `[:SENSe]:ACPower:CARRier[1]|2:LIST:BANDwidth[:INTegration]?`
Example	`:ACP:CARR2:LIST:BAND 25kHz` `:ACP:CARR2:LIST:BAND?`
Notes	In WCDMA Mode, the preset/default value is defined as 3.84 MHz, but internally, 4.6848 MHz is used as the default value Carrier subopcode: 1 for BTS (Downlink), 2 for MS (Uplink). Default is BTS Some Modes do not support Carrier subopcode 2. In those cases, commands with subopcode 2 are accepted without error but ignored When setting these values remotely, the position in the list sent corresponds to the carrier. Missing values are not permitted, so if you want to change values 2 and 6, you must send all values up to 6. Subsequent values remain unchanged, unless the number of values sent is greater than the number of carriers, then subsequent values are ignored For LTEAFDD or LTEATDD Modes, this control is not shown. In order to maintain backwards compatibility with legacy LTE FDD/TDD Modes, the SCPI command is supported in the LTE & LTE-A converged applications
Couplings	Coupled to number of carriers. When the SCPI command is sent, the number of carriers is set to the number of entries in the parameter list
Preset	(see table below)
State Saved	Saved in instrument state
Min/Max	10 Hz/Depends on instrument maximum frequency. Same as Max Span of the Swept SA Measurement

Backwards Compatibility SCPI	`[:SENSe]:ACPower:BANDwidth:INTegration`
	`[:SENSe]:ACPower:BWIDth:INTegration`
	`[:SENSe]:ACPower:CARRier[1]|2:LIST:BWIDth[:INTegration]`
	`[:SENSe]:MCPower:CARRier[1]|2:LIST:BANDwidth[:INTegration]`
	`[:SENSe]:MCPower:CARRier[1]|2:LIST:BWIDth[:INTegration]`

Preset:

Modes	Value
SA	2 MHz
WCDMA	3.84 MHz
LTE, LTETDD	4.515 MHz|4.5 MHz
Radio Test	25 kHz

Method for Carrier

Accesses the carrier configuration method settings.

Remote Command	`[:SENSe]:ACPower:CARRier[1]|2:LIST:FILTer[:RRC][:STATe] ON | OFF | 1 | 0, …` `[:SENSe]:ACPower:CARRier[1]|2:LIST:FILTer[:RRC][:STATe]?`
Example	`:ACP:CARR:LIST:FILT 0,0,0,0` `:ACP:CARR:LIST:FILT?`
Notes	The binary values translate as follows: `1|ON` — RRC Weighted `0|OFF` — Integ BW Maximum of Array length depends on the number of carriers Some Modes do not support Carrier subopcode 2. In those cases, commands with subopcode 2 are accepted without error but ignored For LTEAFDD or LTEATDD Modes, this control is not shown. In order to maintain backwards compatibility with legacy LTE FDD/TDD Modes, the SCPI command is supported in the LTE & LTE-A converged applications
Preset	**Modes** / **Value**: SA, LTE, LTETDD — `OFF` WCDMA — `ON` Radio Test — `OFF`
State Saved	Saved in instrument state
Range	Integration BW | RRC Weighted

Filter Alpha for Carrier

Inputs the alpha value for the filter used in the current carrier configuration.

Remote Command	`[:SENSe]:ACPower:CARRier[1]|2:LIST:FILTer:ALPHa <real>, …` `[:SENSe]:ACPower:CARRier[1]|2:LIST:FILTer:ALPHa?`
Example	`:ACP:CARR2:LIST:FILT:ALPH 0.5` `:ACP:CARR2:LIST:FILT:ALPH?`
Notes	Some Modes do not support Carrier subopcode 2. In those cases, commands with subopcode 2 are accepted without error but ignored For LTEAFDD or LTEATDD Modes, this control is not shown. In order to maintain backwards compatibility with legacy LTE FDD/TDD Modes, the SCPI command is supported in the LTE & LTE-A converged applications

Preset	0.22
State Saved	Saved in instrument state
Min/Max	0.01/1.0

Offset

Lets you configure the spacing of the offset regions.

Offset Frequency Define

Lets you select offset frequency definition. Each standard defines each offset frequency from Carrier.

For example, 3GPP2 requires the “From Carrier Center to Integ BW Closer Edge” definition. LTE conformance test requires “From Carrier Edge to Integ BW Center” and/or “From Carrier Edge to Integ BW Closer Edge” definition.

`CTOCenter`	From the lowermost carrier center frequency (for lower offset), the uppermost carrier center frequency (for upper offset) to the center frequency of each Offset Integ BW
`CTOEdge`	From the lowermost carrier center frequency (for lower offset), the uppermost carrier center frequency (for upper offset) to the closest edge frequency of each Offset Integ BW
`ETOCenter`	From the lowermost carrier center frequency - spacing of this carrier /2 (for lower offset), the uppermost carrier center frequency + spacing of this carrier /2 (for upper offset) to the center frequency of each Offset Integ BW
`ETOEdge`	From the lowermost carrier center frequency - spacing of this carrier /2 (for lower offset), the uppermost carrier center frequency + spacing of this carrier /2 (for upper offset) to the closest edge of each Offset Integ BW
`RTOCenter` 5G NR only	From either the lower or upper RF BW** edge frequency to the center frequency of each Offset Integ BW
`RTOEdge` 5G NR only	From either the lower or upper RF BW** edge frequency to the closest edge frequency of each Offset Integ BW
`RCTOCenter` 5G NR only	From the center frequency of RF BW** to the center frequency of each Offset Integ BW
`SCTOCenter` 5G NR only	From the center frequency of sub-block** to the center frequency of each Offset Integ BW

** RF BW = BWchannel,CA which is defined in each 3GPP standard, regardless of “Measure Carrier” for the uppermost and the lowermost carriers being Enabled or Disabled. When the Number of Component Carrier = 1, RF BW = $BW_{channel}$ = 2 x $F_{offset,RAT}$

** sub-block (bandwidth) = $BW_{channel,block}$ which is defined in each 3GPP standard, regardless of “Measure Carrier” for the uppermost and the lowermost carriers being

Enabled or Disabled. When the Number of Component Carrier within each sub-block = 1, sub-block (bandwidth) = $BW_{channel}$ = 2 x $F_{offset,RAT}$.

See "Diagrams for Offset Freq Define" on page 972.

Modes other than MSR, LTEAFDD, LTEATDD, 5G NR

Remote Command	`[:SENSe]:ACPower:OFFSet[1]|2[:OUTer]:TYPE CTOCenter	CTOEdge	ETOCenter	ETOEdge` `[:SENSe]:ACPower:OFFSet[1]|2[:OUTer]:TYPE?`
Example	`:ACP:OFFS:TYPE ETOC` `:ACP:OFFS:TYPE?`
Notes	Some Modes do not support Offset subopcode 2. In those cases, commands with subopcode 2 are accepted without error but ignored
Preset	`CTOCenter`
State Saved	Saved in instrument state
Range	`CTOCenter|CTOEdge|ETOCenter|ETOEdge`

Mode: MSR, LTEAFDD, LTEATDD

Remote Command	`[:SENSe]:ACPower:OFFSet[1]|2[:OUTer]:TYPE CTOCenter	CTOEdge	ETOCenter	ETOEdge` `[:SENSe]:ACPower:OFFSet[1]|2[:OUTer]:TYPE?`
Example	`:ACP:OFFS:TYPE ETOC` `:ACP:OFFS:TYPE?`
Preset	`CTOCenter`
State Saved	Saved in instrument state
Range	`CTOCenter|CTOEdge|ETOCenter|ETOEdge`

Mode: 5G NR

Remote Command	`[:SENSe]:ACPower:OFFSet[1]|2[:OUTer]:TYPE CTOCenter	CTOEdge	ETOCenter	ETOEdge	RTOCenter	RTOEdge	RCTOCenter	SCTOCenter` `[:SENSe]:ACPower:OFFSet[1]|2[:OUTer]:TYPE?`
Example	`:ACP:OFFS:TYPE ETOC` `:ACP:OFFS:TYPE?`
Preset	`CTOCenter`
State Saved	Saved in instrument state
Range	`CTOCenter	CTOEdge	ETOCenter	ETOEdge	RTOCenter	RTOEdge	RCTOCenter	SCTOCenter`

Diagrams for Offset Freq Define

Details depend on the selected mode.

Diagram for Modes other than MSR, LTEAFDD, LTEATDD, 5G NR

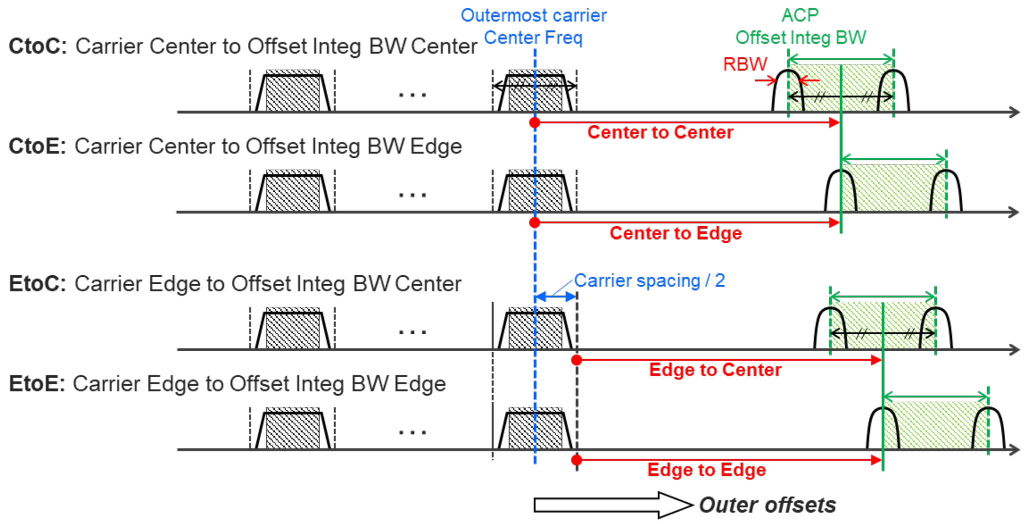
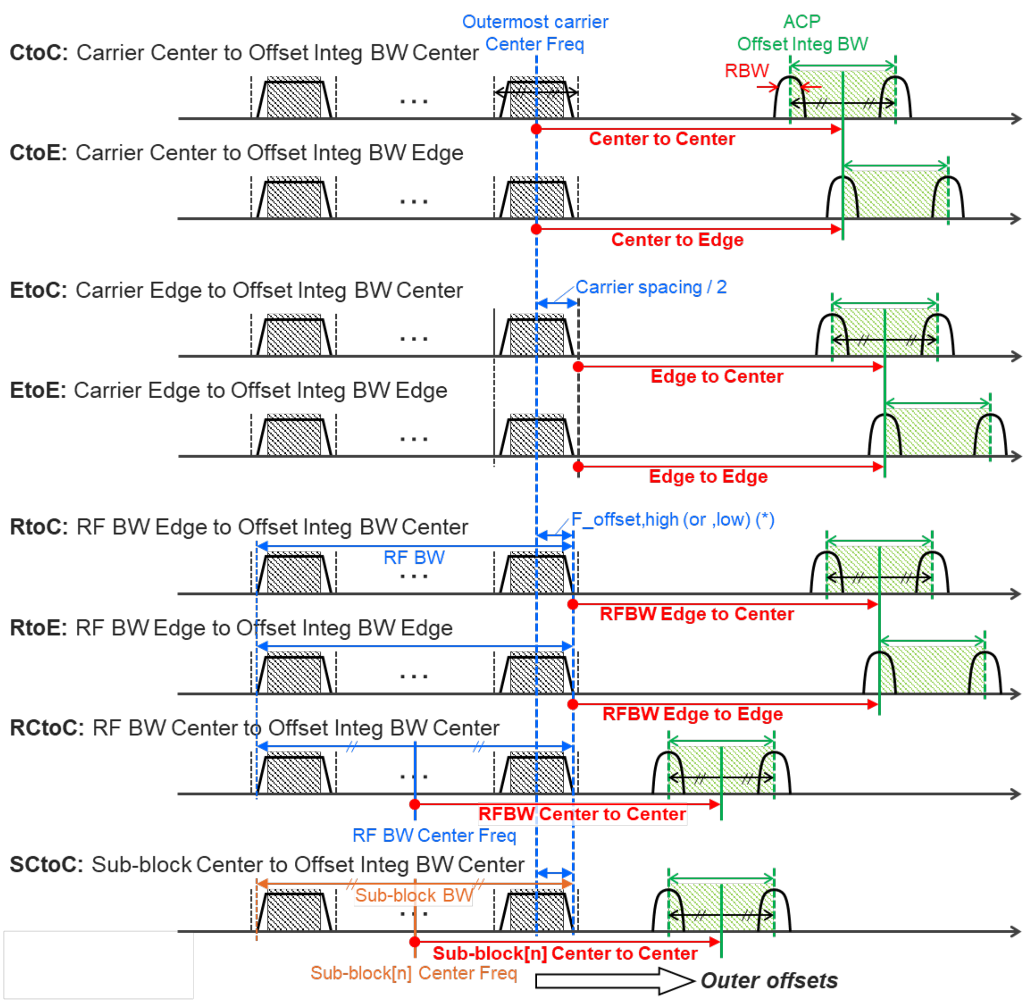


Diagram for MSR, LTEAFDD, LTEATDD, 5G NR



Note:

RF BW Edge and Outermost Carrier Edge are not always the same.
e.g.) 5G NR (3GPP) defines BW_channel, CA which calculates F_offset,high and F_offset,low asymmetrically with SCS shift.
(*) For MSR, F_offset,high (or ,low) = F_offset,RAT,high (or ,low)

Offset Freq

Determines the frequency difference between the center of the main channel and the center of the carrier.

Each **Offset Freq** state value is entered individually by selecting the desired carrier.

The list contains up to six (6) entries, depending on the mode selected, for offset frequencies. Each offset frequency in the list corresponds to a reference bandwidth in the bandwidth list.

An offset frequency of zero turns the display of the measurement for that offset off, but the measurement is still made and reported. You can turn off (not use) specific offsets with `[:SENSe]:ACP:OFFSet:LIST:STATe`.

Turning the offset off has the same effect as setting the frequency of the offset to 0 Hz, and causes it to be removed from the results screen.

Remote Command	`[:SENSe]:ACPower:OFFSet[1]|2[:OUTer]:LIST[:FREQuency] <freq>,…` `[:SENSe]:ACPower:OFFSet[1]|2[:OUTer]:LIST[:FREQuency]?`
Example	`:ACP:OFFS1:LIST 0,0,0,0,0,0` `:ACP:OFFS1:LIST?`
Notes	Offset subopcode. 1 for BTS (Downlink), 2 for MS (Uplink). Default is BTS Some Modes do not support Offset subopcode 2. In those cases, commands with subopcode 2 are accepted without error but ignored When setting these values remotely, the position in the list sent corresponds to the offset. Missing values are not permitted, unless the number of values sent is greater than the number of carriers, in which case subsequent values are ignored
Couplings	Changing Offset Frequency might affect "Span" on page 948
Preset	When "Max Num of Offsets" on page 1000 is set to 12, the preset value of Offset G ~ L is the same as the Offset F value

Modes	Values
SA	3 MHz, 0 Hz, 0 Hz, 0 Hz, 0 Hz, 0 Hz | 3 MHz, 0 Hz, 0 Hz, 0 Hz, 0 Hz, 0 Hz
WCDMA	5.0 MHz, 10.0 MHz, 0 Hz, 0 Hz, 0 Hz, 0 Hz | 5.0 MHz, 10.0 MHz, 0 Hz, 0 Hz, 0 Hz, 0 Hz
LTEAFDD, LTEATDD, MSR	5.0 MHz, 10.0 MHz, 0 Hz, 0 Hz, 0 Hz, 0 Hz | 5.0 MHz, 10.0 MHz, 0 Hz, 0 Hz, 0 Hz, 0 Hz
5G NR	100 MHz, 200 MHz, 0 Hz, 0 Hz, 0 Hz, 0 Hz | 100 MHz, 200 MHz, 0 Hz, 0 Hz, 0 Hz, 0 Hz
Radio Test	25 kHz, 50 kHz, 75 kHz, 0 Hz, 0 Hz, 0 Hz

State Saved	Saved in instrument state
Min/Max	0 Hz/Depends on instrument maximum frequency. Same as Max Span of the Swept SA Measurement
Backwards Compatibility SCPI	`[:SENSe]:MCPower:OFFSet[1]|2:LIST[:FREQuency]`

Auto Function

Remote Command	`[:SENSe]:ACPower:OFFSet[1]|2[:OUTer]:LIST:STATe OFF | ON | 0 | 1,…` `[:SENSe]:ACPower:OFFSet[1]|2[:OUTer]:LIST:STATe?`

Example	`:ACP:OFFS2:LIST:STAT 1,1,0,0,0,0` `:ACP:OFFS2:LIST:STAT?`
Preset	When "Max Num of Offsets" on page 1000 is 12, the preset value of Offset G ~ L is the same as the Offset F value

Modes	Values
SA	ON, OFF, OFF, OFF, OFF, OFF | ON, OFF, OFF, OFF, OFF, OFF
WCDMA	ON, ON, OFF, OFF, OFF, OFF | ON, ON, OFF, OFF, OFF, OFF
LTEAFDD, LTEATDD, MSR	ON, ON, OFF, OFF, OFF, OFF | ON, OFF, OFF, OFF, OFF, OFF
5G NR	ON, ON, OFF, OFF, OFF, OFF | ON, OFF, OFF, OFF, OFF, OFF
Radio Test	ON, ON, ON, OFF, OFF, OFF

State Saved	Yes
Range	OFF|ON

Integ BW

Sets the Integration Bandwidth for the offsets. Each resolution bandwidth in the list corresponds to an offset frequency in the list defined by `[:SENSe]:ACP:OFFSet[n][:OUTer]:LIST[:FREQuency]`.

Enter each value individually by selecting the desired offset, then enter the Offset Integration Bandwidth.

You can turn off (not use) specific offsets with `[:SENSe]:ACP:OFFSet[n][:OUTer]:LIST:STATe`.

Remote Command	`[:SENSe]:ACPower:OFFSet[1]|2[:OUTer]:LIST:BANDwidth[:INTegration] <freq>,…` `[:SENSe]:ACPower:OFFSet[1]|2[:OUTer]:LIST:BANDwidth[:INTegration]?`
Example	`:ACP:OFFS2:LIST:BAND 2MHz,2MHz,2MHz,2MHz,2MHz,2MHz` `:ACP:OFFS2:LIST:BAND?`
Notes	Offset subopcode: 1 for BTS (Downlink), 2 for MS (Uplink). Default is BTS Some Modes do not support Offset subopcode 2. In those cases, commands with subopcode 2 are accepted without error but ignored When setting these values remotely, the position in the list sent corresponds to the offset. Missing values are not permitted, so, if you want to change the second value, you must send all values up to that. Subsequent values remain unchanged, unless the number of values sent is greater than the number of carriers, then subsequent values is ignored
Couplings	Changing **Integ BW** might affect "Span" on page 948
Preset	When "Max Num of Offsets" on page 1000 is set to 12, the preset value of Offset G ~ L is the same as

	the Offset F value **Modes** / **Values** SA: 2 MHz, 2 MHz, 2 MHz, 2 MHz, 2 MHz, 2 MHz|2 MHz, 2 MHz, 2 MHz, 2 MHz, 2 MHz, 2 MHz WCDMA: 3.84 MHz, 3.84 MHz, 3.84 MHz, 3.84 MHz, 3.84 MHz, 3.84 MHz|3.84 MHz, 3.84 MHz, 3.84 MHz, 3.84 MHz, 3.84 MHz, 3.84 MHz LTEAFDD, LTEATDD, MSR: 4.515 MHz, 4.515 MHz, 4.515 MHz, 4.515 MHz, 4.515 MHz, 4.515 MHz|4.5 MHz, 4.5 MHz, 4.5 MHz, 4.5 MHz, 4.5 MHz, 4.5 MHz 5G NR: 98.28 MHz, 98.28 MHz, 98.28 MHz, 98.28 MHz, 98.28 MHz, 98.28 MHz|98.31 MHz, 98.31 MHz, 98.31 MHz, 98.31 MHz, 98.31 MHz, 98.31 MHz Radio Test: 25 kHz, 25 kHz, 25 kHz, 25 kHz, 25 kHz, 25 kHz
State Saved	Saved in instrument state
Min/Max	10 Hz/Depends on instrument maximum frequency. Same as Max Span of the Swept SA Measurement

Backwards Compatibility SCPI	`[:SENSe]:ACPower:OFFSet[1]|2:LIST:BWIDth[:INTegration]`
	`[:SENSe]:ACPR:OFFSet[1]|2:LIST:BANDwidth`
	`[:SENSe]:ACPR:OFFSet[1]|2:LIST:BWIDth`
	`[:SENSe]:MCPower:OFFSet[1]|2:LIST:BANDwidth[:INTegration]`
	`[:SENSe]:MCPower:OFFSet[1]|2:LIST:BWIDth[:INTegration]`

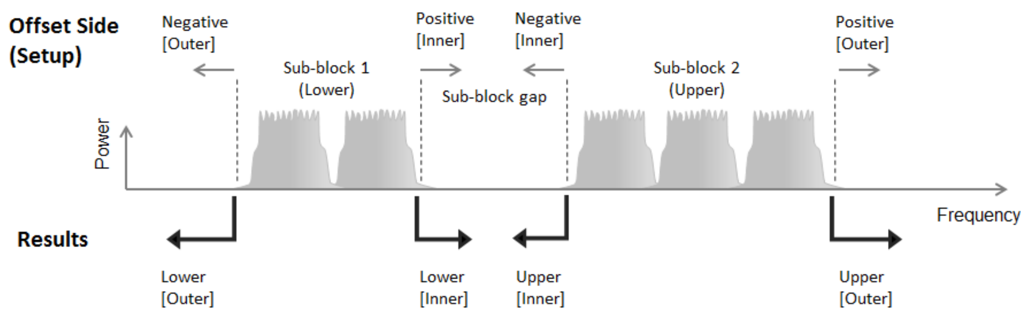
Offset Side

Specifies which offset side to measure.

You can turn off (not use) specific offsets with `[:SENSe]:ACPower:OFFSet[1]|2[:OUTer]:LIST:SIDE`.

`NEGative`	Negative (lower) sideband only
`BOTH`	Both of the negative (lower) and positive (upper) sidebands
`POSitive`	Positive (upper) sideband only

The figure below shows the relation between the negative/positive offset side setups and the upper/lower results in MSR, LTEAFDD and LTEATDD Modes.



Remote Command	`[:SENSe]:ACPower:OFFSet[1]|2[:OUTer]:LIST:SIDE NEGative | BOTH | POSitive, …` `[:SENSe]:ACPower:OFFSet[1]|2[:OUTer]:LIST:SIDE?`
Example	`:ACP:OFFS:LIST:SIDE BOTH` `:ACP:OFFS:LIST:SIDE?`
Notes	`OFFSet1` is for BTS, `2` for MS. Default is BTS Some Modes do not support Offset subopcode 2. In those cases, commands with subopcode 2 are accepted without error but ignored If you set `POS` or `NEG` in an offset, result of the inactive side returns -999
Preset	When "Max Num of Offsets" on page 1000 is 12, the preset value of Offset G ~ L is `BOTH` `BOTH, BOTH, BOTH, BOTH, BOTH, BOTH | BOTH, BOTH, BOTH, BOTH, BOTH, BOTH`
State Saved	Saved in instrument state
Range	`NEGative|BOTH|POSitive`

Method

Allows you to turn RRC filtering of each offset on or off. The value (roll off) for the filter will be set to the value of the **Filter Alpha** parameter.

Remote Command	`[:SENSe]:ACPower:OFFSet[1]|2[:OUTer]:LIST:FILTer[:RRC][:STATe] ON | OFF | 1 | 0,…` `[:SENSe]:ACPower:OFFSet[1]|2[:OUTer]:LIST:FILTer[:RRC][:STATe]?`
Example	`:ACP:OFFS:LIST:FILT 1,0,0` `:ACP:OFFS:LIST:FILT?`
Notes	`1|ON` = RRC Weighted, `0|OFF` = Integ BW Some Modes do not support Offset subopcode 2. In those cases, commands with subopcode 2 are accepted without error but ignored
Preset	When "Max Num of Offsets" on page 1000 is 12, the preset value of Offset G ~ L is the same as the Offset F value

Mode	Values
SA	0, 0, 0, 0, 0, 0 | 0, 0, 0, 0, 0,0

	Mode	**Values**
	WCDMA	1, 1, 1, 1, 1, 1 | 1, 1, 1, 1, 1, 1
	LTEAFDD, LTEATDD, 5G NR, MSR	0, 0, 0, 0, 0, 0 | 0, 0, 0, 0, 0,0
	Radio Test	0, 0, 0, 0, 0, 0
State Saved	Saved in instrument state	
Range	Integ BW | RRC Weighted	

Filter Alpha

Sets the alpha value for the RRC Filter for each offset.

Remote Command	`[:SENSe]:ACPower:OFFSet[1]|2[:OUTer]:LIST:FILTer:ALPHa <real>,…` `[:SENSe]:ACPower:OFFSet[1]|2[:OUTer]:LIST:FILTer:ALPHa?`	
Example	`:ACP:OFFS:LIST:FILT:ALPH 0.5,0.5,0.5,0.5,0.5,0.5` `:ACP:OFFS:LIST:FILT:ALPH?`	
Notes	Some Modes do not support Offset subopcode 2. In those cases, commands with subopcode 2 are accepted without error but ignored	
Preset	When "Max Num of Offsets" on page 1000 is 12, the preset value of Offset G ~ L is the same as the Offset F value	
	SA	0.22,0.22,0.22,0.22,0.22,0.22|0.22,0.22,0.22,0.22,0.22,0.22
	WCDMA	0.22,0.22,0.22,0.22,0.22,0.22|0.22,0.22,0.22,0.22,0.22,0.22
	LTEAFDD, LTEATDD, 5G NR, MSR	0.22,0.22,0.22,0.22,0.22,0.22|0.22,0.22,0.22,0.22,0.22,0.22
State Saved	Saved in instrument state	
Min/Max	0.01/1.00	

Advanced (Offset)

Opens a further menu page, which lets you set advanced properties of the Inner Offset, such as Res BW, Video BW, and Filter parameters.

Offset Freq

This column is the same as "Offset Freq" on page 1014 in the main **Offset** menu.

Res BW

Sets the resolution bandwidth. If an unavailable bandwidth is entered with the numeric keypad, the closest available bandwidth is selected.

Remote Command	`[:SENSe]:ACPower:OFFSet[1]|2[:OUTer]:LIST:BANDwidth:RESolution <freq>,…` `[:SENSe]:ACPower:OFFSet[1]|2[:OUTer]:LIST:BANDwidth:RESolution?`
Example	`:ACP:OFFS2:LIST:BAND:RES 220kHz,220kHz,220kHz,220kHz,220kHz,220kHz` `:ACP:OFFS2:LIST:BAND:RES?`
Notes	Offset subopcode: 1 for BTS (Downlink), 2 for MS (Uplink). Default is BTS Some Modes do not support Offset subopcode 2. In those cases, commands with subopcode 2 are accepted without error but ignored
Dependencies	When "Meas Method" on page 963 is RBW, FAST or Fast Power, this cell is grayed-out and disabled. If the cell is pressed, an advisory message is generated. If the equivalent SCPI remote command is sent, a "Setting conflict" warning is generated
Couplings	When **Res BW** Mode is **Auto**, this value is exactly same as **Res BW**. When you change this value, **Res BW** Mode also changes to **Man**
Preset	When "Max Num of Offsets" on page 1000 is 12, the preset value of Offset G ~ L is the same as the Offset F value SA: 220 kHz, 220 kHz, 220 kHz, 220 kHz, 220 kHz, 220 kHz WCDMA: 100 kHz, 100 kHz, 100 kHz, 100 kHz, 100 kHz, 100 kHz LTEAFDD, LTEATDD, 5G NR, MSR: 100 kHz, 100 kHz, 100 kHz, 100 kHz, 100 kHz, 100 kHz | 100 kHz, 100 kHz, 100 kHz, 100 kHz, 100 kHz, 100 kHz
State Saved	Saved in instrument state
Min/Max	1 Hz/8 MHz
Backwards Compatibility SCPI	`[:SENSe]:ACPower:OFFSet[1]|2:LIST:BWIDth:RESolution`

Auto Function

Remote Command	`[:SENSe]:ACPower:OFFSet[1]|2[:OUTer]:LIST:BANDwidth:RESolution:AUTO ON | OFF | 1 | 0,…` `[:SENSe]:ACPower:OFFSet[1]|2[:OUTer]:LIST:BANDwidth:RESolution:AUTO?`
Example	`:ACP:OFFS2:LIST:BAND:RES:AUTO 1,1,1,1,1,1` `:ACP:OFFS2:LIST:BAND:RES:AUTO?`
Preset	When "Max Num of Offsets" on page 1000 is 12, the preset value of Offset G ~ L is 1 1, 1, 1, 1, 1, 1
State Saved	Yes
Backwards Compatibility SCPI	`[:SENSe]:ACPower:OFFSet[1]|2:LIST:BWIDth:RESolution:AUTO`

Video BW

Enables you to change the instrument post-detection filter (VBW).

Remote Command	`[:SENSe]:ACPower:OFFSet[1]|2[:OUTer]:LIST:BANDwidth:VIDeo <freq>,…` `[:SENSe]:ACPower:OFFSet[1]|2[:OUTer]:LIST:BANDwidth:VIDeo?`
Example	`:ACP:OFFS2:LIST:BAND:VID 5MHz,5MHz,5MHz,5MHz,5MHz,5MHz` `:ACP:OFFS2:LIST:BAND:VID?`
Notes	The values shown in this table reflect the conditions after **Mode Preset** Offset subopcode: 1 for BTS (Downlink), 2 for MS (Uplink). Default is BTS Some Modes do not support Offset subopcode 2. In those cases, commands with subopcode 2 are accepted without error but ignored
Dependencies	When "Meas Method" on page 963 is RBW, FAST or Fast Power, this cell is grayed-out and disabled. If the cell is pressed, an advisory message is generated. If the equivalent remote command is sent, a "Setting conflict" warning is generated
Preset	When "Max Num of Offsets" on page 1000 is 12, the preset value of Offset G ~ L is the same as the Offset F value **Modes** / **Values** SA: 22 kHz, 22 kHz, 22 kHz, 22 kHz, 22 kHz, 22 kHz WCDMA: 1 MHz, 1 MHz, 1 MHz, 1 MHz, 1 MHz, 1 MHz LTEAFDD, LTEATDD, 5G NR, MSR: 1 MHz, 1 MHz, 1 MHz, 1 MHz, 1 MHz, 1 MHz
State Saved	Saved in instrument state
Min/Max	1 Hz/50 MHz
Backwards Compatibility SCPI	`[:SENSe]:ACPower:OFFSet[1]|2:LIST:BWIDth:VIDeo`

Auto Function

Remote Command	`[:SENSe]:ACPower:OFFSet[1]|2[:OUTer]:LIST:BANDwidth:VIDeo:AUTO OFF | ON | 0 | 1,…` `[:SENSe]:ACPower:OFFSet[1]|2[:OUTer]:LIST:BANDwidth:VIDeo:AUTO?`
Example	`:ACP:OFFS2:LIST:BAND:VID:AUTO 0,0,0,0,1,1` `:ACP:OFFS2:LIST:BAND:VID:AUTO?`
Preset	When "Max Num of Offsets" on page 1000 is 12, the preset value of Offset G ~ L is ON `ON, ON, ON, ON, ON, ON`
State Saved	Yes
Backwards Compatibility SCPI	`[:SENSe]:ACPower:OFFSet[1]|2:LIST:BWIDth:VIDeo:AUTO`

Filter Type

Selects the type of bandwidth filter that is used.

Remote Command	`[:SENSe]:ACPower:OFFSet[1]|2[:OUTer]:LIST:BANDwidth:SHAPe GAUSsian	FLATtop,…` `[:SENSe]:ACPower:OFFSet[1]|2[:OUTer]:LIST:BANDwidth:SHAPe?`
Example	`:ACP:OFFS2:LIST:BAND:SHAP FLAT,GAUS,GAUS,GAUS,GAUS,GAUS` `:ACP:OFFS2:LIST:BAND:SHAP?`
Notes	Offset subopcode: 1 for BTS (Downlink), 2 for MS (Uplink). Default is BTS Some Modes do not support Offset subopcode 2. In those cases, commands with subopcode 2 are accepted without error but ignored
Dependencies	When "Res BW" on page 929 Mode for the offset is **Auto**, this cell is grayed out and disabled. Since **Res BW** Mode for the offset is preset to **Auto** on changing "Meas Method" on page 963 to RBW, FAST or Fast Power, this cell is grayed-out and disabled too. If the cell is pressed, an advisory message is generated. If the equivalent remote command is sent, a "Setting conflict" warning is generated
Preset	When "Max Num of Offsets" on page 1000 is 12, the preset value of Offset G ~ L is `GAUSsian GAUSsian, GAUSsian, GAUSsian, GAUSsian, GAUSsian, GAUSsian`
State Saved	Saved in instrument state
Range	`GAUSsian|FLATtop`
Backwards Compatibility SCPI	`[:SENSe]:ACPower:OFFSet[1]|2:LIST:BWIDth:SHAPe`

Filter BW

Selects a Gaussian filter based on its –3 dB (Normal) bandwidth or its –6 dB bandwidth.

Remote Command	`[:SENSe]:ACPower:OFFSet[1]|2[:OUTer]:LIST:BANDwidth:TYPE DB3	DB6,…` `[:SENSe]:ACPower:OFFSet[1]|2[:OUTer]:LIST:BANDwidth:TYPE?`
Example	`:ACP:OFFS2:LIST:BAND:TYPE DB3,DB3,DB3,DB3,DB3,DB3` `:ACP:OFFS2:LIST:BAND:TYPE?`
Notes	Offset subopcode: 1 for BTS (Downlink), 2 for MS (Uplink). Default is BTS Some Modes do not support Offset subopcode 2. In those cases, commands with subopcode 2 are accepted without error but ignored
Dependencies	When "RBW Filter Type" on page 933 is Flattop, or "Res BW" on page 929 Mode for the offset is **Auto**, this cell is grayed-out and disabled. Since **Res BW** Mode for the offset is preset to **Auto** on changing "Meas Method" on page 963 to RBW, FAST or Fast Power, this cell is grayed-out and disabled too. If the cell is pressed, an advisory message is generated. If the equivalent remote command is sent, a "Setting conflict" warning is generated
Preset	When "Max Num of Offsets" on page 1000 is 12, the preset value of Offset G ~ L is `DB3`

	DB3, DB3, DB3, DB3, DB3, DB3
State Saved	Saved in instrument state
Range	–3 dB (Normal)| –6 dB
Backwards Compatibility SCPI	[:SENSe]:ACPower:OFFSet[1]|2:LIST:BWIDth:TYPE

Limits

Lets you configure the limits that are used to determine whether the offset regions PASS or FAIL the limit test.

Limit Test

This checkbox is the same as "Limit Test" on page 982 in the **Meas Setup, Settings** tab.

Offset Freq

This column is the same as "Offset Freq" on page 1014 in the **Offset** index tab.

Abs Limit

Specifies an absolute limit value, which sets the absolute amplitude levels to test against for each of the custom offsets. The list must contain 6 entries. If there is more than one offset, the offset closest to the carrier channel is the first one in the list. [:SENSe]:ACP:OFFSet[n][:OUTer]:LIST:TEST selects the type of testing to be done at each offset.

You can turn off (not use) specific offsets with the [:SENSe]:ACP:OFFSet[n][:OUTer]:LIST:STATe command.

The query returns the six (6) sets of real numbers that are the current absolute amplitude test limits.

Remote Command	[:SENSe]:ACPower:OFFSet[1]|2[:OUTer]:LIST:ABSolute < real>,… [:SENSe]:ACPower:OFFSet[1]|2[:OUTer]:LIST:ABSolute?
Example	:ACP:OFFS2:LIST:ABS -10,-10,-10,-10,-10,-10 :ACP:OFFS2:LIST:ABS?
Notes	Offset subopcode. 1 for BTS (Downlink), 2 for MS (Uplink). Default is BTS Some Modes do not support Offset subopcode 2. In those cases, commands with subopcode 2 are accepted without error but ignored
Preset	When "Max Num of Offsets" on page 1000 is 12, the preset value of Offset G ~ L is the same as the

	Offset F value **Modes** / **Values** SA: 0dBm, 0 dBm, 0 dBm, 0 dBm, 0 dBm, 0 dBm | 0dBm, 0 dBm, 0 dBm, 0 dBm, 0 dBm, 0 dBm WCDMA: 50 dBm, 50 dBm, 50 dBm, 50 dBm, 50 dBm, 50 dBm | 50 dBm, 50 dBm, 50 dBm, 50 dBm, 50 dBm, 50 dBm LTEAFDD, LTEATDD, MSR: -8.45, -8.45, -8.45, -8.45, -8.45, -8.45 | -50.0, -50.0, -50.0, -50.0, -50.0, -50.0 5G NR: 4.92, 4.92, 4.92, 4.92, 4.92, 4.92 | -50.0, -50.0, -50.0, -50.0, -50.0, -50.0
State Saved	Saved in instrument state
Min/Max	-200.0 dBm/50.0 dBm

Backwards Compatibility SCPI	`[:SENSe]:ACPR:OFFSet[1]|2:LIST:ABSolute`
	SA, W-CDMA
	`[:SENSe]:MCPower:OFFSet[1]|2:LIST:ABSolute`
	SA, W-CDMA

Rel Limit (Car)

Enters a relative limit value for the carrier level. This sets the amplitude levels to test against for the specified offsets.

The amplitude level is relative to the carrier amplitude. If multiple offsets are available, the list contains 6 entries. The offset closest to the carrier channel is the first one in the list.

`[:SENSe]:ACP:OFFSet[n][:OUTer]:LIST:TEST` selects the type of testing to be done at each offset.

You can turn off (not use) specific offsets with `[:SENSe]:ACP:OFFSet[n][:OUTer]:LIST:STATe`.

The query returns the 6 sets of real numbers that are the current amplitude test limits, relative to the carrier, for each offset.

Offset[n] n = 1 is base station and n = 2 is mobiles. The default is base station (1).

Remote Command	`[:SENSe]:ACPower:OFFSet[1]|2[:OUTer]:LIST:RCARrier <real>,…` `[:SENSe]:ACPower:OFFSet[1]|2[:OUTer]:LIST:RCARrier?`
Example	`:ACP:OFFS2:LIST:RCAR 0,0,0,0,0,0` `:ACP:OFFS2:LIST:RCAR?`
Notes	Offset subopcode. 1 for BTS (Downlink), 2 for MS (Uplink). Default is BTS Some Modes do not support Offset subopcode 2. In those cases, commands with subopcode 2 are accepted without error but ignored

Preset	When "Max Num of Offsets" on page 1000 is 12, the preset value of Offset G ~ L is the same as the Offset F value **Modes** / **Values** SA: -45, -60, 0, 0, 0, 0 | -45, -60, 0, 0, 0, 0 WCDMA: -44.2, -49.2, -49.2, -49.2, -49.2, -49.2 | -32.2, -42.2, -42.2, -42.2, -42.2, -42.2 LTEAFDD, LTEATDD, MSR: -44.2, -44.2, -44.2, -44.2, -44.2, -44.2 | -29.2, -29.2, -29.2, -29.2, -29.2, -29.2 5G NR: -43.8, -43.8, -43.8, -43.8, -43.8, -43.8 | -29.2, -29.2, -29.2, -29.2, -29.2, -29.2 Radio Test: -60, -60, -60, 0, 0, 0
State Saved	Saved in instrument state
Min/Max	-150/50.0
Backwards Compatibility SCPI	`[:SENSe]:MCPower:OFFSet[1]|2:LIST:RCARrier`

Positive Offset Limit (Remote Command only)

Enables you to set the upper limit for the upper segment of the specified offset pair.

Remote Command	`:CALCulate:ACPower:OFFSet[1]|2[:OUTer]:LIST:LIMit:POSitive[:UPPer]:DATA <real>,...` `:CALCulate:ACPower:OFFSet[1]|2[:OUTer]:LIST:LIMit:POSitive[:UPPer]:DATA?`
Example	`:CALC:ACP:OFFS:LIST:LIM:POS:DATA 0,0,0,0,0,0` `:CALC:ACP:OFFS:LIST:LIM:POS:DATA?`
Notes	Some Modes do not support Offset subopcode 2. In those cases, commands with subopcode 2 are accepted without error but ignored
Preset	When "Max Num of Offsets" on page 1000 is 12, the preset value of Offset G ~ L is the same as the Offset F value **Modes** / **Values** SA: -45, -60, 0, 0, 0, 0 | -45, -60, 0, 0, 0, 0 WCDMA: -44.2, -49.2, -49.2, -49.2, -49.2, -49.2 | -32.2, -42.2, -42.2, -42.2, -42.2, -42.2 LTEAFDD, LTEATDD, MSR: -44.2,-44.2,-44.2,-44.2,-44.2,-44.2 | -29.2, -29.2, -29.2, -29.2, -29.2, -29.2 5G NR: -43.8, -43.8, -43.8, -43.8, -43.8, -43.8 | -29.2, -29.2, -29.2, -29.2, -29.2, -29.2 Radio Test: -60, -60, -60, 0, 0, 0

State Saved	Saved in instrument state
Min/Max	-150.0/50.0
Backwards Compatibility SCPI	`:CALCulate:MCPower:OFFSet:LIST:LIMit:POSitive[:UPPer]:DATA` (Power Suite)

Negative Offset Limit(Remote Command only)

Enables you to set the upper limit for the lower segment of the specified offset pair.

Remote Command	`:CALCulate:ACPower:OFFSet[1]|2[:OUTer]:LIST:LIMit:NEGative[:UPPer]:DATA <real>,...` `:CALCulate:ACPower:OFFSet[1]|2[:OUTer]:LIST:LIMit:NEGative[:UPPer]:DATA?`
Example	`:CALC:ACP:OFFS:LIST:LIM:NEG:DATA 0,0,0,0,0,0` `:CALC:ACP:OFFS:LIST:LIM:NEG:DATA?`
Notes	Some Modes do not support Offset subopcode 2. In those cases, commands with subopcode 2 are accepted without error but ignored
Preset	When "Max Num of Offsets" on page 1000 is 12, the preset value of Offset G ~ L is the same as the Offset F value

Modes	Values
SA	-45, -60, 0, 0, 0, 0 | -45, -60, 0, 0, 0, 0
WCDMA	-44.2, -49.2, -49.2, -49.2, -49.2, -49.2 | -32.2, -42.2, -42.2, -42.2, -42.2, -42.2
LTEAFDD, LTEATDD, MSR	-44.2, -44.2, -44.2, -44.2, -44.2, -44.2 | -29.2, -29.2, -29.2, -29.2, -29.2, -29.2
5G NR	-43.8, -43.8, -43.8, -43.8, -43.8, -43.8 | -29.2, -29.2, -29.2, -29.2, -29.2, -29.2
Radio Test	-60, -60, -60, 0, 0, 0

State Saved	Saved in instrument state
Min/Max	-150.0/50.0
Backwards Compatibility SCPI	`:CALCulate:MCPower:OFFSet:LIST:LIMit:NEGative[:UPPer]:DATA` (Power Suite, WCDMA)

Rel Limit (PSD)

Enters a relative limit value for the level of the power spectral density. This sets the amplitude levels to test against for any custom offsets. The amplitude level is relative to the power spectral density. If multiple offsets are available, the list contains 6 entries. The offset closest to the carrier channel is the first one in the list.

[:SENSe]:ACP:OFFSet[n][:OUTer]:LIST:TEST selects the type of testing to be done at each offset.

You can turn off (not use) specific offsets with [:SENSe]:ACP:OFFSet[n][:OUTer]:LIST:STATe.

The query returns the 6 sets of real numbers that are the current amplitude test limits, relative to the power spectral density, for each offset.

Offset[n] n = 1 is base station and n = 2 is mobiles. The default is base station (1).

Remote Command	[:SENSe]:ACPower:OFFSet[1]|2[:OUTer]:LIST:RPSDensity <rel_ampl>,… [:SENSe]:ACPower:OFFSet[1]|2[:OUTer]:LIST:RPSDensity?
Example	:ACP:OFFS2:LIST:RPSD 10,10,10,10,10,10 :ACP:OFFS2:LIST:RPSD?
Notes	Offset subopcode. 1 for BTS (Downlink), 2 for MS (Uplink). Default is BTS Some Modes do not support Offset subopcode 2. In those cases, commands with subopcode 2 are accepted without error but ignored
Preset	When "Max Num of Offsets" on page 1000 is 12, the preset value of Offset G ~ L is the same as the Offset F value

Modes	Values
SA	-28.87 dB, -43.87 dB, 0 dB, 0 dB, 0 dB, 0 dB | -28.87 dB, -43.87 dB, 0 dB, 0 dB, 0 dB, 0 dB
WCDMA	-44.2 dB, -49.2 dB, -49.2 dB, -49.2 dB, -49.2 dB, -49.2 dB | -32.2 dB, -42.2 dB, -42.2 dB, -42.2 dB, -42.2 dB, -42.2 dB
LTEAFDD, LTEATDD, 5G NR, MSR	0, 0, 0, 0, 0, 0 | 0, 0, 0, 0, 0, 0
Radio Test	-60, -60, -60, 0, 0, 0

State Saved	Saved in instrument state
Min/Max	-150.0 dB/50.0 dB

Fail Mask

Accesses a menu that lets you select one of the logics for the fail conditions between the measurement results and the test limits. The setting defines the type of testing to be done at any custom offset frequencies. The measured powers are tested against the absolute values defined with [:SENSe]:ACP:OFFSet[n][:OUTer]:LIST:ABSolute, or the relative values defined with [:SENSe]:ACP:OFFSet[n][:OUTer]:LIST:RPSDensity and [:SENSe]:ACP:OFFSet[n][:OUTer]:LIST:RCARrier.

You can turn off (not use) specific offsets with [:SENSe]:ACP:OFFSet[n][:OUTer]:LIST:STATe.

Absolute	`ABSolute`	Fail is shown if one of the absolute ACP measurement results is larger than the limit for **Abs Limit**
Relative	`RELative`	Fail is shown if one of the relative ACP measurement results is larger than the limit for **Rel Lim (Car)** or **Rel Lim (PSD)**
Abs AND Rel	`AND`	Fail is shown if one of the absolute ACP measurement results is larger than the limit for **Abs Limit***and* one of the relative ACP measurement results is larger than the limit for **Rel Lim (Car)** or **Rel Lim (PSD)**
Abs OR Rel	`OR`	Fail is shown if one of the absolute ACP measurement results is larger than the limit for **Abs Limit***or* one of the relative ACP measurement results is larger than the limit for **Rel Lim (Car)** or **Rel Lim (PSD)**

Remote Command	`[:SENSe]:ACPower:OFFSet[1]|2[:OUTer]:LIST:TEST ABSolute | AND | OR | RELative,…` `[:SENSe]:ACPower:OFFSet[1]|2[:OUTer]:LIST:TEST?`
Example	`:ACP:OFFS2:LIST:TEST ABS,ABS,ABS,ABS,ABS,ABS` `:ACP:OFFS2:LIST:TEST?`
Notes	Offset subopcode: 1 for BTS (Downlink), 2 for MS (Uplink). Default is BTS Some Modes do not support Offset subopcode 2. In those cases, commands with subopcode 2 are accepted without error but ignored
Preset	When "Max Num of Offsets" on page 1000 is 12, the preset value of Offset G ~ L is the same as the Offset F value

Modes	Values
SA, WCDMA	`REL, REL, REL, REL, REL, REL | REL, REL, REL, REL, REL, REL`
LTEAFDD, LTEATDD, 5G NR, MSR	`AND, AND, AND, AND, AND, AND | AND, AND, AND, AND, AND, AND`
Radio Test	`REL, REL, REL, REL, REL, REL`

State Saved	Saved in instrument state
Range	`ABSolute|AND|OR|RELative`
Backwards Compatibility SCPI	`[:SENSe]:MCPower:OFFSet[1]|2:LIST:TEST`

Offset Frequency Define

Allows you to select "Offset" definition:

`CTOCenter`	From the lowermost carrier center frequency (for lower offset), the uppermost carrier center frequency (for upper offset) to the center frequency of each Offset Integ BW
`CTOEdge`	From the lowermost carrier center frequency (for lower offset), the uppermost carrier center frequency (for upper offset) to the closest edge frequency of each Offset Integ BW

ETOCenter	From the lowermost carrier center frequency - spacing of this carrier /2 (for lower offset), the uppermost carrier center frequency + spacing of this carrier /2 (for upper offset) to the center frequency of each Offset Integ BW
ETOEdge	From the lowermost carrier center frequency - spacing of this carrier /2 (for lower offset), the uppermost carrier center frequency + spacing of this carrier /2 (for upper offset) to the closest edge frequency of each Offset Integ BW
STOCenter	From either the lower or upper sub-block edge frequency to the center frequency of each Offset Integ BW
STOEdge	From either the lower or upper sub-block edge frequency to the closest edge frequency of each Offset Integ BW
SCTOCenter 5G NR only	From the center frequency of sub-block** to the center frequency of each Offset Integ BW

** sub-block (bandwidth) = $BW_{channel,block}$ which is defined in each 3GPP standard, regardless of “Measure Carrier” for the uppermost and the lowermost carriers being Enabled or Disabled. When the Number of Component Carrier within each sub-block = 1, sub-block (bandwidth) = $BW_{channel}$ = 2 x $F_{offset,RAT}$.

See "Diagram for Offset Freq Define" on page 989

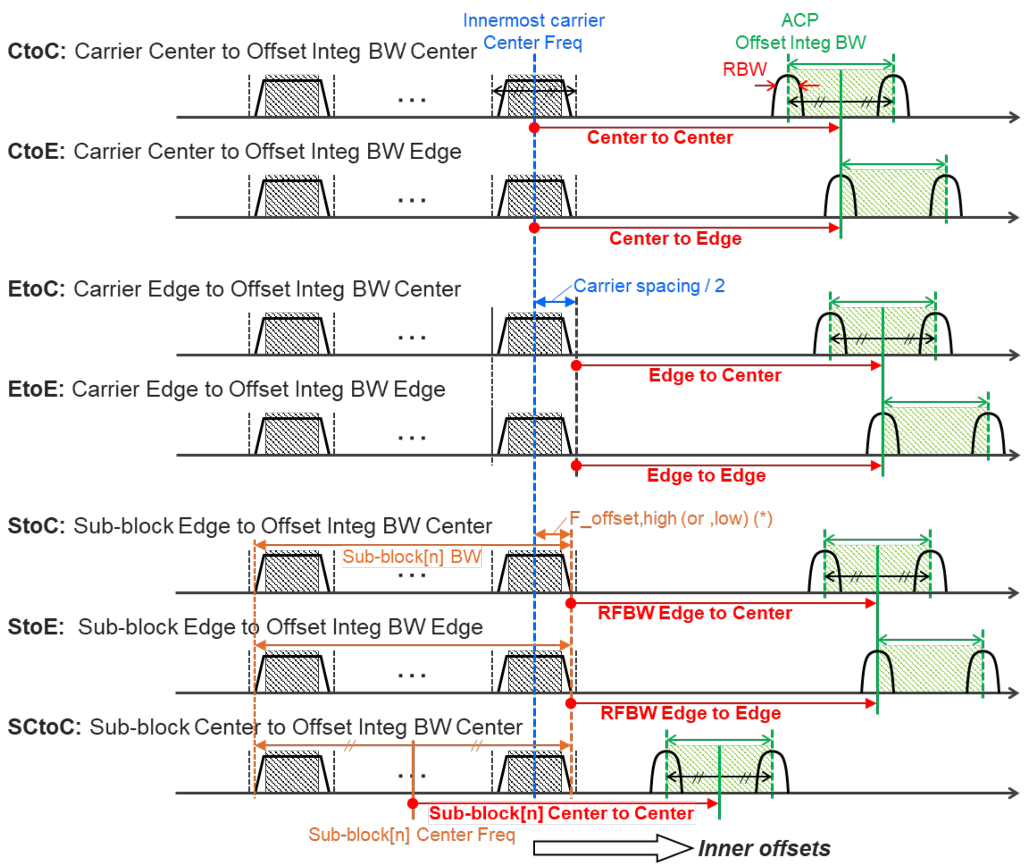
Mode: MSR, LTEAFDD, LTEATDD

Remote Command	`[:SENSe]:ACPower:OFFSet[1]|2:INNer:TYPE CTOCenter | CTOEdge | ETOCenter | ETOEdge | STOCenter | STOEdge` `[:SENSe]:ACPower:OFFSet[1]|2:INNer:TYPE?`
Example	`:ACP:OFFS:INN:TYPE ETOC` `:ACP:OFFS:INN:TYPE?`
Preset	STOCenter
State Saved	Saved in instrument state
Range	CTOCenter|CTOEdge|ETOCenter|ETOEdge|STOCenter|STOEdge

Mode: 5G NR

Remote Command	`[:SENSe]:ACPower:OFFSet[1]|2:INNer:TYPE CTOCenter | CTOEdge | ETOCenter | ETOEdge | STOCenter | STOEdge | SCTOCenter` `[:SENSe]:ACPower:OFFSet[1]|2:INNer:TYPE?`
Example	`:ACP:OFFS:INN:TYPE ETOC` `:ACP:OFFS:INN:TYPE?`
Preset	STOCenter | CTOCenter
State Saved	Saved in instrument state
Range	CTOCenter | CTOEdge | ETOCenter | ETOEdge | STOCenter | STOEdge | SCTOCenter

Diagram for Offset Freq Define



Note:

RF BW Edge and Outermost Carrier Edge are not always same.
e.g.) 5G NR (3GPP) defines BW_channel,CA which calculates F_offset,high and F_offset,low asymmetrically with SCS shift

(*) For MSR, F_offset,high (or ,low) = F_offset,RAT,high (or ,low)

Offset Freq

Determines the frequency difference between the center of the main channel and the center of the carrier. When set to Offset to Edge, this parameter determines the frequency difference between the center of the main channel and the near edge of the offset.

Each **Offset Freq** state value is entered individually by selecting the desired carrier. Use the **Enabled** checkbox to turn the **Offset Freq** State on or off.

The list contains up to 6 entries, depending on the mode selected, for offset frequencies. Each offset frequency in the list corresponds to a reference bandwidth in the bandwidth list.

An offset frequency of zero turns the display of the measurement for that offset off, but the measurement is still made and reported. You can turn off (not use) specific offsets with `[:SENSe]:ACP:OFFSet[n]:INNer:LIST:STATe`.

Turning the offset off has the same effect as setting the frequency of the offset to 0 Hz, and causes it to be removed from the results screen.

Remote Command	`[:SENSe]:ACPower:OFFSet[1]|2:INNer:LIST[:FREQuency] <freq>,…` `[:SENSe]:ACPower:OFFSet[1]|2:INNer:LIST[:FREQuency]?`
Example	`:ACP:OFFS1:INN:LIST 0,0,0,0,0,0` `:ACP:OFFS1:INN:LIST?`
Notes	When setting these values remotely, the position in the list sent corresponds to the offset. Missing values are not permitted, unless the number of values sent is greater than the number of carriers, then subsequent values are ignored Offset subopcode: 1 for BTS (Downlink), 2 for MS (Uplink). Default is BTS
Couplings	Changing Offset Frequency might affect "Span" on page 948
Preset	When "Max Num of Offsets" on page 1000 is 12, the preset value of Offset G ~ L is the same as the Offset F value
State Saved	Saved in instrument state
Min/Max	0 Hz/Depends on instrument maximum frequency. Same as Max Span of the Swept SA Measurement

Modes	Values
5G NR	10 MHz, 30 MHz, 0 Hz, 0 Hz, 0 Hz, 0 Hz | 100 MHz, 200 MHz, 0 Hz, 0 Hz, 0 Hz, 0 Hz
All Others	2.5MHz,7.5MHz,0,0,0,0 | 2.5MHz,7.5MHz,0,0,0,0

Auto Function

Remote Command	`[:SENSe]:ACPower:OFFSet[1]|2:INNer:LIST:STATe OFF | ON | 0 | 1,…` `[:SENSe]:ACPower:OFFSet[1]|2:INNer:LIST:STATe?`
Example	`:ACP:OFFS2:INN:LIST:STAT 1,1,0,0,0,0` `:ACP:OFFS2:INN:LIST:STAT?`
Preset	When "Max Num of Offsets" on page 1000 is 12, the preset value of Offset G ~ L is the same as the Offset F value `ON, ON, OFF, OFF, OFF, OFF | ON, OFF, OFF, OFF, OFF, OFF`
State Saved	Yes

Integ BW

Sets the Integration Bandwidth for the offsets. Each resolution bandwidth in the list corresponds to an offset frequency in the list defined by `[:SENSe]:ACP:OFFSet[n]:INNer:LIST[:FREQuency]`.

Enter each value individually by selecting the desired offset on the **Offset** menu key using the up down arrows, the knob, or the numeric keypad, then enter the Offset Integration Bandwidth using the **Offset Integration Bandwidth** menu key.

You can turn off (not use) specific offsets with `[:SENSe]:ACP:OFFSet[n]:INNer:LIST:STATe`.

Remote Command	`[:SENSe]:ACPower:OFFSet[1]|2:INNer:LIST:BANDwidth[:INTegration] <freq>,…` `[:SENSe]:ACPower:OFFSet[1]|2:INNer:LIST:BANDwidth[:INTegration]?`
Example	`:ACP:OFFS2:INN:LIST:BAND 2MHz,2MHz,2MHz,2MHz,2MHz,2MHz` `:ACP:OFFS2:INN:LIST:BAND?`
Notes	When setting these values remotely, the position in the list sent corresponds to the offset. Missing values are not permitted, so, if you want to change the second value you must send all values up to it. Subsequent values remain unchanged Offset subopcode. 1 for BTS (Downlink), 2 for MS (Uplink). Default is BTS
Couplings	Changing Integ BW might affect "Span" on page 948
Preset	When "Max Num of Offsets" on page 1000 is 12, the preset value of Offset G ~ L is the same as the Offset F value

Modes	Values
LTEAFDD	3.84MHz, 3.84MHz, 3.84MHz, 3.84MHz, 3.84MHz, 3.84MHz | 3.84MHz, 3.84MHz, 3.84MHz, 3.84MHz, 3.84MHz, 3.84MHz
MSR, LTEATDD	4.515MHz, 4.515MHz, 4.515MHz, 4.515MHz, 4.515MHz, 4.515MHz | 4.5MHz, 4.5MHz, 4.5MHz, 4.5MHz, 4.5MHz, 4.5MHz
5G NR	19.08 MHz, 19.08 MHz, 19.08 MHz, 19.08 MHz, 19.08 MHz, 19.08 MHz | 98.31 MHz, 98.31 MHz, 98.31 MHz, 98.31 MHz, 98.31 MHz, 98.31 MHz

State Saved	Saved in instrument state
Min/Max	10 Hz/Depends on instrument maximum frequency. Same as Max Span of the Swept SA Measurement

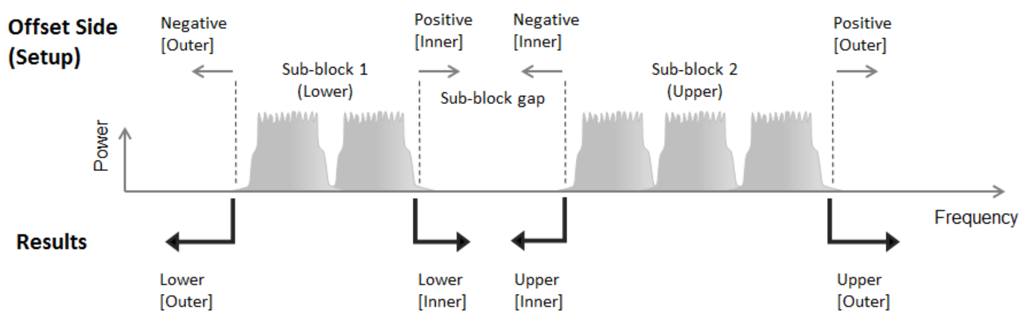
Offset Side

Lets you turn off (not use) specific offsets with `[:SENSe]:ACPower:OFFSet[1]|2:INNer:LIST:SIDE`.

- `NEGative` - The upper side in the sub-block gap only (that is, negative sideband of the upper sub-block) is enabled

- BOTH - Both sides in the sub-block gap are enabled
- POSitive - The lower side in the sub-block gap only (that is, positive sideband of the lower sub-block) is enabled

The diagram below shows the relation between the negative/positive offset side setups and the upper/lower results in the MSR, LTEAFDD and LTEATDD Modes.



Remote Command	`[:SENSe]:ACPower:OFFSet[1]|2:INNer:LIST:SIDE NEGative | BOTH | POSitive, …` `[:SENSe]:ACPower:OFFSet[1]|2:INNer:LIST:SIDE?`
Example	`:ACP:OFFS:INN:LIST:SIDE BOTH` `:ACP:OFFS:INN:LIST:SIDE?`
Notes	OFFSet1 is for BTS, 2 for MS. Default is BTS If you set POS or NEG in an offset, result of the inactive side returns -999
Preset	When "Max Num of Offsets" on page 1000 is 12, the preset value of Offset G ~ L is BOTH BOTH, BOTH, BOTH, BOTH, BOTH, BOTH | BOTH, BOTH, BOTH, BOTH, BOTH, BOTH
State Saved	Saved in instrument state
Range	NEGative|BOTH|POSitive

Method

Lets you turn RRC filtering of each offset on or off. The value (roll off) for the filter is set to the value of the Filter Alpha parameter.

Remote Command	`[:SENSe]:ACPower:OFFSet[1]|2:INNer:LIST:FILTer[:RRC][:STATe] ON | OFF | 1 | 0,…` `[:SENSe]:ACPower:OFFSet[1]|2:INNer:LIST:FILTer[:RRC][:STATe]?`
Example	`:ACP:OFFS:INN:LIST:FILT 1,0,0` `:ACP:OFFS:INN:LIST:FILT?`
Notes	1|ON = RRC Weighted, 0|OFF = Integ BW
Preset	When "Max Num of Offsets" on page 1000 is 12, the preset value of Offset G ~ L is the same as the Offset F value

	Modes	**Values**
	LTEAFDD	1,1,1,1,1,1 | 1,1,1,1,1,1
	MSR, LTEATDD, 5G NR	0,0,0,0,0,0 | 0,0,0,0,0,0
State Saved	Saved in instrument state	
Range	Integ BW | RRC Weighted	

Filter Alpha

Sets the alpha value for the RRC Filter for each offset.

Remote Command	`[:SENSe]:ACPower:OFFSet[1]|2:INNer:LIST:FILTer:ALPHa <real>,…` `[:SENSe]:ACPower:OFFSet[1]|2:INNer:LIST:FILTer:ALPHa?`
Example	`:ACP:OFFS:INN:LIST:FILT:ALPH 0.5,0.5,0.5,0.5,0.5,0.5` `:ACP:OFFS:INN:LIST:FILT:ALPH?`
Preset	When "Max Num of Offsets" on page 1000 is 12, the preset value of Offset G ~ L is 0.22 0.22,0.22,0.22,0.22,0.22,0.22|0.22,0.22,0.22,0.22,0.22,0.22
State Saved	Saved in instrument state
Min/Max	0.01/1.00

Offset Freq

The same as "Offset Freq" on page 1030 in the main **Inner Offset** menu.

Res BW

Sets the Resolution Bandwidth. If an unavailable bandwidth is entered with the numeric keypad, the closest available bandwidth is selected.

Remote Command	`[:SENSe]:ACPower:OFFSet[1]|2:INNer:LIST:BANDwidth:RESolution <freq>,…` `[:SENSe]:ACPower:OFFSet[1]|2:INNer:LIST:BANDwidth:RESolution?`
Example	`:ACP:OFFS2:INN:LIST:BAND:RES 220kHz,220kHz,220kHz,220kHz,220kHz,220kHz` `:ACP:OFFS2:INN:LIST:BAND:RES?`
Notes	Offset subopcode. 1 for BTS (Downlink), 2 for MS (Uplink). Default is BTS
Dependencies	When "Meas Method" on page 963 is RBW, FAST or Fast Power, this control is grayed-out and disabled. If the cell is pressed, an advisory message is generated. If the equivalent SCPI remote command is sent, a "Setting conflict" warning is generated
Couplings	When "Res BW" on page 929 Mode is **Auto**, this value is exactly the same as **Res BW**. When you change this value, **Res BW** Mode also changes to **Man**
Preset	When "Max Num of Offsets" on page 1000 is 12, the preset value of Offset G ~ L is 100 kHz

	100 kHz, 100 kHz, 100k Hz, 100 kHz | 100 kHz,100 kHz, 100 kHz,100 kHz, 100 kHz, 100 kHz
State Saved	Saved in instrument state
Min/Max	1 Hz/8 MHz

Auto Function

Remote Command	`[:SENSe]:ACPower:OFFSet[1]|2:INNer:LIST:BANDwidth:RESolution:AUTO ON | OFF | 1 | 0,…` `[:SENSe]:ACPower:OFFSet[1]|2:INNer:LIST:BANDwidth:RESolution:AUTO?`
Example	`:ACP:OFFS2:INN:LIST:BAND:RES:AUTO 1,1,1,1,1,1` `:ACP:OFFS2:INN:LIST:BAND:RES:AUTO?`
Preset	When "Max Num of Offsets" on page 1000 is 12, the preset value of Offset G ~ L is 1 1, 1, 1, 1, 1, 1
State Saved	Yes

Video BW

Lets you change the instrument post-detection filter (VBW).

Remote Command	`[:SENSe]:ACPower:OFFSet[1]|2:INNer:LIST:BANDwidth:VIDeo <freq>,…` `[:SENSe]:ACPower:OFFSet[1]|2:INNer:LIST:BANDwidth:VIDeo?`
Example	`:ACP:OFFS2:INN:LIST:BAND:VID 5MHz,5MHz,5MHz,5MHz,5MHz,5MHz` `:ACP:OFFS2:INN:LIST:BAND:VID?`
Notes	The values shown in this table reflect the conditions after **Mode Preset** Offset subopcode: 1 for BTS (Downlink), 2 for MS (Uplink). Default is BTS
Dependencies	When "Meas Method" on page 963 is RBW, FAST or Fast Power, this cell is grayed-out and disabled. If the cell is pressed, an advisory message is generated. If the equivalent remote command is sent, a "Setting conflict" warning is generated
Preset	When "Max Num of Offsets" on page 1000 is 12, the preset value of Offset G ~ L is 1 MHz 1 MHz, 1 MHz, 1 MHz, 1 MHz, 1 MHz, 1 MHz
State Saved	Yes
Min/Max	1 Hz/50 MHz

Auto Function

Remote Command	`[:SENSe]:ACPower:OFFSet[1]|2:INNer:LIST:BANDwidth:VIDeo:AUTO OFF | ON | 0 | 1,…` `[:SENSe]:ACPower:OFFSet[1]|2:INNer:LIST:BANDwidth:VIDeo:AUTO?`
Example	`:ACP:OFFS2:INN:LIST:BAND:VID:AUTO 0,0,0,0,1,1` `:ACP:OFFS2:INN:LIST:BAND:VID:AUTO?`
Preset	When "Max Num of Offsets" on page 1000 is 12, the preset value of Offset G ~ L is ON

	ON, ON, ON, ON, ON, ON
State Saved	Yes

Filter Type

Selects the type of bandwidth filter that is used.

Remote Command	[:SENSe]:ACPower:OFFSet[1]|2:INNer:LIST:BANDwidth:SHAPe GAUSsian | FLATtop,… [:SENSe]:ACPower:OFFSet[1]|2:INNer:LIST:BANDwidth:SHAPe?
Example	:ACP:OFFS2:INN:LIST:BAND:SHAP FLAT,GAUS,GAUS,GAUS,GAUS,GAUS :ACP:OFFS2:INN:LIST:BAND:SHAP?
Notes	Offset subopcode: 1 for BTS (Downlink), 2 for MS (Uplink)
Dependencies	When "Res BW" on page 929 Mode for the offset is **Auto**, this cell is grayed-out and disabled. Since **Res BW** Mode for the offset is preset to **Auto** on changing "Meas Method" on page 963 to RBW, FAST or Fast Power, this cell is grayed-out and disabled. If the cell is pressed, an advisory message is generated. If the equivalent remote command is sent, a "Setting conflict" warning is generated
Preset	When "Max Num of Offsets" on page 1000 is 12, the preset value of Offset G ~ L is GAUSsian GAUSsian, GAUSsian, GAUSsian, GAUSsian, GAUSsian, GAUSsian
State Saved	Saved in instrument state
Range	GAUSsian|FLATtop

Filter BW

Selects a Gaussian filter based on its –3 dB (Normal) bandwidth or its –6 dB bandwidth.

Remote Command	[:SENSe]:ACPower:OFFSet[1]|2:INNer:LIST:BANDwidth:TYPE DB3 | DB6,… [:SENSe]:ACPower:OFFSet[1]|2:INNer:LIST:BANDwidth:TYPE?
Example	:ACP:OFFS2:INN:LIST:BAND:TYPE DB3,DB3,DB3,DB3,DB3,DB3 :ACP:OFFS2:INN:LIST:BAND:TYPE?
Notes	Offset subopcode: 1 for BTS (Downlink), 2 for MS (Uplink)
Dependencies	When "RBW Filter Type" on page 933 is FLATtop or "Res BW" on page 929 Mode for the offset is **Auto**, this cell is grayed-out and disabled. Since **Res BW** Mode for the offset is preset to **Auto** on changing "Meas Method" on page 963 to RBW, FAST or Fast Power, this cell is also grayed-out and disabled. If the cell is pressed, an advisory message is generated. If the equivalent remote command is sent, a "Setting conflict" warning is generated
Preset	When "Max Num of Offsets" on page 1000 is 12, the preset value of Offset G ~ L is DB3 DB3, DB3, DB3, DB3, DB3, DB3
State Saved	Saved in instrument state
Range	–3 dB (Normal)| –6 dB

Power Ref Type

Lets you set reference types of inner offsets.

CUMulative	Cumulated power of the upper and lower sub-block carriers is the reference level. This selection is effective only when one of the following "Power Ref" on page 1045 values is selected: Left & Right Carriers — LRCarriers Max Power Carrier in Sub-block — MPCSubblock Min Power Carrier in Sub-block — MINSubbloc Left & Right Sub-blocks — LRSubblocks Manual — MANual When one of the other **Power Ref** values is selected, carrier powers are not cumulated, and the reference level is equivalent to Normal
NORMal	Power of specified carrier or the manual reference level is the reference level

Remote Command	`[:SENSe]:ACPower:OFFSet[1]|2:INNer:LIST:PREFerence CUMulative | NORMal, …` `[:SENSe]:ACPower:OFFSet[1]|2:INNer:LIST:PREFerence?`
Example	`:ACP:OFFS:INN:LIST:PREF CUM,CUM,NORM,NORM,NORM,NORM` `:ACP:OFFS:INN:LIST:PREF?`
Preset	When "Max Num of Offsets" on page 1000 is 12, the preset value of Offset G ~ L is NORMal NORMal, NORMal, NORMal, NORMal, NORMal, NORMal
State Saved	Saved in instrument state
Range	CUMulative|NORMal

Auto Function

Remote Command	`[:SENSe]:ACPower:OFFSet[1]|2:INNer:LIST:PREFerence:AUTO OFF | ON | 0 | 1, …` `[:SENSe]:ACPower:OFFSet[1] | 2:INNer:LIST:PREFerence:AUTO?`
Example	`:ACP:OFFS:INN:LIST:PREF:AUTO OFF,OFF,OFF,OFF,OFF,OFF` `:ACP:OFFS:INN:LIST:PREF:AUTO?`
Dependencies	Available only in LTEAFDD, LTEATDD and 5G NR Modes
Couplings	When in the LTEAFDD, LTEATDD Modes, the inner power ref type is set automatically when the power ref type state is auto according to the scopes of the sub-block gap in the following table

Sub-block Gap	Inner ACP offset	Power Ref Type
Wgap <5MHz	1st (2.5MHz)	Normal
	2nd (7.5MHz)	Normal

Sub-block Gap	Inner ACP offset	Power Ref Type
5MHz≤ Wgap <10MHz	1st (2.5MHz)	Cumulative
	2nd (7.5MHz)	Normal
10MHz≤ Wgap <15MHz	1st (2.5MHz)	Cumulative
	2nd (7.5MHz)	Cumulative
15MHz≤ Wgap <20MHz	1st (2.5MHz)	Normal
	2nd (7.5MHz)	Cumulative
20MHz≤ Wgap	1st (2.5MHz)	Normal
	2nd (7.5MHz)	Normal

When in 5G NR Mode, Power Ref Type "Auto" sets the power reference type of inner-ACLR offset automatically

Downlink: "Cumulative" or "Normal" is selected accordingly when the inner-offsets are configured to meet the test requirements as follows:

FR1, 3GPP TS 38.141-1 v16.5.0 (2020-09) Section 6.6.3.5.3 BS type 1-C:

- Table 6.6.3.5.2-3: Base Station ACLR limit in non-contiguous spectrum or multiple bands
- Table 6.6.3.5.2-4: Base station CACLR limit

FR2, 3GPP TS 38.141-2 v16.5.0 (2020-09) Section 6.7.3.5.3 BS type 2-O:

- Table 6.7.3.5.2-3: BS type 2-O ACLR limit in non-contiguous spectrum
- Table 6.7.3.5.2-4: BS type 2-O CACLR limit in non-contiguous spectrum

Uplink: "Normal" is always selected

Preset	When "Max Num of Offsets" on page 1000 is 12, the preset value of Offset G ~ L is the same as the Offset F value `ON, ON, ON, ON, ON, ON	OFF, OFF, OFF, OFF, OFF, OFF`
State Saved	Saved in instrument state
Range	`Auto|Man`

Limit Test

This checkbox is the same as "Limit Test" on page 1023 in the **Settings** tab.

Offset Freq

This column is the same as "Offset Freq" on page 1030 in the **Offset** tab.

Abs Limit

Specifies an absolute limit value, which sets the absolute amplitude levels to test against for each of the custom offsets. The list must contain 6 entries. If there is more than one offset, the offset closest to the carrier channel is the first one in the list. [:SENSe]:ACP:OFFSet[n]:INNer:LIST:TEST selects the type of testing to be done at each offset.

You can turn off (not use) specific offsets with [:SENSe]:ACP:OFFSet [n]:INNer:LIST:STATe.

The query returns the 6 sets of real numbers that are the current absolute amplitude test limits.

Remote Command	[:SENSe]:ACPower:OFFSet[1]|2:INNer:LIST:ABSolute < real>,… [:SENSe]:ACPower:OFFSet[1]|2:INNer:LIST:ABSolute?
Example	:ACP:OFFS2:INN:LIST:ABS -10,-10,-10,-10,-10,-10 :ACP:OFFS2:INN:LIST:ABS?
Notes	Offset subopcode. 1 for BTS (Downlink), 2 for MS (Uplink). Default is BTS
Preset	When "Max Num of Offsets" on page 1000 is 12, the preset value of Offset G ~ L is the same as the Offset F value **Modes** / **Values** 5G NR: -2.2, -2.2, -2.2, -2.2, -2.2, -2.2 | -50.0,-50.0,-50.0,-50.0,-50.0,-50.0 All Others: -8.45,-8.45,-8.45,-8.45,-8.45,-8.45 | -50.0,-50.0,-50.0,-50.0,-50.0,-50.0
State Saved	Saved in instrument state
Min/Max	-200.0 dBm/50.0 dBm

Rel Limit (Car)

Specifies a relative limit value for the carrier level. This sets the amplitude levels to test against for the specified offsets.

The amplitude level is relative to the carrier amplitude. If multiple offsets are available, the list contains 6 entries. The offset closest to the carrier channel is the first one in the list. [:SENSe]:ACP:OFFSet[n]:INNer:LIST:TEST selects the type of testing to be done at each offset.

You can turn off (not use) specific offsets with [:SENSe]:ACP:OFFSet [n]:INNer:LIST:STATe.

The query returns the 6 sets of real numbers that are the current amplitude test limits, relative to the carrier, for each offset.

Offset[n] n = 1 is base station and n = 2 is mobiles. The default is base station (1).

Remote Command	`[:SENSe]:ACPower:OFFSet[1]|2:INNer:LIST:RCARrier <real>,…` `[:SENSe]:ACPower:OFFSet[1]|2:INNer:LIST:RCARrier?`
Example	`:ACP:OFFS2:INN:LIST:RCAR 0,0,0,0,0,0` `:ACP:OFFS2:INN:LIST:RCAR?`
Notes	Offset subopcode. 1 for BTS (Downlink), 2 for MS (Uplink). Default is BTS
Preset	When "Max Num of Offsets" on page 1000 is 12, the preset value of Offset G ~ L is the same as the Offset F value **Modes** / **Values** 5G NR: -43.8, -43.8, 43.8, -43.8, -43.8, -43.8 | -29.2, -29.2, -29.2, -29.2, -29.2, -29.2 All Others: -44.2, -44.2,-44.2,-44.2,-44.2,-44.2 | -29.2, -29.2, -29.2, -29.2, -29.2, -29.2
State Saved	Saved in instrument state
Min/Max	-150/50.0

Rel Limit (PSD)

Specifies a relative limit value for the level of the power spectral density. This sets the amplitude levels to test against for any custom offsets. The amplitude level is relative to the power spectral density. If multiple offsets are available, the list contains 6 entries. The offset closest to the carrier channel is the first one in the list.

`[:SENSe]:ACP:OFFSet[n]:INNer:LIST:TEST` selects the type of testing to be done at each offset.

You can turn off (not use) specific offsets with `[:SENSe]:ACP:OFFSet[n]:INNer:LIST:STATe`.

The query returns the 6 sets of real numbers that are the current amplitude test limits, relative to the power spectral density, for each offset.

Offset[n] n = 1 is base station and n = 2 is mobiles. The default is base station (1).

Remote Command	`[:SENSe]:ACPower:OFFSet[1]|2:INNer:LIST:RPSDensity <rel_ampl>,…` `[:SENSe]:ACPower:OFFSet[1]|2:INNer:LIST:RPSDensity?`
Example	`:ACP:OFFS2:INN:LIST:RPSD 10,10,10,10,10,10` `:ACP:OFFS2:INN:LIST:RPSD?`
Notes	Offset subopcode: 1 for BTS (Downlink), 2 for MS (Uplink). Default is BTS
Preset	When "Max Num of Offsets" on page 1000 is 12, the preset value of Offset G ~ L is 0 0, 0, 0, 0, 0, 0 | 0, 0, 0, 0, 0, 0
State Saved	Saved in instrument state
Min/Max	-150.0 dB/50.0 dB

Fail Mask

Accesses a menu that enables you to select one of the logics for the fail conditions between the measurement results and the test limits. The setting defines the type of testing to be done at any custom offset frequencies. The measured powers are tested against the absolute values defined with `[:SENSe]:ACP:OFFSet[n]:INNer:LIST:ABSolute`, or the relative values defined with `[:SENSe]:ACP:OFFSet[n]:INNer:LIST:RPSDensity` and `[:SENSe]:ACP:OFFSet[n]:INNer:LIST:RCARrier`.

You can turn off (not use) specific offsets with `[:SENSe]:ACP:OFFSet[n]:INNer:LIST:STATe`.

Option	SCPI	Description
Absolute	`ABSolute`	Fail is shown if one of the absolute ACP measurement results is larger than the limit for Abs Limit
Relative	`RELative`	Fail is shown if one of the relative ACP measurement results is larger than the limit for Rel Lim (Car) or Rel Lim (PSD)
Abs AND Rel	`AND`	Fail is shown if one of the absolute ACP measurement results is larger than the limit for Abs Limit *and* one of the relative ACP measurement results is larger than the limit for Rel Lim (Car) or Rel Lim (PSD)
Abs OR Rel	`OR`	Fail is shown if one of the absolute ACP measurement results is larger than the limit for Abs Limit *or* one of the relative ACP measurement results is larger than the limit for Rel Lim (Car) or Rel Lim (PSD)

Remote Command	`[:SENSe]:ACPower:OFFSet[1]|2:INNer:LIST:TEST ABSolute | AND | OR | RELative,…` `[:SENSe]:ACPower:OFFSet[1]|2:INNer:LIST:TEST?`
Example	`:ACP:OFFS2:INN:LIST:TEST ABS,ABS,ABS,ABS,ABS,ABS` `:ACP:OFFS2:INN:LIST:TEST?`
Notes	Offset subopcode: 1 for BTS (Downlink), 2 for MS (Uplink). Default is BTS
Preset	When "Max Num of Offsets" on page 1000 is 12, the preset value of Offset G ~ L is AND `AND, AND, AND, AND, AND, AND | AND, AND, AND, AND, AND, AND`
State Saved	Saved in instrument state
Range	`ABSolute|AND|OR|RELative`

Max Num of Offsets

Sets the max number of offsets: either 6 or 12.

This setting applies only to SCPI operations. To specify the same behavior as that of the previous version, selecting 6 offsets is recommended. If you select 12 offsets, the results returned by the `:READ|:FETCh` queries increase accordingly.

Example:

When you select 6 offsets, querying the offset state returns 6 values, as below.

```
-> :SENSe:ACPower:OFFSet:LIST:STATe?
<- 1,0,0,0,0,0
```

When you select 12 offsets, sending the same query returns 12 values, as below.

```
-> :SENSe:ACPower:OFFSet:LIST:STATe?
<- 1,0,0,0,0,0,0,0,0,0,0,0
```

If your program depends on the number of returned values, you should select 6 offsets, or else change your program.

Remote Command	`[:SENSe]:ACPower:OFFSet:MAXNumber NUM6 | NUM12` `[:SENSe]:ACPower:OFFSet:MAXNumber?`
Example	`:ACP:OFFS:MAXN NUM12` `:ACP:OFFS:MAXN?`
Preset	`NUM6`
State Saved	Saved in instrument state
Range	6|12

Limit Test

Turns limit checking for each offset On or Off. The limits may be specified in the **Offset** menu, for each offset, both sides of the carrier. For results that fail the limit, a red F is appended. In the **Combined** view, the bar turns red.

Remote Command	`:CALCulate:ACPower:LIMit:STATe OFF | ON | 0 | 1` `:CALCulate:ACPower:LIMit:STATe?`
Example	`:CALC:ACP:LIM:STAT OFF` `:CALC:ACP:LIM:STAT?`
Preset	SA: `OFF` WCDMA, LTEAFDD, LTEATDD, 5G NR, MSR: `ON`
State Saved	Saved in instrument state
Range	`ON|OFF`
Backwards Compatibility SCPI	`[:SENSe]:MCPower:LIMit[:STATe]` `[:SENSe]:ACPower:LIMit[:STATe]`

Spur Avoidance

Because VXT models M9410A/11A/15A are direct-conversion (zero-IF) receivers, feedthrough leakage from the local oscillator appears as a spurious signal (spur) at the center frequency. The **Spur Avoidance** function is provided to eliminate this spur, at the expense of some measurement speed.

When **Spur Avoidance** is enabled (the default), the instrument uses a software algorithm to remove this spur from the displayed measurement data, but the algorithm only operates under certain conditions. Specifically, it only operates in multiple capture case.

You can disable this function to speed up your measurement by setting **Spur Avoidance** to **Disabled**.

Note that when **Spur Avoidance** is not in effect, either because you have disabled it or because you are not in multiple capture, the following warning message appears in the status bar:

`Settings Alert;Spur Avoidance Off`

This is to alert you that measurement accuracy might be impacted by the fact that **Spur Avoidance** is not in effect.

Remote Command	`[:SENSe]:ACPower:SAVoid[:STATe] ON | OFF | 0 | 1` `[:SENSe]:ACPower:SAVoid[:STATe]?`
Example	`:ACP:SAVoid ON` `:ACP:SAVoid?`
Dependencies	Only appears in VXT models M9410A/11A/15A
Preset	`OFF`
State Saved	Saved in instrument state
Range	`ON|OFF`

Meas Setup Summary Table

Lets you view and access many of the parameters in the **Meas Setup** menus on one screen.

Auto Couple

Immediately puts all **Auto/Man** functions into **Auto**. **Auto Couple** is confined to the current measurement only. It does not affect other measurements in the Mode.

In the **Auto** state, **Auto/Man** functions are said to be “coupled”, meaning their values change as you make changes to other values in the measurement. This helps ensure accurate measurements and optimum dynamic range. **Auto Couple** is an immediate action function, and when it is executed, all the **Auto/Man** controls for the current measurement are set to **Auto**, and all measurement settings coupled to the **Auto/Man** parameters are automatically set to their optimal values.

For further details of measurement-specific settings (if any), see "Measurement-Specific Details" on page 1003 below.

Remote Command	`:COUPle ALL`
Example	`:COUP ALL`
Backwards Compatibility SCPI	`:COUPLE ALL | NONE`
Backwards Compatibility Notes	`:COUP:NONE` puts all Auto/Man parameters in manual mode, decoupling all the coupled instrument parameters. It is retained for backwards compatibility and is *not* recommended for making measurements or new designs

All **Auto/Man** parameter couplings in the measurement are set to **Auto**. This includes couplings that may be unavailable or grayed-out due to the current state. For example, in the Swept SA measurement, there is no **Auto/Man** coupling for **RBW** while in Zero Span. Nonetheless, if **Auto Couple** were executed while in Zero Span, it would set **RBW** to Auto "behind the scenes" so that, on exit from Zero Span, it would be in **Auto**.

Any **Auto/Man** selection specific (local) to the other measurements in the current Mode are not affected by **Auto Couple**. Any functions that are *not* coupled with other instrument parameters, such as ranging or leveling variables, such as **AutoRange** or **AutoScale**, are not affected.

Executing **Auto Couple** generates the informational message, "All Auto/Man functions have been set to Auto".

Each parameter, upon being set to **Auto**, selects and sets the appropriate auto-coupled value based on that parameter's coupling rules. The Dependency Resolver orchestrates the couplings for parameters that depend on one or more other parameters. The coupling and dependency rules for each parameter are defined in the section describing that parameter.

Executing **Auto Couple***does not* affect markers, marker functions, trace or display attributes, or any other instrument setting other than those specifically mentioned above.

Measurement-Specific Details

TOI (SA Mode only)

Parameters affected by **Auto Couple** are:

- Center Frequency Step
- Resolution Bandwidth
- Span/RBW Ratio
- Sweep Time
- Video BANDwidth VBW/RBW ratio
- Upper and Lower Tone (set to Sense)
- Zero span measurement Resolution Bandwidth
- Zero span measurement Dwell Time

Harmonics (SA Mode only)

Parameters affected by **Auto Couple** are:

- Resolution Bandwidth
- Fundamental Frequency
- Dwell Time
- Range Table Resolution Bandwidths
- Range Table Dwell Times

Meas Preset

Restores all measurement parameters to their default values.

Remote Command	`:CONFigure:ACPower`
Example	`:CONF:ACP`
Couplings	Selecting **Meas Preset** restores all measurement parameters to their default values

3.5.13.2 Reference

All ACP measurements are taken relative to a specific carrier frequency, relative to whose power the offset channel power is measured.

The controls on this tab let you specify the reference carrier frequency and other parameters relevant to the reference carrier.

Number of Carriers

Specifies the number of carriers to be measured.

Remote Command	`[:SENSe]:ACPower:CARRier[1]|2:COUNt <integer>` `[:SENSe]:ACPower:CARRier[1]|2:COUNt?`
Example	`:ACP:CARR:COUN 1` `:ACP:CARR:COUN?`
Notes	Carrier subopcode: 1 for BTS (Downlink), 2 for MS (Uplink). Default is BTS Note that Carrier subopcode 2 is not supported in some Modes. In those cases, Carrier subopcode 1 is used for both BTS and MS and commands with subopcode 2 are accepted without error but ignored
Dependencies	When Number of Carriers is 1, Ref Carrier is grayed out Does not appear in MSR, LTEAFDD, LTEATDD and 5G NR Modes. In order to maintain backwards compatibility with legacy LTE FDD/TDD Modes, the SCPI command is supported in the LTE-A converged applications
Couplings	Changing this parameter might affect "Span" on page 948
Preset	1
State Saved	Saved in instrument state
Min/Max	1/18
Backwards Compatibility SCPI	`[:SENSe]:MCPower:CARRier[1]|2:COUNt` (Power Suite)

Carrier/Offset/Limits Config

This is the same dialog as "Carrier/Offset/Limits Config" on page 965 in the **Settings** menu.

Carrier

Lets you configure your carriers, carrier spacing, noise bandwidth and measurement method.

Dependencies	Appears in all Modes except MSR, LTEAFDD, LTEATDD and 5G NR

Number of Carriers

This is the same as "Number of Carriers" on page 1005 under **Reference**.

Couple to #1

Couples carrier settings to carrier #1. The coupled parameters are:

– "Carrier Pwr Present" on page 1006
– "Carrier Spacing" on page 1007
– "Measurement Noise Bandwidth" on page 1008
– "Method for Carrier " on page 1009
– "Filter Alpha for Carrier" on page 1010

Remote Command	`[:SENSe]:ACPower:CARRier[1]|2:LIST:COUPle OFF | ON | 0 | 1, …` `[:SENSe]:ACPower:CARRier[1]|2:LIST:COUPle?`
Example	`:ACP:CARR:LIST:COUP OFF` `:ACP:CARR:LIST:COUP?`
Notes	Carrier subopcode: 1 for BTS (Downlink), 2 for MS (Uplink). Default is BTS Some modes do not support Carrier subopcode 2. In those cases, commands with subopcode 2 are accepted without error but ignored For LTEAFDD or LTEATDD Modes, this control is not shown. In order to maintain backwards compatibility with legacy LTE FDD/TDD, the SCPI command is supported in LTE & LTE-A converged applications
Couplings	When ON, the carrier settings are coupled to carrier #1. Coupled parameters are: Carrier Power Present, Carrier Spacing, Measurement Noise Bandwidth, Method and Filter Alpha When a setting is changed, coupling is switched off automatically Carrier #1 is always set to ON and cannot be changed
Preset	ON
State Saved	Saved in instrument state

Carrier Pwr Present

Configures the carriers for this measurement. Allows spaces to be inserted between carriers. Carriers with the power present parameter set to YES are carriers, and those with the power present parameter set to NO are spaces. Each carrier power present is set to YES or NO. The individual carrier can be set by selecting the desired carrier.

The query returns the current values for all of the carriers. If a carrier is defined as having no power present, the power displayed is relative to the reference carrier, otherwise the absolute power is displayed.

If you change the carrier power present to NO, and that carrier is currently configured as the reference carrier, the next carrier to the left (or the right if there are no carriers to the left) is assigned as the reference carrier. This also applies to the scenario where there are only two carriers configured as having power present, and you configure only one carrier to have no power present.

Remote Command	[:SENSe]:ACPower:CARRier[1]|2:LIST:PPResent YES | NO, … [:SENSe]:ACPower:CARRier[1]|2:LIST:PPResent?
Example	:ACP:CARR2:LIST:PPR YES :ACP:CARR2:LIST:PPR?
Notes	Carrier subopcode: 1 for BTS (Downlink), 2 for MS (Uplink). Default is BTS Some Modes do not support Carrier subopcode 2. In those cases, commands with subopcode 2 are accepted without error but ignored When setting these values remotely, the position in the list sent corresponds to the carrier. Missing values are not permitted, so if you want to change values 2 and 6, you must send all values up to 6. Subsequent values remain unchanged, unless the number of values sent is greater than the number of carriers, then subsequent values are ignored For LTEAFDD or LTEATDD Modes, this control is not shown. To maintain backwards compatibility with legacy LTE FDD/TDD Modes, the SCPI command is supported in the LTE & LTE-A converged applic-ations
Couplings	Coupled to number of carriers. When the SCPI command is sent, the number of carriers is set to the number of entries in the parameter list
Preset	YES
State Saved	Saved in instrument state
Backwards Compatibility SCPI	[:SENSe]:MCPower:CARRier[1]|2:LIST:PPResent

Carrier Spacing

Sets the width of the carrier spacing. This is the value applied to all the current slots, whether they are carriers or spaces.

Enter each carrier spacing value individually by selecting the desired carrier, and then enter the carrier width.

Remote Command	[:SENSe]:ACPower:CARRier[1]|2:LIST:WIDTh <freq>, … [:SENSe]:ACPower:CARRier[1]|2:LIST:WIDTh?
Example	:ACP:CARR2:LIST:WIDT 25kHz :ACP:CARR2:LIST:WIDT?
Notes	Carrier subopcode: 1 for BTS (Downlink), 2 for MS (Uplink). Default is BTS Some Modes do not support Carrier subopcode 2. In those cases, commands with subopcode 2 are accepted without error but ignored

	When setting these values remotely, the position in the list sent corresponds to the carrier. Missing values are not permitted, so if you want to change values 2 and 6, you must send all values up to 6. Subsequent values remain unchanged, unless the number of values sent is greater than the number of carriers, then subsequent values are ignored For LTEAFDD or LTEATDD Modes, this control is not shown. To maintain backwards compatibility with legacy LTE FDD/TDD Modes, the SCPI command is supported in the LTE & LTE-A converged applications
Couplings	Coupled to number of carriers. When the SCPI command is sent, the number of carriers is set to the number of entries in the parameter list Changing Carrier Spacing might affect "Span" on page 948
Preset	SA, WCDMA, LTE, LTETDD Modes: 5 MHz Radio Test Mode: 25 kHz
State Saved	Saved in instrument state
Min/Max	0 Hz/Depends on instrument maximum frequency. Same as the Max Span of Swept SA Measurement
Backwards Compatibility SCPI	`[:SENSe]:MCPower:CARRier[1]|2:LIST:WIDTh`

Measurement Noise Bandwidth

Specifies the **Measurement Noise Bandwidth** used to calculate the power in the carriers.

Each **Measurement Noise Bandwidth** value is entered individually by selecting the desired carrier. Enter the measurement noise bandwidth on the **Carrier** page of the **Carr/Offset/Limits Config** dialog.

Remote Command	`[:SENSe]:ACPower:CARRier[1]|2:LIST:BANDwidth[:INTegration] <freq>, …` `[:SENSe]:ACPower:CARRier[1]|2:LIST:BANDwidth[:INTegration]?`
Example	`:ACP:CARR2:LIST:BAND 25kHz` `:ACP:CARR2:LIST:BAND?`
Notes	In WCDMA Mode, the preset/default value is defined as 3.84 MHz, but internally, 4.6848 MHz is used as the default value Carrier subopcode: 1 for BTS (Downlink), 2 for MS (Uplink). Default is BTS Some Modes do not support Carrier subopcode 2. In those cases, commands with subopcode 2 are accepted without error but ignored When setting these values remotely, the position in the list sent corresponds to the carrier. Missing values are not permitted, so if you want to change values 2 and 6, you must send all values up to 6. Subsequent values remain unchanged, unless the number of values sent is greater than the number of carriers, then subsequent values are ignored For LTEAFDD or LTEATDD Modes, this control is not shown. In order to maintain backwards compat-

	ibility with legacy LTE FDD/TDD Modes, the SCPI command is supported in the LTE & LTE-A converged applications
Couplings	Coupled to number of carriers. When the SCPI command is sent, the number of carriers is set to the number of entries in the parameter list
Preset	**Modes** / **Value** SA: 2 MHz WCDMA: 3.84 MHz LTE, LTETDD: 4.515 MHz|4.5 MHz Radio Test: 25 kHz
State Saved	Saved in instrument state
Min/Max	10 Hz/Depends on instrument maximum frequency. Same as Max Span of the Swept SA Measurement

Backwards Compatibility SCPI	`[:SENSe]:ACPower:BANDwidth:INTegration`
	`[:SENSe]:ACPower:BWIDth:INTegration`
	`[:SENSe]:ACPower:CARRier[1]|2:LIST:BWIDth[:INTegration]`
	`[:SENSe]:MCPower:CARRier[1]|2:LIST:BANDwidth[:INTegration]`
	`[:SENSe]:MCPower:CARRier[1]|2:LIST:BWIDth[:INTegration]`

Method for Carrier

Accesses the carrier configuration method settings.

Remote Command	`[:SENSe]:ACPower:CARRier[1]|2:LIST:FILTer[:RRC][:STATe] ON | OFF | 1 | 0, …` `[:SENSe]:ACPower:CARRier[1]|2:LIST:FILTer[:RRC][:STATe]?`
Example	`:ACP:CARR:LIST:FILT 0,0,0,0` `:ACP:CARR:LIST:FILT?`
Notes	The binary values translate as follows: `1|ON`: RRC Weighted `0|OFF`: Integ BW Maximum of Array length depends on the number of carriers Some Modes do not support Carrier subopcode 2. In those cases, commands with subopcode 2 are accepted without error but ignored For LTEAFDD or LTEATDD Modes, this control is not shown. In order to maintain backwards compatibility with legacy LTE FDD/TDD Modes, the SCPI command is supported in the LTE & LTE-A converged applications
Preset	**Modes** / **Value** SA, LTE, LTETDD: `OFF`

	Modes	**Value**
	WCDMA	ON
	Radio Test	OFF
State Saved	Saved in instrument state	
Range	Integration BW | RRC Weighted	

Filter Alpha for Carrier

Inputs the alpha value for the filter used in the current carrier configuration.

Remote Command	`[:SENSe]:ACPower:CARRier[1]|2:LIST:FILTer:ALPHa <real>, …` `[:SENSe]:ACPower:CARRier[1]|2:LIST:FILTer:ALPHa?`
Example	`:ACP:CARR2:LIST:FILT:ALPH 0.5` `:ACP:CARR2:LIST:FILT:ALPH?`
Notes	Some Modes do not support Carrier subopcode 2. In those cases, commands with subopcode 2 are accepted without error but ignored For LTEAFDD or LTEATDD Modes, this control is not shown. In order to maintain backwards compatibility with legacy LTE FDD/TDD Modes, the SCPI command is supported in the LTE & LTE-A converged applications
Preset	0.22
State Saved	Saved in instrument state
Min/Max	0.01/1.0

Offset

Lets you configure the spacing of the offset regions.

Offset Frequency Define

Lets you select offset frequency definition. Each standard defines each offset frequency from Carrier.

For example, 3GPP2 requires the “From Carrier Center to Integ BW Closer Edge” definition. LTE conformance test requires “From Carrier Edge to Integ BW Center” and/or “From Carrier Edge to Integ BW Closer Edge” definition.

`CTOCenter`	From the lowermost carrier center frequency (for lower offset), the uppermost carrier center frequency (for upper offset) to the center frequency of each Offset Integ BW
`CTOEdge`	From the lowermost carrier center frequency (for lower offset), the uppermost carrier center frequency

	(for upper offset) to the closest edge frequency of each Offset Integ BW
ETOCenter	From the lowermost carrier center frequency - spacing of this carrier /2 (for lower offset), the uppermost carrier center frequency + spacing of this carrier /2 (for upper offset) to the center frequency of each Offset Integ BW
ETOEdge	From the lowermost carrier center frequency - spacing of this carrier /2 (for lower offset), the uppermost carrier center frequency + spacing of this carrier /2 (for upper offset) to the closest edge of each Offset Integ BW
RTOCenter 5G NR only	From either the lower or upper RF BW** edge frequency to the center frequency of each Offset Integ BW
RTOEdge 5G NR only	From either the lower or upper RF BW** edge frequency to the closest edge frequency of each Offset Integ BW
RCTOCenter 5G NR only	From the center frequency of RF BW** to the center frequency of each Offset Integ BW
SCTOCenter 5G NR only	From the center frequency of sub-block** to the center frequency of each Offset Integ BW

** RF BW = BWchannel,CA which is defined in each 3GPP standard, regardless of “Measure Carrier” for the uppermost and the lowermost carriers being Enabled or Disabled. When the Number of Component Carrier = 1, RF BW = $BW_{channel}$ = 2 x $F_{offset,RAT}$

** sub-block (bandwidth) = $BW_{channel,block}$ which is defined in each 3GPP standard, regardless of “Measure Carrier” for the uppermost and the lowermost carriers being Enabled or Disabled. When the Number of Component Carrier within each sub-block = 1, sub-block (bandwidth) = $BW_{channel}$ = 2 x $F_{offset,RAT}$.

See "Diagrams for Offset Freq Define" on page 1012.

Modes other than MSR, LTEAFDD, LTEATDD, 5G NR

Remote Command	`[:SENSe]:ACPower:OFFSet[1]|2[:OUTer]:TYPE CTOCenter | CTOEdge | ETOCenter | ETOEdge` `[:SENSe]:ACPower:OFFSet[1]|2[:OUTer]:TYPE?`
Example	`:ACP:OFFS:TYPE ETOC` `:ACP:OFFS:TYPE?`
Notes	Some Modes do not support Offset subopcode 2. In those cases, commands with subopcode 2 are accepted without error but ignored
Preset	CTOCenter
State Saved	Saved in instrument state
Range	CTOCenter|CTOEdge|ETOCenter|ETOEdge

Mode: MSR, LTEAFDD, LTEATDD

Remote Command	[:SENSe]:ACPower:OFFSet[1]|2[:OUTer]:TYPE CTOCenter | CTOEdge | ETOCenter | ETOEdge [:SENSe]:ACPower:OFFSet[1]|2[:OUTer]:TYPE?
Example	:ACP:OFFS:TYPE ETOC :ACP:OFFS:TYPE?
Preset	CTOCenter
State Saved	Saved in instrument state
Range	CTOCenter|CTOEdge|ETOCenter|ETOEdge

Mode: 5G NR

Remote Command	[:SENSe]:ACPower:OFFSet[1]|2[:OUTer]:TYPE CTOCenter | CTOEdge | ETOCenter | ETOEdge | RTOCenter | RTOEdge | RCTOCenter | SCTOCenter [:SENSe]:ACPower:OFFSet[1]|2[:OUTer]:TYPE?
Example	:ACP:OFFS:TYPE ETOC :ACP:OFFS:TYPE?
Preset	CTOCenter
State Saved	Saved in instrument state
Range	CTOCenter | CTOEdge | ETOCenter | ETOEdge | RTOCenter | RTOEdge | RCTOCenter | SCTOCenter

Diagrams for Offset Freq Define

Details depend on the selected mode.

Diagram for Modes other than MSR, LTEAFDD, LTEATDD, 5G NR

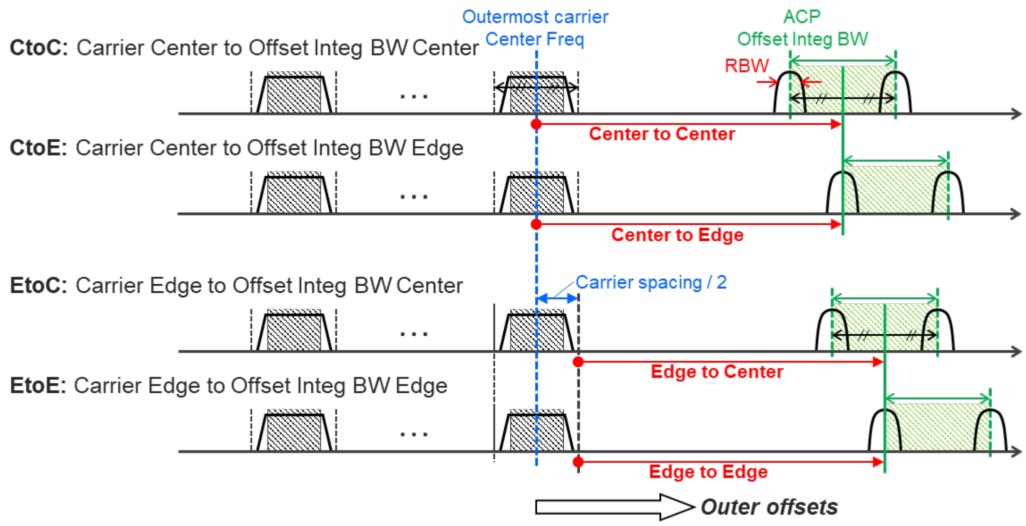
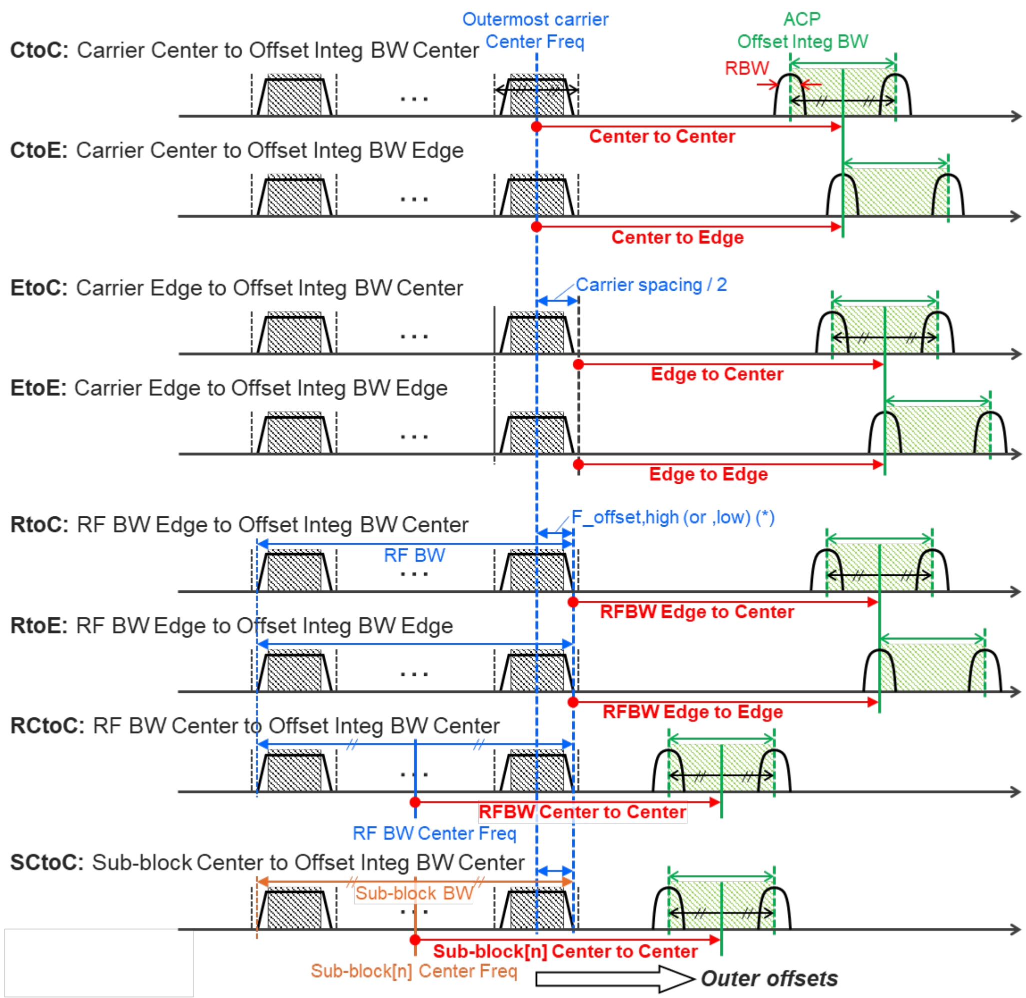


Diagram for MSR, LTEAFDD, LTEATDD, 5G NR



Note:

RF BW Edge and Outermost Carrier Edge are not always the same.
e.g.) 5G NR (3GPP) defines BW_channel, CA which calculates F_offset,high and F_offset,low asymmetrically with SCS shift.
(*) For MSR, F_offset,high (or ,low) = F_offset,RAT,high (or ,low)

Offset Freq

Determines the frequency difference between the center of the main channel and the center of the carrier.

Each **Offset Freq** state value is entered individually by selecting the desired carrier.

The list contains up to six (6) entries, depending on the mode selected, for offset frequencies. Each offset frequency in the list corresponds to a reference bandwidth in the bandwidth list.

An offset frequency of zero turns the display of the measurement for that offset off, but the measurement is still made and reported. You can turn off (not use) specific offsets with `[:SENSe]:ACP:OFFSet:LIST:STATe`.

Turning the offset off has the same effect as setting the frequency of the offset to 0 Hz, and causes it to be removed from the results screen.

Remote Command	`[:SENSe]:ACPower:OFFSet[1]|2[:OUTer]:LIST[:FREQuency] <freq>,…` `[:SENSe]:ACPower:OFFSet[1]|2[:OUTer]:LIST[:FREQuency]?`
Example	`:ACP:OFFS1:LIST 0,0,0,0,0,0` `:ACP:OFFS1:LIST?`
Notes	Offset subopcode. 1 for BTS (Downlink), 2 for MS (Uplink). Default is BTS Some Modes do not support Offset subopcode 2. In those cases, commands with subopcode 2 are accepted without error but ignored When setting these values remotely, the position in the list sent corresponds to the offset. Missing values are not permitted, unless the number of values sent is greater than the number of carriers, in which case subsequent values are ignored
Couplings	Changing Offset Frequency might affect "Span" on page 948
Preset	When "Max Num of Offsets" on page 1000 is set to 12, the preset value of Offset G ~ L is the same as the Offset F value

Modes	Values
SA	3 MHz, 0 Hz, 0 Hz, 0 Hz, 0 Hz, 0 Hz | 3 MHz, 0 Hz, 0 Hz, 0 Hz, 0 Hz
WCDMA	5.0 MHz, 10.0 MHz, 0 Hz, 0 Hz, 0 Hz, 0 Hz | 5.0 MHz, 10.0 MHz, 0 Hz, 0 Hz, 0 Hz, 0 Hz
LTEAFDD, LTEATDD, MSR	5.0 MHz, 10.0 MHz, 0 Hz, 0 Hz, 0 Hz, 0 Hz | 5.0 MHz, 10.0 MHz, 0 Hz, 0 Hz, 0 Hz, 0 Hz
5G NR	100 MHz, 200 MHz, 0 Hz, 0 Hz, 0 Hz, 0 Hz | 100 MHz, 200 MHz, 0 Hz, 0 Hz, 0 Hz, 0 Hz
Radio Test	25 kHz, 50 kHz, 75 kHz, 0 Hz, 0 Hz, 0 Hz

State Saved	Saved in instrument state
Min/Max	0 Hz/Depends on instrument maximum frequency. Same as Max Span of the Swept SA Measurement
Backwards Compatibility SCPI	`[:SENSe]:MCPower:OFFSet[1]|2:LIST[:FREQuency]`

Auto Function

Remote Command	`[:SENSe]:ACPower:OFFSet[1]|2[:OUTer]:LIST:STATe OFF | ON | 0 | 1,…` `[:SENSe]:ACPower:OFFSet[1]|2[:OUTer]:LIST:STATe?`

Example	:ACP:OFFS2:LIST:STAT 1,1,0,0,0,0 :ACP:OFFS2:LIST:STAT?
Preset	When "Max Num of Offsets" on page 1000 is 12, the preset value of Offset G ~ L is the same as the Offset F value

Modes	Values
SA	ON, OFF, OFF, OFF, OFF, OFF | ON, OFF, OFF, OFF, OFF, OFF
WCDMA	ON, ON, OFF, OFF, OFF, OFF | ON, ON, OFF, OFF, OFF, OFF
LTEAFDD, LTEATDD, MSR	ON, ON, OFF, OFF, OFF, OFF | ON, OFF, OFF, OFF, OFF, OFF
5G NR	ON, ON, OFF, OFF, OFF, OFF | ON, OFF, OFF, OFF, OFF, OFF
Radio Test	ON, ON, ON, OFF, OFF, OFF

State Saved	Yes
Range	OFF|ON

Integ BW

Sets the Integration Bandwidth for the offsets. Each resolution bandwidth in the list corresponds to an offset frequency in the list defined by [:SENSe]:ACP:OFFSet[n][:OUTer]:LIST[:FREQuency].

Enter each value individually by selecting the desired offset, then enter the Offset Integration Bandwidth.

You can turn off (not use) specific offsets with [:SENSe]:ACP:OFFSet[n][:OUTer]:LIST:STATe.

Remote Command	[:SENSe]:ACPower:OFFSet[1]|2[:OUTer]:LIST:BANDwidth[:INTegration] <freq>,… [:SENSe]:ACPower:OFFSet[1]|2[:OUTer]:LIST:BANDwidth[:INTegration]?
Example	:ACP:OFFS2:LIST:BAND 2MHz,2MHz,2MHz,2MHz,2MHz,2MHz :ACP:OFFS2:LIST:BAND?
Notes	Offset subopcode: 1 for BTS (Downlink), 2 for MS (Uplink). Default is BTS Some Modes do not support Offset subopcode 2. In those cases, commands with subopcode 2 are accepted without error but ignored When setting these values remotely, the position in the list sent corresponds to the offset. Missing values are not permitted, so, if you want to change the second value, you must send all values up to that. Subsequent values remain unchanged, unless the number of values sent is greater than the number of carriers, then subsequent values is ignored
Couplings	Changing **Integ BW** might affect "Span" on page 948
Preset	When "Max Num of Offsets" on page 1000 is set to 12, the preset value of Offset G ~ L is the same as

	the Offset F value **Modes** / **Values** SA: 2 MHz, 2 MHz, 2 MHz, 2 MHz, 2 MHz, 2 MHz|2 MHz, 2 MHz, 2 MHz, 2 MHz, 2 MHz, 2 MHz WCDMA: 3.84 MHz, 3.84 MHz, 3.84 MHz, 3.84 MHz, 3.84 MHz, 3.84 MHz|3.84 MHz, 3.84 MHz, 3.84 MHz, 3.84 MHz, 3.84 MHz, 3.84 MHz LTEAFDD, LTEATDD, MSR: 4.515 MHz, 4.515 MHz, 4.515 MHz, 4.515 MHz, 4.515 MHz, 4.515 MHz|4.5 MHz, 4.5 MHz, 4.5 MHz, 4.5 MHz, 4.5 MHz, 4.5 MHz 5G NR: 98.28 MHz, 98.28 MHz, 98.28 MHz, 98.28 MHz, 98.28 MHz, 98.28 MHz|98.31 MHz, 98.31 MHz, 98.31 MHz, 98.31 MHz, 98.31 MHz, 98.31 MHz Radio Test: 25 kHz, 25 kHz, 25 kHz, 25 kHz, 25 kHz, 25 kHz
State Saved	Saved in instrument state
Min/Max	10 Hz/Depends on instrument maximum frequency. Same as Max Span of the Swept SA Measurement
Backwards Compatibility SCPI	[:SENSe]:ACPower:OFFSet[1]|2:LIST:BWIDth[:INTegration] [:SENSe]:ACPR:OFFSet[1]|2:LIST:BANDwidth [:SENSe]:ACPR:OFFSet[1]|2:LIST:BWIDth [:SENSe]:MCPower:OFFSet[1]|2:LIST:BANDwidth[:INTegration] [:SENSe]:MCPower:OFFSet[1]|2:LIST:BWIDth[:INTegration]

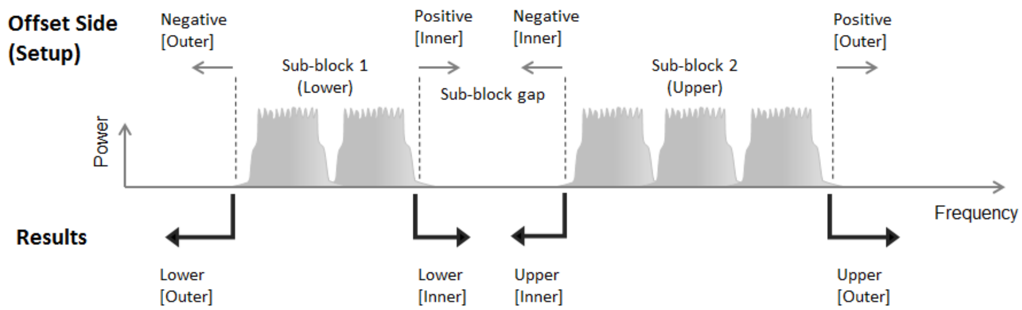
Offset Side

Specifies which offset side to measure.

You can turn off (not use) specific offsets with [:SENSe]:ACPower:OFFSet[1]|2[:OUTer]:LIST:SIDE.

NEGative	Negative (lower) sideband only
BOTH	Both of the negative (lower) and positive (upper) sidebands
POSitive	Positive (upper) sideband only

The figure below shows the relation between the negative/positive offset side setups and the upper/lower results in MSR, LTEAFDD and LTEATDD Modes.



Remote Command	`[:SENSe]:ACPower:OFFSet[1]|2[:OUTer]:LIST:SIDE NEGative | BOTH | POSitive, …` `[:SENSe]:ACPower:OFFSet[1]|2[:OUTer]:LIST:SIDE?`
Example	`:ACP:OFFS:LIST:SIDE BOTH` `:ACP:OFFS:LIST:SIDE?`
Notes	`OFFSet1` is for BTS, `2` for MS. Default is BTS Some Modes do not support Offset subopcode 2. In those cases, commands with subopcode 2 are accepted without error but ignored If you set `POS` or `NEG` in an offset, result of the inactive side returns -999
Preset	When "Max Num of Offsets" on page 1000 is 12, the preset value of Offset G ~ L is `BOTH` `BOTH, BOTH, BOTH, BOTH, BOTH, BOTH | BOTH, BOTH, BOTH, BOTH, BOTH, BOTH`
State Saved	Saved in instrument state
Range	`NEGative|BOTH|POSitive`

Method

Allows you to turn RRC filtering of each offset on or off. The value (roll off) for the filter will be set to the value of the **Filter Alpha** parameter.

Remote Command	`[:SENSe]:ACPower:OFFSet[1]|2[:OUTer]:LIST:FILTer[:RRC][:STATe] ON | OFF | 1 | 0,…` `[:SENSe]:ACPower:OFFSet[1]|2[:OUTer]:LIST:FILTer[:RRC][:STATe]?`
Example	`:ACP:OFFS:LIST:FILT 1,0,0` `:ACP:OFFS:LIST:FILT?`
Notes	`1|ON` = RRC Weighted, `0|OFF` = Integ BW Some Modes do not support Offset subopcode 2. In those cases, commands with subopcode 2 are accepted without error but ignored
Preset	When "Max Num of Offsets" on page 1000 is 12, the preset value of Offset G ~ L is the same as the Offset F value

	Mode	**Values**
	SA	0, 0, 0, 0, 0, 0 | 0, 0, 0, 0, 0,0
	WCDMA	1, 1, 1, 1, 1, 1 | 1, 1, 1, 1, 1, 1
	LTEAFDD, LTEATDD, 5G NR, MSR	0, 0, 0, 0, 0, 0 | 0, 0, 0, 0, 0,0
	Radio Test	0, 0, 0, 0, 0, 0
State Saved	Saved in instrument state	
Range	Integ BW | RRC Weighted	

Filter Alpha

Sets the alpha value for the RRC Filter for each offset.

Remote Command	`[:SENSe]:ACPower:OFFSet[1]|2[:OUTer]:LIST:FILTer:ALPHa <real>,…` `[:SENSe]:ACPower:OFFSet[1]|2[:OUTer]:LIST:FILTer:ALPHa?`
Example	`:ACP:OFFS:LIST:FILT:ALPH 0.5,0.5,0.5,0.5,0.5,0.5` `:ACP:OFFS:LIST:FILT:ALPH?`
Notes	Some Modes do not support Offset subopcode 2. In those cases, commands with subopcode 2 are accepted without error but ignored
Preset	When "Max Num of Offsets" on page 1000 is 12, the preset value of Offset G ~ L is the same as the Offset F value

Mode	Values
SA	0.22,0.22,0.22,0.22,0.22,0.22|0.22,0.22,0.22,0.22,0.22,0.22
WCDMA	0.22,0.22,0.22,0.22,0.22,0.22|0.22,0.22,0.22,0.22,0.22,0.22
LTEAFDD, LTEATDD, 5G NR, MSR	0.22,0.22,0.22,0.22,0.22,0.22|0.22,0.22,0.22,0.22,0.22,0.22

State Saved	Saved in instrument state
Min/Max	0.01/1.00

Advanced (Offset)

Opens a further menu page, which lets you set advanced properties of the Inner Offset, such as Res BW, Video BW, and Filter parameters.

Offset Freq

This column is the same as "Offset Freq" on page 1014 in the main **Offset** menu.

Res BW

Sets the resolution bandwidth. If an unavailable bandwidth is entered with the numeric keypad, the closest available bandwidth is selected.

<table>
<tr><td>Remote Command</td><td><code>[:SENSe]:ACPower:OFFSet[1]|2[:OUTer]:LIST:BANDwidth:RESolution <freq>,…</code>
<code>[:SENSe]:ACPower:OFFSet[1]|2[:OUTer]:LIST:BANDwidth:RESolution?</code></td></tr>
<tr><td>Example</td><td><code>:ACP:OFFS2:LIST:BAND:RES 220kHz,220kHz,220kHz,220kHz,220kHz,220kHz</code>
<code>:ACP:OFFS2:LIST:BAND:RES?</code></td></tr>
<tr><td>Notes</td><td>Offset subopcode: 1 for BTS (Downlink), 2 for MS (Uplink). Default is BTS
Some Modes do not support Offset subopcode 2. In those cases, commands with subopcode 2 are accepted without error but ignored</td></tr>
<tr><td>Dependencies</td><td>When "Meas Method" on page 963 is RBW, FAST or Fast Power, this cell is grayed-out and disabled. If the cell is pressed, an advisory message is generated. If the equivalent SCPI remote command is sent, a "Setting conflict" warning is generated</td></tr>
<tr><td>Couplings</td><td>When Res BW Mode is Auto, this value is exactly same as Res BW. When you change this value, Res BW Mode also changes to Man</td></tr>
<tr><td>Preset</td><td>When "Max Num of Offsets" on page 1000 is 12, the preset value of Offset G ~ L is the same as the Offset F value
<table>
<tr><td>SA</td><td>220 kHz, 220 kHz, 220 kHz, 220 kHz, 220 kHz, 220 kHz</td></tr>
<tr><td>WCDMA</td><td>100 kHz, 100 kHz, 100 kHz, 100 kHz, 100 kHz, 100 kHz</td></tr>
<tr><td>LTEAFDD, LTEATDD, 5G NR, MSR</td><td>100 kHz, 100 kHz, 100 kHz, 100 kHz, 100 kHz, 100 kHz | 100 kHz, 100 kHz, 100 kHz, 100 kHz, 100 kHz, 100 kHz</td></tr>
</table></td></tr>
<tr><td>State Saved</td><td>Saved in instrument state</td></tr>
<tr><td>Min/Max</td><td>1 Hz/8 MHz</td></tr>
<tr><td>Backwards Compatibility SCPI</td><td><code>[:SENSe]:ACPower:OFFSet[1]|2:LIST:BWIDth:RESolution</code></td></tr>
</table>

Auto Function

<table>
<tr><td>Remote Command</td><td><code>[:SENSe]:ACPower:OFFSet[1]|2[:OUTer]:LIST:BANDwidth:RESolution:AUTO ON | OFF | 1 | 0,…</code>
<code>[:SENSe]:ACPower:OFFSet[1]|2[:OUTer]:LIST:BANDwidth:RESolution:AUTO?</code></td></tr>
<tr><td>Example</td><td><code>:ACP:OFFS2:LIST:BAND:RES:AUTO 1,1,1,1,1,1</code>
<code>:ACP:OFFS2:LIST:BAND:RES:AUTO?</code></td></tr>
<tr><td>Preset</td><td>When "Max Num of Offsets" on page 1000 is 12, the preset value of Offset G ~ L is 1
1, 1, 1, 1, 1, 1</td></tr>
<tr><td>State Saved</td><td>Yes</td></tr>
<tr><td>Backwards Compatibility SCPI</td><td><code>[:SENSe]:ACPower:OFFSet[1]|2:LIST:BWIDth:RESolution:AUTO</code></td></tr>
</table>

Video BW

Enables you to change the instrument post-detection filter (VBW).

Remote Command	`[:SENSe]:ACPower:OFFSet[1]|2[:OUTer]:LIST:BANDwidth:VIDeo <freq>,…` `[:SENSe]:ACPower:OFFSet[1]|2[:OUTer]:LIST:BANDwidth:VIDeo?`
Example	`:ACP:OFFS2:LIST:BAND:VID 5MHz,5MHz,5MHz,5MHz,5MHz,5MHz` `:ACP:OFFS2:LIST:BAND:VID?`
Notes	The values shown in this table reflect the conditions after **Mode Preset** Offset subopcode: 1 for BTS (Downlink), 2 for MS (Uplink). Default is BTS Some Modes do not support Offset subopcode 2. In those cases, commands with subopcode 2 are accepted without error but ignored
Dependencies	When "Meas Method" on page 963 is RBW, FAST or Fast Power, this cell is grayed-out and disabled. If the cell is pressed, an advisory message is generated. If the equivalent remote command is sent, a "Setting conflict" warning is generated
Preset	When "Max Num of Offsets" on page 1000 is 12, the preset value of Offset G ~ L is the same as the Offset F value **Modes**: **Values** SA: 22 kHz, 22 kHz, 22 kHz, 22 kHz, 22 kHz, 22 kHz WCDMA: 1 MHz, 1 MHz, 1 MHz, 1 MHz, 1 MHz, 1 MHz LTEAFDD, LTEATDD, 5G NR, MSR: 1 MHz, 1 MHz, 1 MHz, 1 MHz, 1 MHz, 1 MHz
State Saved	Saved in instrument state
Min/Max	1 Hz/50 MHz
Backwards Compatibility SCPI	`[:SENSe]:ACPower:OFFSet[1]|2:LIST:BWIDth:VIDeo`

Auto Function

Remote Command	`[:SENSe]:ACPower:OFFSet[1]|2[:OUTer]:LIST:BANDwidth:VIDeo:AUTO OFF | ON | 0 | 1,…` `[:SENSe]:ACPower:OFFSet[1]|2[:OUTer]:LIST:BANDwidth:VIDeo:AUTO?`
Example	`:ACP:OFFS2:LIST:BAND:VID:AUTO 0,0,0,0,1,1` `:ACP:OFFS2:LIST:BAND:VID:AUTO?`
Preset	When "Max Num of Offsets" on page 1000 is 12, the preset value of Offset G ~ L is ON `ON, ON, ON, ON, ON, ON`
State Saved	Yes
Backwards Compatibility SCPI	`[:SENSe]:ACPower:OFFSet[1]|2:LIST:BWIDth:VIDeo:AUTO`

Filter Type

Selects the type of bandwidth filter that is used.

Remote Command	`[:SENSe]:ACPower:OFFSet[1]|2[:OUTer]:LIST:BANDwidth:SHAPe GAUSsian	FLATtop,…` `[:SENSe]:ACPower:OFFSet[1]|2[:OUTer]:LIST:BANDwidth:SHAPe?`
Example	`:ACP:OFFS2:LIST:BAND:SHAP FLAT,GAUS,GAUS,GAUS,GAUS,GAUS` `:ACP:OFFS2:LIST:BAND:SHAP?`
Notes	Offset subopcode: 1 for BTS (Downlink), 2 for MS (Uplink). Default is BTS Some Modes do not support Offset subopcode 2. In those cases, commands with subopcode 2 are accepted without error but ignored
Dependencies	When "Res BW" on page 929 Mode for the offset is **Auto**, this cell is grayed out and disabled. Since **Res BW** Mode for the offset is preset to **Auto** on changing "Meas Method" on page 963 to RBW, FAST or Fast Power, this cell is grayed-out and disabled too. If the cell is pressed, an advisory message is generated. If the equivalent remote command is sent, a "Setting conflict" warning is generated
Preset	When "Max Num of Offsets" on page 1000 is 12, the preset value of Offset G ~ L is `GAUSsian GAUSsian, GAUSsian, GAUSsian, GAUSsian, GAUSsian, GAUSsian`
State Saved	Saved in instrument state
Range	`GAUSsian|FLATtop`
Backwards Compatibility SCPI	`[:SENSe]:ACPower:OFFSet[1]|2:LIST:BWIDth:SHAPe`

Filter BW

Selects a Gaussian filter based on its –3 dB (Normal) bandwidth or its –6 dB bandwidth.

Remote Command	`[:SENSe]:ACPower:OFFSet[1]|2[:OUTer]:LIST:BANDwidth:TYPE DB3	DB6,…` `[:SENSe]:ACPower:OFFSet[1]|2[:OUTer]:LIST:BANDwidth:TYPE?`
Example	`:ACP:OFFS2:LIST:BAND:TYPE DB3,DB3,DB3,DB3,DB3,DB3` `:ACP:OFFS2:LIST:BAND:TYPE?`
Notes	Offset subopcode: 1 for BTS (Downlink), 2 for MS (Uplink). Default is BTS Some Modes do not support Offset subopcode 2. In those cases, commands with subopcode 2 are accepted without error but ignored
Dependencies	When "RBW Filter Type" on page 933 is Flattop, or "Res BW" on page 929 Mode for the offset is **Auto**, this cell is grayed-out and disabled. Since **Res BW** Mode for the offset is preset to **Auto** on changing "Meas Method" on page 963 to RBW, FAST or Fast Power, this cell is grayed-out and disabled too. If the cell is pressed, an advisory message is generated. If the equivalent remote command is sent, a "Setting conflict" warning is generated
Preset	When "Max Num of Offsets" on page 1000 is 12, the preset value of Offset G ~ L is `DB3`

	DB3, DB3, DB3, DB3, DB3, DB3
State Saved	Saved in instrument state
Range	–3 dB (Normal)| –6 dB
Backwards Compatibility SCPI	[:SENSe]:ACPower:OFFSet[1]|2:LIST:BWIDth:TYPE

Limits

Lets you configure the limits that are used to determine whether the offset regions PASS or FAIL the limit test.

Limit Test

This checkbox is the same as "Limit Test" on page 1023 in the **Meas Setup, Settings** tab.

Offset Freq

This column is the same as "Offset Freq" on page 1014 in the **Offset** index tab.

Abs Limit

Specifies an absolute limit value, which sets the absolute amplitude levels to test against for each of the custom offsets. The list must contain 6 entries. If there is more than one offset, the offset closest to the carrier channel is the first one in the list. [:SENSe]:ACP:OFFSet[n][:OUTer]:LIST:TEST selects the type of testing to be done at each offset.

You can turn off (not use) specific offsets with the [:SENSe]:ACP:OFFSet[n][:OUTer]:LIST:STATe command.

The query returns the six (6) sets of real numbers that are the current absolute amplitude test limits.

Remote Command	[:SENSe]:ACPower:OFFSet[1]|2[:OUTer]:LIST:ABSolute < real>,… [:SENSe]:ACPower:OFFSet[1]|2[:OUTer]:LIST:ABSolute?
Example	:ACP:OFFS2:LIST:ABS -10,-10,-10,-10,-10,-10 :ACP:OFFS2:LIST:ABS?
Notes	Offset subopcode. 1 for BTS (Downlink), 2 for MS (Uplink). Default is BTS Some Modes do not support Offset subopcode 2. In those cases, commands with subopcode 2 are accepted without error but ignored
Preset	When "Max Num of Offsets" on page 1000 is 12, the preset value of Offset G ~ L is the same as the

	Offset F value **Modes** / **Values** SA: 0dBm, 0 dBm, 0 dBm, 0 dBm, 0 dBm, 0 dBm | 0dBm, 0 dBm, 0 dBm, 0 dBm, 0 dBm, 0 dBm WCDMA: 50 dBm, 50 dBm, 50 dBm, 50 dBm, 50 dBm, 50 dBm | 50 dBm, 50 dBm, 50 dBm, 50 dBm, 50 dBm, 50 dBm LTEAFDD, LTEATDD, MSR: -8.45, -8.45, -8.45, -8.45, -8.45, -8.45 | -50.0, -50.0, -50.0, -50.0, -50.0, -50.0 5G NR: 4.92, 4.92, 4.92, 4.92, 4.92, 4.92 | -50.0, -50.0, -50.0, -50.0, -50.0, -50.0
State Saved	Saved in instrument state
Min/Max	-200.0 dBm/50.0 dBm

Backwards Compatibility SCPI	`[:SENSe]:ACPR:OFFSet[1]|2:LIST:ABSolute`
	SA, W-CDMA
	`[:SENSe]:MCPower:OFFSet[1]|2:LIST:ABSolute`
	SA, W-CDMA

Rel Limit (Car)

Enters a relative limit value for the carrier level. This sets the amplitude levels to test against for the specified offsets.

The amplitude level is relative to the carrier amplitude. If multiple offsets are available, the list contains 6 entries. The offset closest to the carrier channel is the first one in the list.

`[:SENSe]:ACP:OFFSet[n][:OUTer]:LIST:TEST` selects the type of testing to be done at each offset.

You can turn off (not use) specific offsets with `[:SENSe]:ACP:OFFSet[n][:OUTer]:LIST:STATe`.

The query returns the 6 sets of real numbers that are the current amplitude test limits, relative to the carrier, for each offset.

Offset[n] n = 1 is base station and n = 2 is mobiles. The default is base station (1).

Remote Command	`[:SENSe]:ACPower:OFFSet[1]|2[:OUTer]:LIST:RCARrier <real>,…` `[:SENSe]:ACPower:OFFSet[1]|2[:OUTer]:LIST:RCARrier?`
Example	`:ACP:OFFS2:LIST:RCAR 0,0,0,0,0,0` `:ACP:OFFS2:LIST:RCAR?`
Notes	Offset subopcode. 1 for BTS (Downlink), 2 for MS (Uplink). Default is BTS Some Modes do not support Offset subopcode 2. In those cases, commands with subopcode 2 are accepted without error but ignored

Preset	When "Max Num of Offsets" on page 1000 is 12, the preset value of Offset G ~ L is the same as the Offset F value

Modes	Values
SA	-45, -60, 0, 0, 0, 0 | -45, -60, 0, 0, 0, 0
WCDMA	-44.2, -49.2, -49.2, -49.2, -49.2, -49.2 | -32.2, -42.2, -42.2, -42.2, -42.2, -42.2
LTEAFDD, LTEATDD, MSR	-44.2, -44.2, -44.2, -44.2, -44.2, -44.2 | -29.2, -29.2, -29.2, -29.2, -29.2, -29.2
5G NR	-43.8, -43.8, -43.8, -43.8, -43.8, -43.8 | -29.2, -29.2, -29.2, -29.2, -29.2, -29.2
Radio Test	-60, -60, -60, 0, 0, 0

State Saved	Saved in instrument state
Min/Max	-150/50.0
Backwards Compatibility SCPI	`[:SENSe]:MCPower:OFFSet[1]|2:LIST:RCARrier`

Positive Offset Limit (Remote Command only)

Enables you to set the upper limit for the upper segment of the specified offset pair.

Remote Command	`:CALCulate:ACPower:OFFSet[1]|2[:OUTer]:LIST:LIMit:POSitive[:UPPer]:DATA <real>,...` `:CALCulate:ACPower:OFFSet[1]|2[:OUTer]:LIST:LIMit:POSitive[:UPPer]:DATA?`
Example	`:CALC:ACP:OFFS:LIST:LIM:POS:DATA 0,0,0,0,0,0` `:CALC:ACP:OFFS:LIST:LIM:POS:DATA?`
Notes	Some Modes do not support Offset subopcode 2. In those cases, commands with subopcode 2 are accepted without error but ignored
Preset	When "Max Num of Offsets" on page 1000 is 12, the preset value of Offset G ~ L is the same as the Offset F value

Modes	Values
SA	-45, -60, 0, 0, 0, 0 | -45, -60, 0, 0, 0, 0
WCDMA	-44.2, -49.2, -49.2, -49.2, -49.2, -49.2 | -32.2, -42.2, -42.2, -42.2, -42.2, -42.2
LTEAFDD, LTEATDD, MSR	-44.2,-44.2,-44.2,-44.2,-44.2,-44.2 | -29.2, -29.2, -29.2, -29.2, -29.2, -29.2
5G NR	-43.8, -43.8, -43.8, -43.8, -43.8, -43.8 | -29.2, -29.2, -29.2, -29.2, -29.2, -29.2
Radio Test	-60, -60, -60, 0, 0, 0

State Saved	Saved in instrument state
Min/Max	-150.0/50.0
Backwards Compatibility SCPI	:CALCulate:MCPower:OFFSet:LIST:LIMit:POSitive[:UPPer]:DATA (Power Suite)

Negative Offset Limit(Remote Command only)

Enables you to set the upper limit for the lower segment of the specified offset pair.

Remote Command	:CALCulate:ACPower:OFFSet[1]|2[:OUTer]:LIST:LIMit:NEGative[:UPPer]:DATA <real>,... :CALCulate:ACPower:OFFSet[1]|2[:OUTer]:LIST:LIMit:NEGative[:UPPer]:DATA?
Example	:CALC:ACP:OFFS:LIST:LIM:NEG:DATA 0,0,0,0,0,0 :CALC:ACP:OFFS:LIST:LIM:NEG:DATA?
Notes	Some Modes do not support Offset subopcode 2. In those cases, commands with subopcode 2 are accepted without error but ignored
Preset	When "Max Num of Offsets" on page 1000 is 12, the preset value of Offset G ~ L is the same as the Offset F value

Modes	Values
SA	-45, -60, 0, 0, 0, 0 | -45, -60, 0, 0, 0, 0
WCDMA	-44.2, -49.2, -49.2, -49.2, -49.2, -49.2 | -32.2, -42.2, -42.2, -42.2, -42.2, -42.2
LTEAFDD, LTEATDD, MSR	-44.2, -44.2, -44.2, -44.2, -44.2, -44.2 | -29.2, -29.2, -29.2, -29.2, -29.2, -29.2
5G NR	-43.8, -43.8, -43.8, -43.8, -43.8, -43.8 | -29.2, -29.2, -29.2, -29.2, -29.2, -29.2
Radio Test	-60, -60, -60, 0, 0, 0

State Saved	Saved in instrument state
Min/Max	-150.0/50.0
Backwards Compatibility SCPI	:CALCulate:MCPower:OFFSet:LIST:LIMit:NEGative[:UPPer]:DATA (Power Suite, WCDMA)

Rel Limit (PSD)

Enters a relative limit value for the level of the power spectral density. This sets the amplitude levels to test against for any custom offsets. The amplitude level is relative to the power spectral density. If multiple offsets are available, the list contains 6 entries. The offset closest to the carrier channel is the first one in the list.

`[:SENSe]:ACP:OFFSet[n][:OUTer]:LIST:TEST` selects the type of testing to be done at each offset.

You can turn off (not use) specific offsets with `[:SENSe]:ACP:OFFSet[n][:OUTer]:LIST:STATe`.

The query returns the 6 sets of real numbers that are the current amplitude test limits, relative to the power spectral density, for each offset.

Offset[n] n = 1 is base station and n = 2 is mobiles. The default is base station (1).

Remote Command	`[:SENSe]:ACPower:OFFSet[1]|2[:OUTer]:LIST:RPSDensity <rel_ampl>,…` `[:SENSe]:ACPower:OFFSet[1]|2[:OUTer]:LIST:RPSDensity?`
Example	`:ACP:OFFS2:LIST:RPSD 10,10,10,10,10,10` `:ACP:OFFS2:LIST:RPSD?`
Notes	Offset subopcode. 1 for BTS (Downlink), 2 for MS (Uplink). Default is BTS Some Modes do not support Offset subopcode 2. In those cases, commands with subopcode 2 are accepted without error but ignored
Preset	When "Max Num of Offsets" on page 1000 is 12, the preset value of Offset G ~ L is the same as the Offset F value

Modes	Values
SA	-28.87 dB, -43.87 dB, 0 dB, 0 dB, 0 dB, 0 dB | -28.87 dB, -43.87 dB, 0 dB, 0 dB, 0 dB, 0 dB
WCDMA	-44.2 dB, -49.2 dB, -49.2 dB, -49.2 dB, -49.2 dB, -49.2 dB | -32.2 dB, -42.2 dB, -42.2 dB, -42.2 dB, -42.2 dB, -42.2 dB
LTEAFDD, LTEATDD, 5G NR, MSR	0, 0, 0, 0, 0, 0 | 0, 0, 0, 0, 0, 0
Radio Test	-60, -60, -60, 0, 0, 0

State Saved	Saved in instrument state
Min/Max	-150.0 dB/50.0 dB

Fail Mask

Accesses a menu that lets you select one of the logics for the fail conditions between the measurement results and the test limits. The setting defines the type of testing to be done at any custom offset frequencies. The measured powers are tested against the absolute values defined with `[:SENSe]:ACP:OFFSet[n][:OUTer]:LIST:ABSolute`, or the relative values defined with [:SENSe]:ACP:OFFSet[n][:OUTer]:LIST:RPSDensity and `[:SENSe]:ACP:OFFSet[n][:OUTer]:LIST:RCARrier`.

You can turn off (not use) specific offsets with `[:SENSe]:ACP:OFFSet[n][:OUTer]:LIST:STATe`.

Absolute	`ABSolute`	Fail is shown if one of the absolute ACP measurement results is larger than the limit for **Abs Limit**
Relative	`RELative`	Fail is shown if one of the relative ACP measurement results is larger than the limit for **Rel Lim (Car)** or **Rel Lim (PSD)**
Abs AND Rel	`AND`	Fail is shown if one of the absolute ACP measurement results is larger than the limit for **Abs Limit***and* one of the relative ACP measurement results is larger than the limit for **Rel Lim (Car)** or **Rel Lim (PSD)**
Abs OR Rel	`OR`	Fail is shown if one of the absolute ACP measurement results is larger than the limit for **Abs Limit***or* one of the relative ACP measurement results is larger than the limit for **Rel Lim (Car)** or **Rel Lim (PSD)**

Remote Command	`[:SENSe]:ACPower:OFFSet[1]|2[:OUTer]:LIST:TEST ABSolute | AND | OR | RELative,…` `[:SENSe]:ACPower:OFFSet[1]|2[:OUTer]:LIST:TEST?`
Example	`:ACP:OFFS2:LIST:TEST ABS,ABS,ABS,ABS,ABS,ABS` `:ACP:OFFS2:LIST:TEST?`
Notes	Offset subopcode: 1 for BTS (Downlink), 2 for MS (Uplink). Default is BTS Some Modes do not support Offset subopcode 2. In those cases, commands with subopcode 2 are accepted without error but ignored
Preset	When "Max Num of Offsets" on page 1000 is 12, the preset value of Offset G ~ L is the same as the Offset F value

Modes	Values
SA, WCDMA	`REL, REL, REL, REL, REL, REL | REL, REL, REL, REL, REL, REL`
LTEAFDD, LTEATDD, 5G NR, MSR	`AND, AND, AND, AND, AND, AND | AND, AND, AND, AND, AND, AND`
Radio Test	`REL, REL, REL, REL, REL, REL`

State Saved	Saved in instrument state
Range	`ABSolute|AND|OR|RELative`
Backwards Compatibility SCPI	`[:SENSe]:MCPower:OFFSet[1]|2:LIST:TEST`

Offset Frequency Define

Allows you to select “Offset” definition:

`CTOCenter`	From the lowermost carrier center frequency (for lower offset), the uppermost carrier center frequency (for upper offset) to the center frequency of each Offset Integ BW
`CTOEdge`	From the lowermost carrier center frequency (for lower offset), the uppermost carrier center frequency (for upper offset) to the closest edge frequency of each Offset Integ BW

ETOCenter	From the lowermost carrier center frequency - spacing of this carrier /2 (for lower offset), the uppermost carrier center frequency + spacing of this carrier /2 (for upper offset) to the center frequency of each Offset Integ BW
ETOEdge	From the lowermost carrier center frequency - spacing of this carrier /2 (for lower offset), the uppermost carrier center frequency + spacing of this carrier /2 (for upper offset) to the closest edge frequency of each Offset Integ BW
STOCenter	From either the lower or upper sub-block edge frequency to the center frequency of each Offset Integ BW
STOEdge	From either the lower or upper sub-block edge frequency to the closest edge frequency of each Offset Integ BW
SCTOCenter 5G NR only	From the center frequency of sub-block** to the center frequency of each Offset Integ BW

** sub-block (bandwidth) = $BW_{channel,block}$ which is defined in each 3GPP standard, regardless of "Measure Carrier" for the uppermost and the lowermost carriers being Enabled or Disabled. When the Number of Component Carrier within each sub-block = 1, sub-block (bandwidth) = $BW_{channel}$ = 2 x $F_{offset,RAT}$.

See "Diagram for Offset Freq Define" on page 1030

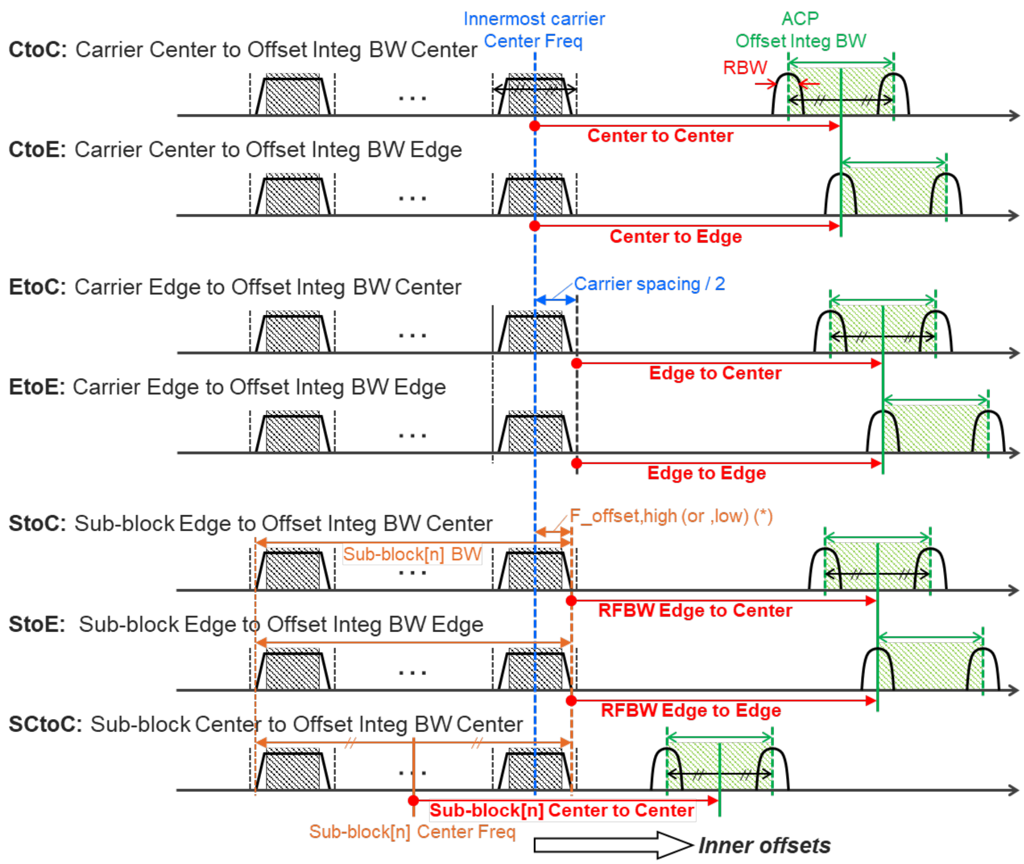
Mode: MSR, LTEAFDD, LTEATDD

Remote Command	`[:SENSe]:ACPower:OFFSet[1]|2:INNer:TYPE CTOCenter | CTOEdge | ETOCenter | ETOEdge | STOCenter | STOEdge` `[:SENSe]:ACPower:OFFSet[1]|2:INNer:TYPE?`
Example	`:ACP:OFFS:INN:TYPE ETOC` `:ACP:OFFS:INN:TYPE?`
Preset	`STOCenter`
State Saved	Saved in instrument state
Range	`CTOCenter|CTOEdge|ETOCenter|ETOEdge|STOCenter|STOEdge`

Mode: 5G NR

Remote Command	`[:SENSe]:ACPower:OFFSet[1]|2:INNer:TYPE CTOCenter | CTOEdge | ETOCenter | ETOEdge | STOCenter | STOEdge | SCTOCenter` `[:SENSe]:ACPower:OFFSet[1]|2:INNer:TYPE?`
Example	`:ACP:OFFS:INN:TYPE ETOC` `:ACP:OFFS:INN:TYPE?`
Preset	`STOCenter | CTOCenter`
State Saved	Saved in instrument state
Range	`CTOCenter | CTOEdge | ETOCenter | ETOEdge | STOCenter | STOEdge | SCTOCenter`

Diagram for Offset Freq Define



Note:

RF BW Edge and Outermost Carrier Edge are not always same.
e.g.) 5G NR (3GPP) defines BW_channel,CA which calculates F_offset,high and F_offset,low asymmetrically with SCS shift

(*) For MSR, F_offset,high (or ,low) = F_offset,RAT,high (or ,low)

Offset Freq

Determines the frequency difference between the center of the main channel and the center of the carrier. When set to Offset to Edge, this parameter determines the frequency difference between the center of the main channel and the near edge of the offset.

Each **Offset Freq** state value is entered individually by selecting the desired carrier. Use the **Enabled** checkbox to turn the **Offset Freq** State on or off.

The list contains up to 6 entries, depending on the mode selected, for offset frequencies. Each offset frequency in the list corresponds to a reference bandwidth in the bandwidth list.

An offset frequency of zero turns the display of the measurement for that offset off, but the measurement is still made and reported. You can turn off (not use) specific offsets with `[:SENSe]:ACP:OFFSet[n]:INNer:LIST:STATe`.

Turning the offset off has the same effect as setting the frequency of the offset to 0 Hz, and causes it to be removed from the results screen.

Remote Command	`[:SENSe]:ACPower:OFFSet[1]|2:INNer:LIST[:FREQuency] <freq>,…` `[:SENSe]:ACPower:OFFSet[1]|2:INNer:LIST[:FREQuency]?`
Example	`:ACP:OFFS1:INN:LIST 0,0,0,0,0,0` `:ACP:OFFS1:INN:LIST?`
Notes	When setting these values remotely, the position in the list sent corresponds to the offset. Missing values are not permitted, unless the number of values sent is greater than the number of carriers, then subsequent values are ignored Offset subopcode: 1 for BTS (Downlink), 2 for MS (Uplink). Default is BTS
Couplings	Changing Offset Frequency might affect "Span" on page 948
Preset	When "Max Num of Offsets" on page 1000 is 12, the preset value of Offset G ~ L is the same as the Offset F value
State Saved	Saved in instrument state
Min/Max	0 Hz/Depends on instrument maximum frequency. Same as Max Span of the Swept SA Measurement

Preset values:

Modes	Values
5G NR	10 MHz, 30 MHz, 0 Hz, 0 Hz, 0 Hz, 0 Hz | 100 MHz, 200 MHz, 0 Hz, 0 Hz, 0 Hz, 0 Hz
All Others	2.5MHz,7.5MHz,0,0,0,0 | 2.5MHz,7.5MHz,0,0,0,0

Auto Function

Remote Command	`[:SENSe]:ACPower:OFFSet[1]|2:INNer:LIST:STATe OFF | ON | 0 | 1,…` `[:SENSe]:ACPower:OFFSet[1]|2:INNer:LIST:STATe?`
Example	`:ACP:OFFS2:INN:LIST:STAT 1,1,0,0,0,0` `:ACP:OFFS2:INN:LIST:STAT?`
Preset	When "Max Num of Offsets" on page 1000 is 12, the preset value of Offset G ~ L is the same as the Offset F value `ON, ON, OFF, OFF, OFF, OFF | ON, OFF, OFF, OFF, OFF, OFF`
State Saved	Yes

Integ BW

Sets the Integration Bandwidth for the offsets. Each resolution bandwidth in the list corresponds to an offset frequency in the list defined by `[:SENSe]:ACP:OFFSet[n]:INNer:LIST[:FREQuency]`.

Enter each value individually by selecting the desired offset on the **Offset** menu key using the up down arrows, the knob, or the numeric keypad, then enter the Offset Integration Bandwidth using the **Offset Integration Bandwidth** menu key.

You can turn off (not use) specific offsets with `[:SENSe]:ACP:OFFSet[n]:INNer:LIST:STATe`.

Remote Command	`[:SENSe]:ACPower:OFFSet[1]|2:INNer:LIST:BANDwidth[:INTegration] <freq>,…` `[:SENSe]:ACPower:OFFSet[1]|2:INNer:LIST:BANDwidth[:INTegration]?`
Example	`:ACP:OFFS2:INN:LIST:BAND 2MHz,2MHz,2MHz,2MHz,2MHz,2MHz` `:ACP:OFFS2:INN:LIST:BAND?`
Notes	When setting these values remotely, the position in the list sent corresponds to the offset. Missing values are not permitted, so, if you want to change the second value you must send all values up to it. Subsequent values remain unchanged Offset subopcode. 1 for BTS (Downlink), 2 for MS (Uplink). Default is BTS
Couplings	Changing Integ BW might affect "Span" on page 948
Preset	When "Max Num of Offsets" on page 1000 is 12, the preset value of Offset G ~ L is the same as the Offset F value

Modes	Values
LTEAFDD	3.84MHz, 3.84MHz, 3.84MHz, 3.84MHz, 3.84MHz, 3.84MHz | 3.84MHz, 3.84MHz, 3.84MHz, 3.84MHz, 3.84MHz, 3.84MHz
MSR, LTEATDD	4.515MHz, 4.515MHz, 4.515MHz, 4.515MHz, 4.515MHz, 4.515MHz | 4.5MHz, 4.5MHz, 4.5MHz, 4.5MHz, 4.5MHz, 4.5MHz
5G NR	19.08 MHz, 19.08 MHz, 19.08 MHz, 19.08 MHz, 19.08 MHz, 19.08 MHz | 98.31 MHz, 98.31 MHz, 98.31 MHz, 98.31 MHz, 98.31 MHz, 98.31 MHz

State Saved	Saved in instrument state
Min/Max	10 Hz/Depends on instrument maximum frequency. Same as Max Span of the Swept SA Measurement

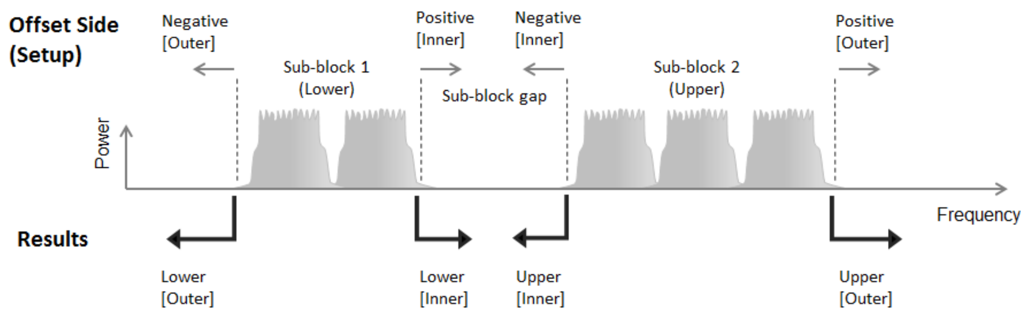
Offset Side

Lets you turn off (not use) specific offsets with `[:SENSe]:ACPower:OFFSet[1]|2:INNer:LIST:SIDE`.

- `NEGative` - The upper side in the sub-block gap only (that is, negative sideband of the upper sub-block) is enabled

- BOTH - Both sides in the sub-block gap are enabled
- POSitive - The lower side in the sub-block gap only (that is, positive sideband of the lower sub-block) is enabled

The diagram below shows the relation between the negative/positive offset side setups and the upper/lower results in the MSR, LTEAFDD and LTEATDD Modes.



Remote Command	[:SENSe]:ACPower:OFFSet[1]|2:INNer:LIST:SIDE NEGative | BOTH | POSitive, … [:SENSe]:ACPower:OFFSet[1]|2:INNer:LIST:SIDE?
Example	:ACP:OFFS:INN:LIST:SIDE BOTH :ACP:OFFS:INN:LIST:SIDE?
Notes	OFFSet1 is for BTS, 2 for MS. Default is BTS If you set POS or NEG in an offset, result of the inactive side returns -999
Preset	When "Max Num of Offsets" on page 1000 is 12, the preset value of Offset G ~ L is BOTH BOTH, BOTH, BOTH, BOTH, BOTH, BOTH | BOTH, BOTH, BOTH, BOTH, BOTH, BOTH
State Saved	Saved in instrument state
Range	NEGative|BOTH|POSitive

Method

Lets you turn RRC filtering of each offset on or off. The value (roll off) for the filter is set to the value of the Filter Alpha parameter.

Remote Command	[:SENSe]:ACPower:OFFSet[1]|2:INNer:LIST:FILTer[:RRC][:STATe] ON | OFF | 1 | 0,… [:SENSe]:ACPower:OFFSet[1]|2:INNer:LIST:FILTer[:RRC][:STATe]?
Example	:ACP:OFFS:INN:LIST:FILT 1,0,0 :ACP:OFFS:INN:LIST:FILT?
Notes	1|ON = RRC Weighted, 0|OFF = Integ BW
Preset	When "Max Num of Offsets" on page 1000 is 12, the preset value of Offset G ~ L is the same as the Offset F value

	<table><tr><th>Modes</th><th>Values</th></tr><tr><td>LTEAFDD</td><td>1,1,1,1,1,1 | 1,1,1,1,1,1</td></tr><tr><td>MSR, LTEATDD, 5G NR</td><td>0,0,0,0,0,0 | 0,0,0,0,0,0</td></tr></table>
State Saved	Saved in instrument state
Range	Integ BW | RRC Weighted

Filter Alpha

Sets the alpha value for the RRC Filter for each offset.

Remote Command	`[:SENSe]:ACPower:OFFSet[1]|2:INNer:LIST:FILTer:ALPHa <real>,…` `[:SENSe]:ACPower:OFFSet[1]|2:INNer:LIST:FILTer:ALPHa?`
Example	`:ACP:OFFS:INN:LIST:FILT:ALPH 0.5,0.5,0.5,0.5,0.5,0.5` `:ACP:OFFS:INN:LIST:FILT:ALPH?`
Preset	When "Max Num of Offsets" on page 1000 is 12, the preset value of Offset G ~ L is 0.22 0.22,0.22,0.22,0.22,0.22,0.22|0.22,0.22,0.22,0.22,0.22,0.22
State Saved	Saved in instrument state
Min/Max	0.01/1.00

Offset Freq

The same as "Offset Freq" on page 1030 in the main **Inner Offset** menu.

Res BW

Sets the Resolution Bandwidth. If an unavailable bandwidth is entered with the numeric keypad, the closest available bandwidth is selected.

Remote Command	`[:SENSe]:ACPower:OFFSet[1]|2:INNer:LIST:BANDwidth:RESolution <freq>,…` `[:SENSe]:ACPower:OFFSet[1]|2:INNer:LIST:BANDwidth:RESolution?`
Example	`:ACP:OFFS2:INN:LIST:BAND:RES 220kHz,220kHz,220kHz,220kHz,220kHz,220kHz` `:ACP:OFFS2:INN:LIST:BAND:RES?`
Notes	Offset subopcode. 1 for BTS (Downlink), 2 for MS (Uplink). Default is BTS
Dependencies	When "Meas Method" on page 963 is RBW, FAST or Fast Power, this control is grayed-out and disabled. If the cell is pressed, an advisory message is generated. If the equivalent SCPI remote command is sent, a "Setting conflict" warning is generated
Couplings	When "Res BW" on page 929 Mode is **Auto**, this value is exactly the same as **Res BW**. When you change this value, **Res BW** Mode also changes to **Man**
Preset	When "Max Num of Offsets" on page 1000 is 12, the preset value of Offset G ~ L is 100 kHz

	100 kHz, 100 kHz, 100k Hz, 100 kHz | 100 kHz,100 kHz, 100 kHz,100 kHz, 100 kHz, 100 kHz
State Saved	Saved in instrument state
Min/Max	1 Hz/8 MHz

Auto Function

Remote Command	`[:SENSe]:ACPower:OFFSet[1]|2:INNer:LIST:BANDwidth:RESolution:AUTO ON | OFF | 1 | 0,…` `[:SENSe]:ACPower:OFFSet[1]|2:INNer:LIST:BANDwidth:RESolution:AUTO?`
Example	`:ACP:OFFS2:INN:LIST:BAND:RES:AUTO 1,1,1,1,1,1` `:ACP:OFFS2:INN:LIST:BAND:RES:AUTO?`
Preset	When "Max Num of Offsets" on page 1000 is 12, the preset value of Offset G ~ L is 1 1, 1, 1, 1, 1, 1
State Saved	Yes

Video BW

Lets you change the instrument post-detection filter (VBW).

Remote Command	`[:SENSe]:ACPower:OFFSet[1]|2:INNer:LIST:BANDwidth:VIDeo <freq>,…` `[:SENSe]:ACPower:OFFSet[1]|2:INNer:LIST:BANDwidth:VIDeo?`
Example	`:ACP:OFFS2:INN:LIST:BAND:VID 5MHz,5MHz,5MHz,5MHz,5MHz,5MHz` `:ACP:OFFS2:INN:LIST:BAND:VID?`
Notes	The values shown in this table reflect the conditions after **Mode Preset** Offset subopcode: 1 for BTS (Downlink), 2 for MS (Uplink). Default is BTS
Dependencies	When "Meas Method" on page 963 is RBW, FAST or Fast Power, this cell is grayed-out and disabled. If the cell is pressed, an advisory message is generated. If the equivalent remote command is sent, a "Setting conflict" warning is generated
Preset	When "Max Num of Offsets" on page 1000 is 12, the preset value of Offset G ~ L is 1 MHz 1 MHz, 1 MHz, 1 MHz, 1 MHz, 1 MHz, 1 MHz
State Saved	Yes
Min/Max	1 Hz/50 MHz

Auto Function

Remote Command	`[:SENSe]:ACPower:OFFSet[1]|2:INNer:LIST:BANDwidth:VIDeo:AUTO OFF | ON | 0 | 1,…` `[:SENSe]:ACPower:OFFSet[1]|2:INNer:LIST:BANDwidth:VIDeo:AUTO?`
Example	`:ACP:OFFS2:INN:LIST:BAND:VID:AUTO 0,0,0,0,1,1` `:ACP:OFFS2:INN:LIST:BAND:VID:AUTO?`
Preset	When "Max Num of Offsets" on page 1000 is 12, the preset value of Offset G ~ L is ON

	ON, ON, ON, ON, ON, ON
State Saved	Yes

Filter Type

Selects the type of bandwidth filter that is used.

Remote Command	[:SENSe]:ACPower:OFFSet[1]|2:INNer:LIST:BANDwidth:SHAPe GAUSsian | FLATtop,… [:SENSe]:ACPower:OFFSet[1]|2:INNer:LIST:BANDwidth:SHAPe?
Example	:ACP:OFFS2:INN:LIST:BAND:SHAP FLAT,GAUS,GAUS,GAUS,GAUS,GAUS :ACP:OFFS2:INN:LIST:BAND:SHAP?
Notes	Offset subopcode: 1 for BTS (Downlink), 2 for MS (Uplink)
Dependencies	When "Res BW" on page 929 Mode for the offset is **Auto**, this cell is grayed-out and disabled. Since **Res BW** Mode for the offset is preset to **Auto** on changing "Meas Method" on page 963 to RBW, FAST or Fast Power, this cell is grayed-out and disabled. If the cell is pressed, an advisory message is generated. If the equivalent remote command is sent, a "Setting conflict" warning is generated
Preset	When "Max Num of Offsets" on page 1000 is 12, the preset value of Offset G ~ L is GAUSsian GAUSsian, GAUSsian, GAUSsian, GAUSsian, GAUSsian, GAUSsian
State Saved	Saved in instrument state
Range	GAUSsian|FLATtop

Filter BW

Selects a Gaussian filter based on its –3 dB (Normal) bandwidth or its –6 dB bandwidth.

Remote Command	[:SENSe]:ACPower:OFFSet[1]|2:INNer:LIST:BANDwidth:TYPE DB3 | DB6,… [:SENSe]:ACPower:OFFSet[1]|2:INNer:LIST:BANDwidth:TYPE?
Example	:ACP:OFFS2:INN:LIST:BAND:TYPE DB3,DB3,DB3,DB3,DB3,DB3 :ACP:OFFS2:INN:LIST:BAND:TYPE?
Notes	Offset subopcode: 1 for BTS (Downlink), 2 for MS (Uplink)
Dependencies	When "RBW Filter Type" on page 933 is FLATtop or "Res BW" on page 929 Mode for the offset is **Auto**, this cell is grayed-out and disabled. Since **Res BW** Mode for the offset is preset to **Auto** on changing "Meas Method" on page 963 to RBW, FAST or Fast Power, this cell is also grayed-out and disabled. If the cell is pressed, an advisory message is generated. If the equivalent remote command is sent, a "Setting conflict" warning is generated
Preset	When "Max Num of Offsets" on page 1000 is 12, the preset value of Offset G ~ L is DB3 DB3, DB3, DB3, DB3, DB3, DB3
State Saved	Saved in instrument state
Range	–3 dB (Normal)| –6 dB

Power Ref Type

Lets you set reference types of inner offsets.

`CUMulative`	Cumulated power of the upper and lower sub-block carriers is the reference level. This selection is effective only when one of the following "Power Ref" on page 1045 values is selected:

Left & Right Carriers	`LRCarriers`
Max Power Carrier in Sub-block	`MPCSubblock`
Min Power Carrier in Sub-block	`MINSubbloc`
Left & Right Sub-blocks	`LRSubblocks`
Manual	`MANual`

When one of the other **Power Ref** values is selected, carrier powers are not cumulated, and the reference level is equivalent to Normal

`NORMal`	Power of specified carrier or the manual reference level is the reference level

Remote Command	`[:SENSe]:ACPower:OFFSet[1]|2:INNer:LIST:PREFerence CUMulative | NORMal, …` `[:SENSe]:ACPower:OFFSet[1]|2:INNer:LIST:PREFerence?`
Example	`:ACP:OFFS:INN:LIST:PREF CUM,CUM,NORM,NORM,NORM,NORM` `:ACP:OFFS:INN:LIST:PREF?`
Preset	When "Max Num of Offsets" on page 1000 is 12, the preset value of Offset G ~ L is `NORMal` `NORMal, NORMal, NORMal, NORMal, NORMal, NORMal`
State Saved	Saved in instrument state
Range	`CUMulative|NORMal`

Auto Function

Remote Command	`[:SENSe]:ACPower:OFFSet[1]|2:INNer:LIST:PREFerence:AUTO OFF | ON | 0 | 1, …` `[:SENSe]:ACPower:OFFSet[1] | 2:INNer:LIST:PREFerence:AUTO?`
Example	`:ACP:OFFS:INN:LIST:PREF:AUTO OFF,OFF,OFF,OFF,OFF,OFF` `:ACP:OFFS:INN:LIST:PREF:AUTO?`
Dependencies	Available only in LTEAFDD, LTEATDD and 5G NR Modes
Couplings	When in the LTEAFDD, LTEATDD Modes, the inner power ref type is set automatically when the power ref type state is auto according to the scopes of the sub-block gap in the following table

Sub-block Gap	Inner ACP offset	Power Ref Type
Wgap <5MHz	1st (2.5MHz)	Normal
	2nd (7.5MHz)	Normal

Sub-block Gap	Inner ACP offset	Power Ref Type
5MHz≤ Wgap <10MHz	1st (2.5MHz)	Cumulative
	2nd (7.5MHz)	Normal
10MHz≤ Wgap <15MHz	1st (2.5MHz)	Cumulative
	2nd (7.5MHz)	Cumulative
15MHz≤ Wgap <20MHz	1st (2.5MHz)	Normal
	2nd (7.5MHz)	Cumulative
20MHz≤ Wgap	1st (2.5MHz)	Normal
	2nd (7.5MHz)	Normal

When in 5G NR Mode, Power Ref Type “Auto” sets the power reference type of inner-ACLR offset automatically

Downlink: “Cumulative” or “Normal” is selected accordingly when the inner-offsets are configured to meet the test requirements as follows:

FR1, 3GPP TS 38.141-1 v16.5.0 (2020-09) Section 6.6.3.5.3 BS type 1-C:

- Table 6.6.3.5.2-3: Base Station ACLR limit in non-contiguous spectrum or multiple bands
- Table 6.6.3.5.2-4: Base station CACLR limit

FR2, 3GPP TS 38.141-2 v16.5.0 (2020-09) Section 6.7.3.5.3 BS type 2-O:

- Table 6.7.3.5.2-3: BS type 2-O ACLR limit in non-contiguous spectrum
- Table 6.7.3.5.2-4: BS type 2-O CACLR limit in non-contiguous spectrum

Uplink: “Normal” is always selected

Preset	When "Max Num of Offsets" on page 1000 is 12, the preset value of Offset G ~ L is the same as the Offset F value `ON, ON, ON, ON, ON, ON | OFF, OFF, OFF, OFF, OFF, OFF`
State Saved	Saved in instrument state
Range	`Auto|Man`

Limit Test

This checkbox is the same as "Limit Test" on page 1023 in the **Settings** tab.

Offset Freq

This column is the same as "Offset Freq" on page 1030 in the **Offset** tab.

Abs Limit

Specifies an absolute limit value, which sets the absolute amplitude levels to test against for each of the custom offsets. The list must contain 6 entries. If there is more than one offset, the offset closest to the carrier channel is the first one in the list. `[:SENSe]:ACP:OFFSet[n]:INNer:LIST:TEST` selects the type of testing to be done at each offset.

You can turn off (not use) specific offsets with `[:SENSe]:ACP:OFFSet[n]:INNer:LIST:STATe`.

The query returns the 6 sets of real numbers that are the current absolute amplitude test limits.

Remote Command	`[:SENSe]:ACPower:OFFSet[1]|2:INNer:LIST:ABSolute < real>,…` `[:SENSe]:ACPower:OFFSet[1]|2:INNer:LIST:ABSolute?`
Example	`:ACP:OFFS2:INN:LIST:ABS -10,-10,-10,-10,-10,-10` `:ACP:OFFS2:INN:LIST:ABS?`
Notes	Offset subopcode. 1 for BTS (Downlink), 2 for MS (Uplink). Default is BTS
Preset	When "Max Num of Offsets" on page 1000 is 12, the preset value of Offset G ~ L is the same as the Offset F value
State Saved	Saved in instrument state
Min/Max	-200.0 dBm/50.0 dBm

Preset values:

Modes	Values
5G NR	-2.2, -2.2, -2.2, -2.2, -2.2, -2.2 | -50.0,-50.0,-50.0,-50.0,-50.0,-50.0
All Others	-8.45,-8.45,-8.45,-8.45,-8.45,-8.45 | -50.0,-50.0,-50.0,-50.0,-50.0,-50.0

Rel Limit (Car)

Specifies a relative limit value for the carrier level. This sets the amplitude levels to test against for the specified offsets.

The amplitude level is relative to the carrier amplitude. If multiple offsets are available, the list contains 6 entries. The offset closest to the carrier channel is the first one in the list. `[:SENSe]:ACP:OFFSet[n]:INNer:LIST:TEST` selects the type of testing to be done at each offset.

You can turn off (not use) specific offsets with `[:SENSe]:ACP:OFFSet[n]:INNer:LIST:STATe`.

The query returns the 6 sets of real numbers that are the current amplitude test limits, relative to the carrier, for each offset.

Offset[n] n = 1 is base station and n = 2 is mobiles. The default is base station (1).

Remote Command	`[:SENSe]:ACPower:OFFSet[1]|2:INNer:LIST:RCARrier <real>,…` `[:SENSe]:ACPower:OFFSet[1]|2:INNer:LIST:RCARrier?`
Example	`:ACP:OFFS2:INN:LIST:RCAR 0,0,0,0,0,0` `:ACP:OFFS2:INN:LIST:RCAR?`
Notes	Offset subopcode. 1 for BTS (Downlink), 2 for MS (Uplink). Default is BTS
Preset	When "Max Num of Offsets" on page 1000 is 12, the preset value of Offset G ~ L is the same as the Offset F value **Modes** / **Values** 5G NR: -43.8, -43.8, 43.8, -43.8, -43.8, -43.8 | -29.2, -29.2, -29.2, -29.2, -29.2, -29.2 All Others: -44.2, -44.2,-44.2,-44.2,-44.2,-44.2 | -29.2, -29.2, -29.2, -29.2, -29.2, -29.2
State Saved	Saved in instrument state
Min/Max	-150/50.0

Rel Limit (PSD)

Specifies a relative limit value for the level of the power spectral density. This sets the amplitude levels to test against for any custom offsets. The amplitude level is relative to the power spectral density. If multiple offsets are available, the list contains 6 entries. The offset closest to the carrier channel is the first one in the list.

`[:SENSe]:ACP:OFFSet[n]:INNer:LIST:TEST` selects the type of testing to be done at each offset.

You can turn off (not use) specific offsets with `[:SENSe]:ACP:OFFSet[n]:INNer:LIST:STATe`.

The query returns the 6 sets of real numbers that are the current amplitude test limits, relative to the power spectral density, for each offset.

Offset[n] n = 1 is base station and n = 2 is mobiles. The default is base station (1).

Remote Command	`[:SENSe]:ACPower:OFFSet[1]|2:INNer:LIST:RPSDensity <rel_ampl>,…` `[:SENSe]:ACPower:OFFSet[1]|2:INNer:LIST:RPSDensity?`
Example	`:ACP:OFFS2:INN:LIST:RPSD 10,10,10,10,10,10` `:ACP:OFFS2:INN:LIST:RPSD?`
Notes	Offset subopcode: 1 for BTS (Downlink), 2 for MS (Uplink). Default is BTS
Preset	When "Max Num of Offsets" on page 1000 is 12, the preset value of Offset G ~ L is 0 0, 0, 0, 0, 0, 0 | 0, 0, 0, 0, 0, 0
State Saved	Saved in instrument state
Min/Max	-150.0 dB/50.0 dB

Fail Mask

Accesses a menu that enables you to select one of the logics for the fail conditions between the measurement results and the test limits. The setting defines the type of testing to be done at any custom offset frequencies. The measured powers are tested against the absolute values defined with `[:SENSe]:ACP:OFFSet[n]:INNer:LIST:ABSolute`, or the relative values defined with `[:SENSe]:ACP:OFFSet[n]:INNer:LIST:RPSDensity` and `[:SENSe]:ACP:OFFSet[n]:INNer:LIST:RCARrier`.

You can turn off (not use) specific offsets with `[:SENSe]:ACP:OFFSet[n]:INNer:LIST:STATe`.

Option	SCPI	Description
Absolute	`ABSolute`	Fail is shown if one of the absolute ACP measurement results is larger than the limit for Abs Limit
Relative	`RELative`	Fail is shown if one of the relative ACP measurement results is larger than the limit for Rel Lim (Car) or Rel Lim (PSD)
Abs AND Rel	`AND`	Fail is shown if one of the absolute ACP measurement results is larger than the limit for Abs Limit *and* one of the relative ACP measurement results is larger than the limit for Rel Lim (Car) or Rel Lim (PSD)
Abs OR Rel	`OR`	Fail is shown if one of the absolute ACP measurement results is larger than the limit for Abs Limit *or* one of the relative ACP measurement results is larger than the limit for Rel Lim (Car) or Rel Lim (PSD)

Remote Command	`[:SENSe]:ACPower:OFFSet[1]|2:INNer:LIST:TEST ABSolute | AND | OR | RELative,…` `[:SENSe]:ACPower:OFFSet[1]|2:INNer:LIST:TEST?`
Example	`:ACP:OFFS2:INN:LIST:TEST ABS,ABS,ABS,ABS,ABS,ABS` `:ACP:OFFS2:INN:LIST:TEST?`
Notes	Offset subopcode: 1 for BTS (Downlink), 2 for MS (Uplink). Default is BTS
Preset	When "Max Num of Offsets" on page 1000 is 12, the preset value of Offset G ~ L is `AND` `AND, AND, AND, AND, AND, AND | AND, AND, AND, AND, AND, AND`
State Saved	Saved in instrument state
Range	`ABSolute|AND|OR|RELative`

Reference Carrier (Carrier Index)

Sets the reference carrier. Relative power measurements are made from the reference carrier.

If set to **Auto**, the measurement selects the carrier with the highest power as the reference carrier and the Ref Carrier parameter is updated. If a value is entered when Ref Carrier Mode is set to **Auto**, the mode changes to **Man**.

If set to **Man**, the value that you enter for the Ref Carrier is used as the reference carrier.

In MSR, LTEAFDD, LTEATDD and 5G NR Modes, this control is called **Carrier Index** and has a different SCPI command. In these Modes, it sets the carrier index of the reference power. The power of the carrier selected by this index becomes reference power when "Power Ref" on page 1045 is **Carrier Index**. Any value up to the MAX can be set, though the measurement only deals with number of carriers specified by Carrier. If the index is larger than Carrier, reference power in this measurement becomes `NaN` and therefore all relative power results are `NaN`.

For more information, see "Carrier Index (Modes: MSR, LTEAFDD, LTEATDD, and 5GNR)" on page 1043.

Remote Command	`[:SENSe]:ACPower:CARRier[1]|2:RCARrier <integer>` `[:SENSe]:ACPower:CARRier[1]|2:RCARrier?`
Example	`:ACP:CARR:RCAR 1` `:ACP:CARR:RCAR?`
Notes	Carrier subopcode: 1 for BTS (Downlink), 2 for MS (Uplink). Default is BTS Note that Carrier subopcode 2 is not supported in some Modes. In those cases, Carrier subopcode 1 is used for both BTS and MS and commands with subopcode 2 are accepted without error but ignored For LTEAFDD and LTEATDD Modes, this control is not shown. In order to maintain backwards compatibility with legacy LTE FDD/TDD Modes, the SCPI command is supported in the LTE & LTE-A converged applications
Dependencies	Grayed-out if there is only one carrier Does not appear in MSR, LTEAFDD, LTEATDD and 5G NR Modes
Couplings	If you enter a carrier value that is currently configured as having no power present, that carrier changes to having power present
Preset	Auto determined
State Saved	Saved in instrument state
Min/Max	1/Number of available carriers
Backwards Compatibility SCPI	`[:SENSe]:MCPower:RCARrier[1]|2`

Auto Function

Remote Command	`[:SENSe]:ACPower:CARRier[1]|2:RCARrier:AUTO OFF | ON | 0 | 1` `[:SENSe]:ACPower:CARRier[1]|2:RCARrier:AUTO?`
Example	`:ACP:CARR:RCAR:AUTO OFF` `:ACP:CARR:RCAR:AUTO?`

Couplings	If you enter a ref carrier this parameter will be set to manual
Preset	1
State Saved	Yes
Range	Auto | Man
Backwards Compatibility SCPI	`[:SENSe]:MCPower:RCARrier[1]|2:AUTO` (Power Suite)

Carrier Index (Modes: MSR, LTEAFDD, LTEATDD, and 5GNR)

Remote Command	`[:SENSe]:ACPower:CARRier[1]|2:INDex <integer>` `[:SENSe]:ACPower:CARRier[1]|2:INDex?`
Example	`:ACP:CARR:IND 1` `:ACP:CARR:IND?`
Notes	Carrier subopcode: 1 for BTS (Downlink), 2 for MS (Uplink). Default is BTS Note that Carrier subopcode 2 is not supported in some Modes. In those cases, Carrier subopcode 1 is used for both BTS and MS and commands with subopcode 2 are accepted without error but ignored
Dependencies	Only appears in MSR, LTEAFDD, LTEATDD and 5G NR Modes
Preset	1
State Saved	Saved in instrument state
Min/Max	LTEAFDD, LTEATDD: 1/Dependent on Num Component Carriers 5G NR: 1/Dependent on Num Component Carriers MSR: 1/100

Carrier Index Zero Base (Remote Command Only)

Remote Command	`[:SENSe]:ACPower:CARRier[1]|2:RCARrier:ZBASe <integer>` `[:SENSe]:ACPower:CARRier[1]|2:RCARrier:ZBASe?`
Example	`:ACP:CARR:RCAR:ZBAS 1` `:ACP:CARR:RCAR:ZBAS?`
Notes	Carrier subopcode: 1 for BTS (Downlink), 2 for MS (Uplink). Default is BTS Note that Carrier subopcode 2 is not supported in some Modes. In those cases, Carrier subopcode 1 is used for both BTS and MS and commands with subopcode 2 are accepted without error but ignored
Dependencies	Not available in multicarrier applications (MSR, 5GNR, LTE Modes)
Couplings	Coupled with: `[:SENSe]:ACPower:CARRier[1]|2:RCARrier <integer>`
Preset	0

State Saved	Saved in instrument state
Min	0
Max	9

Ref Carrier Freq

Sets the reference carrier frequency.

Remote Command	`[:SENSe]:ACPower:CARRier[1]|2:RCFRequency <freq>` `[:SENSe]:ACPower:CARRier[1]|2:RCFRequency?`
Example	`:ACP:CARR:RCFR 250 MHz` `:ACP:CARR:RCFR?`
Notes	Carrier subopcode: 1 for BTS (Downlink), 2 for MS (Uplink). Default is BTS Note that Carrier subopcode 2 is not supported in some Modes. In those cases, Carrier subopcode 1 is used for both BTS and MS and commands with subopcode 2 are accepted without error but ignored For LTEAFDD and LTEATDD Modes, this control is not shown. In order to maintain backwards compatibility with legacy LTE FDD/TDD Modes, the SCPI command is supported in the LTE & LTE-A converged applications
Dependencies	Does not appear in MSR, LTEAFDD, LTEATDD and 5G NR Modes
Couplings	LTEAFDD and LTEATDD Modes do not support the following couplings Coupled to **Center Frequency** If the center frequency changes, **Ref Carrier Freq** is calculated using the following three steps; 1. Ref Freq1 = Ctr Freq - (Total of all Carrier Widths / 2) 2. Ref Freq2 = Ref Freq1 + (Total of all Carrier Widths up to Ref Carrier) 3. Ref Freq = Ref Freq2 + (0.5 * Carrier Width of Ref Carrier) If **Ref Carrier Freq** changes, **Center Frequency** is calculated using the following three steps; 1. Ctr Freq1 = Ref Freq - (0.5 * Carrier Width of Ref Carrier) 2. Ctr Freq2 = Ctr Freq1 - (Total of all Carrier Widths up to Ref Carrier) 3. Ctr Freq = Ctr Freq2 + (Total of all Carrier Widths / 2) This ensures that the carriers are always centered on the screen If there is only one carrier present, **Ref Carrier Freq** is the same as **Center Frequency**
Preset	Calculated based on the current **Center Frequency**
State Saved	Saved in instrument state
Min/Max	-79.999995 MHz/Hardware Dependent:
Backwards Compatibility SCPI	`[:SENSe]:MCPower:RCFRequency[1]|2 (Power Suite)`

Auto Function

Remote Command	[:SENSe]:ACPower:CARRier[1]|2:RCFRequency:AUTO OFF | ON | 0 | 1 [:SENSe]:ACPower:CARRier[1]|2:RCFRequency:AUTO?
Example	:ACP:CARR:RCFR:AUTO OFF :ACP:CARR:RCFR:AUTO?
Preset	ON
State Saved	Yes
Range	Auto | Man
Backwards Compatibility SCPI	[:SENSe]:MCPower:RCFRequency[1]|2:AUTO

Measurement Type

Changes the reference used for the measurement. This allows you to make absolute and relative power measurements of either total power or the power normalized to the measurement bandwidth.

- Total Pwr Ref (TPRef) sets the reference to the total carrier power
- PSD Ref (PSDRef) sets the reference to the power spectral density of the carrier

Remote Command	[:SENSe]:ACPower:TYPE TPRef | PSDRef [:SENSe]:ACPower:TYPE?
Example	:ACP:TYPE PSDR :ACP:TYPE?
Preset	TPRef
State Saved	Saved in instrument state
Range	Total Power Ref | PSD Ref

Power Ref

Selects the power reference type. This control has two different forms, depending on the currently-selected Mode:

- "Power Ref (Modes: SA, WCDMA, VMA, SRComms)" on page 1046
- "Power Ref (Modes: LTEAFDD, LTEATDD, 5G NR, MSR)" on page 1046

Power Ref (Modes: SA, WCDMA, VMA, SRComms)

Type	Option	Description
Ref Carrier	RCARrier	Power of the specified carrier is the reference of measurement. Use the Reference Carrier control to select Carrier Index
Manual Power	MANual	Power or PSD specified by the user is the reference of measurement
Total Multicarriers	TMCarriers	Total Power of multi carriers is the power reference of measurement. Each carrier power is calculated with its own carrier configuration settings

Remote Command	`[:SENSe]:ACPower:CARRier[1]|2:PREFerence:TYPE RCARrier | MANual | TMCarriers` `[:SENSe]:ACPower:CARRier[1]|2:PREFerence:TYPE?`
Example	`:ACP:CARR:PREF:TYPE RCARrier` `:ACP:CARR:PREF:TYPE?`
Notes	Available only in SA, WCDMA, VMA and Short-Range Comms Modes Carrier subopcode: 1 for BTS (Downlink), 2 for MS (Uplink). Default is BTS Note that Carrier subopcode 2 is not supported in some Modes. In those cases, Carrier subopcode 1 is used for both BTS and MS and commands with subopcode 2 are accepted without error but ignored
Preset	RCARrier
State Saved	Saved in instrument state
Range	RCARrier|MANual|TMCarriers

Power Ref (Modes: LTEAFDD, LTEATDD, 5G NR, MSR)

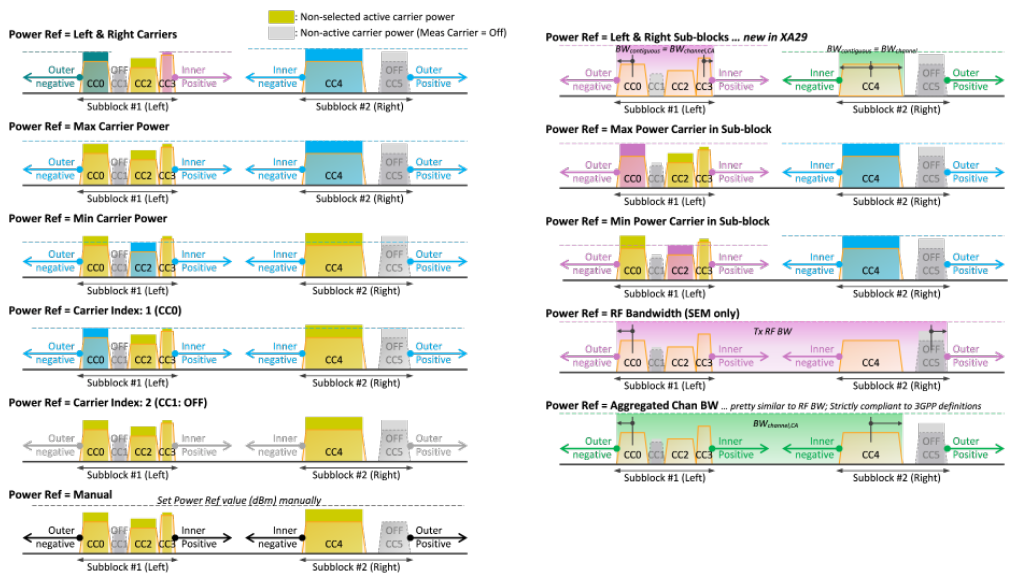
Selects the power reference type:

Type	Option	Description
Left & Right Carriers	LRCarriers	Powers of leftmost and rightmost carriers with Measure Carrier On in a sub-block are the references of left and right sides respectively. Left and right carriers are determined based on the carrier center frequencies. If Measure Carriers of all the carriers in a sub-block are off, the reference power in a sub-block and all the relative power results are NaN. Relative limits are not evaluated
Max Power Carrier	MPCarrier	Maximum carrier power among the carriers of Measure Carrier On is the reference of measurement. If Measure Carriers of all the carriers are off, the reference power and all the relative power results are NAN. Relative limits are not evaluated
Min Power Carrier 5G NR only	MINPcarrier	Minimum carrier power among the carriers of Measure Carrier On is the reference of measurement. If Measure Carriers of all the carriers are off, the reference power and all the relative power results are NAN. Relative limits are not evaluated

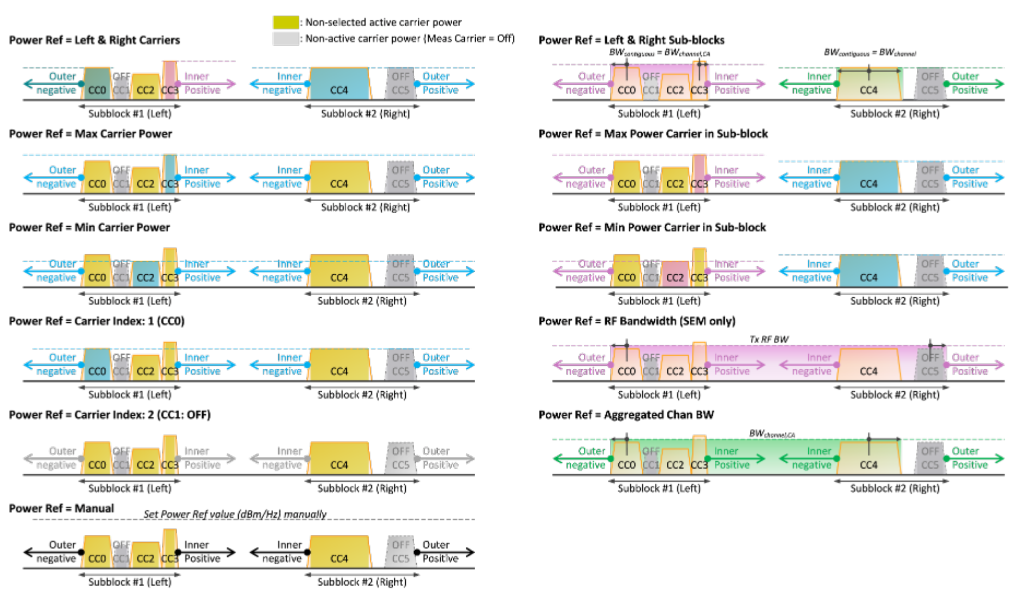
Type	Option	Description
Carrier Index	CINDex	Power of the specified carrier is the reference of measurement. If Measure Carriers of this carrier index is off, the reference power and all the relative power results are NAN. Relative limits are not evaluated
Manual	MANual	Power or PSD specified by the user is the reference of measurement
Aggregated Chan BW LTEAFDD, LTEATDD, 5G NR only	ACBandwidth	The assigned aggregated channel bandwidth power which is measured with a rectangular filter with measurement bandwidth specified as aggregated channel bandwidth based on the definition of each 3GPP standard. Calculated from the carrier configuration including SCS (Power Meas), the smallest SCS among the enabled SCSs of the selected component carrier. If Measure Carriers of all the carriers are off, the reference power and all the relative power results are NAN. Relative limits are not evaluated
Max Power Carrier in Sub-block	MPCSubblock	Maximum carrier power among the sub-block carriers of Measure Carrier On is the reference of measurement. If Measure Carriers of all the carriers in a sub-block are off, the reference power of the sub-block and all the relative power results referring to this sub-block are NAN, and these relative limits are not evaluated
Total Multicarriers MSR only	TMCarriers	Total power of multi carriers is the power reference of measurement. Each carrier power is calculated with its own carrier configuration settings
Min Power Carrier in Sub-block 5G NR only	MINSubbloc	Minimum carrier power among the sub-block carriers of Measure Carrier On is the reference of measurement. If Measure Carriers of all the carriers in a sub-block are off, the reference power of the sub-block and all the relative power results referring to this sub-block are NAN, and these relative limits are not evaluated
Left & Right Sub-blocks 5G NR only	LRSubblocks	The reference depends on the number of Component Carriers (CC) and Carrier Allocation as follows: – Num of CC is 1: the carrier power is the reference – Num of CC is 2 or more & Carrier Allocation is Contiguous: Aggregated Channel power is the reference – Num of CC is 2 or more & Carrier Allocation is Non-Contiguous: Aggregated powers of left and right sub-blocks are the references. Left and right sub-blocks are determined by component carrier configuration

The powers of carriers are not included in the reference power when their Measure Carriers are Off. When Measure Carriers of all the carriers in a sub-block are Off, the reference power and all the relative power results are NaN. Therefore, relative limits are not evaluated.

Measurement Type = Total Power Ref



Measurement Type = PSD Ref



Remote	`[:SENSe]:ACPower:CARRier[1]|2:PREFerence:TYPE LRCarriers | MPCarrier | CINDex`

Command	| MANual | MPCSubblock | ACBandwidth | TMCarriers | MINPcarrier | MINSubblock | LRSubblocks [:SENSe]:ACPower:CARRier[1]|2:PREFerence:TYPE?
Example	:ACP:CARR:PREF:TYPE CIND :ACP:CARR:PREF:TYPE?
Notes	Available only in MSR, LTEAFDD, LTEATDD and 5G NR Modes ACBandwidth is available only in LTEAFDD, LTEATDD and 5G NR Modes TMCarriers is available only in MSR Mode MINPcarrier,MINSubblock, and LRSubblocks are available only in 5G NR Mode Carrier subopcode: 1 for BTS (Downlink), 2 for MS (Uplink). Default is BTS Note that Carrier subopcode 2 is not supported in some Modes. In those cases, Carrier subopcode 1 is used for both BTS and MS and commands with subopcode 2 are accepted without error but ignored
Preset	MPCarrier
State Saved	Saved in instrument state

Power Ref State (Remote Command Only)

Remote Command	[:SENSe]:ACPower:CARRier[1]|2:AUTO[:STATe] OFF | ON | 0 | 1 [:SENSe]:ACPower:CARRier[1]|2:AUTO[:STATe]?
Example	:ACP:CARR:AUTO OFF :ACP:CARR:AUTO?
Preset	ON
State Saved	Saved in instrument state
Range	Auto | Man
Backwards Compatibility SCPI	[:SENSe]:MCPower:CARRier[1]|2:AUTO[:STATe]

Total Power Ref

Sets manual total power reference.

This control has two different forms, depending on the currently-selected Mode:

- "Total Power Ref (Modes: SA, WCDMA, VMA, SRComms)" on page 1050
- "Total Power Ref (Modes: LTEAFDD, LTEATDD, 5G NR, MSR)" on page 1050

Total Power Ref (Modes: SA, WCDMA, VMA, SRComms)

This is used when Power Ref is Manual and "Measurement Type" on page 1045 is Total Power.

Remote Command	`[:SENSe]:ACPower:CARRier[1]|2[:POWer] <real>` `[:SENSe]:ACPower:CARRier[1]|2[:POWer]?`
Example	`:ACP:CARR 10` `:ACP:CARR?`
Notes	Although the default value is defined, the value is recalculated by the measurement result just after measurement Carrier subopcode: 1 for BTS (Downlink), 2 for MS (Uplink). Default is BTS Note that Carrier subopcode 2 is not supported in some Modes. In those cases, Carrier subopcode 1 is used for both BTS and MS and commands with subopcode 2 are accepted without error but ignored The Unit Terminators differ depending on whether or not the mode supports Y Axis Unit and also which Y Axis Unit is selected
Dependencies	Available only when **Measurement Type** is `TPRef`, otherwise grayed-out
Preset	0.0
State Saved	Saved in instrument state
Min/Max	-200 dBm/200 dBm
Backwards Compatibility SCPI	`[:SENSe]:MCPower:CARRier[1]|2[:POWer]`

Total Power Ref (Modes: LTEAFDD, LTEATDD, 5G NR, MSR)

Sets the multi-carrier power reference. This is used when Power Ref is Manual and "Measurement Type" on page 1045 is Total Power.

When set to **Auto**, the carrier power result reflects the measured power value in the selected reference carrier.

When set to **Man**, the result is referenced to the last measured value, or you may specify the reference for the multi-carrier power measurement. Relative values are displayed, referenced to the “Power Reference” value.

Remote Command	`[:SENSe]:ACPower:CARRier[1]|2[:POWer] <real>` `[:SENSe]:ACPower:CARRier[1]|2[:POWer]?`
Example	`:ACP:CARR 10` `:ACP:CARR?`
Notes	Although the default value is defined, the value is recalculated by the measurement result just after measurement

	Carrier subopcode: 1 for BTS (Downlink), 2 for MS (Uplink). Default is BTS Note that Carrier subopcode 2 is not supported in some Modes. In those cases, Carrier subopcode 1 is used for both BTS and MS and commands with subopcode 2 are accepted without error but ignored The Unit Terminators differ depending on whether or not the mode supports Y Axis Unit and also which Y Axis Unit is selected
Dependencies	Enabled when "Measurement Type" on page 1045 is Total Power and "Power Ref" on page 1045 is Manual
Preset	0.0
State Saved	Saved in instrument state
Min/Max	-200 dBm/200 dBm
Backwards Compatibility SCPI	`[:SENSe]:MCPower:CARRier[1]|2[:POWer]`

PSD Ref

Sets manual PSD reference.

This control has two different forms, depending on the currently-selected Mode:

- "PSD Ref (Modes: SA, WCDMA, VMA, SRComms)" on page 1051
- "PSD Ref (Modes: LTEAFDD, LTEATDD, 5GNR, MSR)" on page 1052

PSD Ref (Modes: SA, WCDMA, VMA, SRComms)

This is used when "Power Ref" on page 1045 is Manual and "Measurement Type" on page 1045 is PSD.

Sets the power spectral density in the carrier (main channel) that is used to compute the relative power spectral density values for the offsets when **Measurement Type** is PSD Ref.

Remote Command	`[:SENSe]:ACPower:CARRier[1]|2:CPSD <real>` `[:SENSe]:ACPower:CARRier[1]|2:CPSD?`
Example	`:ACP:CARR:CPSD 25` `:ACP:CARR:CPSD?`
Notes	Although the default value is defined, the value is recalculated by the measurement result just after measurement Carrier subopcode: 1 for BTS (Downlink), 2 for MS (Uplink). Default is BTS Note that Carrier subopcode 2 is not supported in some Modes. In those cases, Carrier subopcode 1 is used for both BTS and MS and commands with subopcode 2 are accepted without error but ignored
Dependencies	Available only when Measurement Type is `PSDRef`, otherwise grayed-out

Couplings	The value of PSD Ref is automatically converted when PSD Unit is changed
Preset	0.0
State Saved	Saved in instrument state
Min/Max	-999/999

Power Ref State (Backwards Compatibility SCPI)

Sets the Power Reference State to auto or manual.

Example	`:ACP:CARR:AUTO OFF`
	`:ACP:CARR:AUTO?`
	`:MCP:CARR:AUTO ON`
	`:MCP:CARR:AUTO?`

Notes	For backwards compatibility with legacy SA and WCDMA, this command is supported When `ON`, corresponds to the Ref Carrier of the "Power Ref" on page 1045 selection When `OFF`, corresponds to the Manual of the **Power Ref** selection
Preset	`ON`
State Saved	Saved in instrument state
Range	`Auto|Man`

Backwards Compatibility SCPI	`[:SENSe]:ACPower:CARRier[1]|2:AUTO[:STATe] OFF | ON | 0 | 1`
	`[:SENSe]:ACPower:CARRier[1]|2:AUTO[:STATe]?`
	`[:SENSe]:MCPower:CARRier[1]|2:AUTO[:STATe] OFF | ON | 0 | 1`
	`[:SENSe]:MCPower:CARRier[1]|2:AUTO[:STATe]?`

PSD Ref (Modes: LTEAFDD, LTEATDD, 5GNR, MSR)

Sets manual PSD reference. This is used when "Power Ref" on page 1045 is **Manual** and "Measurement Type" on page 1045 is **PSD**.

Sets the power spectral density in the carrier (main channel) that is used to compute the relative power spectral density values for the offsets when **Measurement Type** is set to **PSD Ref**. When the **PSD Ref** state is set to **Auto**, this will be set to the measured carrier power spectral density.

Remote Command	`[:SENSe]:ACPower:CARRier[1]|2:CPSD <real>` `[:SENSe]:ACPower:CARRier[1]|2:CPSD?`
Example	`:ACP:CARR:CPSD 25` `:ACP:CARR:CPSD?`
Notes	Although the default value is defined, the value is recalculated by the measurement result just after

	measurement Carrier subopcode: 1 for BTS (Downlink), 2 for MS (Uplink). Default is BTS Note that Carrier subopcode 2 is not supported in some Modes. In those cases, Carrier subopcode 1 is used for both BTS and MS and commands with subopcode 2 are accepted without error but ignored
Dependencies	Enabled when "Measurement Type" on page 1045 is PSD Reference and **Power Ref** is Manual
Couplings	The value of PSD is automatically converted when PSD Unit is changed
Preset	0.0
State Saved	Saved in instrument state
Min/Max	-999/999

PSD Unit

Sets the unit bandwidth for Power Spectral Density. The available units are dBm/Hz (DBMHZ) and dBm/MHz (DBMMHZ).

Remote Command	`:UNIT:ACPower:POWer:PSD DBMHZ | DBMMHZ` `:UNIT:ACPower:POWer:PSD?`
Example	`:UNIT:ACP:POW:PSD DBMMHZ` `:UNIT:ACP:POW:PSD?`
Dependencies	Enabled when "Measurement Type" on page 1045 is PSD Reference
Couplings	When the PSD unit is changed, the PSD reference result of `:MEAS|READ|FETCH:ACP[n]?` is also changed by the PSD unit basis (in either dBm/Hz or dBm/MHz)
Preset	DBMHZ
State Saved	Saved in instrument state
Range	dBm/Hz | dBm/MHz

3.5.13.3 Meas Standard

Contains controls that allow you to preset the PowerSuite measurements to conform to various communications standards.

Radio Standard Presets

Lets you specify the Radio Standard to be used. Spectrum Analyzer Mode supports many Radio Standards. You can select the desired Radio Standard using the **Radio Std Presets** dialog, which is a cascading list of standards. When you have the selected the desired Standard, press **OK** and the measurement settings will change to reflect that standard.

Remote Command	`[:SENSe]:RADio:STANdard[:SELect] NONE | JSTD | IS95a | IS97D | IS98D | GSM`

	| W3GPP | C2000MC1 | C20001X | NADC | PDC | BLUEtooth | TETRa | WL802DOT11A | WL802DOT11B | WL802DOT11G | HIPERLAN2 | DVBTLSN | DVBTGPN | DVBTIPN | FCC15 | SDMBSE | UWBINDOOR | LTEB1M4 | LTEB3M | LTEB5M | LTEB10M | LTEB15M | LTEB20M | WL11N20M | WL11N40M | WL11AC20M | WL11AC40M | WL11AC80M | WL11AC160M | WL11AX20M | WL11AX40M | WL11AX80M | WL11AX160M | WL11BE20M | WL11BE40M | WL11BE80M | WL11BE160M | WL11BE320M | WL11AD2G | WL11AY2G16 | WL11AY4G32 | WL11AY6G48 | WL11AY8G64 | NR5GFR1B100M [:SENSe]:RADio:STANdard[:SELect]?
Example	:RAD:STAN NONE :RAD:STAN?
Dependencies	Some selections appear only when support license is valid
Couplings	By changing the radio standard, the measurement parameters will be automatically set to an appropriate default value
State Saved	Saved in instrument state

The **Radio** column in the table lets you specify the device to be used. It is a global setting that affects the Device selection, between Mobile (MS) and Base Station (BTS) settings, for all relevant PowerSuite measurements. The Device SCPI command has the same effect as a selection in the **Radio** column:

Remote Command	[:SENSe]:RADio:STANdard:DEVice BTS | MS [:SENSe]:RADio:STANdard:DEVice?
Example	:RAD:STAN:DEV MS :RAD:STAN:DEV?
Preset	BTS
State Saved	Saved in instrument state
Range	BTS|MS

Chart for Standard and Available Measurements

Note that not every measurement in Spectrum Analyzer Mode is available for every standard. The chart below describes which measurements are available for each Radio Standard.

For TOI or Harmonics measurements, *no* Radio Standards are available.

	Swept SA	CHP	OBW	ACP	CCDF	Burst Power	Spurious Emission	SEM	List Sweep
None	X	X	X	X	X	X	X	X	(X)
3GPP 5G NR	(X)	X	X	X	X			X	(X)
3GPP LTE	(X)	X	X	X	X			X	(X)
3GPP W-CDMA	(X)	X	X	X	X	X		X	(X)
GSM/EDGE	(X)				X	X			(X)

	Swept SA	CHP	OBW	ACP	CCDF	Burst Power	Spurious Emission	SEM	List Sweep
cdma2000 1x	(X)	X	X	X	X	X			(X)
IS-95A	(X)	X	X	X	X	X			(X)
J-STD-008	(X)	X	X	X	X	X			(X)
IS-97D/98D	(X)	X	X	X	X				(X)
NADC	(X)	X	X	X	X	X			(X)
PDC	(X)	X	X	X	X	X			(X)
Bluetooth	(X)				X	X			(X)
W-LAN 802.11a	(X)							X	(X)
W-LAN 802.11b	(X)							X	(X)
W-LAN 802.11g	(X)							X	(X)
W-LAN 802.11n	(X)	X	X		X			X	(X)
W-LAN 802.11ac	(X)	X	X		X			X	(X)
W-LAN 802.11ax	(X)	X	X		X			X	(X)
W-LAN 802.11be	(X)	X	X		X			X	(X)
W-LAN 802.11ad	(X)	X	X		X			X	(X)
W-LAN 802.11ay	(X)	X	X		X			X	(X)
W-LAN HiperLAN/2	(X)							X	(X)
TETRA	(X)	X		X					(X)
DVB-T L/SECAM/NICAM	(X)	X			X				(X)
FCC Part 15 Subpart F	(X)	X			X				(X)
DVBT-T G/PAL/NICAM	(X)	X			X				(X)
DVB-T I/PAL/NICAM	(X)						X		(X)
S-DMB System E	(X)	X	X	X					(X)
UWB Indoor	(X)						X		(X)

General Radio Standards

The table below lists the settings and provides an example for each general Radio Standard.

None	Command Example	:RAD:STAN NONE
	IBW	2 MHz
	Span	3 MHz
	RBW	Auto rules
	VBW	Auto rules
TETRA	Command Example	:RAD:STAN TETR
	IBW	18 kHz
	Span	27 kHz
	RBW	1.2 kHz
	VBW	Auto rules
	RRC Filter	On
	RRC Filter Alpha	0.35
FCC Part15 Subpart F	Command Example	:RAD:STAN FCC15

Video Radio Standards

The table below lists the settings and provides an example for each video Radio Standard.

DVB-T L/SECAM/NICAM	Command Example	:RAD:STAN DVBTLSN
	IBW	7.61 MHz
	Span	24 MHz
	RBW	3.9 kHz
	VBW	Auto rules
	Sweep Points	8001
DVB-T G/PAL/NICAM	Command Example	:RAD:STAN DVBTGPN
	IBW	7.61 MHz
	Span	24 MHz
	RBW	3.9 kHz
	VBW	Auto rules
	Sweep Points	8001

DVB-T I/PAL/NICAM	Command Example	:RAD:STAN DVBTIPN
	IBW	7.61 MHz
	Span	24 MHz
	RBW	3.9 kHz
	VBW	Auto rules
	Sweep Points	8001
S-DMB System E	Command Example	:RAD:STAN SDMBSE
	IBW	25 MHz
	Span	37.5 MHz
	RBW	360 kHz
	VBW	Auto rules
	RRC Filter	Off
	RRC Filter Alpha	0.22

Cellular Radio Standards

The table below lists the CHP settings and provides an example for each cellular Radio Standard.

GSM/EDGE	Command Example	:RAD:STAN GSM
3GPP 5G NR	Command Example	:RAD:STAN NR5GFR1B100M
	IBW	100 MHz
	Span	150 MHz
	RBW	Auto rules
	VBW	Auto rules
3GPP W-CDMA	Command Example	:RAD:STAN W3GPP
	IBW	5 MHz
	Span	7.5 MHz
	RBW	240 kHz
	VBW	Auto rules
	RRC Filter	Off
	RRC Filter Alpha	0.22
3GPP LTE 1.4 MHz	Command Example	:RAD:STAN LTEB1M4
	IBW	1.4 MHz
	Span	2.1 MHz
	RBW	Auto rules
	VBW	Auto rules

3GPP LTE 3 MHz	Command Example	:RAD:STAN LTEB3M
	IBW	3 MHz
	Span	4.5 MHz
	RBW	Auto rules
	VBW	Auto rules
3GPP LTE 5 MHz	Command Example	:RAD:STAN LTEB5M
	IBW	5 MHz
	Span	7.5 MHz
	RBW	Auto rules
	VBW	Auto rules
3GPP LTE 10 MHz	Command Example	:RAD:STAN LTEB10M
	IBW	10 MHz
	Span	15 MHz
	RBW	Auto rules
	VBW	Auto rules
3GPP LTE 15 MHz	Command Example	:RAD:STAN LTEB15M
	IBW	15 MHz
	Span	22.5 MHz
	RBW	Auto rules
	VBW	Auto rules
3GPP LTE 20 MHz	Command Example	:RAD:STAN LTEB20M
	IBW	20 MHz
	Span	30 MHz
	RBW	Auto rules
	VBW	Auto rules
cdma2000	Command Example	:RAD:STAN C20001X :RAD:STAN C2000MC1 :RAD:STAN? (Query always returns C20001X)
	IBW	1.23 MHz
	Span	1.845 MHz
	RBW	24 kHz
	VBW	Auto rules

IS-95A	Command Example	:RAD:STAN IS95
	IBW	1.23 MHz
	Span	1.845 MHz
	RBW	24 kHz
	VBW	Auto rules
J-STD-008	Command Example	:RAD:STAN JSTD
	IBW	1.23 MHz
	Span	1.845 MHz
	RBW	24 kHz
	VBW	Auto rules
NADC	Command Example	:RAD:STAN NADC
	IBW	32.8 kHz
	Span	49.2 kHz
	RBW	1.2 kHz
	VBW	Auto rules
PDC	Command Example	:RAD:STAN PDC
	IBW	21 kHz
	Span	31.5 kHz
	RBW	6.2 kHz
	VBW	Auto rules
IS-97D/98D	Command Example	:RAD:STAN IS97D :RAD:STAN IS98D :RAD:STAN IS95C :RAD:STAN? Query always returns `IS97D`
	IBW	1.23 MHz
	Span	1.845 MHz
	RBW	24kHz
	VBW	Auto rules

Band Class (IS-97D/98D only)

The following function is only available when you have selected the standard: IS-97D/98D. It lets you select the band class.

Remote Command	`[:SENSe]:RADio:STANdard:BAND:CLASs BC0 | BC1` `[:SENSe]:RADio:STANdard:BAND:CLASs?`
Example	`:RAD:STAN:BAND:CLAS BC0` `:RAD:STAN:BAND:CLAS?`

Preset	BC0
State Saved	Saved in instrument state
Range	0 (800 MHz Band)|1 (1900 MHz Band)

Wireless Radio Standards

The table below lists the CHP settings and provides an example for each wireless Radio Standard.

WLAN 802.11a	Command Example	:RAD:STAN WL802DOT11A
	IBW	20 MHz
	Span	30 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11g	Command Example	:RAD:STAN WL802DOT11G
	IBW	20 MHz
	Span	30 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11b	Command Example	:RAD:STAN WL802DOT11B
	IBW	25 MHz
	Span	37.5 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11n 20 MHz	Command Example	:RAD:STAN WL11N20M
	IBW	20 MHz
	Span	30 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11n 40 MHz	Command Example	:RAD:STAN WL11N40M
	IBW	40 MHz
	Span	60 MHz
	RBW	100 kHz
	VBW	Auto rules

WLAN 802.11ac 20 MHz	Command Example	:RAD:STAN WL11AC20M
	IBW	20 MHz
	Span	30 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11ac 40 MHz	Command Example	:RAD:STAN WL11AC40M
	IBW	40 MHz
	Span	60 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11ac 80 MHz	Command Example	:RAD:STAN WL11AC80M
	IBW	80 MHz
	Span	120 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11ac 160 MHz	Command Example	:RAD:STAN WL11AC160M
	IBW	160 MHz
	Span	240 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11ax 20 MHz	Command Example	:RAD:STAN WL11AX20M
	IBW	20 MHz
	Span	30 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11ax 40 MHz	Command Example	:RAD:STAN WL11AX40M
	IBW	40 MHz
	Span	60 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11ax 80 MHz	Command Example	:RAD:STAN WL11AX80M
	IBW	80 MHz
	Span	120 MHz
	RBW	100 kHz
	VBW	Auto rules

WLAN 802.11ax 160 MHz	Command Example	:RAD:STAN WL11AX160M
	IBW	160 MHz
	Span	240 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11be 20 MHz	Command Example	:RAD:STAN WL11BE20M
	IBW	20 MHz
	Span	30 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11be 40 MHz	Command Example	:RAD:STAN WL11BE40M
	IBW	40 MHz
	Span	60 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11be 80 MHz	Command Example	:RAD:STAN WL11BE80M
	IBW	80 MHz
	Span	120 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11be 160 MHz	Command Example	:RAD:STAN WL11BE160M
	IBW	160 MHz
	Span	240 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11be 320 MHz	Command Example	:RAD:STAN WL11BE320M
	IBW	320 MHz
	Span	480 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11ad 2 GHz	Command Example	:RAD:STAN WL11AD2G
	IBW	2.16 GHz
	Span	3.24 GHz
	RBW	1 MHz
	VBW	Auto rules

WLAN 802.11ay 2.16 GHz	Command Example	:RAD:STAN WL11AY2G16
	IBW	2.16 GHz
	Span	3.24 GHz
	RBW	1 MHz
	VBW	Auto rules
WLAN 802.11ay 4.32 GHz	Command Example	:RAD:STAN WL11AY4G32
	IBW	4.32 GHz
	Span	6.48 GHz
	RBW	1 MHz
	VBW	Auto rules
WLAN 802.11ay 6.48 GHz	Command Example	:RAD:STAN WL11AY6G48
	IBW	6.48 GHz
	Span	9.72 GHz
	RBW	1 MHz
	VBW	Auto rules
WLAN 802.11ay 8.64 GHz	Command Example	:RAD:STAN WL11AY8G64
	IBW	8.64 GHz
	Span	12.96 GHz
	RBW	1 MHz
	VBW	Auto rules
3GPP 5G NR	Command Example	:RAD:STAN NR5GFR1B100M
5G NR FR1 100MHz	IBW	100 MHz
	Span	150 MHz
	RBW	Auto rules
	VBW	Auto rules

WLAN HiperLAN/2	Command Example	`:RAD:STAN HIPERLAN2`
	UWB Indoor	Command Example RAD:STAN UWBINDOOR
	Bluetooth	Command Example RAD:STAN BLUE

Packet Type (Bluetooth only)

The command below sets the packet type for the Bluetooth measurement

Remote Command	`[:SENSe]:RADio:STANdard:PACKet DH1 | DH3 | DH5` `[:SENSe]:RADio:STANdard:PACKet?`
Example	`:RAD:STAN:PACK DH1` `:RAD:STAN:PACK?`
Notes	The packet length is: DH1 366 µs

	DH3	1622 µs
	DH5	2870 µs
Preset	DH1	
State Saved	Saved in instrument state	
Range	DH1 | DH3 | DH5	

Radio Standard Presets Hierarchy

General	None	
	TETRA	BTS
		MS
	FCC Part 15 Subpart F	
	APCO-25	
	DMR	
	dPMR	
Video	DVB-T	L/SECAM/NICAM
		G/PAL/NICAM
		I/PAL/NICAM
	S-DMB System E	

Cellular	3GPP 5G NR	BTS	FR1 100 MHz
		MS	FR1 100 MHz
	3GPP LTE	BTS	1.4 MHz (6 RB)
			3 MHz (15 RB)
			5 MHz (25 RB)
			10 MHz (50 RB)
			15 MHz (75 RB)
			20 MHz (100 RB)
		MS	1.4 MHz (6 RB)
			3 MHz (15 RB)
			5 MHz (25 RB)
			10 MHz (50 RB)
			15 MHz (75 RB)
			20 MHz (100 RB)
	3GPP W-CDMA	BTS	
		MS	
	GSM/EDGE	BTS	
		MS	
	cdma2000 1x	BTS	
		MS	
	IS-95A	BTS	
		MS	
	J-STD-008	BTS	
		MS	
	IS-97D/98D	BTS	Band Class 0
			Band Class 1
		MS	Band Class 0
			Band Class 1
	NADC	BTS	
		MS	
	PDC	BTS	
		MS	

Wireless	W-LAN	802.11a	
		802.11b	
		802.11g	
		802.11n	20 MHz
			40 MHz
		802.11ac	20 MHz
			40 MHz
			80 MHz
			160 MHz
		802.11ax	20 MHz
			40 MHz
			80 MHz
			160 MHz
		802.11be	20 MHz
			40 MHz
			80 MHz
			160 MHz
			320 MHz
		802.11ad	
		802.11ay	2.16 GHz
			4.32 GHz
			6.48 GHz
			8.64 GHz
		HiperLAN/2	
	Bluetooth	DH1	
		DH3	
		DH5	
	UWB Indoor		

Each Radio Standard has the preset parameter set for the measurement.

When a standard is selected, the default value of the measurement parameters are overwritten by those preset values.

When the standard is `NONE`, or the standard does not specify the firm RBW requirement, then the table displays “auto”, and the following definition is used to compute the proper RBW setting:

1. Compute the guard-band = [Offset Freq A] - 0.5*([Chan Integ BW] + [Ref BW])
2. Divide by 4.5. Call the result GuardbandGoalRBW

3. Compute the greater of the Reference and Offset A integration bandwidths. Divide that result by 100 and call it the ChannelWidthGoalRBW
4. Find the smallest integration bandwidth of any of the offsets; divide it by two and call the result IntegBWGoalRBW
5. Compute AutoRBWGoal = min(IntegBWGoal, max(GuardbandGoalRBW, ChannelWidthGoalRBW))
6. Compute the RBW to be selected to be the largest available RBW that is smaller than AutoRBWGoal

Measurements that are unavailable for a particular Radio Standard are grayed-out. Radio Standards that are unavailable for the current active measurement are also grayed-out.

However, remote operations, such as `:CONF` allow the measurement to be active even if it is not a supported format. In this case, the measurement configuration should be set to `NONE`.

Enable Non-Std Meas

Lets you specify whether all measurements and radio standards are enabled or not.

By default, **Enable Non-Std Measurements** is set to `NO`, so you can select only valid combinations of preset available standards and measurements. Combinations of measurement and standard that would have no valid preset value are grayed-out.

When **Enable Non-Std Measurements** is set to `YES`, all measurements and standard selections are enabled, so you can select any combination.

NOTE **If you select an unavailable measurement or unavailable radio standard using the Enable Non-Std Meas control, the measurement results may not conform to the selected standard.**

Remote Command	`[:SENSe]:RADio:STANdard:EAMeas YES | NO` `[:SENSe]:RADio:STANdard:EAMeas?`
Example	`:RAD:STAN:EAM YES` `:RAD:STAN:EAM?`
Preset	`NO`
State Saved	Saved in instrument state
Range	`YES|NO`

3.5.13.4 Advanced

Contains controls for setting advanced functions of the instrument.

This tab does *not* appear in the following instruments:

- EXM
- VXT model M9420A

Phase Noise Opt

Selects the LO (local oscillator) phase noise behavior for various operating conditions.

Remote Command	`[:SENSe]:ACPower:FREQuency:SYNThesis[:STATe] 1 | … | 5`
	For the meaning of each numeric option value, see "Parameter Options, Installed Options, Auto Rules & Ranges" on page 1069 below
	`[:SENSe]:ACPower:FREQuency:SYNThesis[:STATe]?`

Example	`:ACP:FREQ:SYNT 1` `:ACP:FREQ:SYNT?`
Dependencies	Does not appear in all models. For models that do not display this control, the SCPI command is accepted for compatibility (although no action is taken) Not available in VXT models M9410A/11A/15A
Preset	Because this function is in **Auto** after preset, the state of this function after **Preset** will be automatically calculated
State Saved	Saved in instrument state
Range	See "Ranges" on page 1074 below

Auto Function

Remote Command	`[:SENSe]:ACPower:FREQuency:SYNThesis:AUTO[:STATe] OFF | ON | 0 | 1` `[:SENSe]:ACPower:FREQuency:SYNThesis:AUTO[:STATe]?`
Example	`:ACP:FREQ:SYNT:AUTO 1` `:ACP:FREQ:SYNT:AUTO?`
Preset	ON

Parameter Options, Installed Options, Auto Rules & Ranges

The Phase Noise Optimization control lets you optimize the setup and behavior of the Local Oscillator (LO) depending on your specific measurement conditions. You may wish to trade off noise and speed, for example, to make a measurement faster without regard to noise or with optimum noise characteristics without regard to speed.

Parameter Values Summary

Option	#	Description
"Balanced" on page 1071	1	– In instruments with EP0, balances close-in phase noise with spur avoidance – In instruments without EP0 optimizes phase noise for small frequency offsets from the carrier
"Best Wide-offset" on page 1071	2	Optimizes phase noise for wide frequency offsets from the carrier
"Fast Tuning" on page 1072	3	Optimizes LO for tuning speed
"Best Close-in" on page 1070	4 or 1*	– In instruments with EP0, emphasizes close-in phase noise performance without regard to spur avoidance – In instruments without EP0, this setting is accepted but no action is taken
"Best Spurs" on page 1071	5	– In instruments with EP0, emphasizes spur avoidance over close-in phase noise performance – In instruments without EP0, this setting is accepted but no action taken
Auto	-	Automatically selects LO (local oscillator) phase noise behavior to optimize dynamic range and speed for various instrument operating conditions

*Dependent on Option EP0 installation. See "Best Close-in" on page 1070 below.

The actual behavior varies somewhat depending on model number and option; for example, you always get Fast Tuning by choosing Option #3, but in some models, "Fast Tuning" on page 1072 is identical in effect to "Best Close-in" on page 1070.

Best Close-in

Without option EP0

```
:FREQ:SYNT 1
```

The LO phase noise is optimized for smaller offsets from the carrier, at the expense of phase noise farther out.

The actual frequency offset within which noise is optimized is shown with in square brackets, as this can vary depending on the hardware set in use. For example, in some instruments this annotation appears as [offset <20 kHz]

With option EP0

```
:FREQ:SYNT 4
```

In instruments with Option EP0, the LO is configured for the best possible close-in phase noise (offsets up to 600 kHz from the carrier), regardless of spurious products that occur with some center frequencies. Because this is generally less desirable for close-in measurements than the "Balanced" on page 1071 setting, parameter 1 selects "Balanced" on page 1071 in EP0 instruments, in the interests of optimizing code compatibility across the family. Parameter 4 selects "Best Close-in" on page 1070, which is usually not as good a choice as "Balanced" on page 1071.

Balanced

```
:FREQ:SYNT 1
```

In instruments with EP0, the LO is configured for the best possible phase noise at offsets up to 600 kHz from the carrier whenever there are no significant spurs within the span observed with an on-screen carrier. When there will be such a spur, the LO is reconfigured in a way that allows the phase noise to increase by 7 dB mostly within ±1 octave around 400 kHz offset. The spurs will always be below –70 dBc.

Best Spurs

```
:FREQ:SYNT 5
```

In instruments with EP0, the LO is configured for better phase noise than the "Best Wide-offset" on page 1071 case close to the carrier, but the configuration has 11 dB worse phase noise than the "Best Close-in" on page 1070 case mostly within ±1 octave around 300 kHz offset. Spurs are even lower than in the "Balanced" on page 1071 case at better than –90 dBc, whether or not the carrier is on-screen.

This setting is never selected when Phase Noise Optimization is in Auto, you must select it manually.

Best Wide-offset

```
:FREQ:SYNT 2
```

The LO phase noise is optimized for wider offsets from the carrier. Optimization is especially improved for offsets from 70 kHz to 300 kHz. Closer offsets are compromised and the throughput of measurements (especially remote measurements where the center frequency is changing rapidly), is reduced.

The actual frequency offset beyond which noise is optimized is shown with in square brackets, as this can vary depending on the hardware set in use. For example, in some instruments this annotation appears as [offset >30 kHz]

In instruments with Option EP0, the LO is configured for the best possible phase noise at offsets up to 600 kHz from the carrier whenever there are no significant spurs within the span observed with an on-screen carrier. When there will be such a spur, the LO is reconfigured in a way that allows the phase noise to increase by 7 dB mostly within ±1 octave around 400 kHz offset. The spurs will always be below –70 dBc.

Fast Tuning

`:FREQ:SYNT 3`

In this mode, the LO behavior compromises phase noise at many offsets from the carrier in order to allow rapid measurement throughput when changing the center frequency or span. The term "Fast Tuning" on page 1072 refers to the time it takes to move the local oscillator to the start frequency and begin a sweep; this setting does not impact the actual sweep time in any way.

In instruments with EP1, the LO behavior compromises phase noise at offsets below 4 MHz in order to improve measurement throughput. The throughput is especially affected when moving the LO more than 2.5 MHz and up to 10 MHz from the stop frequency to the next start frequency.

In instruments with Option EP0, this is the same configuration as "Best Spurs" on page 1071. It is available with the "Fast Tuning" on page 1072 label for convenience, and to make the user interface more consistent with other X-Series instrument family members.

(In models whose hardware does not provide for a "Fast Tuning" on page 1072 option, the settings for "Best Close-in" on page 1070 are used if "Fast Tuning" on page 1072 is selected. This gives the fastest possible tuning for that hardware set.)

Auto

`:FREQ:SYNT:AUTO ON`

Selects the LO (local oscillator) phase noise behavior to optimize dynamic range and speed for various instrument operating conditions. The selection rules are as follows.

Auto Optimization Rules

X-Series instruments have several grades of LO, offering different configurations when in the Auto Mode. The rules for Auto selection are as follows:

Models with Option	Conditions	Selection
EP0 Models with option EP0 have a two stage local oscillator, which switches to a single loop for fast tuning (available in UXA)	Center frequency is < 699.9 kHz	"Balanced" on page 1071
	Span > 114.1 MHz, *or* RBW > 800 kHz	"Fast Tuning" on page 1072
	RBW > 290 kHz, *or* Span > 4.2 MHz	"Best Wide-offset" on page 1071
	Other conditions	"Balanced" on page 1071

Models with Option	Conditions	Selection
EP1 Models with option EP1 have a two-loop local oscillator, which switches to a single loop for fast tuning (available in PXA)	Span > 44.44 MHz, *or* RBW > 1.9 MHz, *or* Source Mode is set to “Tracking”	"Fast Tuning" on page 1072
	Center frequency is < 195 kHz, *or* CF >= 1 MHz *and* Span <= 1.3 MHz *and* RBW <= 75 kHz	"Best Close-in" on page 1070
	All other conditions	"Best Wide-offset" on page 1071
EP2 Models with option EP2 use a different loop bandwidth for the fast-tuning choice, which is a compromise between tuning speed and phase noise, giving good tuning speed at all offsets. Although not as good as for "Best Close-in" on page 1070; this is useful when you have to look across a wide range of spans (available, for example, in MXA for excellent phase noise)	CF < 130 kHz , *or* CF > 12 MHz *and* Span < 495 kHz *and* RBW < 40 kHz	"Best Close-in" on page 1070
	Span > 22 MHz, *or* RBW > 400 kHz, *or* CF ≤ 12 MHz *and* Span < 495 kHz *and* RBW < 23 kHz	"Fast Tuning" on page 1072
	All other conditions	"Best Wide-offset" on page 1071
EP4 (available in CXA for improved phase noise)	Span > 101 MHz *or* RBW > 1.15 MHz *or* Source Mode is set to “Tracking”	"Fast Tuning" on page 1072
	CF is < 109 kHz *or* CF >= 4.95 MHz *and* Span <= 666 kHz *and* RBW < 28 kHz	"Best Close-in" on page 1070
	All other conditions	"Best Wide-offset" on page 1071
All Other Models Note that in these models, the hardware does not actually provide for an extra-fast tuning option, so the settings for "Fast Tuning" on page 1072 are actually the same as "Best Close-in" on page 1070, but the rules are implemented this way so that the user who doesn't care about phase noise but does care about tuning speed doesn't have to remember which of the other two settings gives faster tuning	Span > 12.34 MHz, *or* RBW > 250 kHz, *or* Source Mode is set to “Tracking”	"Fast Tuning" on page 1072
	Center frequency is < 25 kHz, *or* CF >= 1 MHz *and* Span <= 141.4 kHz *and* RBW <= 5 kHz	"Best Close-in" on page 1070
	All other conditions	"Best Wide-offset" on page 1071

In all the above cases:

- The RBW to be used in the calculations is the equivalent –3 dB bandwidth of the current RBW filter
- The rules apply whether in swept spans, zero span, or FFT spans

Ranges

Option	Option #	Phase Noise Option	Range
No EPx Option	1	Best Close-in	[offset < 20 kHz]
	2	Best Wide-offset	[offset > 30 kHz]
	3	Fast Tuning	[same as Best Close-In]
EP0	4	Best Close-in	[offset < 600 kHz]
	1	Balanced	[offset < 600 kHz]
	5	Best Spurs	[offset < 600 kHz]
	2	Best Wide-offset	[offset > 800 kHz]
	3	Fast Tuning	[same as Best Close-In]
EP1	1	Best Close-in	[offset < 140 kHz]
	2	Best Wide-offset	[offset > 160 kHz]
	3	Fast Tuning	[single loop]
EP2, EP3, EP5	1	Best Close-in	[offset < 70 kHz]
	2	Best Wide-offset	[offset > 100 kHz]
	3	Fast Tuning	[medium loop bw]
EP4	1	Best Close-in	[offset < 90 kHz]
	2	Best Wide-offset	[offset > 130 kHz]
	3	Fast Tuning	[same as Best Close-In]

Noise Correction

Sets the measurement noise floor correction function to On or Off. On enables measurement noise correction when the measured power in the reference channel or any offset is close to the noise floor of the instrument. Off turns these corrections off.

In instruments with the noise floor extensions option (option NFE) enabled, there are two ways to compensate for the analyzer noise floor: through the NFE and through this noise corrections control. The techniques are results are similar but not identical. NFE uses a model of the analyzer noise floor, adapted to the current conditions such as center frequency, RBW and ambient temperature. The parameters of this model are measured in the factory or field calibration in a highly averaged measurement. So, they are consistent. However, because the model is imperfect, the corrections are imperfect. Using NFE is very convenient; the user need not wait for the ACP noise corrections calibration to occur. The ACP NC calibration, though, has advantages of being measured very recently, at the current ambient, and the exact center frequency, with no requirement that the model be perfect. So, it will often (but not always) have slightly better dynamic range. If both ACP NC is turned on and NFE is turned on, the instrument uses only the ACP NC. When ACP NC is turned off, but NFE is on, NFE is used, and performance should still be excellent.

When **Meas Method** is Fast Power, HW supported noise correction works when either or both of Noise Correction and NFE is on.

Remote Command	`[:SENSe]:ACPower:CORRection:NOISe[:AUTO] OFF | ON | 0 | 1` `[:SENSe]:ACPower:CORRection:NOISe[:AUTO]?`
Example	`:ACP:CORR:NOIS OFF` `:ACP:CORR:NOIS?`
Dependencies	Not available when "Meas Method" on page 963 is RBW or Fast
Preset	0
State Saved	Saved in instrument state
Range	`OFF|ON`

Noise Floor Extension

Lets you turn on/configure the **Noise Floor Extension** (NFE) function. Some Modes (such as Spectrum Analyzer), support two states of NFE, Full and Adaptive. The `ON` state (in Modes that do not support Adaptive NFE) matches the `FULL` state (in Modes that *do* support Adaptive NFE).

In `ON` or `FULL` NFE, the expected noise power of the instrument (derived from a factory calibration) is subtracted from the trace data. This will usually reduce the apparent noise level by about 10 dB in low band, and 8 dB in high band (>~3.6 GHz).

In Adaptive NFE (see "Adaptive NFE" on page 1076 below), there is not the same dramatic visual impact on the noise floor as there is in `FULL` NFE. Adaptive NFE controls the amount of correction that is applied based on other instrument settings like RBW, averaging and sweep time. Adaptive NFE controls the degree of potential improvement in the noise floor to give more improvement for those instrument settings that can make good use of the potential improvement, such as settings that provide more averaging. The result is that when not much averaging is being performed, the signal displays more like the NFE-`OFF` case; and when lots of averaging is being performed, the signal displays more like the `FULL` NFE case.

Adaptive NFE (in Modes that support it) is recommended for general-purpose use. For fully ATE (automatic test equipment) applications, where the distraction of a person using the instrument is not a risk, Full NFE is recommended.

NFE works with any RBW, VBW, detector, any setting of Average Type, any amount of trace averaging, and any signal type. It is ineffective when the trace is not smoothed (smoothing processes include narrow VBWs, trace averaging, and long sweep times with the detector set to Average or Peak). It works best with extreme amounts of smoothing, and with the average detector, with the **Average Type** set to Power.

In those cases where the cancelation is ineffective, it nonetheless has no undesirable side-effects. There is no significant speed impact to having **Noise Floor Extension**ON.

The best accuracy is achieved when substantial smoothing occurs in each point before trace averaging. Thus, when using the average detector, results are better with long sweep times and fewer trace averages. When using the sample detector, the VBW filter should be set narrow with less trace averaging, instead of a wide VBW filter with more trace averaging.

NOTE	**Noise Floor Extension** has no effect unless the RF Input is selected, so it does nothing when External Mixing is selected. In Modes that support Adaptive NFE, the default state of NFE is `ADAptive`. In Modes that do not support Adaptive NFE, the default state of NFE is `OFF`. Prior to the introduction of Adaptive NFE (firmware version A.18.00), the default state of NFE was `OFF` for all Modes.

Remote Command	`[:SENSe]:CORRection:NOISe:FLOor ON | OFF | 1 | 0` `[:SENSe]:CORRection:NOISe:FLOor?`
Example	`:CORR:NOIS:FLO ON`
Dependencies	Only appears in instruments with the NFE or NF2 license installed. In all others, the control does not appear, but the SCPI command is accepted without error (but has no effect) Not available in VXT models M9410A/11A
Couplings	When NFE is enabled in any Mode manually, a prompt is displayed reminding you to perform the Characterize Noise Floor operation if it is needed. If NFE is enabled via SCPI, and a Characterize Noise Floor operation is needed, an error is entered in the system error queue
Preset	Unaffected by **Mode Preset**. Turned ON at startup and by **Restore Mode Defaults** in Modes that support Adaptive. Turned OFF at startup and by **Restore Mode Defaults** in Modes that do not support Adaptive
State Saved	No

Adaptive NFE

Remote Command	`[:SENSe]:CORRection:NOISe:FLOor:ADAptive ON | OFF | 1 | 0` `[:SENSe]:CORRection:NOISe:FLOor:ADAptive?`
Example	`:CORR:NOIS:FLO ON` First turn NFE ON, this is FULL mode

	:CORR:NOIS:FLO:ADAP ON Then set it to ADAptive
Dependencies	Only available in Modes that support Adaptive NFE Only appears in instruments with the NFE or NF2 license installed. In all others, the control does not appear, but the SCPI command is accepted without error (but will have no effect)
Couplings	Sending :CORR:NOIS:FLO ON turns NFE Adaptive OFF for backwards compatibility. So, to turn ADAptive on, you must issue the commands in the proper order, as shown in the example above
Preset	Not affected by **Mode Preset**, but set to ON at startup and by **Restore Mode Defaults**
State Saved	No

More Information

The instrument is characterized in the factory (or during a field calibration) with a model of the noise, referred to the input mixer, versus frequency in each band and path combination. Bands are 0 (low band) and 1 through 4 (high band) in a 26.5 GHz instrument, for example. Paths include normal paths, preamp paths, the electronic attenuator, etc.

In most band/path combinations, the noise can be well characterized based on just two parameters and the instrument frequency response before compensation for frequency-dependent losses.

After the noise density at the input mixer is estimated, the effects of the input attenuator, RBW, detector, etc. are computed to get the estimated input-port-referred noise level.

In the simplest case, the measured power (signal plus analyzer noise) in each display point (bucket) is compensated by subtracting the estimated noise power, leaving just the signal power. This is the operation when the detector is Average, and the Average Type is set to Power.

In other cases, operation is often not quite as good but still highly effective. With peak detection, the noise floor is estimated based on the RBW and the duration of the bucket using the same equations used in the noise marker function. The voltage of the noise is subtracted from the voltage of the observed signal-plus-noise measurement to compute the estimated signal voltage. The peak detector is one example of processing that varies with detector to give good estimates of the signal level without the analyzer noise.

For best operation, the average detector and the power scale are recommended, as already stated. Peak detection for pulsed-RF can still give excellent effectiveness. FFT analysis does not work well, and does not do NFE well, with pulsed-RF signals, so this combination is not recommended. Negative peak detection is not very useful, either. Sample detection works well, but is never better than the average detector because it doesn't smooth as well. The Normal detector is a combination of peak and negative peak behaviors, and works about as well as these.

For best operation, extreme smoothing is desirable, as already stated. Using narrow VBWs works well, but using very long bucket durations and the average detector works best. Reducing the number of trace points will make the buckets longer.

For best operation, the power scale (**Average Type** = Power) is optimum. When making CW measurements in the presence of noise without NFE, averaging on the decibel scale has the advantage of reducing the effect of noise. When using NFE, the NFE does an even better job than using the log scale ever could. Using NFE with the log scale is not synergistic, though; NFE with the power scale works a little better than NFE with log averaging type.

The results from NFE with internal preamp can often be lower than the theoretical noise in a signal source at room temperature, a noise density of -174 dBm/Hz. This is expected and useful behavior, because NFE is designed to report the amount of input signal that is in excess of the thermal noise, not the amount that includes the thermal noise. This can be a useful behavior because thermal noise often interferes with what you want to measure, instead of being part of what you want to measure. Note that NFE is not adequately accurate to always be able to read below kTB.

Adaptive NFE provides an alternative to fully-on and -off NFE. Fully-on NFE can, notably in cases with little or no averaging of the spectrum, result in a display that is distractingly unfamiliar in the variability in response to low level signals. Fully-off NFE fails to achieve the potential improvement in dynamic range and associated accuracy of measurement of low-level signals. Adaptive NFE controls the degree of potential improvement in the noise floor to give more improvement for those instrument settings that can make good use of the potential improvement—those settings with high degrees of variance reduction through some variant of averaging. When the potential improvement is small, the display acts like the NFE-off case, and when it is high, it acts like the fully-on case, and in-between, application is a compromise between attractiveness and effectiveness.

On instruments with the NF2 license installed, the calibrated Noise Floor used by Noise Floor Extensions should be refreshed periodically. Keysight recommends that the **Characterize Noise Floor** operation be performed after the first 500 hours of operation, *and* once every calendar year. The control to perform this is located in the **System, Alignments, Advanced** menu. If you have not done this yourself at the recommended interval, then when you turn on Noise Floor Extensions, the instrument will prompt you to do so with a dialog that says:

```
“This action will take several minutes to perform. Please disconnect all cables
from the RF input and press Enter to proceed. Press ESC to cancel, or Postpone
to postpone for a week.”
```

If you cancel, you will be prompted again the next time you turn NFE on. If you postpone, you will be prompted again after a week passes and you then turn NFE on.

Fast Power RBW Mode

Specifies RBW behavior of Fast Power under **Meas Method**.

Option	SCPI	Description
Best Speed	SPEed	The acquisition RBW is set to be configured for best speed. The RBW is automatically calculated, and is not configurable
Explicit	EXPLicit	You can configure RBW manually

Remote Command	[:SENSe]:ACPower:BANDwidth[:RESolution]:FPOWer:MODE SPEed | EXPLicit [:SENSe]:ACPower:BANDwidth[:RESolution]:FPOWer:MODE?
Example	:ACP:BAND:FPOW:MODE EXPL :ACP:BAND:FPOW:MODE?
Dependencies	Grayed-out when "Meas Method" on page 963 is not Fast Power Not available in VXT models M9410A/11A/15A
Couplings	If EXPLicit is selected, "Res BW" on page 929 is configurable. If not, **Res BW** is grayed-out
Preset	SPEed
State Saved	Saved in instrument state

Fast Power IF Gain Offset

Lets you optimize for dynamic range versus input signal level.

Remote Command	[:SENSe]:ACPower:IF:GAIN:FPOWer <integer> [:SENSe]:ACPower:IF:GAIN:FPOWer?
Example	:ACP:IF:GAIN:FPOW 10 :ACP:IF:GAIN:FPOW?
Dependencies	Grayed-out when "Meas Method" on page 963 is not Fast Power Not available in VXT models M9410A/11A/15A
Preset	0
State Saved	Saved in instrument state
Min/Max	-20/20

Integration BW

Selects an Integration BW passband from either -3 dB (DB3) or -6 dB (DB6).

Remote Command	[:SENSe]:ACPower:FILTer:BANDwidth[:INTegration] DB3 | DB6 [:SENSe]:ACPower:FILTer:BANDwidth[:INTegration]?

Example	`:ACP:FILT:BAND DB3` `:ACP:FILT:BAND?`
Dependencies	Applicable for carriers and offsets whose filter method is not RRC, and when "Meas Method" on page 963 is other than `RBW`
Preset	`DB3`
State Saved	Saved in instrument state
Range	-3 dB|-6 dB

3.5.13.5 Global

The controls in this menu apply to all Modes in the instrument.

Some controls (for example, "Global Center Freq" on page 2013) allow you to switch certain Meas Global parameters to a Mode Global state. These switches apply to all Modes that support global settings. For example, no matter what Mode you are in when you set **Global Center Freq** to `ON`, it applies to all Modes that support Global settings.

Other controls (for example, **Extend Low Band**) are actually set in this menu, but apply to all Modes.

Global Center Freq

The software maintains a Mode Global value called **Global Center Freq**.

When **Global Center Freq** is switched `ON`, the current Mode's center frequency is copied into the **Global Center Frequency**, and from then on all Modes that support global settings use the **Global Center Frequency**, so you can switch between any of these Modes and the **Center Frequency** remains unchanged.

Adjusting the **Center Frequency** of any Mode that supports Global Settings, while **Global Center Freq** is `ON`, modifies the **Global Center Freq**.

When **Global Center Freq** is switched `OFF`, the **Center Frequency** of the current Mode is unchanged, but now the **Center Frequency** of each Mode is once again independent.

When **Mode Preset** is pressed while **Global Center Freq** is `ON`, the **Global Center Freq** is preset to the preset **Center Frequency** of the current Mode.

This function resets to `OFF` when "Restore Defaults" on page 2016 is pressed, or when **System**, **Restore Defaults**, **All Modes** is pressed.

Remote Command	`:INSTrument:COUPle:FREQuency:CENTer ALL | NONE` `:INSTrument:COUPle:FREQuency:CENTer?`
Example	`:INST:COUP:FREQ:CENT ALL`

	:INST:COUP:FREQ:CENT?
Preset	Set to OFF on **Global** Settings, **Restore Defaults** and **System, Restore Defaults, All Modes**
Range	ALL|NONE

Preset	OFF
Backwards Compatibility SCPI	:GLOBal:FREQuency:CENTer[:STATe] 1 | 0 | ON | OFF :GLOBal:FREQuency:CENTer[:STATe]?

Global EMC Std

When this control is switched ON, the current Mode's EMC Std is copied into the **Global EMC Std**, and from then on all Modes that support global settings use the **Global EMC Std**, so you can switch between any of these Modes and the EMC Std remains unchanged.

Adjusting the EMC Std of any Mode that supports Global settings, while **Global EMC Std** is ON modifies the **Global EMC Std**.

When **Global EMC Std** is switched OFF, the EMC Std of the current Mode remains unchanged, but now the EMC Std of each Mode is once again independent. When **Mode Preset** is pressed while **Global EMC Std** is ON, **Global EMC Std** is preset to the preset EMC Std of the current Mode.

This function resets to OFF when "Restore Defaults" on page 2016 is pressed, or when **System, Restore Defaults, All Modes** is pressed.

Remote Command	:INSTrument:COUPle:EMC:STANdard ALL | NONE :INSTrument:COUPle:EMC:STANdard?
Example	:INST:COUP:EMC:STAN ALL :INST:COUP:EMC:STAN?
Dependencies	Only available if Option EMC is installed
Preset	Set to OFF on **Global** Settings, **Restore Defaults** and **System, Restore Defaults, All Modes**
Range	ALL | NONE

Global Limit Lines (Freq and Amptd)

When this control is set to ALL, the current Mode's Limit Line is copied into the **Global Limit Lines**, and from there to all Modes that support Global settings and use **Global Limit Lines**, so you can switch between any of these Modes and the Limit Lines remain unchanged.

Adjusting the Limit Lines of any Mode that supports **Global** Settings, while **Global Limit Lines** is ALL, modifies the **Global Limit Lines**.

When **Global Limit Lines** is set to `NONE`, the Limit Lines of the current Mode are unchanged, but now the Limit Lines of each Mode are once again independent. When **Mode Preset** is pressed while **Global Limit Lines** is `ALL`, **Global Limit Lines** is preset to the preset Limit Lines of the current Mode.

This function is reset to `NONE` when "Restore Defaults" on page 2016 is pressed, or when **System**, **Restore Defaults**, **All Modes** is pressed.

Remote Command	`:INSTrument:COUPle:LLINe ALL | NONE` `:INSTrument:COUPle:LLINe?`
Example	`:INST:COUP:LLIN ALL | NONE` `:INST:COUP:LLIN?`
Preset	Set to `OFF` on **Global** Settings, **Restore Defaults** and **System, Restore Defaults, All Modes**
Range	`ALL | NONE`

Extend Low Band

The software maintains a Mode Global value called **Extend Low Band**.

Under the current sweep configuration crossing over two bands, when **Extend Low Band** is turned `ON`, the instrument checks whether one band can cover the whole sweep frequency range or not. If it can, then the instrument locks the band; otherwise, it does nothing (the band crossover occurs).

This function does *not* work when **Band Lock** under **System** > **Service** > **Lock Functions** is not -1 (no Band Lock). In that case, **Band Lock** takes priority over **Extend Low Band**.

This function resets to `OFF` when "Restore Defaults" on page 2016 is pressed, or when **System**, **Restore Defaults**, **All Modes** is pressed.

Remote Command	`:INSTrument:COUPle:FREQuency:BAND:EXTend 0 | 1 | ON | OFF` `:INSTrument:COUPle:FREQuency:BAND:EXTend?`
Example	`:INST:COUP:FREQ:BAND:EXT 1` `:INST:COUP:FREQ:BAND:EXT?`
Preset	Set to `OFF` by **Global** Settings > **Restore Defaults** and **System** > **Restore Defaults** > **All Modes**
Range	`ON|OFF`

Restore Defaults

Resets all functions in the **Global** settings menu to `OFF`. Pressing **System**, **Restore Defaults**, **All Modes** has the same effect.

Remote Command	`:INSTrument:COUPle:DEFault`

Example	`:INST:COUP:DEF`
Backwards Compatibility SCPI	`:GLOBal:DEFault`

3.5.13.6 Offset RRC Weighting (Backwards Compatibility SCPI)

Example	`:ACP:FILT OFF` `:ACP:FILT?`
Couplings	This command is an alias of: `[:SENSe]:ACPower:OFFSet[1]|2:LIST:FILTer[:RRC][:STATe]` Sending the command sets values of all offsets for BS and MS, but the query always returns a value of BS Offset A
Preset	SA, LTEAFDD, LTEATDD, MSR: `OFF` WCDMA: `ON`
State Saved	Yes

Backwards Compatibility SCPI	`[:SENSe]:ACPower:FILTer[:RRC][:STATe] OFF | ON | 0 | 1`
	`[:SENSe]:ACPower:FILTer[:RRC][:STATe]?`
	`[:SENSe]:ACPR:FILTer[:RRC][:STATe]`
	`[:SENSe]:MCPower:FILTer[:RRC][:STATe]`

3.5.13.7 Offset Filter Alpha (Backward Compatibility SCPI)

Example	`:ACP:FILT:ALPH 0.5` `:ACP:FILT:ALPH?`
Couplings	This command is an alias of: `[:SENSe]:ACPower:OFFSet[1]|2:LIST:FILTer:ALPHa` Sending the command sets values of all offsets for BS and MS, but the query always returns a value of BS Offset A
Preset	0.22
State Saved	Saved in instrument state
Min/Max	0.01/1.00

Backwards Compatibility SCPI	`[:SENSe]:ACPower:FILTer[:RRC]:ALPHa <real>`
	`[:SENSe]:ACPower:FILTer[:RRC]:ALPHa?`
	`[:SENSe]:ACPR:FILTer[:RRC]:ALPHa`
	`[:SENSe]:MCPower:FILTer[:RRC]:ALPHa`

3.5.13.8 Method for Carrier (Backward Compatibility SCPI)

Example	`:ACP:CARR2:LIST:METH RRC` `:ACP:CARR2:LIST:METH?`
Notes	Maximum of Array length depends on the number of carriers
Couplings	This command is an alias of: `[:SENSe]:ACPower:CARRier[1]|2:LIST:FILTer[:RRC][:STATe]` The enum value translates as follows: – RRC Weighted = `1|ON` – Integ BW = `0|OFF` Maximum of Array length depends on the number of carriers
Preset	**Modes** / **Value**: SA: `IBW` WCDMA: `RRC` LTEAFDD, LTEATDD, MSR: `IBW`
State Saved	Saved in instrument state
Backwards Compatibility SCPI	`[:SENSe]:ACPower:CARRier[1]|2:LIST:METHod IBW | RRC, …` `[:SENSe]:ACPower:CARRier[1]|2:LIST:METHod?`

3.5.14 Sweep

Accesses controls to configure and control the acquisition of data, and the X-axis parameters of the instrument.

Depending on the selected mode and measurement, these controls might include: **Sweep Time**, **Continuous/Single**, **Pause/Resume**, **X Scale** and **Number of Points**.

3.5.14.1 Sweep/Control

Accesses controls that let you operate the sweep and control functions of the instrument, such as **Sweep Time** and **Continuous/Single**.

Sweep Time

Controls the time the instrument takes to sweep the current frequency span in swept measurements, displays the sweep time in swept measurements, and displays the equivalent Sweep Time in FFT measurements.

When **Sweep Time** is in Auto, the instrument computes a time that will give accurate measurements based on other settings, such as RBW and VBW.

You can select a shorter sweep time to improve the measurement throughput (with some potential unspecified accuracy reduction), but the **Meas Uncal** indicator will appear if the sweep time you set is less than the calculated Auto Sweep time.

You can also select a longer sweep time, which can be useful (for example) for obtaining accurate insertion loss measurements on very narrowband filters.

NOTE Significantly faster sweep times are available with Option FS1.

NOTE The **Meas Uncal** (measurement uncalibrated) warning is displayed in the Status Bar at the bottom of the screen when the manual Sweep time entered is faster than the time computed by the instrument's Sweep time equations, that is, the Auto Sweep Time. The instrument's computed Sweep time will provide accurate measurements; if you sweep faster than this your measurements may be inaccurate. A **Meas Uncal** condition may be corrected by returning the Sweep Time to Auto; by entering a longer Sweep Time; or by choosing a wider RBW and/or VBW.

NOTE On non-sweeping hardware, this control is grayed-out. The value shown on this control is an estimate. It is the measurement's turnaround time, which is the sum of signal acquisition time, FFT time, and other overhead time, to complete the entire span of the measurement. If you need to specify the same "Sweep Time" as you would for sweeping hardware, send `[:SENSe]:<meas>:SWEep:TIME <time>`. The measurement emulates the "Sweep Time" effect, but this emulation is not straightforward, and therefore the behavior is not specified. Instead, we recommend using Minimum Acquisition Time, which provides better control.

Remote Command	`[:SENSe]:<meas>:SWEep:TIME <time>` `[:SENSe]:<meas>:SWEep:TIME?`

Example	Channel Power measurement:
	`:CHP:SWE:TIME 25ms`
	`:CHP:SWE:TIME?`

Notes	In the ACP measurement in WCDMA Mode, this parameter is preset by **Meas Method** selection. Preset

	values are as follows: – IBW: 29 ms – IBWR: 108 ms – FAST 7.5 ms
Dependencies	On non-sweeping hardware, this control is grayed out, and the Auto/Man toggle disappears. The read-only control shows estimated sweep time In those instruments, "Minimum Acquisition Time" on page 1087 is available
Couplings	Coupled to **Span**, **RBW**, **VBW**, and **Sweep Time Rules** when **Sweep Time** is set to Auto; **Sweep Time** changes when these parameters are changed When you manually set a value when in the **Auto** state, the state automatically changes to **Man**
Preset	Automatically Calculated unless noted below WCDMA Mode – Channel Power: 1.0 msOBW: 32.6 ms – ACP: 29 ms
State Saved	Saved in instrument state
Min	Other than non-sweeping hardware: Typically, 1 ms Non-sweeping hardware: N/A In the ACP measurement, when **Meas Method** is **Fast Power**, the minimum sweep time is span-dependent and automatically calculated
Max	Other than non-sweeping hardware: 4000 s Non-sweeping hardware: N/A
Annotation	The sweep time is displayed in the lower-right corner of the screen. The number of points is displayed parenthetically, as: Sweep 13.3 ms (1001 points) A "#" mark appears before "Sweep" in the annotation when it is switched from Auto to Manual coupling
Status Bits/OPC dependencies	Meas Uncal is Bit 0 in the register: `STATus:QUEStionable:INTegrity:UNCalibrated`

Auto Function

Remote Command	`[:SENSe]:<meas>:SWEep:TIME:AUTO OFF | ON | 0 | 1` `[:SENSe]:<meas>:SWEep:TIME:AUTO?`

Example	Channel Power measurement:
	`:CHP:SWE:TIME:AUTO OFF`
	`:CHP:SWE:TIME:AUTO?`

Preset	WCDMA Mode: `OFF` All others: `ON`

Minimum Acquisition Time

Available on non-sweeping hardware.

Specifies the minimum acquisition time for each “chunk” of the measurement result. The instrument automatically divides Span into multiple chunks if needed. Therefore, the total signal acquisition time for the entire Span is:

~(>~Minimum Acquisition Time) * (The number of chunks)

When in Auto, this parameter’s value is determined by other parameters, such as **Span**, **RBW** and **VBW**.

You can manually increase this parameter value from this Auto value.

If increased, the instrument acquires signal for the specified time duration for each chunk. It performs additional FFTs, and averages or peak-holds the FFT results for a chunk, depending on **Detector** settings.

Note that the actual acquisition time for each chunk may exceed the **Minimum Acquisition Time** value, in order to satisfy FFT time required by other parameters, and to perform an integer number of FFTs.

Remote Command	`[:SENSe]:<meas>:SWEep:ACQuisition:TIME <time>`
	`[:SENSe]:<meas>:SWEep:ACQuisition:TIME?`
	`<meas>` is the identifier for the current measurement; any one of `CHPower-|ACPower|OBWidth|MONitor`

Example	Channel Power measurement
	`:CHP:SWE:ACQ:TIME 500 ms`
	`:CHP:SWE:ACQ:TIME?`

Dependencies	Available only on non-sweeping hardware
Couplings	Coupled to **Span**, **RBW**, and **VBW** when in the Auto state When you manually set a value when in the **Auto** state, the state automatically changes to **Man**
Preset	Automatically calculated
State Saved	Saved in instrument state
Min	100 ns
Max	4.00 ks

Auto Function

Remote Command	`[:SENSe]:<meas>:SWEep:ACQuisition:TIME:AUTO OFF	ON	0	1` `[:SENSe]:<meas>:SWEep:ACQuisition:TIME:AUTO?`

	`<meas>` is the identifier for the current measurement; any one of `CHPower-|ACPower|OBWidth|MONitor`
Example	Channel Power measurement: `:CHP:SWE:ACQ:TIME:AUTO OFF`
Preset	`ON`

Sweep/Measure

Lets you toggle between **Continuous** and **Single** sweep or measurement operation. The single/continuous state is Meas Global, so the setting affects all measurements.

The front-panel key **Single/Cont** performs exactly the same function

See "More Information" on page 1088

Remote Command	`:INITiate:CONTinuous OFF | ON | 0 | 1` `:INITiate:CONTinuous?`

Example	Put instrument into **Single** measurement operation:
	`:INIT:CONT 0`
	`:INIT:CONT OFF`
	Put instrument into **Continuous** measurement operation:
	`:INIT:CONT 1`
	`:INIT:CONT ON`

Preset	`ON` Note that `:SYST:PRES` sets `:INIT:CONT` to `ON`, but `*RST` sets `:INIT:CONT` to `OFF`
State Saved	Saved in instrument state
Annunciation	The **Single/Continuous** icon in the Meas Bar changes depending on the setting: – A line with an arrow is **Single** – A loop with an arrow is **Continuous**
Backwards Compatibility Notes	X-Series A-models had **Single** and **Cont** hardkeys in place of the **SweepSingleCont** softkey. In the X-Series A-models, if in single measurement, the **Cont** hardkey (and `INIT:CONT ON`) switched to continuous measurement, but never restarted a measurement and never reset a sweep X-Series B-models have a **Cont/Single** toggle control instead of **Single** and **Cont** hardkeys, but it is still true that, if in single measurement, the **Cont/Single** toggle control never restarts a measurement and never resets a sweep

More Information

Continuous Mode	The instrument takes repetitive sweeps, averages, measurements, etc., when in continuous mode. If in average or Max/Min Hold, and the average/hold count reaches the **Average/Hold Num**, the count stops incrementing, but the instrument

	keeps sweeping See the **Trace** key description under **Trace Average** for the averaging formula used both before and after the **Average/Hold Num** is reached. The trigger condition must be met prior to each sweep The type of trace processing for multiple sweeps is set under the **Trace** key, with choices of **Trace Average**, **Max Hold**, or **Min Hold**
Single Mode	The instrument takes a single sweep when in **Single** mode, or if in average or Max/Min Hold, or if there is a **Waterfall** window displayed, it takes multiple sweeps until the average/hold count reaches the **Average/Hold Num**, then the count stops incrementing, and the instrument stops sweeping See the **Trace** key description under **Trace Average** for the averaging formula used. The trigger condition must be met prior to the sweep The type of trace processing for multiple sweeps is set under the **Trace** key, with choices of **Trace Average**, **Max Hold**, or **Min Hold**

If the instrument is in **Single** measurement mode, pressing the **Cont/Single** toggle control does not zero the count and does not cause the sweep to be reset; the only action is to put the instrument into Continuous measurement operation.

If the instrument is already in **Continuous** sweep:

– `:INIT:CONT 1` has no effect

– `:INIT:CONT 0` places the instrument in Single Sweep but has no effect on the current sequence until k = N, at which point the current sequence will stop and the instrument will go to the idle state

See "Restart" on page 2018 for details of `:INIT:IMMediate`.

If the instrument is already in **Single** sweep, `:INIT:CONT OFF` has no effect.

If the instrument is already in **Single** sweep, then pressing **Cont/Single** in the middle of a sweep does not restart the sweep or sequence. Similarly, pressing **Cont/Single** does not restart the sweep or sequence if the sweep is not in the idle state (for example, if you are taking a very slow sweep, or the instrument is waiting for a trigger). Even though pressing **Cont/Single** in the middle of a sweep does not restart the sweep, sending `:INIT:IMM` *does* reset it.

If the instrument is in **Single** sweep, and *not* Averaging/Holding, and you want to take one more sweep, press **Restart**.

If the instrument is in **Single** sweep, *and* Averaging/Holding, and you want to take one more sweep without resetting the Average trace or count, go to **Meas Setup** and increment the average count by 1 by pressing the **Step-Up** key while **Average/Hold Num** is the active function. You can also do this by sending `:CALC:AVER:TCON UP`.

Restart

Restarts the current sweep, or measurement, or set of averaged/held sweeps or measurements. If you are Paused, pressing **Restart** performs a Resume.

The front-panel key **Restart** performs exactly the same function.

The **Restart** function is accessed in several ways:

- Pressing the **Restart** key
- Sending `:INIT:IMM`
- Sending `:INIT:REST`

See "More Information" on page 1090

Remote Command	`:INITiate[:IMMediate]` `:INITiate:RESTart`
Example	`:INIT:IMM` `:INIT:REST`
Notes	`:INIT:REST` and `:INIT:IMM` perform exactly the same function
Couplings	Resets average/hold count k. For the first sweep overwrites all active (update = on) traces with new current data. For application modes, it resets other parameters as required by the measurement
Status Bits/OPC dependencies	This is an Overlapped command The `STATus:OPERation` register bits 0 through 8 are cleared , *except* bit 6 (Waiting for Periodic Sync). Initiating a measurement and Waiting for Periodic Sync could be asynchronous The `STATus:QUEStionable` register bit 9 (`INTegrity` sum) is cleared The `SWEEPING` bit is set The `MEASURING` bit is set
Backwards Compatibility Notes	For Spectrum Analysis Mode in ESA and PSA, the **Restart** hardkey and the `:INIT:REST` command restarted trace averages (displayed average count reset to 1) for a trace in **Clear Write**, but did not restart **Max Hold** and **Min Hold** In X-Series, the **Restart** hardkey and the `:INIT:REST` command restart not only **Trace Average**, but **MaxHold** and **MinHold** traces as well

More Information

The **Restart** function first aborts the current sweep or measurement as quickly as possible. It then resets the sweep and trigger systems, sets up the measurement and initiates a new data measurement sequence with a new data acquisition (sweep) taken once the trigger condition is met.

If the instrument is in the process of aligning when a **Restart** is executed, the alignment finishes before the restart function is performed.

Even when set for **Single** operation, multiple sweeps may be taken when **Restart** is pressed (for example, when averaging/holding is on). Thus, when we say that **Restart** "restarts a measurement", depending on the current settings, we may mean that it:

- Restarts the current sweep
- Restarts the current measurement
- Restarts the current set of sweeps if any trace is in Trace Average, Max Hold or Min Hold
- Restarts the current set of measurements if Averaging, or Max Hold, or Min Hold is on for the measurement

If there is no Average or Max/Min Hold function (no trace in Trace Average or Hold, or **Average/Hold Num** set to 1), and no **Waterfall** window is being displayed, a single sweep is equivalent to a single measurement. A single sweep is taken after the trigger condition is met; and the instrument stops sweeping once that sweep has completed. However, with **Average/Hold Num** >1, and at least one trace set to Trace Average, Max Hold, or Min Hold, or a **Waterfall** window being displayed, multiple sweeps/data acquisitions are taken for a single measurement. The trigger condition must be met prior to each sweep. The sweep is stopped when the average count k equals the number N set for **Average/Hold Num**.

Once the full set of sweeps has been taken, the instrument goes to the idle state. To take one more sweep without resetting the average count, increment the average count by 1, by pressing the **Step-Up** key while **Average/Hold Number** is the active function, or by sending the remote command `:CALC:AVER:TCON UP`.

Trace Update

The numeric results are not blanked at any time during the restart cycle.

For slow sweeps (see **Trace Update** section in **Trace/Detector**), the traces are updated real-time during the sweep. There may be a special circumstance in application mode measurements where an exception is made and the traces and/or results need to be blanked before displaying the new results.

To summarize, the following list shows what happens to the trace data on various events:

Event	Trace Effect
Clear/Write pressed (even if already in Clear/Write)	Set to mintracevalue
Max Hold pressed (even if already in Max Hold)	Set to mintracevalue

Event	Trace Effect
Min Hold pressed (even if already in Min Hold)	Set to maxtracevalue
Trace Average pressed (even if already in Trace Average)	Trace data unaffected but start new sweep/avg/hold
Restart pressed	Trace data unaffected but start new sweep/avg/hold
Parameter requiring restart changed (e.g., RBW)	Trace data unaffected but start new sweep/avg/hold

Sweep and Trigger Reset

Resetting the sweep system resets the average/hold count k to 0. It also resets the set point counter to 0. Resetting the trigger system resets the internal auto trig timer to the value set by the **Auto Trig** control.

Averaging

The weighting factor used for averaging is k. This k is also the average/hold count for how many valid sweeps (data acquisitions) have been done. This k is used for comparisons with N, as those comparisons always needs to be based on valid completed sweeps.

The displayed average/hold, K, shows the count for the sweep (data acquisition) in progress. K = k + 1, with a limit of N. The displayed value K changes from its previous value to 1 as soon as the trigger condition for the first data acquisition (sweep) is met.

Pause/Resume

Pauses a measurement after the current data acquisition is complete.

When paused, the label on the control changes to **Resume**. Pressing **Resume** un-pauses the measurement. When paused, pressing **Restart** performs a Resume.

Remote Command	`:INITiate:PAUSe` `:INITiate:RESume`
Example	`:INIT:PAUS` `:INIT:RES`
Dependencies	Not displayed in Modes that do not support pausing
Annotation	Only on control

Abort (Remote Command Only)

Stops the current measurement. Aborts the current measurement as quickly as possible, resets the sweep and trigger systems, and puts the measurement into an "idle" state. If the instrument is in the process of aligning when `:ABORt` is sent, the alignment finishes *before* the abort function is performed, so `:ABORt` does not abort an alignment.

If the instrument is set for **Continuous** measurement, it sets up the measurement and initiates a new data measurement sequence with a new data acquisition (sweep) taken once the trigger condition is met.

If the instrument is set for **Single** measurement, it remains in the "idle" state until an `:INIT:IMM` command is received.

Remote Command	`:ABORt`
Example	`:ABOR`
Notes	If :`INIT:CONT` is `ON`, then a new continuous measurement will start immediately, with sweep (data acquisition) occurring once the trigger condition has been met If :`INIT:CONT` is `OFF`, then `:INIT:IMM` is used to start a single measurement, with sweep (data acquisition) occurring once the trigger condition has been met
Dependencies	For continuous measurement, `:ABORt` is equivalent to the **Restart** key Not all measurements support this command
Status Bits/OPC dependencies	The `STATus:OPERation` register bits 0 through 8 are cleared , *except* bit 6 (Waiting for Periodic Sync). Initiating a measurement and Waiting for Periodic Sync could be asynchronous The `STATus:QUEStionable` register bit 9 (`INTegrity` sum) is cleared Since all the bits that feed into OPC are cleared by `:ABORt`, the Abort command will cause the `*OPC` query to return true

Sweep Time Annotation (Remote Query Only)

Returns the **Sweep Time Annotation** value. Available only on non-sweeping hardware.

This value is also displayed in the result trace window.

The value returned is the estimated turnaround time of each measurement cycle, in seconds. The turnaround time is the sum of the signal acquisition time, FFT time, and other overhead time, to complete the entire span of each measurement cycle.

Remote Command	`[:SENSe]:<meas>:SWEep:ETIMe?` `<meas>` is the identifier for the current measurement; any one of `CHPower|ACPower|OBWidth|MONitor`
Example	Channel Power measurement

	:CHP:SWE:ETIMe?
Dependencies	Available only on non-sweeping hardware
Preset	Automatically calculated

3.5.14.2 Sweep Config

Accesses controls that enable you to configure the Sweep and Control functions of the instrument.

Sweep Time Rules

Switches the instrument between NORMal and ACCuracy sweep states.

Setting Auto Sweep Time to ACCuracy results in slower sweep times, usually about three times as long, but yields better amplitude accuracy for CW signals. The instrument amplitude accuracy specifications only apply when Auto Sweep Time is set to ACCuracy.

Additional amplitude errors that occur when Auto Sweep Time is set to NORMal are usually well under 0.1 dB, though this is not guaranteed. Because of the faster sweep times and still low errors, NORMal is the preferred setting of Auto Sweep Time. Auto Sweep Time is set to NORMal on a Preset. This means that in the Preset state, instrument amplitude accuracy specifications do not apply.

Remote Command	[:SENSe]:ACPower:SWEep:TIME:AUTO:RULes NORMal | ACCuracy [:SENSe]:ACPower:SWEep:TIME:AUTO:RULes?
Example	:ACP:SWE:TIME:AUTO:RUL NORM :ACP:SWE:TIME:AUTO:RUL?
Dependencies	Does not appear in Spectrum Analyzer Mode in VXT model M9420A
Preset	(see table below)
State Saved	Saved in instrument state
Range	NORMal|ACCuracy

Preset:

Modes, Instruments	Value
SA, WCDMA, LTEAFDD, LTEATDD, MSR	ACCuracy
5G NR	NORMal
5G NR in VXT models M9410A/11A/15A	ACCuracy

Points

Sets the number of points taken per sweep, and displayed in the traces. The current value of points is displayed parenthetically, next to the sweep time in the lower-right corner of the display. Using more points provides greater resolution. Using fewer points compacts the data and decreases the time required to access a trace over the remote interface.

Increasing the number of points does not increase the sweep time. However, it can slightly impact the trace processing time and therefore the overall measurement speed. Decreasing the number of points does not decrease the sweep time, but it may speed up the measurement, depending on the other sweep settings (for example, in FFT sweeps). Fewer points will always speed up the I/O.

Due to minimum sweep rate limitations of the hardware, the minimum sweep time available will increase above its normal value of 1 ms as the number of sweep points increases above 15001.

Changing the number of sweep points has several effects on the instrument. Since markers are read at the point location, the marker reading may change. The sweep time resolution changes. Trace data for all the traces is cleared and, if **Sweep** is in **Cont**, a new trace is taken. If any trace is in average or hold, the averaging starts over.

Because of sweep time quantization issues, the knob and up/down keys cannot be used to adjust the number of points.

When in a split screen display each window may have its own value for points.

When sweep points is changed, an informational message "Sweep points changed, all traces cleared" is displayed and in 5G NR Mode, **Auto Sweep Points** is set to `OFF` (0).

Remote Command	`[:SENSe]:ACPower:SWEep:POINts <integer>` `[:SENSe]:ACPower:SWEep:POINts?`
Example	`:ACP:SWE:POIN 500` `:ACP:SWE:POIN?`
Dependencies	Not available when Signal ID is On in External Mixing Neither the knob nor the step keys can be used to change this value. If it is tried, a warning is given Not displayed in Modes that do not support **Swept** This parameter is automatically calculated and not configurable when **Meas Method** is set to Fast Power
Couplings	Whenever the number of sweep points change: – All trace data is erased – Any traces with Update Off will also go to Display OffSweep time is re-quantized – Any limit lines that are on will be updated – If averaging/hold is on, averaging/hold starts over – **Auto Sweep Points** is set to `OFF` (5G NR Mode only)

	The resolution of setting the sweep time depends on the number of points selected	
Preset	5G NR Mode, in all models except M9410A/11A/15A	5001
	All others	1001
State Saved	Saved in instrument state	
Min	1	
Max	20001	
Annotation	On second line of annotations, in lower right corner in parenthesis behind the sweep annotation	

IF Dithering

Lets you turn IF Dithering on or off. This is a technique used in unpreselected instruments (such as Keysight's modular instruments) to enhance the rejection of images and internally-generated spurious signals.

Remote Command	`[:SENSe]:SWEep:IF:DITHer OFF | ON | 0 | 1` `[:SENSe]:SWEep:IF:DITHer?`
Dependencies	Only appears in Spectrum Analyzer Mode in VXT models
Preset	`OFF`
State Saved	Saved in instrument state

Image Protection

Lets you turn IF Protection on or off. This is a technique used in unpreselected instruments (such as Keysight's modular instruments) to detect and suppress images and spurs that may be present in non-preselected hardware.

IF Protection takes two sweeps and by correlating the data between them, provides a single, correct power-versus-frequency trace.

Remote Command	`[:SENSe]:SWEep:IMAGeprot OFF | ON | 0 | 1` `[:SENSe]:SWEep:IMAGeprot?`
Dependencies	Only appears in Spectrum Analyzer Mode in VXT models
Preset	`ON`
State Saved	Saved in instrument state

3.5.14.3 X Scale

Accesses controls that enable you to set the horizontal scale parameters.

Auto Scaling

Toggles the scale coupling function On or Off.

Remote Command	`:DISPlay:ACPower:VIEW[1]:WINDow[1]:TRACe:X[:SCALe]:COUPle 0 | 1 | OFF | ON` `:DISPlay:ACPower:VIEW[1]:WINDow[1]:TRACe:X[:SCALe]:COUPle?`
Example	`:DISP:ACP:WIND:TRAC:X:COUP ON` `:DISP:ACP:WIND:TRAC:X:COUP?`
Couplings	When **Auto Scaling** is ON and the "Restart" on page 2018 front-panel key is pressed, this function automatically determines the scale per division and reference values based on the measurement results When you set a value to either **Scale/Div** or **Ref Valu**e manually, **Auto Scaling** automatically changes to OFF
Preset	OFF
State Saved	Saved in instrument state
Range	OFF|ON
Backwards Compatibility SCPI	`:DISPlay:ACPower:VIEW[1]:WINDow[1]:TRACe:X[:SCALe]:COUPle`

3.5.15 Trace

Lets you control the acquisition, display, storage, detection and manipulation of trace data for the available traces. The Trace Control tab of this menu contains radio-button selections for the trace type (**Clear/Write, Trace Average, Max Hold, Min Hold**) and **View/Blank** setting for the selected trace.

For the Spectrum Analyzer Mode, when in **Single** Mode, Measurements and their Views save the trace data from the last acquisition. This is true for multiple screens. The marker and trace data will be present whenever the measurement is brought back into focus. The measurement switches for these measurements do not clear the traces, so the data will be present until the next acquisition is completed.

3.5.15.1 Select Trace

Specifies the *selected trace*, which is the trace that will be affected when you change trace settings.

Select Trace appears above the menu panel, indicating that it applies to *all* controls in the menu panel. **Select Trace** is blanked if you select a tab whose controls do *not* depend on the selected trace (for example, **Trace Function**).

Notes	The selected trace is remembered even when not in the **Trace** menu
Dependencies	For the Swept SA measurement: – In Image Suppress mode, when you select a trace it becomes the active trace, and the formerly active trace goes into View – When you turn on Image Suppress, Update turns off for all traces except the selected trace For the ACP measurement, when **Meas Method** is `RBW`, `FAST` or `FPOWer`, **Select Trace** is disabled
Preset	Trace 1
State Saved	Yes

3.5.15.2 Trace Control

The controls on this tab allow you to set the "Trace Type" on page 1905 and its update mode.

There are four Trace Types:

- Clear/Write
- Trace Average
- Max Hold
- Min Hold

Each type handles data in a different way.

Each trace also has two values that determine whether it is being written or not, and whether it is being displayed or not. These values, **Update** and **Display,** are described fully in the "View/Blank" on page 1721 control description. Essentially, when **Update** is `ON`, a trace is updating, and when **Update** is `OFF` it is not. When **Display** is `ON`, it is visible and when **Display** is `OFF` it is not. These terms are used throughout the descriptions in this section.

Trace Type

There are four trace Types:

Option	Parameter	SCPI Example	Details
Clear/Write	`WRITe`	`:TRAC2:TYPE WRIT`	See: "Clear/Write" on page 1101
Trace Average	`AVERage`	`:TRAC2:TYPE AVER`	See: "Trace Average" on page 1102
Maximum Hold	`MAXHold`	`:TRAC3:TYPE MAXH`	See: "Max Hold" on page 1102
Minimum Hold	`MINHold`	`:TRAC5:TYPE MINH`	See: "Min Hold" on page 1103

Full descriptions of each type are provided below. You may select one of these types for each trace. Re-selecting the current **Trace Type** initiates the same action that selecting it the first time did, even though it is already selected. For example, selecting **Clear/Write** while **Clear/Write** is already selected will nonetheless clear the trace and begin rewriting it.

Besides the **Trace Type**, the "View/Blank" on page 1721 state must be set to **Active** (**Update**: `ON`, **Display**: `ON`) for a trace to be updating and visible. Selecting any **Trace Type** automatically makes the trace **Active**.

See also: "Trace Mode Backwards Compatibility Commands" on page 1099

Remote Command	For Swept SA Measurement (in SA Mode): `:TRACe[1]|2|…|6:TYPE WRITe	AVERage	MAXHold	MINHold` `:TRACe[1]|2|…|6:TYPE?` For all other measurements: `:TRACe[1]|2|3:<meas>:TYPE WRITe	AVERage	MAXHold	MINHold` `:TRACe[1]|2|3:<meas>:TYPE?` where `<meas>` is the identifier for the current measurement
Example	`:TRAC:TYPE WRIT` `:TRAC:TYPE?`
Couplings	Selecting a **Trace Type** (by pressing any of the Trace Type selections or sending `:TRAC:TYPE`) sets the Trace to **Active** (**Update**: `ON`, **Display**: `OFF`), even if the same trace type was already selected When Detector setting is "Auto" (`[:SENSe]:<meas>:DETector:AUTO?)`, Detector `([:SENSe]:<meas>:DETector[:FUNCtion]?`) switches aligning with the switch of this parameter: "`NORMal`" with `WRITe` (Clear Write), "`AVERage`" with `AVERage`, "`POSitive` (peak)" with `MAXHold`, and "`NEGative` (peak)" with `MINHold`
Preset	Swept SA and Monitor Spectrum: `WRITe` All other measurements: `AVERage` Following **Preset**, all traces are cleared (all trace points set to mintracevalue)
State Saved	The type of each trace is saved in instrument state
Annunciation	The type for each trace is indicated in the Trace annunciator panel on the Measurement Bar

Trace Mode Backwards Compatibility Commands

In earlier instruments, the "Trace Modes" were: Clear/Write, Max Hold, Min Hold, View and Blank. Averaging was global to all traces and was controlled under the **BW/Avg** menu.

In X-Series, trace averaging can be done on a per-trace basis. The Trace Modes (now called Trace Types) are Clear/Write, Trace Average, Max Hold and Min Hold. View and Blank are set separately under "View/Blank" on page 1721.

While this provides more flexibility, it also gives rise to potential backwards compatibility problems. To mitigate these, the old Trace Mode command has been retained and a new Trace Type command has been added. The :TRACe:MODE command is retained for backwards compatibility, and the :TRACe:TYPE, :TRACe:UPDate and :TRACe:DISPlay commands introduced for ongoing use. The old Trace Modes are selected using :TRAC:MODE, whose parameters are mapped into calls to :TRACe:TYPE, :TRACe:UPDate and :TRACe:DISPlay, and the old global Averaging command [:SENSe]:AVERage[:STATe] is provided for backwards compatibility. See the individual command descriptions for details.

When **Average/Hold** in the **Meas Setup**, **Legacy Compatibility** menu is ON, the following is true for traces in Max Hold and Min Hold:

- They ignore the **Average/Hold** number; **Single** for Max Hold causes one sweep only, so switching to **Single** stops after the current sweep, and switching to **Cont** starts again without clearing the accumulated result
- Max Hold is not cleared on a **Restart**, **Single** or :INIT:IMM, but changing a measurement parameter, like frequency or bandwidth etc., still restarts the Max Hold

Preset	WRITe
State Saved	The trace mode is an alias only
Backwards Compatibility SCPI	:TRACe[1]|2|…|6:MODE WRITe | MAXHold | MINHold | VIEW | BLANk :TRACe[1]|2|…|6:MODE?
Backwards Compatibility Notes	The legacy :TRACe:MODE command is retained for backwards compatibility. In conjunction with the legacy :AVErage command, it works as follows: – :AVErage ON|OFF sets/clears a variable that we will call average for the sake of this discussion. This variable is maintained by the instrument solely for backwards compatibility. See the [:SENSe]:AVERage[:STATe] command description below – :TRACe:MODE WRITe sets :TRACe:TYPE WRITe (Clear/Write) unless average is true, in which case it sets it to :TRACe:TYPE AVErage. It also sets :TRACe:UPDate ON, :TRACe:DISPlay ON, for the selected trace – :TRACe:MODE MAXHold sets :TRACe:TYPE MAXHold (Max Hold). It also sets :TRACe:UPDate ON, :TRACe:DISPlay ON, for the selected trace – :TRACe:MODE MINHold sets :TRACe:TYPE MINHold (Min Hold). It also sets :TRACe:UPDate ON, :TRACe:DISPlay ON, for the selected trace – :TRACe:MODE VIEW sets :TRACe:UPDate OFF, :TRACe:DISPlay ON, for the selected trace – :TRACe:MODE BLANk sets :TRACe:UPDate OFF, :TRACe:DISPlay OFF, for the selected trace The query returns the same value as :TRACe:TYPE?, meaning that if you set :TRACe:MODE:VIEW or :TRACe:MODE:BLANk, the query response will not be what you sent

`:TRACe[n]:MODE` was formerly used to set the type or "writing mode" of the trace. At that time, View and Blank were writing modes. The new `:TRACe:TYPE` command should be used in the future, but `:TRACe:MODE` is retained to provide backwards compatibility

In X-Series, unlike earlier instruments, Max Hold and Min Hold now obey the Average Number and counts up to a terminal value as Average always has

As the **Average/Hold Number** now affects **Min Hold** and **Max Hold**, the operations that restart Averaging (for example, the **Restart** key) now also restart **Min Hold** and **Max Hold**

As a result of these changes, legacy code that restarts averaging while retaining a running Max Hold will need to be rewritten, because the Max Hold will now restart when the Average does

Also, previous to X-Series:

- Pressing **Max Hold** while already in **Max Hold** (or doing so remotely) had no effect. Now it will clear the trace and restart the sweep and the Max Hold sequence
- Changing the vertical scale (Log/Lin or dB/div) of the display restarted **Max Hold** and **Min Hold**. This is no longer the case

Preset	`OFF`
State Saved	The state of Average is saved in Instrument State for ghosting purposes
Backwards Compatibility SCPI	`[:SENSe]:AVERage[:STATe] ON | OFF | 1 | 0` `[:SENSe]:AVERage[:STATe]?`
Backwards Compatibility Notes	Previous to X-Series, Averaging (also sometimes known as trace averaging) was global to all traces, that is, it was either on or off for all active traces. The legacy command `[:SENSe]:AVERage [:STATe] ON|OFF|1|0` was used to turn Averaging on or off In X-Series, Averaging is turned on or off on a per-trace basis, so it can be on for one trace and off for another For backwards compatibility, the old global Average State variable is retained solely as a legacy variable, turned on and off and queried by the legacy command `[:SENSe]:AVERage[:STATe] OFF|ON|0|1.` When Average is turned on, any trace in Clear/Write will get put into Average. While Average is on, any trace put into Clear/Write by the old `:TRAC:MODE` command will instead get put into Average. When Average is turned off, any trace in Average will get put into Clear/Write

Trace Type Details

Clear/Write

Each trace update replaces the old data in the trace with new data.

Pressing **Clear/Write** for the selected trace, or sending `:TRAC:TYPE WRIT` for the specified trace, sets the trace type to **Clear/Write** and clears the trace, even if you are already in **Clear/Write**. Then a new sweep is initiated. Trigger conditions must be met before the sweep actually starts, and if in **Single** the sweep won't start until **Restart** is pressed.

Pressing **Clear/Write** stops the current sweep and initiates a new one, so **Trace Average, Max Hold** and **Min Hold** data may be interrupted in mid-sweep when **Clear/Write** is pressed, and therefore may not accurately reflect the displayed count. Therefore, when **Clear/Write** is pressed for one trace, **Trace Average, Max Hold** and **Min Hold** must restart for all traces.

When in **Clear/Write**, if a measurement-related instrument setting is changed (that is, one which requires new data to be taken, like **Center Frequency** or **Attenuation**), a new sweep is initiated but the trace is not cleared.

Trace Average

The instrument maintains and displays an average trace, which represents the cumulative average on a point-by-point basis of the new trace data and previous averaged trace data.

Pressing **Trace Average** (for the selected trace), or sending `:TRAC:TYPE AVER` (for the specified trace), sets the trace type to **Trace Average**, clears the trace, initiates a new sweep, and restarts the Average sequence.

Details of the count limiting behavior and the averaging calculations may be found under **Avg|Hold Number** and **Average Type** under **Meas Setup.**

When in **Trace Average**, if a measurement-related instrument setting is changed (that is, one which requires new data to be taken, like Center Frequency or Attenuation), the average restarts and a new sweep is initiated but the trace is not cleared.

Restarting the average means:

- The average/hold count k is set to 1, so that the next time the average trace is displayed it simply represents one trace of new data
- A new sweep is initiated
- Once the new sweep starts, the trace is overwritten with current trace data as the first trace of the new average

Remember that restarting averaging also restarts **Max Hold** and **Min Hold**, as there is only one count for Trace Average and Hold.

Max Hold

The instrument maintains and displays a max hold trace, which represents the maximum data value on a point-by-point basis of the new trace data and previous trace data. Details of the count limiting behavior may be found under **Avg|Hold Number** under **Meas Setup.**

Pressing **Max Hold** for the selected trace, or sending `:TRAC:TYPE MAXH` for the specified trace, sets the Trace Type to **Max Hold,** clears the trace , initiates a new sweep, and restarts the hold sequence, even if you are already in **Max Hold**.

When in **Max Hold**, if a measurement-related instrument setting is changed(that is, one which requires new data to be taken, like **Center Frequency** or **Attenuation**), the **Max Hold** sequence restarts and a new sweep is initiated but the trace is not cleared.

Restarting the **Max Hold** sequence means:

- The average/hold count k is set to 1, so that the next time the max hold trace is displayed it simply represents one trace of new data
- A new sweep is initiated.

Remember that restarting **Max Hold** also restarts averaging and **Min Hold**, as there is only one count for Trace Average and Hold.

Min Hold

The instrument maintains and displays a min hold trace, which represents the minimum data value on a point-point basis of the new trace data and previous trace data. Details of the count limiting behavior may be found under **Avg|Hold Number** under the **Meas Setup** functions.

Pressing **Min Hold** for the selected trace, or sending `:TRAC:TYPE MINH` for the specified trace, sets the Trace Type to **Min Hold,** clears the trace, initiates a new sweep, and restarts the hold sequence, even if you are already in **Min Hold**.

When in **Min Hold**, if a measurement-related instrument setting is changed(that is, one which requires new data to be taken, like **Center Frequency** or **Attenuation**), the **Min Hold** sequence restarts and a new sweep is initiated but the trace is not cleared.

Restarting the **Min Hold** sequence means:

- The average/hold count k is set to 1, so that the next time the min hold trace is displayed it simply represents one trace of new data
- A new sweep is initiated

Remember that restarting **Min Hold** also restarts **Max Hold** and averaging, because there is only one count for Trace Average and Hold.

Clear and Write | Restart Averaging | Restart Max/Min Hold

Starts the trace writing, as though the "Trace Type" on page 1905 had just been selected. The effect is exactly the same as reselecting the current **Trace Type** again

– the control is provided because it may not be obvious that reselecting the same selection from a radio button menu will take any action.

This control displays different labels, depending on the selected Trace Type:

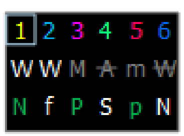
- **Clear/Write**: Clear and Write
- **Trace Average**: Restart Averaging
- **Max Hold**: Restart Max Hold
- **Min Hold**: Restart Min Hold

View/Blank

Lets you set the state of the two trace variables: **Update** and **Display**. The choices available in this dropdown menu are:

Active	Update and Display both ON
View	Update OFF; Display ON
Blank	Update OFF; Display OFF
Background	Update ON, Display OFF Allows a trace to be blanked *and* continue to update "in the background", which was not possible in the past

In the Swept SA measurement, a trace with **Display**OFF is indicated by a strikethrough of the type letter in the trace annotation panel in the Measurement Bar. A trace with **Update**OFF is indicated by dimming the type letter in the trace annotation panel in the Measurement Bar. In the example below, Traces 3, 4, 5 and 6 have **Update**OFF, and Traces 4 and 6 have **Display**OFF.



See: "More Information" on page 1106

Notes	For the commands to control the two variables, Update and Display, see "Trace Update State On/Off" on page 1105 and "Trace Display State On/Off" on page 1105 below
Dependencies	When Signal ID is on, this key is grayed-out
Couplings	Selecting a Trace Type for a trace (pressing the key or sending the equivalent command) puts the trace in **Active** (Update ON and Display ON), even if that trace type was already selected Selecting a detector for a trace (pressing the key or sending `[:SENS]:DET:TRAC`) puts the trace in **Active** (**Update**ON and **Display**ON), even if that detector was already selected Selecting a "Math Function" on page 1724 other than OFF for a trace (pressing the key or sending the equivalent command) puts the trace in **Active** (**Update**ON and **Display**ON), even if that Math Mode was

already selected

Loading a trace from a file puts that trace in **View** regardless of the state it was in when it was saved; as does being the target of a **Copy** or a participant in an **Exchange**

Trace Update State On/Off

Remote Command	For Swept SA Measurement (in SA Mode):
	`:TRACe[1]|2|…|6:UPDate[:STATe] ON | OFF | 1 | 0`
	`:TRACe[1]|2|…|6:UPDate[:STATe]?`
	For all other measurements:
	`:TRACe[1]|2|3:<meas>:UPDate[:STATe] ON | OFF | 1 | 0`
	`:TRACe[1]|2|3:<meas>:UPDate[:STATe]?`
	where <meas> is the identifier for the current measurement

Example	Make trace 2 inactive (stop updating): `:TRAC2:UPD 0`
Couplings	Whenever you set **Update** to ON for any trace, the **Display** is set to ON for that trace

Preset	For Swept SA Measurement (in SA Mode):
	`1|0|0|0|0|0`
	ON for Trace 1; OFF for 2–6
	For all other measurements:
	`1|0|0`
	ON for Trace 1; OFF for 2 &3

State Saved	Saved in instrument state

Trace Display State On/Off

Remote Command	For Swept SA Measurement (in SA Mode):
	`:TRACe[1]|2|…|6:DISPlay[:STATe] ON | OFF | 1 | 0`
	`:TRACe[1]|2|…|6:DISPlay[:STATe]?`
	For all other measurements:
	`:TRACe[1]|2|3:<meas>:DISPlay[:STATe] ON | OFF | 1 | 0`
	`:TRACe[1]|2|3:<meas>:DISPlay[:STATe]?`
	where <meas> is the identifier for the current measurement

Example	Make trace 1 visible:
	`:TRAC2:DISP 1`
	Blank trace 3:
	`:TRAC3:DISP 3`

Couplings	Whenever you set **Update** to ON for any trace, the **Display** is set to ON for that trace

Preset	For Swept SA Measurement (in SA Mode):
	`1|0|0|0|0|0`
	`ON` for Trace 1; `OFF` for 2–6
	For all other measurements:
	`1|0|0`
	`ON` for Trace 1; `OFF` for 2 &3

State Saved	Saved in instrument state

More Information

When a trace becomes inactive, any update from the `:SENSe` system (detectors) immediately stops, without waiting for the end of the sweep. The trace data remains unchanged, but stops updating. If the trace is blanked, this still does not affect the data in the trace. Traces that are blanked (**Display**=`OFF`) do not display nor appear on printouts, but their data stays intact, they may be queried, and markers may be placed on them

In most cases, inactive traces are static and unchanging; however, there are cases when an inactive trace will update, specifically:

– if data is written to that trace from remote

– if trace data is loaded from mass storage

– if the trace is the target of a **Copy** or participant in an **Exchange**

– if the trace is cleared using **Clear Trace**

Inactive traces that are also being displayed (traces in **View**) are displayed at half intensity. Traces in **View** display across the entire X-Axis of the instrument. Their horizontal placement does not change, even if X-Axis settings subsequently are changed, although Y-Axis settings do affect the vertical placement of data.

When a trace becomes active (**Update**=`ON`), the trace is cleared, the average count is reset, and a new sweep is initiated.

Note that putting a trace into **Display**=`OFF` and/or **Update**=`OFF` does *not* restart the sweep and does *not* restart Averaging or Hold functions for any traces.

3.5.15.3 Math

Lets you turn on and configure Trace Math functions.

Math Function

Trace Math functions perform mathematical operations between traces and, in some cases, user-specified offsets. When in a Trace Math function, the indicated function is performed during the sweep with the math function used in place of a detector. The trace operands for the math function are set using the "Operand 1 / Operand 2" on page 1730 controls.

– See "How trace math is processed" on page 1111

Remote Command

For option details, see "Trace Math Options" on page 1109

For Swept SA Measurement (in SA Mode):

```
:CALCulate:MATH <trace_num>, PDIFference | PSUM | LOFFset | LDIFference |
OFF, <trace_num>, <trace_num>, <real>,<real>
```

```
:CALCulate:MATH? <trace_num>
```

where `<trace_num>` is any one of:

`TRACE1|…|TRACE6`

For all other measurements:

```
:CALCulate:<meas>:MATH <trace_num>, PDIFference | PSUM | LOFFset |
LDIFference | OFF, <trace_num>, <trace_num>, <real>,<real>
```

```
:CALCulate[:<meas>]:MATH? <trace_num>
```

where:

`<meas>` is the identifier for the current measurement, and

`<trace_num>` is any one of:

`TRACe1|TRACe2|TRACe3`

Note that the format of the `TRACe<n>` parameter differs from that for the Swept SA Measurement

Example

```
:CALC:MATH TRACE3,PDIF,TRACE1,TRACE2,0,0
```

Sets Trace 3 to Power Diff trace math function, and sets the First Trace operand (for Trace 3) to Trace 1 and the Second Trace operand (for Trace 3) to Trace 2

```
:CALC:MATH TRACE3,PSUM,TRACE1,TRACE2,0,0
```

Sets Trace 3 to Power Sum trace math function and sets the First Trace operand (for Trace 3) to Trace 1 and the Second Trace operand (for Trace 3) to Trace 2

```
:CALC:MATH TRACE3,LOFF,TRACE1,TRACE2,-6.00,0
```

Sets Trace 3 to Log Offset trace math function, sets the First Trace operand (for Trace 3) to Trace 1, leaves the Second Trace operand (for Trace 3) unchanged (it is irrelevant for this function) and sets the Log Offset (for Trace 3) to -6 dB

```
:CALC:MATH TRACE3,LDIF,TRACE1,TRACE2,0,-6.00
```

Sets Trace 3 to Log Diff trace math function, sets the First Trace operand (for Trace 3) to Trace 1, sets the Second Trace operand (for Trace 3) to Trace 2, and sets the Log Difference reference (for Trace 3) to -6 dBm

```
:CALC:MATH TRACE1,OFF,TRACE2,TRACE3,0,0
```

	Turns off trace math for trace 1

Notes	The Trace Math Function command has 6 main set of parameters:
	- Set 1 defines the “result trace”:
	`TRACE1|…|TRACE6`
	-Set 2 defines the “function”:
	`PDIFference|PSUM|LOFFset|LDIFference|OFF`
	- Set 3 is a “trace operand” (1):
	`TRACE1|…|TRACE6`
	- Set 4 is a “trace operand” (2):
	`TRACE1|…|TRACE6`
	- Set 5 defines the “Log Offset” (in dB)
	- Set 6 defines the “Log Difference Reference” (in dBm)
	Note that the trace math mode is an enumeration; that is, when a math function is set for a trace, it turns off any math function that is on for that trace, then sets the new math function
	The parameters sent in the command are reflected in the values in the control menu. There is no default for any parameter; all 6 parameters must be sent to satisfy the parser. Failure to specify a parameter will result in a missing parameter message
	The query returns the math mode, the operand traces, the offset and the reference for the specified trace, all separated by commas

Dependencies	Trace Math is not available if **Normalize** is on Trace Math is not available if Signal ID is on None of the trace operands can be the destination trace. If any of the three trace math commands is sent with a destination trace number matching one of the operands, a warning is generated and the function does not turn on
Couplings	When a math function is changed for a trace, that trace is set to Display = ON; and Update = ON
Preset	For Swept SA Measurement (in SA Mode): `OFF,TRACE5,TRACE6,0,0	OFF,TRACE6,TRACE1,0,0	OFF,TRACE1,TRACE2,0,0	OFF,TRACE2,TRACE3,0,0	OFF,TRACE3,TRACE4,0,0	OFF,TRACE4,TRACE5,0,0` For all other measurements: `OFF,TRACE2,TRACE3,0,0	OFF,TRACE3,TRACE1,0,0	OFF,TRACE1,TRACE2,0,0`
State Saved	The trace math function for each trace is saved in instrument state
Annunciation	An “f” is shown on the trace annunciation panel in the Measurement Bar when a math function is on; and the function is annotated on the trace if Trace Annotation is on
Status Bits/OPC dependencies	*OPC can be used to detect the completion of a sweep, which will also correspond to the completion of the math operation, since all math takes place during the sweep

Trace Math Options

IMPORTANT

To generate a trace math result, *you must take a sweep*. The trace math engine, described below, operates in concert with the sweep engine in the instrument. Until a sweep has been taken, even if the constituent traces are not in Update mode, no result is generated.

Note that certain events can affect the trace in ways that affects all points at once. This can happen in any number of ways, including:

- A trace clear taking place
- A trace being loaded from the file system
- Trace data being sent in from the remote interface
- A copy or exchange of trace data

You should try to avoid these occurrences during a sweep, as they will tend to invalidate the math result being accumulated.

The Trace Math functions are:

Power Diff (Op1 - Op2)

Calculates a power difference between the `First Trace` operand and the `Second Trace` operand and puts the result in the destination trace.

During the sweep, the following formula is executed for each point in the trace operands, and the corresponding point is generated for the destination trace:

```
DestinationTrace = 10 log(10(1/10)(FirstTrace) – 10(1/10)(SecondTrace))
```

The values of the trace points are assumed to be in a decibel scale, as they are internally stored.

If a point in `FirstTrace` is equal to `maxtracevalue`, the resultant point is also `maxtracevalue`.

Otherwise, if the result of the subtraction is less than or equal to 0, the resultant point is `mintracevalue`.

Power Sum (Op1 + Op2)

Calculates a power sum between the `First Trace` operand and the `Second Trace` operand and puts the result in the destination trace.

During the sweep, the following formula is executed for each point in the trace operands, and the corresponding point is generated for the destination trace.

`DestinationTrace = 10 log(10(1/10)(FirstTrace) + 10(1/10)(SecondTrace))`

The values of the trace points are assumed to be in a decibel scale, as they are internally stored.

If a point in either trace operand is equal to `maxtracevalue`, the resultant point is also `maxtracevalue`.

Log Offset (Op1 + Offset)

Calculates a log offset from the `First Trace` operand and puts the result in the destination trace. This is like the B-DL function in some older instruments. The offset is entered on the `Offset` control, which only appears when this math function is in force for the selected trace. Each destination trace has its own offset.

During the sweep, the following formula is executed for each point in the trace operand, and the corresponding point is generated for the destination trace.

`DestinationTrace = FirstTrace + Offset`

The values of the trace points are assumed to be in dBm (as they are internally stored) and the offset is in dB.

If a point in the trace operand is equal to `maxtracevalue`, the resultant point is also `maxtracevalue`.

If a point in the trace operand is equal to `mintracevalue`, the resultant point is also `mintracevalue`.

Example: If offset is 25 dB, then our destination trace will be higher than the operand trace by 25 dB.

Note that the `Second Trace` operand is not used for this function.

Log Diff (Op1 - Op2 + Ref)

Offsets the difference between the `First Trace` operand and the `Second Trace` operand by a reference and puts the result in the destination trace. This is like the A-B+DL function in some older instruments. The Reference is entered on the **Reference** control, which only appears when this math function is in force for the selected trace. Each destination trace has its own reference.

Offsets the difference between the `First Trace` operand and the `Second Trace` operand by a reference and puts the result in the destination trace. This is like the A-B+DL function in some older instruments. The Reference is entered on the **Reference** control, which only appears when this math function is in force for the selected trace. Each destination trace has its own reference.

During the sweep, the following formula is executed for each point in the trace operands, and the corresponding point is generated for the destination trace.

`DestinationTrace = (FirstTrace - SecondTrace) + Reference`

The values of the operand trace points are assumed to be in decibel units (as they are internally stored) and the reference is in dBm so the result is in dBm.

Example: If the first operand trace 1 is at 5 dBm, the second operand trace 2 is at –5 dBm, and the reference is –25 dBm, then the destination trace will be –15 dBm.

Example: If the first operand trace1 is at 60 dBuV, the second operand trace 2 is at 50 dBuV, and the reference is 35 dBuV, then the destination trace will be 45 dBuV.

If a point in `FirstTrace` is equal to `maxtracevalue`, the resultant point is also `maxtracevalue`.

If a point in `FirstTrace` is equal to `mintracevalue`, the resultant point is also `mintracevalue`.

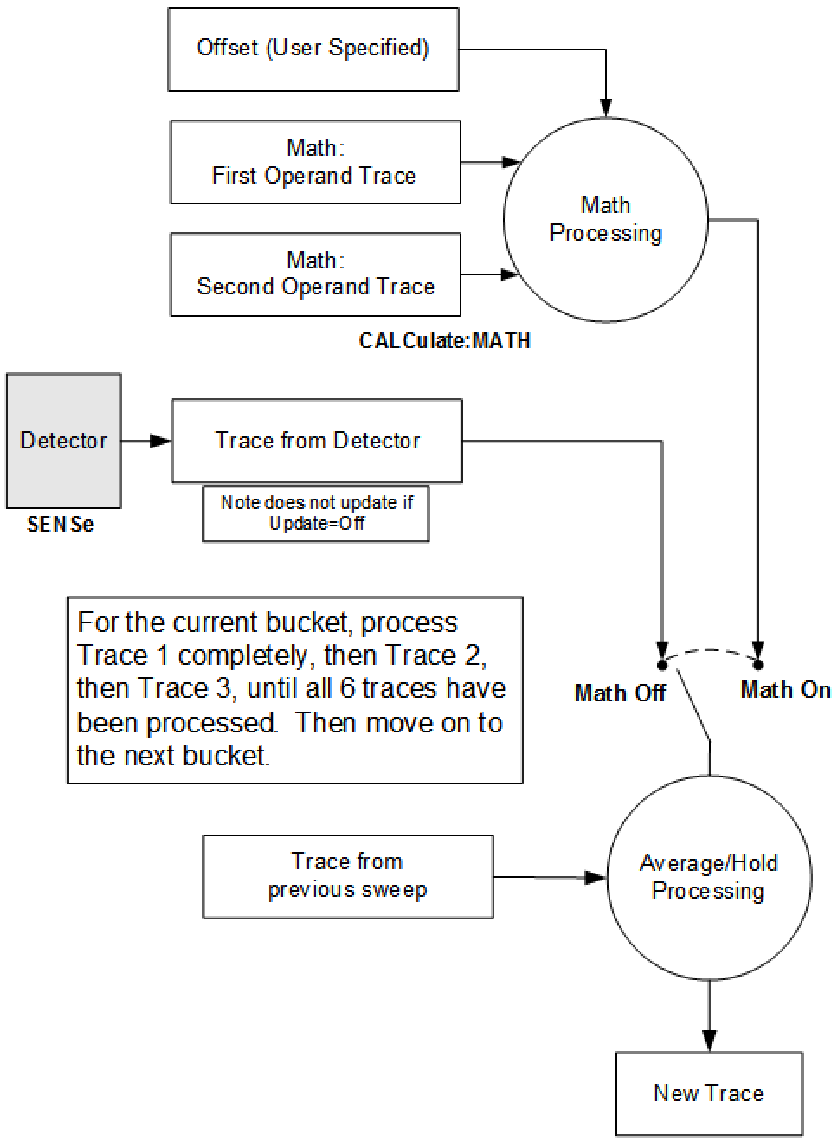
If neither of the above is true for a given point, then:

- If that point in `SecondTrace` is equal to `maxtracevalue`, the resultant point is `mintracevalue`.
- If that point in `SecondTrace` is equal to `mintracevalue`, the resultant point is `maxtracevalue`.

How trace math is processed

Whenever a trace math function is turned on, or the parameters and/or operands of an existing trace math function are changed, the destination trace is cleared. After the trace is cleared, all x-axis values in the trace, and the domain of the trace, are set to match the X-Axis settings of the first trace operand. When this is complete, a new sweep is initiated.

The process of acquiring data, processing it using the math and Average/Hold functions, and presenting it as trace data, consists of several functional blocks, as shown below:



NOTE ABOUT OFFSETS: When either External Gain or Ref Level Offset is on, an offset is applied to the trace operands, and when Trace Math is on this offset is applied before any math processing is performed. Since the operands have already been offset the result trace should NOT be offset. Therefore when any Trace Math operation is performed, the sum of (External Gain - Ref Level Offset) is added to the result before it is stored in the result trace.

For each active trace, the current trace point is processed for `Trace 1`, then `Trace 2`, then `Trace 3`, etc. Trace data is taken from either the detector for that trace, or

from the mathematical result of up to two other traces and an offset, depending on whether trace math is on or not. The resultant data is then fed to the Average/Hold processing block, where (if the trace type is **Average**, **Max Hold**, or **Min Hold**) it is processed with previous trace data. The new trace data resulting from this process is then available for display, storage or remote output.

When the processing is complete for `Trace 1`, `Trace 2` is processed, and so on until all six traces have been processed. This allows a downstream trace to use as one of its math components a fully processed upstream trace. In other words, if math is `ON` for `Trace 4`, and its operand traces are `Trace 2` and `Trace 3`, then all detector, math, average and hold processing for Traces 2 and 3 is completed before the math is performed for `Trace 4`. When the current trace point is completed for all traces, the instrument moves on to the next trace point.

This allows very flexible and powerful math functions to be configured. For example, `Trace 1` can be an average trace, which can be fed with an offset to `Trace 2`, which can also be in **Max Hold**, allowing you to obtain the **Max Hold** of an Average trace.

Note that none of this processing is performed on inactive traces.

Note also that for any active trace with math `ON`, the Operand traces should have *lower* numbers than the trace (for example, using `Trace 4` as an operand for `Trace 1` will cause the data coming from `Trace 4` to be delayed by one sweep).

Operand 1 / Operand 2

These two controls select the first and second trace operands to be used for the trace math functions for the destination trace. The operands are common to all math functions for a given trace. The most recently sent `:CALCulate:MATH` command for a given trace sets the operands for that trace. Those settings are displayed on the trace operand controls for that trace.

Example	The following examples are for the Swept SA measurement
	Set Trace 3 to Power Diff trace math function. Set the First Trace operand (for Trace 3) to Trace 1 and the Second Trace operand (for Trace 3) to Trace 2:
	`:CALC:MATH TRACE3,PDIF,TRACE1,TRACE2,0,0`
	Set Trace 3 to Log Offset trace math function. Set the First Trace operand (for Trace 3) to Trace 1, leave the Second Trace operand (for Trace 3) unchanged (it is irrelevant for this function) and set the Log Offset (for Trace 3) to -6 dB:
	`:CALC:MATH TRACE3,LOFF,TRACE1,TRACE2,-6.00,0`

Notes	See "Math Function" on page 1724 for how to specify Operands 1 and 2 using `:CALCulate:MATH`
Dependencies	The destination trace cannot be an operand. The destination trace number is grayed-out on the dropdown
Preset	Operand 1: Trace number minus 2 (wraps at 1). For example, for Trace 1, Operand 1 presets to Trace

	5; for Trace 6, it presets to Trace 4 Operand 2: Trace number minus 1 (wraps at 1). For example, for Trace 1, Operand 2 presets to Trace 6; for Trace 6, it presets to Trace 5
State Saved	Operands 1 and 2 for each trace are stored in instrument state

Offset

Used by the Log Offset math function.

Example	The following example is for the Swept SA measurement Set Trace 3 to Log Offset trace math function, set the First Trace operand (for Trace 3) to Trace 1, leave the Second Trace operand (for Trace 3) unchanged (it is irrelevant for this function) and set the Log Offset (for Trace 3) to -6 dB: `:CALC:MATH TRACE3,LOFF,TRACE1,TRACE2,-6.00,0`
State Saved	The Log Offset value for each trace is saved in Instrument State
Min	–100 dB
Max	100 dB

Reference

Used by the Log Diff math function.

Example	The following example is for the Swept SA measurement Set Trace 3 to Log Diff trace math function, set the First Trace operand (for Trace 3) to Trace 1, set the Second Trace operand (for Trace 3) to Trace 2, and set the Log Difference reference (for Trace 3) to -6 dBm: `:CALC:MATH TRACE3,LDIF,TRACE1,TRACE2,0,-6.00`
State Saved	The Log Difference reference value for each trace is saved in instrument state
Min/Max	Same as reference level

3.5.15.4 Detector

Lets you choose and configure detectors for the selected trace.

Detector

Selects a detector to be used by the instrument for the current measurement. Allows up to three (3) traces, but each use the same detector type choice. The following choices are available:

Option	Parameters	Description
Auto	See "Detector Select Auto/Man" on page 1116	Detector selected depends on marker functions, trace functions, average type, and the trace averaging function When in AUTO, the detector selected is set to AVERage, unless the Radio Standard defaults state otherwise, for example, it is set to POS for Radio Standard = PDC when Device = both MS and BTS, and when Radio Standard = NADC and Device = MS
Normal	NORMal	Detector determines the peak of the CW-like signals, and yields alternating maximums and minimums of noise-like signals. This is also referred to as Rosenfell detection
Average	AVERage RMS	Detector determines the average of the signal within the sweep points, using RMS averaging
Peak (Positive)	POSitive	Detector determines the maximum of the signal within the sweep points
Sample	SAMPle	Detector indicates the instantaneous level of the signal at the center of the sweep points represented by each display point
Negative Peak	NEGative	Detector determines the minimum of the signal within the sweep points

Because they may not find a spectral component's true peak, neither Average nor Sample detectors measure amplitudes of CW signals as accurately as Peak or Normal, but they do measure noise without the biases of peak detection.

When **Meas Method** is Fast Power, Auto, Peak and Average are selectable.

Remote Command	`[:SENSe]:ACPower:DETector[:FUNCtion] NORMal | AVERage | POSitive | SAMPle | NEGative | RMS` `[:SENSe]:ACPower:DETector[:FUNCtion]?`

Example	`:ACP:DET NORM`
	`:ACP:DET?`
	`:ACP:DET RMS`
	Sets the detector to AVERage. In ACP, AVERage uses RMS averaging, so this is equivalent to selecting an RMS detector

Notes	The query returns a name that corresponds to the detector type, as shown below The RMS selection sets the detector type to AVERage with RMS averaging. Therefore, if RMS has been selected, the query returns AVER

String Returned	Definition
NORM	Normal
AVER	Average (RMS)
POS	Peak
SAMP	Sample
NEG	Negative Peak

Couplings	When "Detector Select Auto/Man" on page 1116 is **Auto**, **Detector** switches aligning with the switch of this parameter: NORMal with Clear Write, AVERage with AVERage, POSitive (Peak) with MAXHold, and NEGative (Peak) with MINHold When **Detector Select Auto/Man** is **Auto**, **Detector** is set to what the Radio Standard defaults states for all conditions of Trace Type and for all traces When **Detector Select Auto/Man** is set to **Manual**, all Traces use the same detector type When Average State = Off then Trace Types AVERage, MaxHold and MinHold do not function, since Averaging must be 'on' for them to operate. Only one Detector type for all 3 traces is allowed When "Meas Method" on page 963 is RBW or FAST, Detector is disabled
Preset	AVERage
State Saved	Saved in instrument state
Range	NORMal|AVERage|POSitive|SAMPle|NEGative|RMS
Annotation	The four-letter mnemonic for the detector appears in the trace window next to the referenced trace
Backwards Compatibility SCPI	[:SENSe]:ACPR:SWEep:DETector[:FUNCtion]

Detector Select Auto/Man

Sets the Detector mode to Auto (ON|1) or Manual (OFF|0). In Auto, the proper detector is chosen based on rules that take into account the measurement settings and other instrument settings.

When you manually select any detector, this toggle is automatically set to Manual (OFF).

Remote Command	[:SENSe]:ACPower:DETector:AUTO ON | OFF | 1 | 0 [:SENSe]:ACPower:DETector:AUTO?
Example	:ACP:DET:AUTO 1 :ACP:DET?
Notes	When "Meas Method" on page 963 is Fast Power, Peak and Average are selectable
Couplings	When **Detector Select Auto/Man** is **Auto**, "Detector" on page 1114 switches aligning with the switch of this parameter: NORMal with **Clear Write**, AVERage with **AVERage**, POSitive with MAXHold, and NEGative with MINHold When **Detector Select Auto/Man** is **Auto**, **Detector** is set to what the Radio Standard defaults states for all conditions of Trace Type and for all traces When **Detector Select Auto/Man** is set to **Manual**, all Traces use the same detector type When Average State = Off then Trace Types AVERage, MaxHold and MinHold do not function, since Averaging must be ON for them to operate
Preset	ON
State Saved	Yes

3.5.15.5 Trace Function

Contains controls to:

- Copy and Exchange traces
- Preset or Clear all traces

From Trace

Selects the trace to be copied to or exchanged with the "To Trace" on page 1732 when a "Copy" on page 1732 or "Exchange" on page 1733 is performed

Preset	1

To Trace

Selects the trace to be copied from or exchanged with the "From Trace" on page 1732 when a "Copy" on page 1732 or "Exchange" on page 1733 is performed

Preset	2

Copy

Executes a Trace Copy based on the "From Trace" on page 1732 and "To Trace" on page 1732 parameters. The copy operation is from the **From Trace** to the **To Trace**. The action is performed once.

The X-Axis settings and domain of a trace are also copied.

Remote Command	For Swept SA Measurement (in SA Mode):
	`:TRACe:COPY TRACE1 | … | TRACE6, TRACE1 | … | TRACE6`
	For all other measurements:
	`:TRACe:<meas>:COPY TRACe1 | TRACe2 | TRACe3, TRACe1 | TRACe2 | TRACe3`
	where `<meas>` is the identifier for the current measurement
	Note that the format of the `TRACe<n>` parameter differs from that for the Swept SA Measurement

Example	Copy Trace 1 to Trace 3 and put Trace 3 in Update=Off, Display=On `:TRAC:COPY TRACE1,TRACE3`
Notes	The command is of the form: `:TRACe:COPY <source_trace>,<dest_trace>`
Dependencies	When Signal ID is on, this key is grayed-out

Couplings	The destination trace is put in **View** (Update = Off, Display = On) after the copy

Preset	For Swept SA Measurement (in SA Mode):
	`TRACE1, TRACE2`
	For all other measurements:
	`TRACe1, TRACe2`

Exchange

Executes a Trace Exchange based on the "From Trace" on page 1732 and "To Trace" on page 1732 parameters. The **From Trace** and **To Trace** values are exchanged with each other. The action is performed once.

The X-Axis settings and domain of a trace are also copied when it is exchanged with another trace.

Remote Command	For Swept SA Measurement (in SA Mode):
	`:TRACe:EXCHange TRACE1 | … | TRACE6, TRACE1 | … | TRACE6`
	For all other measurements:
	`:TRACe:<meas>:EXCHange TRACe1 | TRACe2 | TRACe3, TRACe1 | TRACe2 | TRACe3`
	where `<meas>` is the identifier for the current measurement
	Note that the format of the `:TRACe<n>` parameter differs from that for the Swept SA Measurement

Example	Exchange Trace 1 and Trace 2 and put both traces in Update=`OFF`, Display=`ON`: `:TRAC:EXCH TRACE1,TRACE2`
Notes	The command is of the form: `:TRACe:EXCHange <trace_1>,<trace_2>`
Couplings	Both traces are put in **View** (Update=Off, Display=On) after the exchange

Preset All Traces

Turns on Trace 1 and blanks all other traces. This is useful when you have many traces on and you want to return to having only Trace 1 on the display. Does not affect the trace type, detector or any other aspect of the trace system.

Remote Command	`:TRACe[:<meas>]:PRESet:ALL`
Example	`:TRAC:PRES:ALL`
Dependencies	When Signal ID is on, this key is grayed-out

Clear All Traces

Clears all traces. Does not affect the state of any function or variable in the instrument. Loads `mintracevalue` into all of the points for all traces, except traces in **Min Hold**, in which case it loads `maxtracevalue`, even if **Update** = `OFF`.

Remote Command	`:TRACe[:<meas>]:CLEar:ALL`
Example	`:TRAC:CLE:ALL`
Dependencies	When Signal ID is on, this key is grayed-out

3.5.15.6 Advanced

Contains controls for setting advanced trace functions of the instrument.

Measure Trace

Specifies which trace's scalar results are displayed in the **Metrics** window, and retrieved by sending a `:READ` or `:FETCh` query:

- Trace 1
- Trace 2
- Trace 3

Remote Command	`:CALCulate:<meas>:MTRace TRACe1 | TRACe2 | TRACe3`
	`:CALCulate:<meas>:MTRace?`
	`<meas>` is the identifier for the current measurement; any one of `CHPower | ACPower | OBWidth | SEMask | SPURious | PVTime`

Example	Channel Power
	`:CALC:CHP:MTR TRAC1`
	`:CALC:CHP:MTR?`

Dependencies	In the ACP measurement, this control is grayed-out when **Meas Method** is set to `RBW` or `FAST`, and only Trace 1 is enabled
Preset	`TRACe1`
State Saved	No
Range	Trace 1 | Trace 2 | Trace 3

3.6 Power Stat CCDF Measurement

Many modern digitally-modulated signals look noise-like in the time and frequency domain, requiring statistical measurement of these signals for meaningful characterization and differentiation. The **Power Statistics Complementary Cumulative Distribution Function** (CCDF) measurement displays curves to characterize the higher-level power statistics of digitally modulated signals. The curves can be useful in determining design parameters for digital communications systems.

The Power Statistics CCDF measurement displays probability on the Y-Axis and amplitude on the X-axis, for a display of the statistical amplitude distribution of a signal. This distribution can be affected by many factors. For example, modulation filtering, modulation format, combining the multiple signals at different frequencies, number of active codes, and correlation between symbols on different codes with spread spectrum systems will all affect measurement results. These factors are all related to modulation and signal parameters. External factors such as signal compression and expansion by nonlinear components, group delay distortion from filtering, and power control within the observation interval also affect the measurement.

The power measured in power statistics CCDF curves is actually instantaneous envelope power defined by the equation:

$P = (I^2 + Q^2) / Zo$

where I & Q are the quadrature voltage components of the waveform, and Zo is the characteristic impedance.

A CCDF curve is defined by how much time the waveform spends at or above a given power level. The percent of time the signal spends at or above the level defines the probability for that particular power level. For capturing a lower probability down to 0.0001%, this measurement is made in the single mode by pressing Single. To make the power statistics CCDF measurement, the instrument uses digital signal processing (DSP) to sample the input signal in the channel bandwidth. The Gaussian distribution line as the band-limited Gaussian noise CCDF reference line, the user-definable reference trace, and the currently measured trace can be displayed on a semi-log graph. If the currently measured trace is above the user reference trace, it means that the higher peak power levels against the average power are included in the input signal.

Power Stat CCDF Measurement Commands

The general functionality of "CONFigure" on page 2732, "INITiate" on page 2733, "FETCh" on page 2733, "MEASure" on page 2735, and "READ" on page 2734 are described in the section **SCPI Operation and Results Query** in the topic

Programming the Instrument.

The following measurement commands and queries are used to configure the measurement:

`:INITiate:PSTatistic`	Initiates a trigger cycle for the `PST` measurement, but does not return any data. You must then use `:FETC:PST[n]?` to retrieve data Does not change any measurement settings
`:CONFigure?`	Returns the long form name of current measurement, in this case, `PSTatistic`
`:CONFigure:PSTatistic`	Selects `PST` measurement with Meas Setup settings in preset state – same as "Meas Preset" on page 1198
`:CONFigure:PSTatistic:NDEFault`	Selects `PST` measurement *without* affecting settings

The following queries are used to retrieve the results:

`:FETCh:PSTatistic?`	Retrieves the data specified by `n`
`:MEASure:PSTatistic[n]?`	Switches to `PST` measurement, restores default values, starts the measurement, then retrieves the data specified by `n`
`:READ:PSTatistic[n]?`	Starts the measurement, then retrieves the data specified by `n`

Measurement Results for Power Stat CCDF

The following table describes the results returned by the `:FETCh`, `:MEASure`, and `:READ` queries listed above, according to the index value `n`.

n	Results Returned		
0	Returns unprocessed I/Q trace data, as a series of trace point values, in volts. The I values are listed first in each pair, using the 0 through even-indexed values. The Q values are the odd-indexed values		
1, or not specified	Returns 11 scalar results:		
	#	**Item**	**Unit, if any**
	1	Average input power	dBm
	2	Probability at the average input power level	%
	3	Power level that has 10 % of the power	
	4	Power level that has 1 % of the power	
	5	Power level that has 0.1 % of the power	
	6	Power level that has 0.01 % of the power	
	7	Power level that has 0.001 % of the power	

n	Results Returned		
	#	**Item**	**Unit, if any**
	8	Power level that has 0.0001 % of the power	
	9	Peak power	dB
	10	Count	
	11	Power level that has 0.00001% of the power if "Minimum Probability" on page 1127 is PP7 (0.00001 %) This value is returned only when PP7 is selected	
2	Returns a series of 5001 floating point numbers (in percent) that represent the current measured power stat trace. This is the probability at particular power levels (average power), in the following order: 1. Probability at 0.0 dB power 2. Probability at 0.01 dB power 3. Probability at 0.02 dB power ... 5000. Probability at 49.9 dB power 5001. Probability at 50.0 dB power		
3	Returns a series of 5001 floating point numbers (in percent) that represent the Gaussian trace. This is the probability at particular power levels (average power), in the following order: 1. Probability at 0.0 dB power 2. Probability at 0.01 dB power 3. Probability at 0.02 dB power ... 5000. Probability at 49.9 dB power 5001. Probability at 50.0 dB power		
4	Returns a series of 5001 floating point numbers (in percent) that represent the user-definable reference trace. This is the probability at particular power levels (average power), in the following order: 1. Probability at 0.0 dB power 2. Probability at 0.01 dB power 3. Probability at 0.02 dB power ... 5000. Probability at 49.9 dB power 5001. Probability at 50.0 dB power		

3.6.1 Views

In the LTEATDD and 5GNR Modes, this measurement has two views: "Normal" on page 1123 and Slot. In all other Modes, there is only a single view (**Normal**). For the SCPI command to select **Slot** View, see Slot View [Mode: LTEATDD, 5GNR].

These are multiple-window Views. When in a multiple-window View, you select a window by touching it. The menu controls may sometimes change depending on which window is selected.

3.6.1.1 Normal

Windows: "Metrics" on page 1124, "Graph" on page 1123

The Power Stat CCDF measurement provides CCDF curves and power statistics metrics. This is common for both Uplink (MS) and Downlink (BTS).

Example	`:PST:SLTV OFF`

3.6.2 Windows

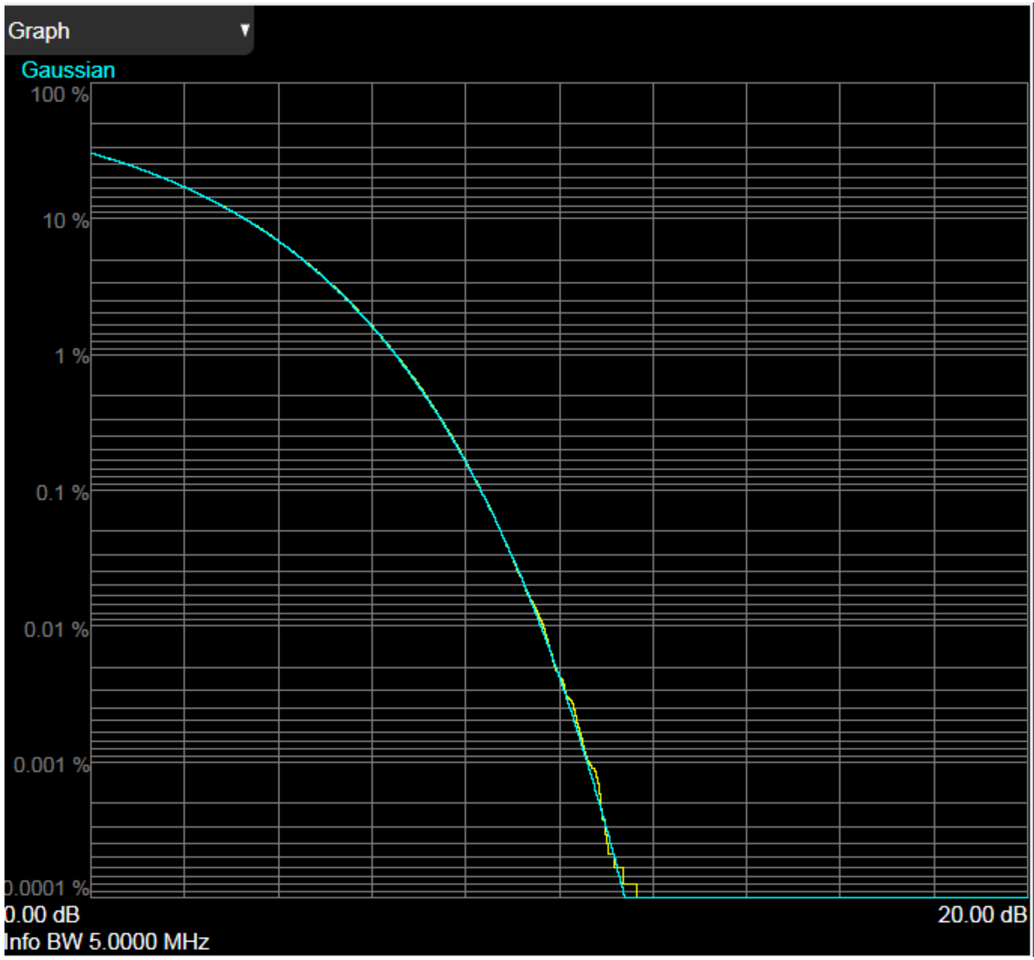
Three window types are defined:

1. "Graph" on page 1123
2. Slot
3. "Metrics" on page 1124

Slot only appears in LTEATDD and 5GNR Modes.

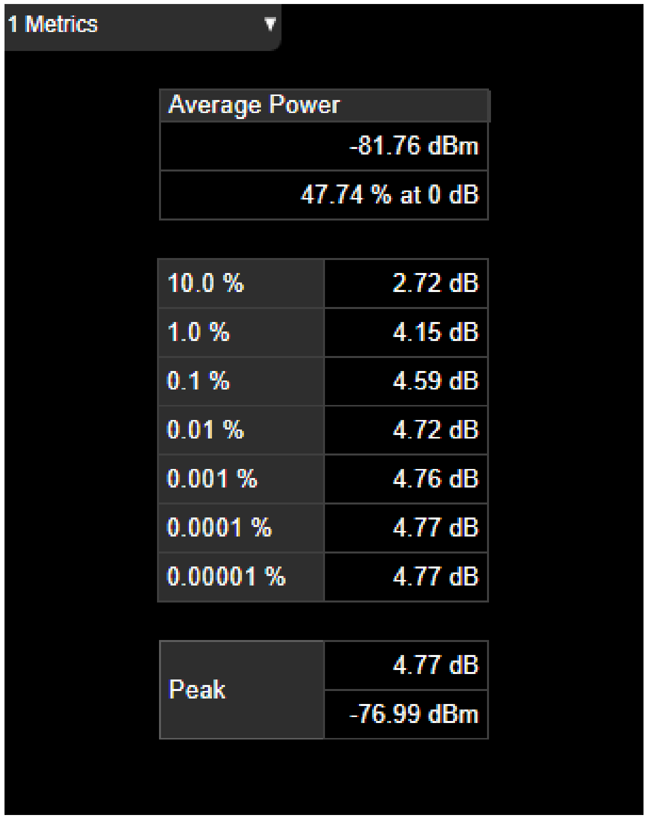
3.6.2.1 Graph

Displays Amplitude versus probability



3.6.2.2 Metrics

Displays the textual results of the Power Stat CCDF measurement.



For the list of n = 1 measurement results, see "Measurement Results for Power Stat CCDF" on page 1121 above.

Name	Unit	Corresponding Results	Results Item for n = 1	Explanation
Average Power	dBm	Average input power	1	99.99 dBm
Average Power	%	Probability at the average input power level	2	99.99 %
10.0%	dB	Power level that has 10 % of the power	3	99.99 dB
1.0%	dB	Power level that has 1 % of the power	4	99.99 dB
0.1%	dB	Power level that has 0.1 % of the power	5	99.99 dB
0.01%	dB	Power level that has 0.01 % of the power	6	99.99 dB
0.001%	dB	Power level that has 0.001 % of the power	7	99.99 dB

Name	Unit	Corresponding Results	Results Item for n = 1	Explanation
0.0001%	dB	Power level that has 0.0001 % of the power	8	99.99 dB
0.00001%	dB	Power level that has 0.00001% of the power if "Minimum Probability" on page 1127 is PP7 (0.00001 %)	11	99.99 dB
Peak	dB	Peak power	9	99.99 dB
Peak	dBm	Not available via remote commands	n/a	99.99 dBm

3.6.3 Amplitude

Activates the **Amplitude** menu and selects **Reference Level** or **Reference Value** as the active function, depending on the measurement.

Some features in this menu apply to multiple measurements. Some other features apply only to specific measurements and their controls are blanked or grayed-out in measurements that do not support the feature.

3.6.3.1 Y Scale

Contains controls that pertain to the Y axis parameters of the measurement. These parameters control how data on the vertical (Y) axis is displayed and control instrument settings that affect the vertical axis.

Ref Level Offset

Adds an offset value to the displayed reference level. The reference level is the absolute amplitude represented by the top graticule line on the display.

The on/off switch turns **Ref Level Offset** on or off. Setting a specific value turns **Ref Level Offset**ON.

For more on using offsets, see the Ref Level Offset control description for the Swept SA measurement.

Remote Command	`:DISPlay:WINDow[1]:TRACe:Y[:SCALe]:RLEVel:OFFSet <rel_ampl>` `:DISPlay:WINDow[1]:TRACe:Y[:SCALe]:RLEVel:OFFSet?`
Example	`:DISP:WIND:TRAC:Y:RLEV:OFFS 12.7` `:DISP:WIND:TRAC:Y:RLEV:OFFS?`

	Sets the Ref Level Offset to 12.7 dB. The only valid suffix is dB. If no suffix is sent, dB will be assumed
Dependencies	Appears only in Spectrum Analyzer Mode
Preset	0 dBm
State Saved	Saved in instrument state
Min	The range for Ref Lvl Offset is variable. It is limited to values that keep the reference level within the range of -327.6 dB to 327.6 dB
Max	327.6 dB
Annotation	The offset is displayed as “Ref Offset <value>” to the right of the reference level annotation if nonzero. When the offset is zero, no annotation is shown

Auto Function

Remote Command	`:DISPlay:WINDow[1]:TRACe:Y[:SCALe]:RLEVel:OFFSet:STATe OFF | ON | 0 | 1` `:DISPlay:WINDow[1]:TRACe:Y[:SCALe]:RLEVel:OFFSet:STATe?`
Example	Turn Ref Level Offset ON: `:DISP:WIND:TRAC:Y:RLEV:OFFS:STAT ON`
Preset	`OFF`

Minimum Probability

Sets the minimum probability range.

Remote Command	`:CALCulate:PSTatistic:RANGe[:PROBability]:MINimum PP2 | … | PP7`
	For parameter values, see "Parameter Options" on page 1127 below
	`:CALCulate:PSTatistic:RANGe[:PROBability]:MINimum?`

Example	`:CALC:PST:RANG:MIN PP6` `:CALC:PST:RANG:MIN?`
Preset	`PP6`
State Saved	Yes
Range	1 % | 0.1 % | 0.01 % | 0.001 %| 0.0001 % | 0.00001 %

Parameter Options

Option	Value
`PP2`	1.0e-2 (1 %)
`PP3`	1.0e-3 (0.1 %)
`PP4`	1.0e-4 (0.01 %)
`PP5`	1.0e-5 (0.001 %)

Option	Value
PP6	1.0e-6 (0.0001 %)
PP7	1.0e-7 (0.00001 %)

3.6.3.2 Attenuation

Controls the attenuator functions and interactions between the attenuation system components.

There are two attenuator configurations in the X-Series. One is a Dual-Attenuator configuration consisting of a mechanical attenuator and an optional electronic attenuator. The other configuration uses a single attenuator with combined mechanical and electronic sections that controls all the attenuation functions. Different models in the X-Series come with different configurations.

– See "Dual-Attenuator Configurations" on page 1128

– See "Single-Attenuator Configuration" on page 1129

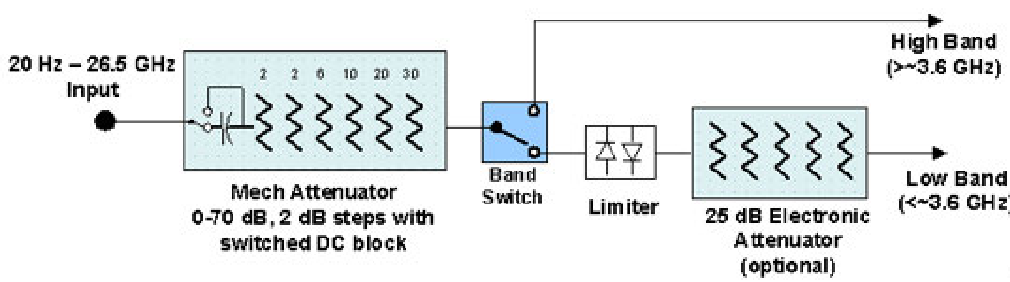
Most attenuation settings are the same for all measurements – they do not change as you change measurements. Settings like these are called “Meas Global” and are unaffected by **Meas Preset**.

Only available when the hardware set includes an input attenuator, which is typically only the case for Keysight’s benchtop instruments. For example, this tab does *not* appear in VXT models M9421A/10A/11A, nor in UXM. In UXM, all **Attenuation** and **Range** settings are disabled, as the expected input power level is handled by the Call Processing App that drives the DUT power control.

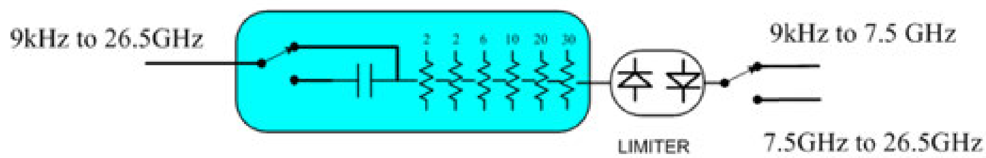
Dependencies	In measurements that support the I/Q inputs, unavailable when I/Q is the selected input. Replaced by the **Range** tab in that case

Dual-Attenuator Configurations

Configuration 1: Mechanical attenuator + optional electronic attenuator

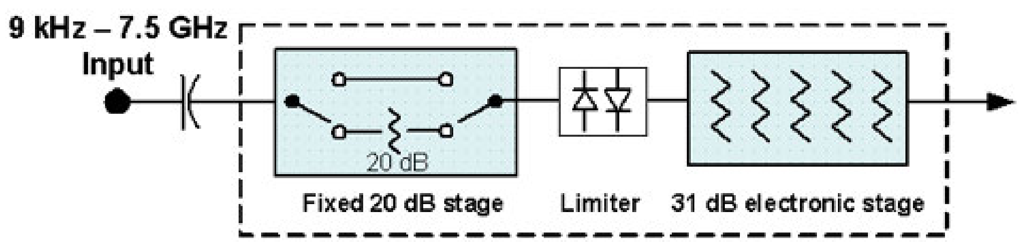


Configuration 2: Mechanical attenuator, no optional electronic attenuator



Note that Configuration 2 is not strictly speaking a dual-section attenuator, since there is no electronic section available. However, it behaves exactly like Configuration 1 without the Electronic Attenuator Option EA3, therefore for the sake of this document it is grouped into the “Dual-Attenuator” configuration.

Single-Attenuator Configuration



You can tell which attenuator configuration you have by pressing the Attenuation tab, which (in most Modes) opens the Attenuation menu. If the first control in the Attenuation menu says **Mech Atten** you have the Dual-Attenuator configuration. If the first control says **Atten** you have the Single-Attenuator configuration.

Dual Attenuator **Single Attenuator**

(Note that depending on the measurement, there may be no Auto/Man functionality on the Mech Atten control.)

In the Single-Attenuator configuration, you control the attenuation with a single control, as the fixed stage has only two states. In the Dual-Attenuator configuration, both stages have significant range, so you are given separate control of the mechanical and electronic attenuator stages.

When you have the Dual-Attenuator configuration, you may still have only a Single-Attenuator, because unless Option EA3 (the Electronic Attenuator option) is available, and you purchase it, you will have only the mechanical attenuator.

Full Range Atten

This control and **Attenuator Summary** only appear in N9041B, when the RF input is selected, the RF Input Port is set to RF Input 2, and the Full Range Attenuator is installed. The Full Range Attenuator adds a second input attenuator in front of RF Input 2, which enhances the protection and optimizes the performance of the extra internal mixers used by RF Input 2.

Remote Command	`[:SENSe]:POWer[:RF]:FRATten <rel_ampl>` `[:SENSe]:POWer[:RF]:FRATten?`
Example	`:POW:FRAT 14` `:POW:FRAT?`
Notes	When you enter an amplitude value that falls between valid values, the value will be incremented to the next smallest valid value
Dependencies	Only appears if input RF is selected, RF Input Port 2 is selected, and the Full Range Attenuator exists
Couplings	This value is never changed by any coupling, but other couplings use this value. See **Reference Level** and "Mech Atten" on page 1935 command descriptions
Preset	20 dB
State Saved	Saved in instrument state
Min	0 dB
Max	Only valid values are 0, 6, 14, 20 dB
Annotation	When the **Input** is **RF**, and the **Input Port** is **RF Input 2**, and the Full Range Attenuator is installed: On the Meas Bar, the field “Atten” displays as follows: – If the sweep is entirely < 50 GHz, the value shown after “Atten:” is equal to Mech Atten + Elec Atten + Full Range Atten – If the sweep is entirely > 50 GHz, the value shown after “Atten:” is equal to Full Range Atten – If the sweep straddles 50 GHz, the value shown after “Atten:” is preceded by the symbol “>=” and is equal to Full Range Atten In the **Amplitude**, "Y Scale" on page 1929 menu, and the Atten **Meas Bar** dropdown menu panel, a summary is displayed as follows: “Total Atten below 50 GHz” followed by the value of Full Range Atten + Mech Atten + Elec Atten “Total Atten above 50 GHz” followed by the value of Full Range Atten For example, if Mech Atten = 6 dB, Elec Atten = 4 dB, and Full Range Atten = 20 dB, the summary below is shown: – Attenuator summary: – Total Atten below 50 GHz: 30 dB – Total Atten above 50 GHz: 20 dB

Mech Atten

Labeled **Mech Atten** in Dual-Attenuator models and **Atten** in Single-Attenuator models. In the Dual-Attenuator configuration, this control only affects the mechanical attenuator.

Lets you modify the attenuation applied to the RF input signal path. This value is normally auto-coupled to the Ref Level, the Internal Preamp Gain, any External Gain that is entered, and the Max Mixer Level, as described in the table below.

See "Attenuator Configurations and Auto/Man" on page 1133

Remote Command	`[:SENSe]:POWer[:RF]:ATTenuation <rel_ampl>`
	`[:SENSe]:POWer[:RF]:ATTenuation?`
	`[:SENSe]:POWer[:RF]:ATTenuation:AUTO OFF | ON | 0 | 1`
	`[:SENSe]:POWer[:RF]:ATTenuation:AUTO?`

Example	`:POW:ATT 20`
	Dual-Attenuator configuration: sets the mechanical attenuator to 20 dB
	Single-Attenuator mode: sets the main attenuation to 20 dB (see below for definition of “main” attenuation)
	In either case, if the attenuator was in Auto, it is set to Manual
	`:POW:ATT:AUTO ON`
	Turn Auto Mech Atten ON

Dependencies	Some measurements do not support Auto setting of "Mech Atten" on page 1131. In these measurements, the **Auto/Man** selection is not available, and the Auto/Man toggle function is not available In Dual-Attenuator configurations, when the electronic attenuator is enabled, the mechanical attenuator has no auto setting, and the Auto/Man toggle function is not available. The state of Auto/Man is remembered and restored when the electronic attenuator is once again disabled. This is described in more detail in "Elec Atten" on page 1937 See "Attenuator Configurations and Auto/Man" on page 1133 for more information on the Auto/Man functionality `:POW:ATT:AUTO` is only available in measurements that support Mech Atten Auto, such as Swept SA
Couplings	If the RF Input Port is the RF Input: – If the USB Preamp is connected to USB, use 0 dB for Mech Atten – Otherwise compute the auto-selected value of Mech Atten based on **Reference Level**, Int Preamp, External Gain, Ref Level Offset, Max Mixer Level, µW Path Control and IF Gain settings. Limit this value to be no less than 6 dB (total attenuation below 6 dB can never be chosen by Auto) – In the N9041B, if the RF Input Port is RF Input 2, use the formula above and subtract the Full Range Atten value from the result to determine the Mech Atten. Limit the value so that it is never lower than 0 dB and so that total attenuation, including Full Range Atten, is never less than 6 dB

	(total attenuation, including Full Range Atten below 6 dB, can never be chosen by Auto) In External Mixing and BBIQ, where the Attenuator is not in the signal path, the Attenuator setting changes as described above when "Mech Atten" on page 1131 is in Auto, but no changes are made to the actual attenuator hardware setting until the input is changed back to the RF Input For CXA-m with option FSA (Fine-Step Attenuator or 2 dB steps), the FSA-like behavior is only available when the frequency setting is <= 7.5 GHz. So, when the frequency is changed from below 7.5 GHz to above 7.5 GHz, the attenuation setting will be changed to a multiple of 10 dB which will be no smaller than the previous setting. For example, 4 dB attenuation will be changed to 10 dB
Preset	The preset for Mech Attenuation is “Auto” The Auto value of attenuation is 10 dB ON
State Saved	Saved in instrument state
Min	0 dB The attenuation set by this control cannot be decreased below 6 dB with the knob or step keys. Values below 6 dB must be directly entered from the keypad or via SCPI. This protects against setting a dangerously small attenuation value, which can put the instrument at risk of damage to input circuitry. If the current mechanical attenuation is below 6 dB, it can be increased with the knob and step keys, but not decreased
Max	CXA Option 503 or 507: 50 dB EXA: 60 dB All other models: 70 dB Note that in the Single-Attenuator configuration, the total of ATT and EATT cannot exceed 50 dB. So, if the EATT is set to 24 dB first, the main attenuation cannot be greater than 26 dB and will be reduced accordingly; if the main attenuator is set to 40 dB first, EATT cannot be greater than 10 dB
Annotation	The current value for Total Atten is displayed in the Measurement Bar at the top of the display. A value appears for Electronic Attenuation only if the Electronic Attenuator is enabled. The annotation appears as Atten: <total> dB (e<elec>) The e letter is in amber in Single-Attenuator configurations For example: Dual-Attenuator configuration: Atten: 24 dB (e14) Indicating the total attenuation is at 24 dB and the electronic attenuation is at 14 dB Single-Attenuator configuration: A: 24 dB (e14) Indicating the total attenuation is at 24 dB and the “soft” attenuation is at 14 dB (see below for definition of “soft” attenuation) When in Manual, a # sign appears in front of Atten in the annotation

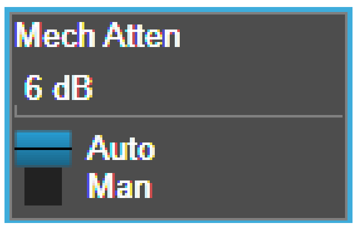
Attenuator Configurations and Auto/Man

As described under "Y Scale" on page 1929, there are two distinct attenuator configurations available in the X-Series, the single attenuator and Dual-Attenuator configurations. In Dual-Attenuator configurations, we have the mechanical attenuation and the electronic attenuation, and the current total attenuation is the sum of the electronic + mechanical attenuation. In Single-Attenuator configurations, we refer to the attenuation set using "Mech Atten" on page 1131 (or `:POW:ATT`) as the “main” attenuation; and the attenuation that is set by `:POW:EATT` as the “soft” attenuation (`:POW:EATT` is honored even in the Single-Attenuator configuration, for compatibility purposes). Then the current total attenuation is the sum of the main + soft attenuation.

See "Elec Atten" on page 1937 for more about “soft” attenuation.

NOTE

In some measurements, the **Mech Atten** control has an Auto/Man function. In these measurements, an Auto/Man switch is shown on the **Mech Atten** control:



Note that in configurations that include an Electronic Attenuator, this switch is only shown when the Electronic Attenuator is disabled.

In other measurements, **Mech Atten** has no Auto/Man function. In these measurements, no switch is shown on the **Mech Atten** control:

Mech Atten also appears with no switch, as above, in configurations that include an Electronic Attenuator but when the Electronic Attenuator is enabled.

Elec Atten

Controls the Electronic Attenuator in Dual-Attenuator configurations. Does not appear in Single-Attenuator configurations, because the control of both the mechanical and electronic stages of the Single-Attenuator is integrated into the single **Atten** control.

This control includes an **Enable/Disable** toggle switch; it is only possible to enter a value for the Electronic Attenuator when this switch is in the **Enable** position.

For more details about the Electronic Attenuator, see "More Information" on page 1135

Remote Command	`[:SENSe]:POWer[:RF]:EATTenuation <rel_ampl>`
	`[:SENSe]:POWer[:RF]:EATTenuation?`
	`[:SENSe]:POWer[:RF]:EATTenuation:STATe OFF | ON | 0 | 1`
	`[:SENSe]:POWer[:RF]:EATTenuation:STATe?`

Example	`:POW:EATT 10`
	`:POW:EATT?`
	`:POW:EATT:STAT ON`
	`:POW:EATT:STAT?`

Notes	Electronic Attenuation's specification is defined only when Mechanical Attenuation is 6 dB
Dependencies	Only appears in Dual-Attenuator models with an Electronic Attenuator installed and licensed. Does not appear in models with the Single-Attenuator configuration, because in the Single-Attenuator configuration there is no "electronic attenuator"; there is only a single integrated attenuator (which has both a mechanical and electronic stage). However, in the Single-Attenuator configuration, EATT SCPI commands are accepted for compatibility with other X-series instruments, and set a "soft" attenuation. The "soft" attenuation is treated as an addition to the "main" attenuation value set by the **Attenuation** control or `:POW:ATT`, and affects the total attenuation displayed on the **Attenuation** control and the Meas Bar The electronic attenuator, and the "soft" attenuation function provided in Single-Attenuator configurations, are unavailable above the low band (0-3.6 GHz, 0-3.4 GHz, 0-3 GHz, depending on the model). If the low band range is from 0-3.6 GHz, and Stop Frequency of the instrument is > 3.6 GHz, then the **Enabled/Disabled** section of the **Elec Atten** control will be `OFF` and grayed-out If "Internal Preamp" on page 1959 is `ON` (that is, set to Low Band or Full), the electronic attenuator (and the "soft" attenuation function provided in Single-Attenuator configurations) is unavailable. In this case the **Enabled/Disabled** section of the **Elec Atten** control will be `OFF` and grayed-out If either of the above is true, and the SCPI command is sent, an error indicating that the electronic attenuator is unavailable is returned If both the above are true, pressing the control generates error message -221, in other words, the frequency range lockout takes precedence If the electronic/soft Attenuator is enabled, then the **Stop Freq** of the instrument is limited to 3.6 GHz and **Internal Preamp** is unavailable If "LNA" on page 1960 is `ON`, the electronic attenuator (and the "soft" attenuation function provided in Single-Attenuator configurations) is unavailable. In this case the **Enabled/Disabled** section of the **Elec Atten** control will be `OFF` and grayed-out. This coupling works in the following modes/measurements: – Channel Power, Occupied BW, ACP, SEM, Spurious Emissions, Power Stat CCDF measurements in all Modes – Transmit On|Off Power measurement in 5GNR Mode – Power vs. Time and Transmit Power measurement in GSM/EDGE Mode – Burst Power measurement in Spectrum Analyzer Mode

	The SCPI-only “soft” electronic attenuation for the single-attenuator configuration is not available in all measurements; in particular, it is not available in the Swept SA measurement
Couplings	Enabling and disabling the Electronic Attenuator affects the setting of the Mechanical Attenuator (in Dual-Attenuator configurations). This is described in more detail below and in "Mechanical Attenuator Transition Rules" on page 1135
Preset	0 dB OFF (Disabled) for Swept SA measurement ON (Enabled) for all other measurements that support the electronic attenuator
State Saved	Saved in instrument state
Min	0 dB
Max	Dual-Attenuator configuration: 24 dB Single-Attenuator configuration: the total of ATT and EATT cannot exceed 50 dB. So, if the EATT is set to 24 dB first, the main attenuation cannot be greater than 26 dB and will be reduced accordingly; if the main attenuator is set to 40 dB first, EATT cannot be greater than 10 dB
Annotation	See Annotation under the **Mech Atten** control description

More Information

The electronic attenuator offers finer steps than the mechanical attenuator, has no acoustical noise, is faster, and is less subject to wear. These advantages primarily aid in remote operation and are negligible for front panel use. See "Using the Electronic Attenuator: Pros and Cons" on page 1136 for a detailed discussion of the pros and cons of using the electronic attenuator.

For the Single-Attenuator configuration, for SCPI backwards compatibility, the “soft” attenuation feature replaces the Dual-Attenuator configuration’s electronic attenuator. All the same couplings and limitations apply. See "Attenuator Configurations and Auto/Man" on page 1937

Mechanical Attenuator Transition Rules

When the Electronic Attenuator is enabled, the Mechanical Attenuator transitions to a state that has no Auto function. Below are the rules for transitioning the Mechanical Attenuator. Note that the information below *only* applies to the Dual-Attenuator configurations, and *only* when the Electronic Attenuator is installed:

When the Electronic Attenuation is enabled from a disabled state:

- The Mechanical Attenuator is initialized to 10 dB (this is its optimal performance setting). You can then set it as desired with SCPI, numeric keypad, step keys, or knob, and it behaves as it normally would in manual mode
- The Auto/Man state of (Mech) Atten is saved

- The Auto/Man toggle on the (Mech) Atten control disappears, and the auto rules are disabled
- The Electronic Attenuator is set to 10 dB less than the previous value of the Mechanical Attenuator, within the limitation that it must stay within the range of 0 to 24 dB of attenuation

Examples in the Dual-Attenuator configuration:

- Mech Atten at 20 dB. Elec Atten enabled, Mech Atten set to 10 dB, and Elec Atten set to 10 dB. New total attenuation equals the value before Elec Atten enabled
- Mech Atten at 0 dB. Elec Atten enabled, Mech Atten set to 10 dB, and Elec Atten set to 0 dB. New total attenuation does not equal the value before Elec Atten enabled
- Mech Atten at 40 dB. Elec Atten enabled, Mech Atten set to 10 dB, and Elec Atten set to 24 dB. New total attenuation does not equal the value before Elec Atten enabled

When the Electronic Attenuation is disabled from an enabled state:

- The Elec Atten control is grayed out
- The Auto/Man state of (Mech) Atten is restored
- If now in Auto, (Mech) Atten recouples
- If now in Man, (Mech) Atten is set to the value of total attenuation that existed before the Elec Atten was disabled. The resulting value is rounded up to the smallest value possible given the (Mech) Atten Step setting - (That is, 57 dB changes to 58 dB when (Mech) Atten Step is 2 dB)

Using the Electronic Attenuator: Pros and Cons

The electronic attenuator offers finer steps than the mechanical attenuator, has no acoustical noise, is faster, and is less subject to wear.

The “finer steps” advantage of the electronic attenuator is beneficial in optimizing the alignment of the instrument dynamic range to the signal power in the front panel as well as remote use. Thus, you can achieve improved relative signal measurement accuracy. Compared to a mechanical attenuator with 2 dB steps, the 1 dB resolution of the electronic attenuator only gives better resolution when the odd-decibel steps are used. Those odd-decibel steps are less accurately calibrated than the even-decibel steps, so one tradeoff for this superior relative accuracy is reduced absolute amplitude accuracy.

Another disadvantage of the electronic attenuator is that the spectrum analyzer loses its “Auto” setting, making operation less convenient.

Also, the relationship between the dynamic range specifications (TOI, SHI, compression, and noise) and instrument performance are less well-known with the electrical attenuator. With the mechanical attenuator, TOI, SHI, and compression threshold levels increase dB-for-dB with increasing attenuation, and the noise floor does as well. With the electronic attenuator, there is an excess attenuation of about 1 to 3 dB between 0 and 3.6 GHz, making the effective TOI, SHI, and so forth, less well known. Excess attenuation is the actual attenuation relative to stated attenuation. Excess attenuation is accounted for in the instrument calibration.

Adjust Atten for Min Clipping

Sets the combination of mechanical and electronic attenuation and gain based on the current measured signal level so that clipping will be at a minimum.

This is an immediate action function, that is, it executes once, when the control is pressed.

The algorithms that are used for the adjustment are documented under "Pre-Adjust for Min Clipping" on page 1942.

Remote Command	`[:SENSe]:POWer[:RF]:RANGe:OPTimize IMMediate`
Example	`:POW:RANG:OPT IMM`
Notes	Executing **Adjust Atten for Min Clipping** initiates the measurement
Dependencies	Does not appear in the Swept SA, RTSA, Monitor Spectrum and Complex Spectrum measurements Appears in the Waveform measurement in 5G NR Mode only

Adjust Atten

Allows you to select;

- Electric attenuator only
- Combination of Electric attenuator and Mechanical attenuator

when `[:SENSe]:POWer[:RF]:RANGe:OPTimize IMMediate` is executed.

Remote Command	`[:SENSe]:POWer[:RF]:RANGe:OPTimize:TYPE EONLy | COMBined` `[:SENSe]:POWer[:RF]:RANGe:OPTimize:TYPE?`
Example	`:POW:RANG:OPT:TYPE EONL` `:POW:RANG:OPT:TYPE?`
Dependencies	Does not appear in the Swept SA, RTSA, Monitor Spectrum and Complex Spectrum measurements

	Appears in the Waveform measurement in 5G NR Mode only
Preset	COMBined
State Saved	Saved in instrument state

Pre-Adjust for Min Clipping

If this function is ON, it applies the adjustment described under "Adjust Atten for Min Clipping" on page 1941 each time a measurement restarts. Therefore, in Continuous measurement mode, it only executes before the first measurement.

In Dual-Attenuator models, you can set **Elec+Mech Atten**, in which case both attenuators participate in the autoranging, or **Elec Atten Only**, in which case the mechanical attenuator does not participate in the autoranging. This latter case results in less wear on the mechanical attenuator and is usually faster.

See "Adjustment Algorithm" on page 1139

Selection	SCPI	Note
Off	OFF	This is the default setting
On	ON	Available in Single-Attenuator instruments. For compatibility with models that do not have an input attenuator, the ON parameter is supported and mapped to COMBined
Elec Atten Only	ELECtrical	Selects only the electric attenuator to participate in auto ranging. This offers less wear on the mechanical attenuator and is usually faster
Elec+Mech Atten	COMBined	In Dual-Attenuator models, this selects both attenuators to participate in the autoranging

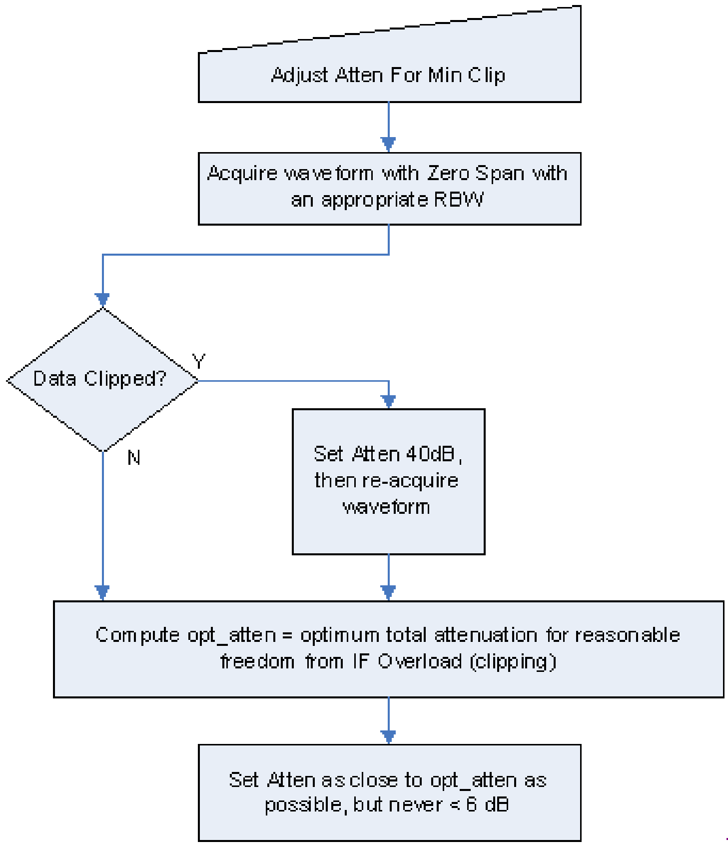
Remote Command	[:SENSe]:POWer[:RF]:RANGe:OPTimize:ATTenuation OFF | ON | ELECtrical | COMBined [:SENSe]:POWer[:RF]:RANGe:OPTimize:ATTenuation?
Example	:POW:RANG:OPT:ATT OFF :POW:RANG:OPT:ATT?
Notes	The parameter option ELECtrical sets this function to ON in Single-Attenuator models The parameter option COMBined is mapped to ELECtrical in Single-Attenuator models. If you send COMBined, it sets the function to ON and returns ELEC to a query For SCPI compatibility with models that do not have an input attenuator, the ON parameter is honored and mapped to COMBined
Dependencies	Only appears in Dual-Attenuator models with an Electronic Attenuator installed In instruments with Dual-Attenuator model, when "Elec Atten" on page 1937 is OFF or grayed-out, "Pre-Adjust for Min Clipping" on page 1138 is grayed-out Does not appear in the Swept SA, RTSA, Monitor Spectrum and Complex Spectrum measurements For the Waveform measurement, available only in 5G NR Mode

Preset	OFF when Elec Atten is Disabled at preset, otherwise ELEC
State Saved	Saved in instrument state
Range	Dual-Attenuator models: Off | Elec Atten Only | Mech + Elec Atten Single-Attenuator models: Off | On
Notes	ON aliases to "Elec Atten Only" (:POW:RANG:OPT:ATT ELEC) OFF aliases to "Off" (:POW:RANG:OPT:ATT OFF) :POW:RANG:AUTO? returns true if :POW:RANG:OPT:ATT is not OFF
Backwards Compatibility SCPI	[:SENSe]:POWer[:RF]:RANGe:AUTO ON | OFF | 1 | 0 [:SENSe]:POWer[:RF]:RANGe:AUTO?

Adjustment Algorithm

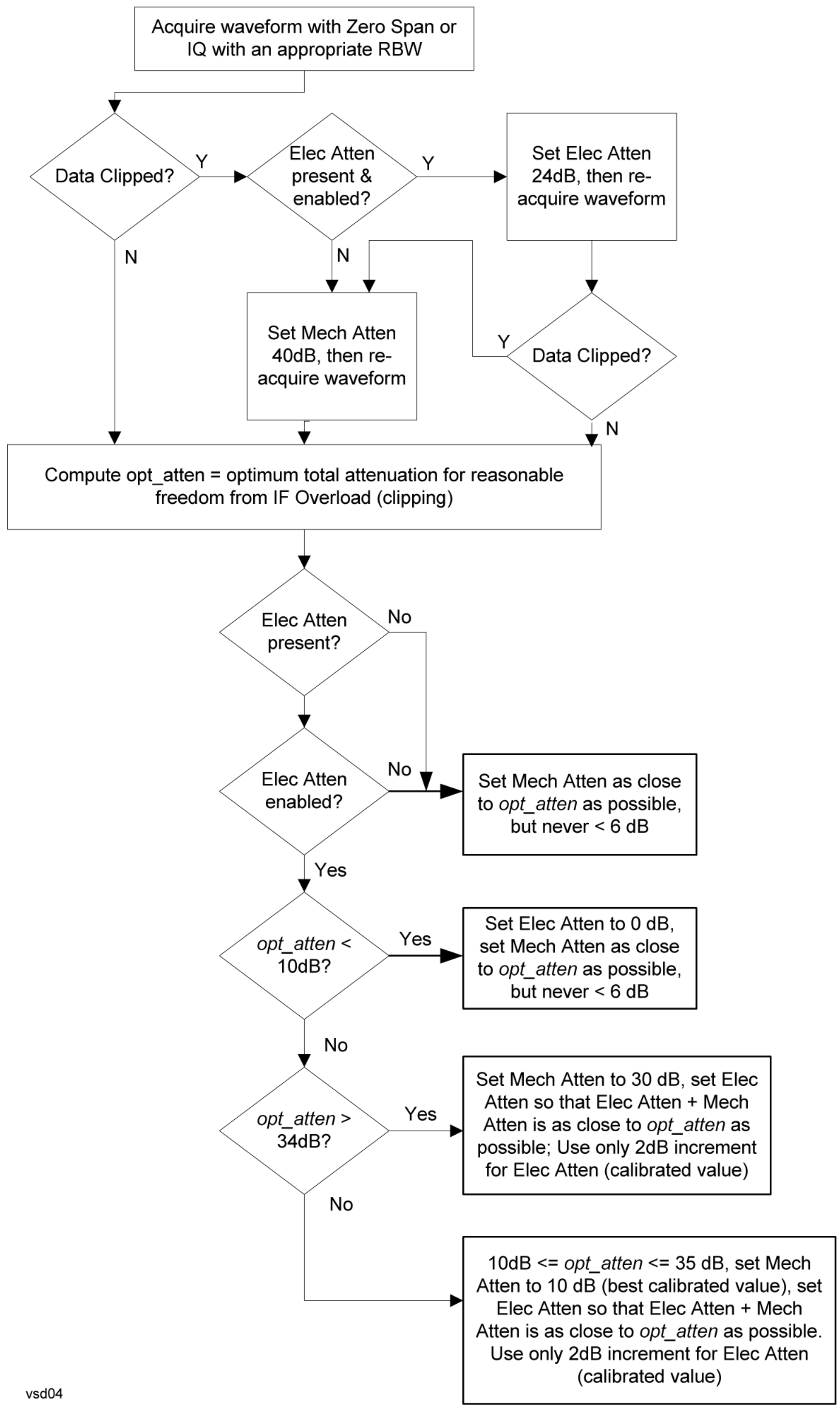
The algorithms for the adjustment are documented below:

Single-Attenuator Models



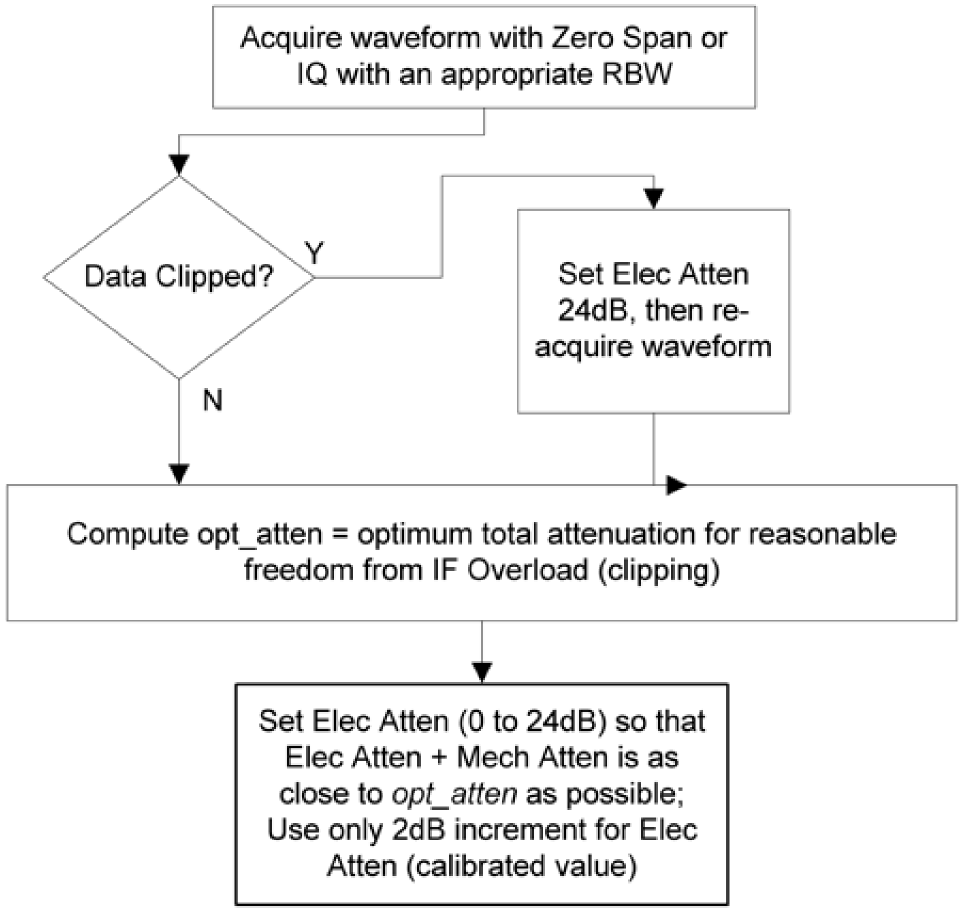
Dual-Attenuator models

"Adjust Atten for Min Clipping" on page 1941 or "Pre-Adjust for Min Clipping" on page 1138 selection is Mech + Elec Atten:


Acquire waveform with Zero Span or IQ with an appropriate RBW
Data Clipped?
Y
N
Elec Atten present & enabled?
Y
N
Set Elec Atten 24dB, then re-acquire waveform
Set Mech Atten 40dB, then re-acquire waveform
Data Clipped?
Y
N
Compute opt_atten = optimum total attenuation for reasonable freedom from IF Overload (clipping)
Elec Atten present?
No
Elec Atten enabled?
No
Yes
Set Mech Atten as close to *opt_atten* as possible, but never < 6 dB
opt_atten < 10dB?
Yes
No
Set Elec Atten to 0 dB, set Mech Atten as close to *opt_atten* as possible, but never < 6 dB
opt_atten > 34dB?
Yes
No
Set Mech Atten to 30 dB, set Elec Atten so that Elec Atten + Mech Atten is as close to *opt_atten* as possible; Use only 2dB increment for Elec Atten (calibrated value)
10dB <= *opt_atten* <= 35 dB, set Mech Atten to 10 dB (best calibrated value), set Elec Atten so that Elec Atten + Mech Atten is as close to *opt_atten* as possible. Use only 2dB increment for Elec Atten (calibrated value)
vsd04

"Pre-Adjust for Min Clipping" on page 1138 selection is Elec Only.

Note that the **Mech Atten** value is not adjusted, and the value previously set is used. Therefore, there is a case that IF Overload is still observed depending on the input signal level and the Mech Atten setting.



Mech Atten Step

Controls the step size used when making adjustments to the input attenuation.

Labeled **Mech Atten Step** in Dual-Attenuator models and **Atten Step** in Single-Attenuator models. In the Dual-Attenuator configuration, only affects the step size of the mechanical attenuator.

Remote Command	`[:SENSe]:POWer[:RF]:ATTenuation:STEP[:INCRement] 10 dB | 2 dB`

	`[:SENSe]:POWer[:RF]:ATTenuation:STEP[:INCRement]?`
Example	`:POW:ATT:STEP 2` `:POW:ATT:STEP?`
Notes	Has a toggle control on the front panel, but takes a specific value (in dB) when used remotely. The only valid values are 2 and 10
Dependencies	Blanked in EXA, CXA and CXA-m if option FSA (2 dB steps) is not present. If blanked, attempts to set it via SCPI yield an error
Couplings	When the attenuation step size changes, the current mechanical attenuation value is adjusted (if necessary) to be quantized to the new step size. That is, if step is set to 10 dB, mech atten is increased if necessary so it is a multiple of 10 dB
Preset	EXA, CXA and CXA-m: 10 dB (2 dB with option FSA) All other models: 2 dB
State Saved	Saved in instrument state

Max Mixer Level

Allows you to set the maximum level to be applied to the mixer for a signal at the top of the screen. By setting this value up or down you can allow more or less signal through the system.

The major impact of changes to **Max Mixer Level** is seen in changes to the value to which **Reference Level** is limited. Max Ref Level depends on Max Mixer Level and Attenuation, and therefore a higher Max Mixer Level may let you set Ref Level higher. However, changing this value can impact your TOI, compression, or dynamic range. The preset value of this function is best for most measurements.

See also "Max Mixer Lvl Rules" on page 1948.

Remote Command	`[:SENSe]:POWer[:RF]:MIXer:RANGe[:UPPer] <real>` `[:SENSe]:POWer[:RF]:MIXer:RANGe[:UPPer]?`
Example	`:POW:MIX:RANG -15 dBm` `:POW:MIX:RANG?`
Dependencies	Only appears in Swept SA and RTSA measurements
Preset	-10 dBm
State Saved	Saved in instrument state
Min	-50 dBm
Max	0 dBm

Max Mixer Lvl Rules

Allows you to optimize the Max Mixer Level setting for certain kinds of measurements.

`NORMal`	The historical, and thus backwards compatible, setting range (–50 to 0 dBm) and default setting (–10 dBm). The instrument has been designed so that, at the default setting, any signal below the Reference Level is extremely unlikely to create ADC overloads. At this mixer level the scale fidelity will be within specifications, thus compression with be negligible
`TOI`	Allows a range of settings of the "Max Mixer Level" on page 1947, –50 to –10 dBm, that can be optimum for measurements limited by the instrument third-order dynamic range. The default setting, –25 dBm, is commonly appropriate but RBW affects this. A good setting for Max Mixer Level would be higher than the optimum mixer level by half of the attenuator step size
`COMPression`	Allows a range of settings of the Max Mixer Level, –10 to +10 dBm or more, that can be optimum for measurements limited by the tradeoffs between instrument accuracy due to compression, and dynamic range due to the noise floor. The default setting, –3 dBm, is commonly appropriate, representing mixer drive levels that cause 1 dB or less compression at most carrier frequencies Typical measurements that would be optimized by this setting are the measurement of low sideband levels, including nulls, in angle-modulated signals (FM and PM). Also pulsed-RF measurements, including finding nulls to estimate pulse width, which are often best done with significant overdrive (compression) of the front end

Setting Name (readback)	Setting Name (verbose)	Max Mixer Level Preset Value, dBm	Max Mixer Level minimum value, dBm	Max Mixer Level maximum value, dBm
`NORMal`	Normal – balance TOI, noise, and compression	–10	–50	0
`TOI`	TOI-limited dynamic range	–25	–50	–10
`COMPression`	Compression-limited dynamic range	–3	–10	+30

Remote Command	`[:SENSe]:POWer[:RF]:MIXer:RULEs NORMal | TOI | COMPression` `[:SENSe]:POWer[:RF]:MIXer:RULEs?`
Example	`:POW:MIX:RULE:COMP`
Dependencies	Only appears in the Swept SA and RTSA measurements
Preset	`NORM`

3.6.3.3 Range (Baseband Input models)

Only available when Option BBA is present (I/Q Baseband Inputs), the current measurement supports option BBA, and I/Q is the selected input. In these cases, replaces the **Attenuation** tab.

Each input channel (I and Q) has four internal gain ranges. The maximum allowed voltage in each gain range is slightly more than the nominal value, so the break point between ranges is a few millivolts higher than the nominal (setting a peak voltage of 0.502 mV will still map to the 0.5 V Peak range).

Gain Setting	Volts RMS	Volts Peak	Volts Peak - Peak	dBm (50Ω)	Break Point
0 dB	0.7071	1.0	2.0	10	n/a
6 dB	0.3536	0.5	1.0	4	0.502 V Peak
12 dB	0.1768	0.25	0.5	-2	0.252 V Peak
18 dB	0.0884	0.125	0.25	-8	0.127 V Peak

Dependencies	Available only when the selected input is I/Q. If the current measurement does not support baseband inputs, an error will be displayed: “No result; Meas invalid with I/Q inputs”
State Saved	No

Range Auto/Man

The **Auto** setting for **Range** causes the range to be set based on the Y Scale settings. When **Range** is **Auto**, the I & Q Range are set based on the top of the Y Scale when the Y scale is in dB units (for example, power), or to the max(abs(top), abs(bottom)) when the Y scale reference is not at the top of the screen.

Not all measurements support **Range Auto/Man**. If **Auto** is not supported in the current measurement, this control is grayed-out, displaying **Man**, and `MAN` is returned to a SCPI query, but this does *not* change the Auto/Man setting for **Range**. When you switch to a measurement that supports **Auto**, it goes back to **Auto** if it was previously in **Auto** mode.

Remote Command	`[:SENSe]:VOLTage:IQ:RANGe:AUTO OFF | ON | 0 | 1` `[:SENSe]:VOLTage:IQ:RANGe:AUTO?`

Example	Put the I Range and Q Range in manual
	`:VOLT:IQ:RANG:AUTO OFF`
	`:VOLT:IQ:RANG:AUTO?`

Dependencies	If **Auto** is not supported, sending the SCPI command generates an error
Couplings	When in **Auto**, both I Range and Q Range are set to the same value, computed as follows: Maximum absolute value is computed for the Y Scale. The top and bottom of the graph are computed based on Ref Value, Scale/Div, and Ref Position. Formula: YMax = max(abs(top), abs(bottom))

	The I Range and Q Range are then set to YMax
Preset	`ON`
State Saved	Saved in instrument state
Annotation	When in Man, the Range annotation is preceded by "#"

This is an alternate form of the command to match the `POWer` form of the I Range and Q Range SCPI.

Remote Command	`[:SENSe]:POWer:IQ:RANGe:AUTO OFF | ON | 0 | 1` `[:SENSe]:POWer:IQ:RANGe:AUTO?`

Example	Put the I Range and Q Range in manual
	`:POW:IQ:RANG:AUTO OFF`
	`:POW:IQ:RANG:AUTO?`

Notes	`:POW:IQ:RANG:AUTO` is an alternate form of `:VOLT:IQ:RANG:AUTO`, to maintain consistency with I Range and Q Range, which support both the `POWer` and `VOLTage` forms of the command
Preset	`ON`
Range	Auto | Man

I Range

The internal gain range for the I channel when the Input Path is I Only or I and I/Q. Used for both the I and Q channels when the Input Path is I+jQ.

Remote Command	`[:SENSe]:VOLTage:IQ[:I]:RANGe[:UPPer] <voltage>` `[:SENSe]:VOLTage:IQ[:I]:RANGe[:UPPer]?`

Example	Set the I Range to 0.5 V Peak
	`:VOLT:IQ:RANG 0.5 V`
	`:VOLT:IQ:RANG?`

Notes	The numeric entries are mapped to the smallest gain range whose break point is greater than or equal to the value, or 1 V Peak if the value is greater than 1 V
Couplings	When "Q Same as I" on page 1953 is On, the **I Range** value will be copied to "Q Range" on page 1951 Changing the value also sets Range = Man
Preset	Complex `SPECtrum` Measurement: 0.5 V Peak All others: 1 V Peak
State Saved	Saved in instrument state
Range	1 V Peak (10 dBm @ 50 Ω) | 0.5 V Peak (4 dBm @ 50Ω) | 0.25 V Peak (-2 dBm @ 50Ω) | 0.125 V Peak (-8 dBm @ 50Ω)
Min	0.125 V
Max	1 V
Annotation	The Range annotation replaces the RF Input context's "Atten" annotation

	"Rng: <I Range>". When Range = Man the annotation is preceded by "#" The I Range is not annotated in Input Path Q Only. When I Range and Q Range are the same, the annotation is "Rng: <Range>". When I Range and Q Range are different and the Input Path is Ind I/Q, the annotation is "Rng: <I Range>, <Q Range>" and "Peak" is removed from the text. Examples: "Rng: 1 V Peak" the I Range is 1 V Peak "Rng: 1 V, 0.5 V " the I Range is 1 V Peak and the Q Range is 0.5 V Peak

This is an alternate form of the command to allow entry as a power.

Remote Command	`[:SENSe]:POWer:IQ[:I]:RANGe[:UPPer] <ampl>` `[:SENSe]:POWer:IQ[:I]:RANGe[:UPPer]?`

Example	Set the I Range to 0.5 V Peak when Reference Z is 50 Ω, and to 1.0 V Peak when Reference Z is 75 Ω
	`:POW:IQ:RANG 4 dBm`
	`:POW:IQ:RANG?`

Notes	The `POWer` form of the command is provided for convenience. It maps to the same underlying gain range parameter as the `VOLTage` form The Reference Z (not the I channel Input Z) is used to convert the power to peak voltage, which is then used to set the I Range as with the `VOLTage` form of the command. The power values of the 4 range states (1V Peak, 0.5V Peak, 0.25V Peak, and 0.125V Peak) will vary with Reference Z. Here are some examples: 50 Ω: 10, 4, -2, -8 75 Ω: 8.2, 2.2, -3.8, -9.8 600 Ω: -0.8, -6.8, -12.8, -18.9
Preset	10.0 dBm
Range	-20 dBm to 10 dBm
Min	-20 dBm
Max	10 dBm

Q Range

The internal gain range for the Q channel. **Q Range** only applies to Input Path Q Only and Ind I/Q. For input I+jQ "I Range" on page 1950 determines both I and Q channel range settings.

Remote Command	`[:SENSe]:VOLTage:IQ:Q:RANGe[:UPPer] <voltage>` `[:SENSe]:VOLTage:IQ:Q:RANGe[:UPPer]?`

Example	Set the Q Range to 0.5 V Peak:
	`:VOLT:IQ:Q:RANG 0.5 V`
	`:VOLT:IQ:Q:RANG?`

Notes	The numeric entries are mapped to the smallest gain range whose break point is greater than or equal to the value, or 1 V Peak if the value is greater than 1 V

	Q Range is only used for Input Path Q Only and Ind I/Q. For input I+jQ, "I Range" on page 1950 determines both I and Q channel range settings
Couplings	When "Q Same as I" on page 1953 is On, the "I Range" on page 1950 value is copied to **Q Range** and the range value keys are disabled Changing the value also sets Range = Man
Preset	1 V Peak
State Saved	Saved in instrument state
Range	1 V Peak (10 dBm @ 50Ω) | 0.5 V Peak (4 dBm @ 50Ω) | 0.25 V Peak (-2 dBm @ 50Ω) | 0.125 V Peak (-8 dBm @ 50Ω)
Min	0.125 V
Max	1 V
Annotation	The Range annotation replaces the RF Input context's "Atten" annotation "Rng: <Q Range>". When Range = Man the annotation is preceded by "#" The Q Range is not annotated in Input Path I Only or I+jQ. When I Range and Q Range are the same, the annotation is "Rng: <Range>". When I Range and Q Range are different and the Input Path is Ind I/Q, the annotation is "Rng: <I Range>, <Q Range>" and "Peak" is removed from the text. Examples: "Rng: 1 V Peak" the Q Range is 1 V Peak "Rng: 1 V, 0.5 V " the I Range is 1 V Peak and the Q Range is 0.5 V Peak

This is an alternate form of the command to allow entry as a power.

Remote Command	`[:SENSe]:POWer:IQ:Q:RANGe[:UPPer] <ampl>` `[:SENSe]:POWer:IQ:Q:RANGe[:UPPer]?`

Example	Sets the Q Range to 0.5 V Peak when Reference Z is 50 **Ω**, and to 1.0 V Peak when Reference Z is 75 **Ω**:
	`:POW:IQ:Q:RANG 4 dBm`
	`:POW:IQ:Q:RANG?`

Notes	The `POWer` form of the command is provided for convenience. It maps to the same underlying gain range parameter as the `VOLTage` form of the command The Reference Z (not the Q channel Input Z) is used to convert the power to peak voltage, which is then used to set the Q Range as with the `VOLTage` form of the command. The power values of the 4 range states (1V Peak, 0.5V Peak, 0.25V Peak, and 0.125V Peak) will vary with Reference Z. Here are some examples: 50 Ω: 10, 4, -2, -8 75 Ω: 8.2, 2.2, -3.8, -9.8 600 Ω: -0.8, -6.8, -12.8, -18.9
Preset	10.0 dBm
Range	-20 dBm to 10 dBm
Min	-20 dBm
Max	10 dBm

Q Same as I

Many, but not all, usages require the I and Q channels to have an identical setup. To simplify channel setup, **Q Same as I** causes the Q channel range to be mirrored from the I channel. That way, you only need to set up one channel (the I channel). The I channel values are copied to the Q channel, so at the time **Q Same as I** is Off, the I and Q channel setups will be identical.

Remote Command	`[:SENSe]:VOLTage|POWer:IQ:MIRRored OFF | ON | 0 | 1` `[:SENSe]:VOLTage|POWer:IQ:MIRRored?`

Example	Turn off the mirroring of I Range to Q Range
	`:VOLT:IQ:MIRR OFF`
	`:POW:IQ:MIRR OFF`

Couplings	When ON, the "I Range" on page 1950 value is mirrored (copied) to the "Q Range" on page 1951
Preset	ON
State Saved	Saved in instrument state
Range	OFF|ON

3.6.3.4 Range (Non-attenuator models)

Only available for Keysight’s modular signal analyzers and certain other Keysight products, such as VXT

State Saved	No

Range

Represents the amplitude of the largest sinusoidal signal that could be present within the IF without being clipped by the ADC. For signals with high peak-to-average ratios, the range may need to exceed the rms signal power by a significant amount to avoid clipping.

This is a measurement global setting.

Remote Command	`[:SENSe]:POWer[:RF]:RANGe <real>` `[:SENSe]:POWer[:RF]:RANGe?`
Example	`:POW:RANG 10 dBm` `:POW:RANG?`
Notes	The MIN and MAX values are affected by the External Gain parameters, and by the **Center Frequency** The hardware compensates for frequency response and alters the Range setting

Preset	0 dBm
State Saved	Yes
Min	-100
Max	100
Annotation	Meas Bar

Adjust Range for Min Clipping

Sets the combination of attenuation and gain based on the current measured signal level so that clipping will be at a minimum.

This is an "immediate action" function, that is, it executes once, when the key is pressed.

This key does not appear in measurements that do not support this functionality.

Remote Command	`[:SENSe]:POWer[:RF]:RANGe:OPTimize IMMediate`
Notes	Executing Adjust Range for Min Clipping initiates the measurement
Dependencies	Does not appear in the Swept SA and Monitor Spectrum measurements

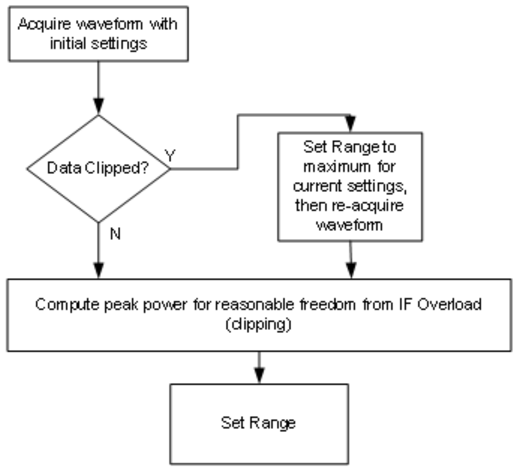
Pre-Adjust for Min Clipping

If this function is `ON`, it applies the adjustment described under Adjust Range For Min Clipping each time a measurement restarts. Therefore, in Continuous measurement mode, it only executes before the first measurement.

Remote Command	`[:SENSe]:POWer[:RF]:RANGe:OPTimize:ATTenuation OFF | ON | ELECtrical | COMBined` `[:SENSe]:POWer[:RF]:RANGe:OPTimize:ATTenuation?`
Notes	Because there is no attenuator control available in these models, the control displays only `ON` and `OFF` choices. However, for SCPI compatibility with other platforms, all three parameters (`ELECtrical`, `COMBined`, and `ON`) are honored and all are mapped to `ELECtrical`, so if any of these three parameters is sent, a subsequent query will return `ELEC`
Dependencies	Does not appear in the Swept SA and Monitor Spectrum measurements
Preset	`OFF` for Swept SA measurement; `ON` for all other measurements that support **Pre-Adjust for Min Clipping**
State Saved	Saved in instrument state

Adjustment Algorithm

The algorithm for the adjustment is documented below:



Peak-to-Average Ratio

Used with "Range (Non-attenuator models)" on page 1953 to optimize the level control in the instrument. The value is the ratio, in dB, of the peak power to the average power of the signal to be measured. A ratio of 0 should be used for sinusoidal signals; for 802.11g OFDM signals use 9 dB.

All Modes show the current value of Peak-to-Average ratio on the control. However, some Modes do not permit changing the value. In these situations, the control is grayed-out.

Remote Command	`[:SENSe]:POWer[:RF]:RANGe:PARatio <real>` `[:SENSe]:POWer[:RF]:RANGe:PARatio?`
Example	`:POW:RANG:PAR 12 dB`
Notes	In some Modes, this parameter is read-only; meaning the value will appear on the control and query via SCPI, but is not changeable. In such applications the control is grayed-out. Attempting to change the value via SCPI will be ignored but no error message will be generated
Dependencies	Does not appear in Spectrum Analyzer Mode
Preset	10 dB VXT Models M9410A/11A: 0 dB
State Saved	Saved in instrument state
Min	0 dB
Max	20 dB VXT Models M9410A/11A: 50 dB

Mixer Lvl Offset

This is an advanced setting to adjust target Range at the input mixer, which in turn affects the signal level in the instrument's IF. This setting can be used when additional optimization is needed after setting "Peak-to-Average Ratio" on page 1955. Positive values of offset optimize noise performance over distortion, negative values optimize distortion performance over noise.

Remote Command	`[:SENSe]:POWer[:RF]:RANGe:MIXer:OFFSet <real>` `[:SENSe]:POWer[:RF]:RANGe:MIXer:OFFSet?`
Example	`:POW:RANG:MIX:OFFS -5 dB`
Preset	0 dB
State Saved	Saved in instrument state
Min	-35 dB VXT Models M9410A/11A: -34 dB
Max	30 dB

3.6.3.5 Signal Path

Contains controls that pertain to the routing of the signal through the frontend of the instrument.

In general, only appears in instruments whose hardware supports this signal routing. For example, this tab does not appear in many of the modular instrument products, including VXT Model M9421A, or UXM.

This tab *does* appear in VXT Models M9410A/11A, because "Software Preselection" on page 1971 is under this tab, and VXT Models M9410A/11A implement a version of Software Preselection.

Presel Center

Adjusts the centering of the preselector filter to optimize the amplitude accuracy at the frequency of the selected marker. If the selected marker is not on when **Presel Center** is pressed, the instrument turns on the selected marker, performs a peak search, and then performs centering on the marker's center frequency. If the selected marker is already on and between the start and stop frequencies of the instrument, the instrument performs the preselector calibration on that marker's frequency. If the selected marker is already on, but outside the frequency range between **Start Freq** and **Stop Freq**, the instrument first performs a peak search, and then performs centering on the marker's center frequency.

The value displayed on "Preselector Adjust" on page 1958 changes to reflect the new preselector tuning.

Certain considerations should be observed to ensure proper operation, as detailed in "Proper Preselector Operation" on page 1153.

Remote Command	`[:SENSe]:POWer[:RF]:PCENter`
Example	`:POW:PCEN`
Notes	The rules outlined above under the control description apply for the remote command as well as the key. The result of the command depends on marker position, etc. Any message generated by the control press is also generated in response to the remote command
Dependencies	Does not appear in CXA-m, nor in VXT Models M9410A/11A Grayed-out if the microwave preselector is off – If the selected marker's frequency is below Band 1, an advisory message is generated "Preselector not used in this frequency range" and no action is taken – Grayed-out if entirely in Band 0, that is, if **Stop Freq** is below about 3.6 GHz Grayed-out if entirely above 50 GHz, that is, if **Start Freq** is above 50 GHz – Blanked in models that do not include a preselector, such as Option 503. If the remote command is sent in these instruments, accepted without error, and the query always returns 0 – Grayed-out in the Spectrogram View
Couplings	The active marker position determines where the centering will be attempted If the instrument is in a measurement such as averaging when centering is initiated, the act of centering the preselector restarts averaging, but the first average trace will not be taken until the centering is completed The offset applied to do the centering appears in "Preselector Adjust" on page 1958
Status Bits/OPC dependencies	When centering the preselector, `*OPC` does not return true until the process is complete and a subsequent measurement has completed, nor are results returned in response to `:READ` or `:MEASure` queries The `Measuring` bit remains set (true) while this command is operating, and does not go false until the subsequent sweep/measurement has completed

Proper Preselector Operation

Certain considerations should be observed to ensure proper operation:

1. If the selected marker is **Off**, the instrument turns on a marker, performs a peak search, and adjusts the preselector using the selected marker's frequency. It uses the "highest peak" peak search method unqualified by threshold or excursion, so that there is no chance of a 'no peak found' error. It continues with that peak, even if it is the peak of just noise. Therefore, for this operation to work properly, there should be a signal on-screen in a preselected range for the peak search to find

2. If the selected marker is already **On**, the instrument attempts the centering at that marker's frequency. There is no preselector for signals below about 3.6 GHz, so if the marker is on a signal below 3.6 GHz, no centering is attempted, and an advisory message is generated

3. In some models, the preselector can be bypassed. If it is bypassed, no centering is attempted in that range and a message is generated

Preselector Adjust

Lets you manually adjust the preselector filter frequency to optimize its response to the signal of interest. Only available when "Presel Center" on page 1956 is available.

For general purpose signal analysis, using **Presel Center** is recommended. Centering the filter minimizes the impact of long-term preselector drift. **Preselector Adjust** can be used instead to manually optimize the preselector. One application of manual optimization would be to peak the preselector response, which both optimizes the signal-to-noise ratio and minimizes amplitude variations due to small (short-term) preselector drifting.

When **Presel Center** is performed, the offset applied to do the centering becomes the new value of **Preselector Adjust**.

Remote Command	`[:SENSe]:POWer[:RF]:PADJust <freq>` `[:SENSe]:POWer[:RF]:PADJust?`
Example	`:POW:PADJ 100KHz` `:POW:PADJ?`
Notes	The value on the control is displayed to 0.1 MHz resolution
Dependencies	– Does not appear in CXA-m – Does not appear in VXT Models M9410A/11A – Grayed-out if microwave preselector is off – Grayed-out if entirely in Band 0, that is, if Stop Freq is lower than about 3.6 GHz – Grayed-out if entirely above 50 GHz, that is, if Start Freq is higher than 50 GHz – Blank in models that do not include a preselector, such as Option 503. If the command is sent in these instruments, it is accepted without error, and the query always returns 0 – Grayed-out in the Spectrogram View
Preset	0 MHz
State Saved	The **Preselector Adjust** value set by "Presel Center" on page 1956, or by manually adjusting **Preselector Adjust** Not saved in instrument state, and does not survive a Preset or power cycle

Min	-500 MHz
Max	500 MHz
Backwards Compatibility SCPI	`[:SENSe]:POWer[:RF]:MW:PADJust` `[:SENSe]:POWer[:RF]:MMW:PADJust`

Notes	The command has no effect, and the query always returns `MWAVe`
Backwards Compatibility SCPI	`[:SENSe]:POWer[:RF]:PADJust:PRESelector MWAVe | MMWave | EXTernal` `[:SENSe]:POWer[:RF]:PADJust:PRESelector?`

Internal Preamp

Accesses a menu of controls for the internal preamps. Turning on the preamp gives a better noise figure, but a poorer inter-modulation distortion (TOI) to noise floor dynamic range. You can optimize this setting for your measurement.

The instrument takes the preamp gain into account as it sweeps. If you sweep outside of the range of the preamp, the instrument will also account for that. The displayed result always reflects the correct gain.

For some measurements, when the preamp is on and any part of the displayed frequency range is below the lowest frequency for which the preamp has specifications, a warning condition message appears in the status line. For example, for a preamp with a 9 kHz lowest specified frequency: "Preamp: Accy unspec'd below 9 kHz".

Selection	Example	Note
Off	`:POW:GAIN OFF`	
Low Band	`:POW:GAIN ON` `:POW:GAIN:BAND LOW`	Sets the internal preamp to use only the low band. The frequency range of the installed (optional) low-band preamp is displayed in square brackets on the Low Band selection in the dropdown
Full Range	`:POW:GAIN ON` `:POW:GAIN:BAND FULL`	Sets the internal preamp to use its full range. The low band (0-3.6 GHz, 0-3.4 GHz, 0-3 GHz, depending on the model) is supplied by the low band preamp and the frequencies above low band are supplied by the high band preamp The frequency range of the installed (optional) low-band preamp is displayed in square brackets on the Full Range selection in the dropdown. If the high band option is not installed the Full Range selection does not appear

NOTE The maximum **Center Frequency** for Low Band, displayed in square brackets, can change based on the selected IFBW for measurements that support IFBW (for example, Waveform measurement across all Modes that support it). In certain models (such as N9042B & N9032B), IFBW values <= 40 MHz have a maximum Low Band frequency of 3.6 GHz, while 40 MHz < IFBW <= 1 GHz have a maximum of 3.3 GHz, and 1 GHz < IFBW <= 1.5 GHz have a maximum of 3.5 GHz. IFBW values > 1.5 GHz do not support a **Center Frequency** that can reach the Low Band maximum frequency. In these cases, **N/A** is displayed in the square brackets for Low Band.

Remote Command	`[:SENSe]:POWer[:RF]:GAIN:BAND LOW | FULL`
	`[:SENSe]:POWer[:RF]:GAIN:BAND?`
	`[:SENSe]:POWer[:RF]:GAIN[:STATe] OFF | ON | 0 | 1`
	`[:SENSe]:POWer[:RF]:GAIN[:STATe]?`

Example	`:POW:GAIN:BAND LOW`
	`:POW:GAIN:BAND?`
	`:POW:GAIN OFF`
	`:POW:GAIN?`

Dependencies	Not available on all hardware platforms. If the preamp is not present or is unlicensed, this control is not shown Does not appear in VXT Models M9410A/11A/15A/16A If `:POW:GAIN:BAND FULL` is sent when a low band preamp is available, the preamp band parameter is set to `LOW` instead of `FULL`, and an "Option not installed" message is generated Not available when the electronic/soft attenuator is enabled
Preset	`LOW` `OFF`
State Saved	Saved in instrument state
Annotation	When the USB Preamp is not connected to USB, the Preamp annotation in the Meas Bar says “Off” if the preamp is off and displays the frequency range of the low band or full range preamp depending on the setting. For example, if the Preamp is set to Low Band and the Low Band is 3.6 GHz the annotation says “3.6 GHz”. If it is a 13.6 GHz preamp and it is set to Full Range the annotation says “13.6 GHz” When the USB Preamp is connected to USB, the Preamp annotation says “Preamp: USB” if the internal preamp is off or “Preamp: USB, Int” if the internal preamp is on (only for measurements that support the USB preamp)

LNA

Lets you turn the Low Noise Amplifier (LNA) on or off.

LNA is an additional preamplifier that provides superior DANL and frequency range compared to "Internal Preamp" on page 1959. LNA provides lower system noise

figure, especially at frequencies above 100 MHz, and can be operated up to the full range of 50 GHz instruments.

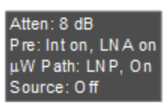
For best possible sensitivity, **LNA** can be turned on *together* with "Internal Preamp" on page 1959, although if you operate both preamps together, note that the TOI (distortion) specifications are impacted. The sensitivity improvement of this combination is substantial when operating in high band (frequencies above 3.6 GHz).

For more details about annotation, see "More Information" on page 1157

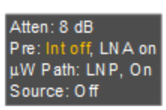
Remote Command	`[:SENSe]:POWer[:RF]:GAIN:LNA[:STATe] OFF | ON | 0 | 1` `[:SENSe]:POWer[:RF]:GAIN:LNA[:STATe]?`
Example	`:POW:GAIN:LNA ON`
Dependencies	Requires Option LNA, except for VXT models M9415A/16A Does not appear in VXT models M9421A/10A/11A May not appear in some measurements **LNA** is not available when the electronic/soft attenuator is enabled
Preset	`OFF`
State Saved	Saved in State

More Information

When **LNA** is installed, the preamp annotation changes to show the state of both **LNA** and **Internal Preamp**. Below is an example:



Note that when operating entirely in the low band (below about 3.6 GHz), if **LNA** is on, **Internal Preamp** is switched off (even if you have its switch set to `ON`). This is because the noise performance is actually degraded in low band if both preamps are on. In this case, the annotation reflects the actual state of the two preamps, but the **Internal Preamp** annotation displays in amber, to warn you that the actual state of **Internal Preamp** does not match its switch control display:



µW Path Control

Options for this control include **µW Preselector Bypass** (Option MPB), **Low Noise Path** (Option LNP) and **Full Bypass Enable** in the High Band path circuits.

When the µW Preselector is bypassed, flatness is improved, but will be subject to spurs from out of band interfering signals. When **Low Noise Path Enable** is selected, the instrument automatically bypasses certain circuitry in the high frequency bands that can contribute to noise, when it is appropriate based on other instrument settings.

For most applications, the preset state is **Standard Path**, which provides the best remote-control throughput, minimizes acoustic noise from switching and minimizes the risk of wear in the hardware switches, particularly in remote test scenarios where both low band and high band setups will follow in rapid succession. In this path, the bypass of the low band/high band switch and microwave preamp is never activated, which can cause some noise degradation but preserves the life of the bypass switch.

For applications that utilize the wideband IF paths, the preset state is **µW Preselector Bypas**s, if option MPB is present. This is because, when using a wideband IF such as the 140 MHz IF, the µW Preselector's bandwidth can be narrower than the available IF bandwidth, causing degraded amplitude flatness and phase linearity, so it is desirable to bypass the preselector in the default case.

You may choose **Low Noise Path Enable** for a lower noise floor, especially in the 21-26.5 GHz region, though without improving many measures of dynamic range, and without giving the best possible noise floor. The preamp, if purchased and used, gives better noise floor than does **Low Noise Path Enable**, but the preamp's compression threshold and third-order intercept are much poorer than that of **Low Noise Path Enable**.

A fourth choice is **Full Bypass Enable**, which combines **µW Preselector Bypass** and **Low Noise Path Enable**. Because this can bypass most of the circuitry between the input and the first mixer, care should be taken when using this setting to avoid damaging the mixer. **Full Bypass Enable** is only available if both options LNP and MPB are present, as well as option FBP.

Path	Example	Note
Standard Path	`:POW:MW:PATH STD`	Normal setting for most measurements. µW Preselector in circuit, Low Noise Path disabled
Low Noise Path Enable	`:POW:MW:PATH LNP`	See "Low Noise Path Enable" on page 1162
µW Preselector Bypass	`:POW:MW:PATH MPB`	See "µW Preselector Bypass" on page 1164
Full Bypass Enable	`:POW:MW:PATH FULL`	See "Full Bypass Enable" on page 1165

Remote Command	`[:SENSe]:POWer[:RF]:MW:PATH STD | LNPath | MPBypass | FULL` `[:SENSe]:POWer[:RF]:MW:PATH?`

Example	`:POW:MW:PATH LNP`
	Enables the Low Noise path
	`:POW:MW:PATH?`

<table>
<tr><td>Notes</td><td>If "Presel Center" on page 1956 is performed, the instrument will momentarily switch to the Standard Path, regardless of the setting of µW Path Control

The DC Block will always be switched in when the low noise path is switched in, to protect succeeding circuitry from DC. Note that this does not mean “when the low noise path is enabled” but when, based on the Low Noise Path rules, the path is actually switched in. This can happen when the selection is Low Noise Path Enable or Full Bypass Enable. In the case where the DC Block is switched in the instrument is now AC coupled. However, if you selected DC coupling, the UI would still behave as though it were DC coupled, including all annunciation, warnings, status bits, and responses to SCPI queries. This is because, based on other settings, the instrument could switch out the low noise path at any time and hence go back to being DC coupled

Alignment switching ignores the settings in this menu, and restores them when finished</td></tr>
<tr><td>Dependencies</td><td>Does not appear in CXA-m, VXT Models M9410A/11A, nor in BBIQ and External Mixing

– The Low Noise Path Enable selection does not appear unless Option LNP is present and licensed

– The µW Preselector Bypass selection does not appear unless Option MPB is present and licensed

– The Full Bypass Enable selection does not appear unless options LNP and MPB are both present as well as option FBP

In any of these cases, if the required options are not present and the SCPI command is sent, error -241, "Hardware missing; Option not installed" is generated

Low Noise Path Enable and Full Bypass Enable are grayed-out if the current measurement does not support them

Low Noise Path Enable and Full Bypass Enable are not supported in Avionics and MMR Modes (non-modulation measurements). In any of these cases (that is, the feature is not supported in either measurement or Mode), if the SCPI command is sent, the following error is generated: -221, “Setting Conflict; Feature not supported for this measurement”</td></tr>
<tr><td>Preset</td><td><table><tr><th>Mode</th><th>Value</th></tr><tr><td>IQ Analyzer
Pulse
Avionics</td><td>MPB option present and licensed: <code>MPB</code>
MPB option not present and licensed: <code>STD</code></td></tr><tr><td>All other Modes</td><td><code>STD</code></td></tr></table></td></tr>
<tr><td>State Saved</td><td>Save in instrument state</td></tr>
<tr><td>Range</td><td>Standard Path | Low Noise Path Enable | µW Presel Bypass | Full Bypass Enable</td></tr>
<tr><td>Annotation</td><td>In the Meas Bar, if the Standard path is chosen:
µW Path: Standard
If Low Noise Path is enabled but the LNP switch is not thrown:
µW Path: LNP,Off
If the Low Noise Path is enabled and the LNP switch is thrown:
µW Path: LNP,On
If the preselector is bypassed:
µW Path: Bypass</td></tr>
</table>

If Full Bypass Enable is selected but the LNP switch is not thrown:

µW Path: FByp,Off

If Full Bypass Enable is selected and the LNP switch *is* thrown:

µW Path: FByp,On

µW Path Control Auto

In VMA, WLAN, 5G NR, CQM Modes, an **Auto/Man** switch is added to **µW Path Control**:

This allows the function to automatically switch based on certain Auto Rules as shown below:

VMA Mode

Measurement	When µW Path Control is in Auto
Digital Demod	Use Standard Path unless tuned frequency > 3.6 GHz and IFBW > 15 MHz, in which case choose Preselector Bypass
Monitor Spectrum	Always Presel Bypass
IQ Waveform	Use Standard Path unless tuned frequency > 3.6 GHz and IFBW > 15 MHz, in which case choose Preselector Bypass
Custom OFDM	Use Standard Path unless tuned frequency > 3.6 GHz and IFBW > 15 MHz, in which case choose Preselector Bypass
Channel Power	Always Presel Bypass
Occupied BW	Always Presel Bypass
CCDF	Use Standard Path unless tuned frequency > 3.6 GHz and IFBW > 15 MHz, in which case choose Preselector Bypass
ACP	Always Presel Bypass
SEM	Always Presel Bypass
Spurious Emissions	Always Standard Path

WLAN Mode

Measurement	When µW Path Control is in Auto
Modulation Analysis	Always Presel Bypass

Measurement	When µW Path Control is in Auto
Spectral Flatness	Always Presel Bypasss
Power vs Time	Always Presel Bypass
Monitor Spectrum	Always Presel Bypass
IQ Waveform	Always Presel Bypass
Channel Power	Always Presel Bypass
Occupied BW	Always Presel Bypass
CCDF	Always Presel Bypass
SEM	For 11be 320M, when 'Enabled Wideband IF for FFT' is OFF or 'Sweep Type Rule' is Best Dynamic Range, auto µW path is standard For other cases, auto µW path is presel bypass if presel bypass is enabled, auto µW path is standard if presel bypass is not enabled
Spurious Emissions	Always Standard Path

5G NR Mode

Measurement	When µW Path Control is in Auto
Modulation Analysis	Use Standard Path unless tuned frequency > 3.6 GHz and IFBW > 15 MHz, in which case choose Full Bypass if conditions warrant(FBP Option is available and "Allow Full Bypass in Auto" is On), otherwise choose Preselector Bypass
Monitor Spectrum	Always Standard Path
IQ Waveform	Use Standard Path unless tuned frequency > 3.6 GHz and IFBW > 15 MHz, in which case choose Full Bypass if conditions warrant(FBP Option is available and "Allow Full Bypass in Auto" is On), otherwise choose Preselector Bypass
Channel Power	Always Standard Path
Occupied BW	Always Standard Path
CCDF	Use Standard Path unless tuned frequency > 3.6 GHz and IFBW > 15 MHz, in which case choose Preselector Bypass
ACP	Always Standard Path
SEM	Always Standard Path
Spurious Emissions	Always Standard Path
Transmit On|Off Power	Use Standard Path unless tuned frequency > 3.6 GHz and Info BW > 15 MHz, in which case choose Preselector Bypass

Channel Quality Mode

Measurement	When µW Path Control is in Auto
Group Delay	Use Standard Path unless tuned frequency > 3.6 GHz and IFBW > 15 MHz, in which case choose Full Bypass if conditions warrant(FBP Option is available and "Allow Full Bypass in Auto" is On), otherwise choose Preselector Bypass

Measurement	When µW Path Control is in Auto
Monitor Spectrum	Always Standard Path
IQ Waveform	Use Standard Path unless tuned frequency > 3.6 GHz and IFBW > 15 MHz, in which case choose Preselector Bypass
CCDF	Use Standard Path unless tuned frequency > 3.6 GHz and IFBW > 15 MHz, in which case choose Preselector Bypass

Remote Command	`[:SENSe]:POWer[:RF]:MW:PATH:AUTO ON | OFF | 1 | 0` `[:SENSe]:POWer[:RF]:MW:PATH:AUTO?`
Example	`:POW:MW:PATH:AUTO ON` `:POW:MW:PATH:AUTO?`
Dependencies	Only appears in VMA, WLAN, 5G NR and CQM Modes
Couplings	See the tables above
Preset	ON
Range	ON|OFF

Low Noise Path Enable

Low Noise Path Enable provides a lower noise floor under some circumstances, particularly when operating in the 21–26.5 GHz region. With the Low Noise Path enabled, the low band/high band switch and microwave preamp are bypassed whenever *all* the following are true:

- The instrument is not in the Low Band, meaning:
- the start frequency is above 3.5 GHz and
- the stop frequency is above 3.6 GHz
- The internal preamp is not installed, or if installed, is set to **Off** or **Low Band**

Note that this means that, when any part of a sweep is done in Low Band, the Low Noise Path is not used, whether or not the **Low Noise Path Enable** is selected in the user interface. Also, if the preamp is turned on, the Low Noise Path is not used, whether or not the **Low Noise Path Enable** is selected in the user interface. The only time the Low Noise Path is used is when **Low Noise Path Enable** is selected, the sweep is completely in High Band (> 3.6 GHz) and no preamp is in use.

For measurements that use IQ acquisition, the low noise path is used when **Center Frequency** is in High Band (> 3.6 GHz) and no preamp is in use. In other words, the rules above are modified to use only the center frequency to qualify which path to switch in. This is not the case for FFTs in the Swept SA measurement; they use the same rules as swept measurements.

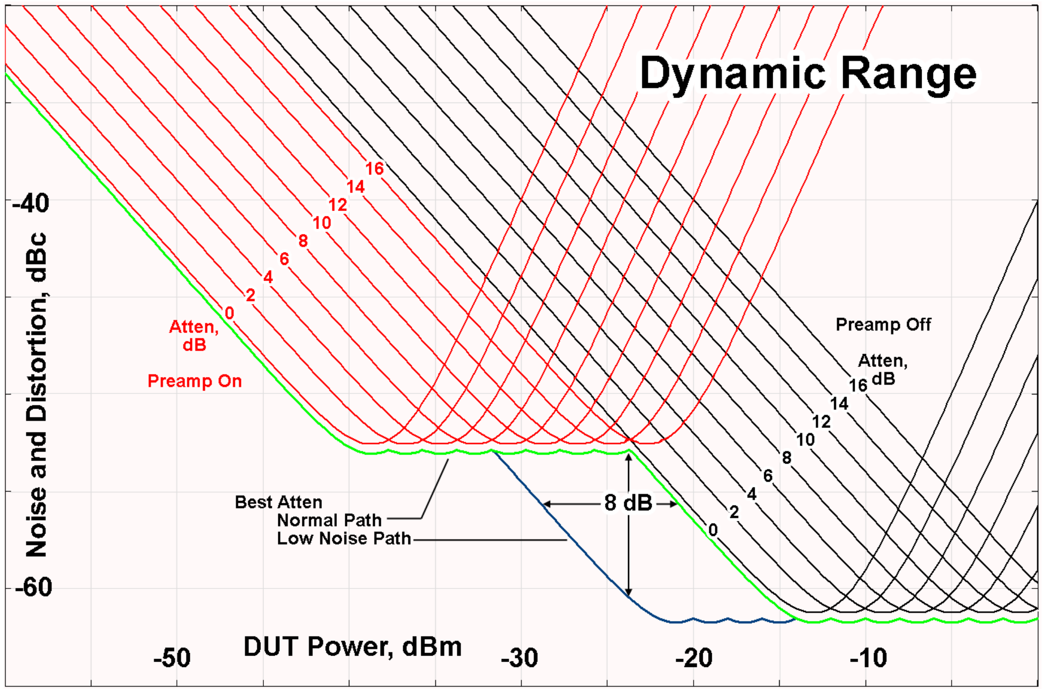
Note that the Low Noise Path, while giving improved DANL, has the disadvantage of decreased TOI performance and decreased gain compression performance relative to the standard path.

Note also that the bypass switch is a mechanical switch and has finite life, so if the **Low Noise Path Enable** is selected, it is possible to cause frequent cycling of this switch by frequently changing instrument settings such that the above conditions hold true only some of the time. A user making tests of this nature should consider opting for the **Standard Path**, which will never throw the bypass switch, at the expense of some degraded noise performance.

The low noise path is useful for situations where the signal level is so low that the instrument performance is dominated by noise even with 0 dB attenuation, but still high enough that the preamp option would have excessive third-order intermodulation or compression. The preamp, if purchased and used, gives better noise floor than does the “Low Noise Path.” However, its compression threshold and third-order intercept are much poorer than that of the non-preamp path.

There are some applications, typically for signals around –30 dBm, for which the third-order dynamic range of the standard path is good enough, but the noise floor is not low enough even with 0 dB input attenuation. When the third-order dynamic range of the preamp path is too little and the noise floor of the standard path is too high, the Low Noise Path can provide the best dynamic range

The graph below illustrates the concept. It shows, in red, the performance of an instrument at different attenuation settings, both with the preamp on and off, in a measurement that is affected by both instrument noise and instrument TOI. The green shows the best available dynamic range, offset by 0.5 dB for clarity. The blue shows how the best available dynamic range improves for moderate signal levels with the low noise path switched in. In this illustration, the preamp improves the noise floor by 15 dB while degrading the third-order intercept by 30 dB, and the low noise path reduces loss by 8 dB. The attenuator step size is 2 dB.



There are other times where selecting the low noise path improves performance, too. Compression-limited measurements such as finding the nulls in a pulsed-RF spectrum can profit from the low noise path in a way similar to the TOI-limited measurement illustrated. Accuracy can be improved when the low noise path allows the optimum attenuation to increase from a small amount like 0, 2 or 4 dB to a larger amount, giving better return loss at the instrument input. Harmonic measurements, such as second and third harmonic levels, are much improved using the low noise path because of the superiority of that path for harmonic (though not intermodulation) distortion performance.

µW Preselector Bypass

Toggles the preselector bypass switch for band 1 and higher. When the microwave presel is on, the signal path is preselected. When the microwave preselector is off, the signal path is not preselected. The preselected path is the normal path for the instrument.

The preselector is a tunable bandpass filter which prevents signals away from the frequency of interest from combining in the mixer to generate in-band spurious signals (images). The consequences of using a preselector filter are its limited bandwidth, the amplitude and phase ripple in its passband, and any amplitude and phase instability due to center frequency drift.

Option MPB or pre-selector bypass provides an unpreselected input mixer path for certain X-Series signal analyzers with frequency ranges above 3.6 GHz. This signal path allows a wider bandwidth and less amplitude variability, which is an advantage when doing modulation analysis and broadband signal analysis. The disadvantage is that, without the preselector, image signals will be displayed. Another disadvantage of bypassing the preselector is increased LO emission levels at the front panel input port.

Image responses are separated from the real signal by twice the 1st IF. For IF Paths of 10 MHz and 25 MHz, the 1st IF is 322.5 MHz, so the image response and the real signal will be separated by 645 MHz. The 1st IF will be different for other IF Path settings. When viewing a real signal and its corresponding image response in internal mixing, the image response will be to the left of the real signal.

Also, the image response and the real signal typically have the same amplitude and exhibit the same shape factor.

However, if Option FS1 (Fast Sweep Capability) is enabled, the image response in the Swept SA measurement appears lower in amplitude and has a much wider shape factor compared to the real signal.

Full Bypass Enable

With **Full Bypass Enable** selected, the microwave preselector is bypassed. In addition, the low band/high band switch and microwave preamp are bypassed whenever *all* the following are true:

- The instrument is not in the Low Band, meaning:
- the start frequency is above 3.5 GHz and
- the stop frequency is above 3.6 GHz.
- the internal preamp is not installed or if installed, is set to **Off** or **Low Band**

Note that this means that, when any part of a sweep is done in Low Band, the Low Noise Path is not used, whether or not the **Full Bypass Enable** is selected in the user interface. Also, if the preamp is turned on, the Low Noise Path is not used, whether or not the **Full Bypass Enable** is selected in the user interface. The only time the Low Noise Path is used is when **Full Bypass Enable** is selected, the sweep is completely in High Band (> 3.6 GHz) and no preamp is in use.

CAUTION	When **Full Bypass Enable** is selected, and "Y Scale" on page 1929 is set to 0 dB, there will be a direct AC connection between the input and the first converter when the Low Noise Path switches in (when Start Freq >3.6 GHz and the Preamp is either not licensed, set to Low Band, or Off). This puts the first converter at considerable risk to be damaged by high AC power. Consequently,

whenever **Full Bypass Enable** is selected, a warning message appears in the status bar:

“Full Bypass Enabled, maximum safe input power reduced”

Microwave Preselector Bypass Backwards Compatibility

Example	`:POW:MW:PRES OFF` Bypasses the microwave preselector
Notes	Included for Microwave Preselector Bypass backwards compatibility The `ON` parameter sets the `STD` path (`:POW:MW:PATH STD`) The `OFF` parameter sets path `MPB` (`:POW:MW:PATH MPB`)
Preset	`ON`
Backwards Compatibility SCPI	`[:SENSe]:POWer[:RF]:MW:PRESelector[:STATe] ON | OFF | 0 | 1` `[:SENSe]:POWer[:RF]:MW:PRESelector[:STATe]?`

Frequency Extender Preselection Bypass

Only applies to the high frequency path of the Frequency Extender, and only if the Frequency Extender allows it. For example, the V3050A high frequency path is 50 – 110 GHz and *does* allow control of the preselector bypass.

When the Frequency Extender’s preselection is bypassed, flatness is improved, but will be subject to spurs from out-of-band interfering signals. For bandwidths greater than 2.5 [GHz], it is recommended that the signal bypass the Frequency Extender Preselector since the max bandwidth of the Preselector can be as narrow as 2.5 [GHz].

For most applications, the preset state is `OFF`, which gives the best remote-control throughput, minimizes acoustic noise from switching, minimizes out of band spurs, and minimizes the risk of wear in the hardware switches.

Preselector and Bandwidth Conflict

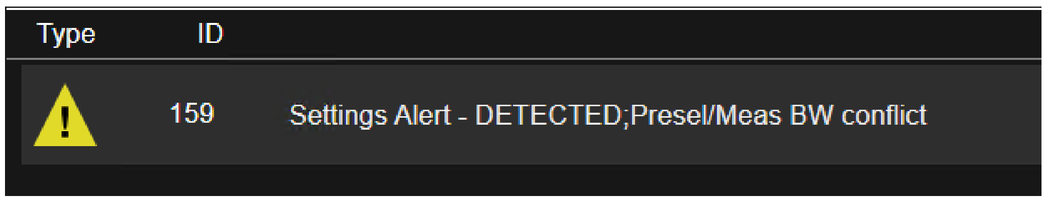
When the Frequency Extender Preselector is applied and the signal bandwidth is greater than 2.5 [GHz], then a settings alert message will show to warn the user that the signal may be distorted due to the limitation of the Frequency Extender Preselector bandwidth.

An example of the settings alert message is shown below.

Settings Alert message in the Status Bar at the bottom of the display.

Settings Alert message in the error queue

.



Software Preselection

Provided in some instruments, either to compensate for issues with provided hardware preselection or to provide the preselection function when there is no hardware preselector.

N9041B

Software Preselection compensates for the frequency range limit of the microwave preselector. Since the microwave preselector only goes up to 50 GHz, software preselection must be used to suppress and separate images above 50 GHz. The specific algorithm used for software preselection is specified by the SW Preselection Type selection – Normal or Advanced.

In N9041B, **Software Preselection** only applies for frequencies above 50 GHz, therefore it is only used for RF Input 2. Even if turned on, it is not used for other inputs, and never for frequencies below 50 GHz. This is why the label of this control contains the parenthetical note “(>~50 GHz)”.

Note that in N9041B, in Swept SA measurement, **Software Preselection** works even if the measurement is using an FFT Sweep Type. In measurements other than Swept SA, Software Preselection is not used if the measurement is using an FFT sweep type.

N9042B+V3050A

Software Preselection compensates for the frequency range limit of the microwave preselector. Since the microwave preselector only goes up to 50 GHz, software preselection must be used to suppress and separate images above 50 GHz. The specific algorithm used for software preselection is specified by the SW Preselection Type selection – Normal or Advanced.

For N9042B+V3050A, Software Preselection only applies for frequencies above 50 GHz, therefore it is only used for External RF. Even if it is turned on, it will not be used for other inputs and never for frequencies below 50 GHz. This is why the label of this control contains the parenthetical note “(>~50 GHz)”.

Note that for N9042B+V3050A, in the Swept SA measurement, Software Preselection works even if the measurement is using an FFT Sweep Type. In measurements other than Swept SA, Software Preselection is not used if the measurement is using an FFT Sweep Type.

VXT models M9410A/11A

Software Preselection is used to provide the preselection function, as there is no hardware preselector in these models. Two background traces are taken and compared point by point, and the point with the lowest amplitude from the two traces is used. This provides a method to reduce spurs that are internally generated within the VXT, but you should note the following when using Software Preselection:

- There is some speed cost due to the need to take multiple captures
- Taking the point with the lowest amplitude in each trace will make the average noise level lower at all points that do not have a spur. This can reduce the accuracy of the measurement of noise and noise-like signals

Because of the difficulty in identifying spurs manually, you are recommended to leave Software Preselection ON at all times in VXT models M9410A/11A. If you turn it off in order to speed up your measurement or improve noise accuracy, be aware of unwanted onscreen spurs.

Remote Command	`[:SENSe]:POWer[:RF]:SWPResel:STATe 0 | 1 | ON | OFF` `[:SENSe]:POWer[:RF]:SWPresel:STAT?`
Example	`:POW:SWPR:STAT 1` `:POW:SWPR:STAT?`
Dependencies	Only appears in N9041B, N9042B+V2050A, and VXT models M9410A/11A. Does not appear in all measurements
Couplings	Affects **Sweep Time** **Auto Tune** supports **Software Preselection**, so **Auto Tune** should be performed after setting the **Software Preselection** state
Preset	N9041B: OFF N9042B+V3050A: ON M9410A/11A: ON
State Saved	Saved in instrument state

SW Preselection Type

Specifies the algorithm used for software preselection.

Two hidden sweeps occur in succession. The second sweep is offset in LO frequency by 2 * IF / N. For each point in each trace, the smaller amplitude from the two traces is taken and placed in that point in the selected trace. The Peak detector is auto-selected to improve the image suppression effectiveness. Responses of each trace that lie on top of one another will remain and are valid signals. Other signals are images, which are suppressed. The action of taking the smaller of the two traces will make the average noise level lower in all points that do not have an image, thus reducing the accuracy of the measurement of noise and noise-like signals.

- `NORMal` - mathematically removes all image and multiple responses of signals present at the input
- `ADVanced` - any trace processing (such as "max hold" or trace averaging) is performed on the points of both candidate traces before the "select minimum" operation occurs. This form of processing works better for non-stationary signals, such as pulsed-RF signals

Remote Command	`[:SENSe]:POWer[:RF]:SWPResel NORMal | ADVanced` `[:SENSe]:POWer[:RF]:SWPResel?`
Example	`:POW:SWPR NORM` `:POW:SWPR?`
Dependencies	Only appears in N9041B and N9042B+V3050A. Only appears in measurements that use the Swept method Grayed-out when "Software Preselection" on page 1971 is `OFF`. The grayout message is "Unavailable unless SW Presel enabled"
Preset	N9041B: `ADVanced` N9042B+V3050A: `NORMal`
State Saved	Saved in instrument state

SW Preselection BW

Specifies the effective bandwidth to be used for Software Preselection.

The options are:

- `NORMal` – when making Swept measurements, a software preselection algorithm is used which takes up to 4 background acquisitions, then post-processes the result. This algorithm can remove images from signals with an occupied

bandwidth up to around 3 GHz. (Default/Preset setting). When making FFT measurements, this algorithm is not used, instead the same algorithm is used as for NARRow (below)

– NARRow– a software preselection algorithm is used which takes two background acquisitions, then post-processes the result to detect and remove images from wideband signals with occupied bandwidths up to 2 GHz. This increases the risk of images failing to be rejected, but improves the measurement speed

Remote Command	`[:SENSe]:POWer[:RF]:SWPResel:BW NORMal | NARRow` `[:SENSe]:POWer[:RF]:SWPResel:BW?`
Example	`:POW:SWPR:BW NARR`
Dependencies	Only appears in N9041B and N9042B+V3050A. Only appears in measurements that use the Swept method Grayed-out when "Software Preselection" on page 1971 is OFF. The grayout message is “Unavailable unless SW Presel enabled” For N9042B+V3050A, the parameter is SCPI-only, and always set to NARRow when **Software Preselection** is enabled
Preset	N9041B: NORMal N9042B+V3050A: NARRow
State Saved	Saved in instrument state

High Freq Prefilter

Lets you set the state of Prefilter for center frequencies above 1310 MHz.

In VXT Models M9410A/11A, the Receiver RF path has a bank of filters that come after the RF Attenuator in the signal path. Since this bank of filters precedes the mixer they are known as the “Prefilter” bank. Their purpose is to eliminate unwanted in-band mixing products by filtering out all but the desired frequencies before the signals get to the mixer. There are 13 prefilter bands to cover the frequencies between 9 kHz and 6000 MHz. The Prefilter provides the necessary rejection of the unwanted signal.

Remote Command	`[:SENSe]:<measurement>:PFILter[:STATe] ON | OFF | 1 | 0` `[:SENSe]:<measurement>:PFILter[:STATe]?`

Example	Enable High Freq Prefilter for the Complex Spectrum Measurement in BASIC Mode:
	`:SPEC:PFIL ON`
	Enable High Freq Prefilter for the IQ Waveform Measurement, in multiple Modes:
	`:WAV:PFIL ON`
	Enable High Freq Prefilter for the Swept SA Measurement in SA Mode:

	`:SAN:PFIL ON`
Dependencies	Only appears in VXT models M9410A/11A with center frequency above 1310 MHz
Preset	See "Prefilter Presets" on page 1171 below
State Saved	Saved in instrument state

Prefilter Presets

Meas	Mode	Preset
SPEC	BASIC	OFF
WAV	BASIC, WCDMA, WLAN, LTEAFDD, LTEATDD, 5GNR, VMA	OFF
MON	WCDMA, WLAN, LTEAFDD, LTEATDD, 5GNR, VMA	OFF
RHO	WCDMA	OFF
CDP	WCDMA	OFF
PCON	WCDMA	OFF
EVMQ	WCDMA	OFF
CHP	WCDMA, WLAN, LTEAFDD, LTEATDD, 5GNR, VMA, SA	OFF
OBW	WCDMA, WLAN, LTEAFDD, LTEATDD, 5GNR, VMA, SA	OFF
ACP	WCDMA, LTEAFDD, LTEATDD, 5GNR, VMA, SA	OFF
SEM	WCDMA, WLAN, LTEAFDD, LTEATDD, 5GNR, VMA, SA	OFF
PST	WCDMA, WLAN, LTEAFDD, LTEATDD, 5GNR, VMA, SA	OFF
PVT	WLAN, LTEAFDD, LTEATDD, 5GNR	OFF
EVM	WLAN, LTEAFDD, LTEATDD, 5GNR	OFF
FLAT	WLAN	OFF
EVMM	WLAN	OFF
CEVM	LTEAFDD, LTEATDD	OFF
PAVT	5GNR, VMA	OFF
DDEM	VMA	OFF
OFDM	VMA	OFF
SAN	SA	ON
HARM	SA	ON

3.6.4 BW

Opens the Bandwidth (**BW**) menu, which contains the Info BW control.

3.6.4.1 Settings

Contains basic bandwidth functions. It is the only tab under **BW**.

Info BW

Allows you to enter a frequency value to set the channel bandwidth that will be used for data acquisition. When in **Auto**, it is set to the value that covers carriers set by carrier configuration.

Remote Command	`[:SENSe]:PSTatistic:BANDwidth <freq>` `[:SENSe]:PSTatistic:BANDwidth?`	
Example	`:PST:BAND 8 MHz` `:PST:BAND?`	
Notes	Auto/Man is available only for 5G NR, LTE, LTETDD, LTEAFDD, LTEA TDD	
Preset	Depends on Mode and installed Options. See "Preset Values" on page 1172 below	
State Saved	Saved in instrument state	
Min	10 kHz	
Max	Hardware-dependent:	
	RF Input	– No Option = 10 MHz – WB (25 MHz or wider) = Hardware Option Limit
	I/Q Input (for I+jQ)	– No Option = 20 MHz – Option B25 = 50 MHz
Backwards Compatibility SCPI	`[:SENSe]:PSTatistic:BWIDth`	

Auto Function

Remote Command	`[:SENSe]:PSTatistic:BANDwidth:AUTO ON | OFF | 1 | 0` `[:SENSe]:PSTatistic:BANDwidth:AUTO`
Example	`:PST:BAND:AUTO 0` `:PST:BAND:AUTO?`
Preset	`ON`

Preset Values

Modes	Option	Preset Values
SA, WCDMA	All	5 MHz
CQM	All	10 MHz
LTEATDD, LTEAFDD, 5G NR	All	Automatically calculated

<table>
<tr><th>Modes</th><th>Option</th><th>Preset Values</th></tr>
<tr><td>MSR</td><td>All</td><td>Same as max value</td></tr>
<tr><td>WLAN</td><td>None</td><td>10 MHz</td></tr>
<tr><td></td><td>B25</td><td>25 MHz</td></tr>
<tr><td></td><td>B40</td><td><table>
<tr><th>Radio Std</th><th>Preset</th></tr>
<tr><td>802.11a/b/g/n/ac/ax/be (20 MHz)</td><td>25 MHz</td></tr>
<tr><td>802.11n/ac/ax/be (40 MHz)</td><td>40 MHz</td></tr>
<tr><td>802.11ac/ax/be (80 MHz)</td><td>80 MHz</td></tr>
<tr><td>802.11ac/ax/be (160 MHz)</td><td>160 MHz</td></tr>
<tr><td>802.11be (320 MHz)</td><td>320 MHz</td></tr>
</table></td></tr>
<tr><td></td><td>B1X</td><td><table>
<tr><th>Radio Std</th><th>Preset</th></tr>
<tr><td>802.11ac(80 MHz)</td><td>80 MHz</td></tr>
</table></td></tr>
<tr><td></td><td>B1Y</td><td><table>
<tr><th>Radio Std</th><th>Preset</th></tr>
<tr><td>802.11ac(160 MHz)</td><td>160 MHz</td></tr>
</table></td></tr>
</table>

3.6.5 Display

Lets you configure display items for the current Mode, Measurement View or Window.

3.6.5.1 View

Contains controls for selecting the current **View**, and for editing User Views.

View

See "Views" on page 1122.

User View

Lets you choose a View from the saved User Views for the current measurement. This panel only appears if a User View exists for the current measurement.

Remote Command	`:DISPlay:VIEW:ADVanced:SELect <alphanumeric>` `:DISPlay:VIEW:ADVanced:SELect?`
Example	Select Baseband as the current View `:DISP:VIEW:ADV:SEL “Baseband”`

Notes	You must be in the measurement whose View you are trying to set to send the command. You can only set Views for the current measurement using this command
	For predefined views, the parameter is derived from the view name that is shown in the View list in the user interface. For example, if you are trying to select the Trace Zoom view in the Swept SA measurement, you send:
	`:DISP:VIEW:ADV:SEL "Trace Zoom"`
	because “Trace Zoom” is the name of the View as seen in the Mode/Meas dialog or in the Display, View menu
	You *cannot* use the legacy View parameter (which in this case would be `TZOom`) with `:DISP:VIEW:ADV:SEL`
	`<alphanumeric>` is case insensitive; you can specify mixed case, however the name will be evaluated on a single case. Thus, both of the following forms work:
	`:DISP:VIEW:ADV:SEL "Trace Zoom"`
	`:DISP:VIEW:ADV:SEL "TRACE ZOOM"`
	If the specified view is not a valid View, the query returns the error message “-224, Illegal parameter value; View with the name <alphanumeric> does not exist”
	If the display is disabled (via `:DISP:ENAB OFF`) then the error message “-221, Settings conflict; View SCPI cannot be used while Display is disabled” is generated

Backwards Compatibility SCPI	The legacy node `:DISPlay:VIEW[:SELect]` is retained for backwards compatibility, but it only supports predefined views

Restore Layout to Default

Restores the Layout to the default for Basic.

Modified Views are very temporary; if you exit the current measurement they are discarded, and they are not saved in State. To retain this View for later use, and to be able to return easily to your original Basic View, you can save your edited View as a “User View”.

Save Layout as New View

Saves your new View as a User View. An alpha keyboard appears, which lets you name your new View; the default is the old View name plus a number.

Remote Command	`:DISPlay:VIEW:ADVanced:NAME <alphanumeric>`

Example	`:DISP:VIEW:ADV:NAME "Baseband"` Creates a new View named `Baseband` from the current View, and selects it as the current View
Notes	`<alphanumeric>` is case insensitive; you can specify mixed case, however the name will be evaluated on a single case If `<alphanumeric>` name already exists as a View, the error message "-224, Illegal parameter value; View <alphanumeric> already exists" is generated If the display is disabled (via `:DISP:ENAB OFF`) then the error message "-221, Settings conflict; User View SCPI cannot be used while Display is disabled" is generated

Re-Save User View

You can re-edit a User View; if you make changes, then an asterisk will appear next to the User View's name. You can then tap **Re-Save User View** to save it back to its existing name, or **Save Layout as New View** to add another, new User View.

This is a front panel function only, there is no remote command available to perform this function. To do this remotely, you must first perform **Save Layout as New View**, then delete the old User View and rename the new one with the name of the View you just deleted.

Rename User View

You can rename the current View by giving it a new unique name. Only User Views can be renamed, if the current View is a Predefined View, an error occurs.

Remote Command	`:DISPlay:VIEW:ADVanced:REName <alphanumeric>`
Example	`:DISP:VIEW:ADV:REN "Baseband"`
Notes	`<alphanumeric>` is case insensitive; you can specify mixed case, however the name will be evaluated on a single case If the `<alphanumeric>` specifying the new name is already present in the list of View names, the error message "-224, Illegal parameter value; View <alphanumeric> already exists" is generated If the current View is a Predefined View, the error message "-224, Illegal parameter value; Cannot rename a Predefined View" is generated If the display is disabled (via `:DISP:ENAB OFF`) then the error message "-221, Settings conflict; View SCPI cannot be used while Display is disabled" is generated

Delete User View

You can delete the current View if it is a User View. The default view becomes the current view for the Measurement.

Remote Command	:DISPlay:VIEW:ADVanced:DELete
Example	:DISP:VIEW:ADV:DEL
Notes	<alphanumeric> is case insensitive; you can specify mixed case, however the name will be evaluated on a single case If the <alphanumeric> is not present in the list of View names, the error message "-224, Illegal parameter value; View <alphanumeric> does not exist" is generated If the current View is a Predefined View, the error message "-224, Illegal parameter value; Cannot delete a Predefined View" is generated If the display is disabled (via :DISP:ENAB OFF) then the error message "-221, Settings conflict; View SCPI cannot be used while Display is disabled" is generated

Delete All User Views

Deletes all previously saved User Views. The default view becomes the current view for the Measurement if a User View was the current view when this command was executed.

Remote Command	:DISPlay:VIEW:ADVanced:DELete:ALL
Example	:DISP:VIEW:ADV:DEL:ALL
Notes	Disabled if there are no User Views

View Editor Remote Commands

The following remote commands help you manage Views and User Views. Note that the SCPI node for User Views handles both Predefined and User Views. The legacy nodes, :DISPlay:VIEW[:SELect] and :DISPlay:VIEW:NSEL, are retained for backwards compatibility, but they only support predefined views.

View Listing Query

Returns a string containing a comma-separated list of names for *all* the Views, including User Views, available for the current Measurement.

Remote Command	:DISPlay:VIEW:ADVanced:CATalog?
Example	:DISP:VIEW:ADV:CAT?
Notes	Returns a quoted string of the available Views for the current measurement, separated by commas. The list includes names for *all* the Views, including User Views, available for the current Measurement Example: "Normal,Trace Zoom,Spectrogram,Baseband,myView1,yourView1"

	No distinction is made between Predefined and User Views If you switch measurements with the display disabled (via `:DISP:ENAB OFF`), then query the list of available Views, the result is undefined

User View Listing Query

Returns a string containing a comma-separated list of names for *only* the User Views available for the current Measurement.

Remote Command	`:DISPlay:VIEW:ADVanced:USER:CATalog?`
Example	`:DISP:VIEW:ADV:USER:CAT?`
Notes	Returns a quoted string of the available User Views for the current measurement, separated by commas. Example: `"Baseband,myView1,yourView1"` If you switch measurements with the display disabled (see "Display Enable (Remote Command Only)" on page 1983), then query the list of available Views, the result is undefined

3.6.5.2 Annotation

Contains controls for setting up the annotation for the current Mode or Measurement.

Graticule

Turns the display graticule On or Off for all windows with graticules in all measurements in the current Mode. Also turns the graticule Y-Axis annotation on and off.

Remote Command	`:DISPlay:GRATicule[:STATe] OFF | ON | 0 | 1` `:DISPlay:GRATicule[:STATe]?`
Example	`:DISP:GRAT OFF`
Notes	The graticule is the set of horizontal and vertical lines that make up the grid/divisions for the X-Axis and Y-Axis
Preset	`ON`
State Saved	Saved in instrument state

Backwards Compatibility SCPI	`:DISPlay:WINDow[1]:TRACe:GRATicule:GRID[:STATe] OFF | ON | 0 | 1`
	`:DISPlay:WINDow[1]:TRACe:GRATicule:GRID[:STATe]?`
	This command is accepted for backwards compatibility with older instruments, but the `WINDow`, `TRACe` and `GRID` parameters are ignored

Screen Annotation

Controls the display of the annunciation and annotation around the graticule, including any annotation on lines (such as the display line, the threshold line, etc.) and the Y-Axis annotation, for all windows with screen annotation in all measurements in the current Mode.

This does *not* include marker annotation (or the N dB result). When OFF, the graticule expands to fill the entire graticule area, leaving only the 1.5% gap above the graticule, as described in the **Trace** section.

Remote Command	:DISPlay:ANNotation:SCReen[:STATe] OFF | ON | 0 | 1 :DISPlay:ANNotation:SCReen[:STATe]?
Example	:DISP:ANN:SCR OFF
Dependencies	Grayed-out and forced to OFF when **System Display Settings**, **Annotation** is OFF
Preset	ON This remains OFF through a Preset when **System Display Settings**, **Annotation** is set to OFF
State Saved	Saved in instrument state

Trace Annotation

Turns on and off the labels on the traces, showing their detector (or their Math Mode) as described in the **Trace** section, for all windows in all measurements in the current Mode for which Trace Annotation on/off is supported.

If Trace Math is being performed on a trace, then the Trace Math annotation replaces the detector annotation.

For measurements that support limit lines, this key also turns on and off the labels on the Limit Lines. The label is the Limit number annotation and Limit Comment displayed on the graph. If the length of the comment is greater than 20 characters, the first 8 characters and the last 8 characters are displayed, joined with **...**.

Remote Command	:DISPlay:ANNotation:TRACe[:STATe] ON | OFF | 1 | 0 :DISPlay:ANNotation:TRACe[:STATe]?
Example	:DISP:ANN:TRAC OFF
Preset	OFF
State Saved	Saved in instrument state

Control Annotation

Turns on and off the display of values on the Active Function controls for all measurements in the current Mode. This is a security feature.

Remote Command	`:DISPlay:ACTivefunc[:STATe] ON | OFF | 1 | 0` `:DISPlay:ACTivefunc[:STATe]?`
Example	`:DISP:ACT OFF`
Dependencies	Grayed out and forced to `OFF` when **System Display Settings**, **Annotation** is `OFF`
Preset	`ON` This remains `OFF` through a Preset when **System Display Settings**, **Annotation** is set to `OFF`
State Saved	Saved in instrument state

Frequency Annotation

Turns on and off the absolute frequency annotation in the main display for all windows in all measurements in the current Mode for which Frequency Annotation on/off is supported.

The affected annotations include Center Frequency, Start/Stop Frequency, Frequency Offset, Marker Frequency. Any relative frequency annotation such as Span and Marker Delta are not affected.

The frequency annotations in any other associated display, such as in Active Function, Softkey label, Limit Editor, Amp Corr Editor and Marker Table are not changed.

Frequency annotations that are not associated with the spectrum, such as RBW, IBW, Sweep Time, are excluded and they are shown regardless of this selection.

Remote Command	`:DISPlay:ANNotation:FREQuency[:STATe] ON | OFF | 1 | 0` `:DISPlay:ANNotation:FREQuency[:STATe]?`
Example	`:DISP:ANN:FREQ OFF`
Dependencies	Only appears in the Swept SA measurement in Spectrum Analyzer Mode
Preset	`ON`

Meas Bar

Turns the Measurement Bar at the top of the screen on and off for all measurements in the current Mode. When `OFF`, the graticule area expands to fill the area formerly occupied by the Measurement Bar.

Remote Command	`:DISPlay:ANNotation:MBAR[:STATe] OFF | ON | 0 | 1` `:DISPlay:ANNotation:MBAR[:STATe]?`
Example	`:DISP:ANN:MBAR OFF`
Dependencies	Grayed out and forced to `OFF` when **System Display Settings**, **Annotation** is `OFF`
Preset	`ON` This remains `OFF` through a Preset when **System Display Settings**, **Annotation** is set to `OFF`
State Saved	Saved in instrument state

Display Enable (Remote Command Only)

Turns the display on/off, including the display drive circuitry. The backlight stays lit to confirm that the instrument is on. The display enable setting is mode global. Theare three reasons for turning the display off:

1. To increase speed as much as possible by freeing the instrument from having to update the display
2. To reduce emissions from the display, drive circuitry
3. For security purposes

If you have turned off the display:

- and you are in local operation, the display can be turned back on by pressing any key or by sending `:SYSTem:DEFaults MISC` or `:DISPlay:ENABle ON` (neither `*RST` nor :SYSTem:PRESet enable the display)
- and you are in remote operation, the display can be turned back on by pressing the **Local** or **Esc** keys, or by sending `:SYSTem:DEFaults MISC` or `:DISPlay:ENABle ON` (neither `*RST` nor `:SYSTem:PRESet` enable the display)
- and you are using either the `:SYSTem:KLOCk` command or GPIB local lockout, then *no* front-panel key press will turn the display back on. You must turn it back on remotely.

If the display is `OFF`, many SCPI commands related to User Views and Multiscreen functionality do not work, and return the error messages “-221, Settings conflict; Screen SCPI cannot be used when Display is disabled” or “221, Settings conflict; View SCPI cannot be used while Display is disabled”. These commands include:

Name	Command
Select User View	`:DISPlay:VIEW:ADVanced:SELect`
Rename User View	`:DISPlay:VIEW:ADVanced:REName`
Delete User View	`:DISPlay:VIEW:ADVanced:DELete`
Create User View	`:DISPlay:VIEW:ADVanced:NAME`

Name	Command
Select Screen	:INSTrument:SCReen:SELect
Delete Screen	:INSTrument:SCReen:DELete
Delete All But This Screen	:INSTrument:SCReen:DELete:ALL
Add Screen	:INSTrument:SCReen:CREate
Rename Screen	:INSTrument:SCReen:REName
Sequencer On/Off	:SYSTem:SEQuencer

Remote Command	:DISPlay:ENABle OFF | ON | 0 | 1 :DISPlay:ENABle?
Example	:DISP:ENAB OFF
Couplings	:DISP:ENAB OFF turns Backlight OFF and :DISP:ENAB ON turns Backlight ON, but changing Backlight settings does *not* change the state of :DISP:ENAB
Preset	ON Set by :SYST:DEF MISC, but not affected by *RST or :SYSTem:PRESet
State Saved	Not saved in instrument state
Backwards Compatibility Notes	:SYST:PRES no longer turns on :DISPlay:ENABle as it did in legacy analyzers

3.6.6 Frequency

Opens the **Frequency** menu, which contains controls that allow you to control the frequency and channel parameters of the instrument.

Some features in this menu are the same for all measurements in the current Mode – they do not change as you change measurements. Settings like these are called “Meas Global” and are unaffected by Meas Preset. For example, **Center Frequency** is the same for all measurements — it does not change as you change measurements.

3.6.6.1 Settings

Contains controls that pertain to the X-Axis parameters of the measurement. These parameters control how data on the vertical (X) axis is displayed and control instrument settings that affect the horizontal axis.

Center Frequency

Sets the frequency that corresponds to the horizontal center of the graticule. While adjusting **Center Frequency**, **Span** is held constant.

The **Center Frequency** setting is the same for all measurements within a mode, that is, it is Meas Global. Some Modes are also able to share a Mode Global center frequency value. If this is the case, the Mode will have a **Global** tab in its **Meas Setup** menu.

Center Frequency sets (and queries) the center frequency for the currently selected input. If your instrument has multiple inputs, and you select another input, **Center Frequency** changes to the value for that input. SCPI commands are available to directly set the center frequency for a specific input.

Center Frequency is remembered as you go from input to input. Thus, you can set a **Center Frequency** of 10 GHz with the RF Input selected, change to BBIQ and set a **Center Frequency** of 20 MHz, then switch to External Mixing and set a Center Freq of 60 GHz, and when you go back to the RF Input, **Center Frequency** will go back to 10 GHz; back to BBIQ and it is 20 MHz; back to External Mixing and it is 60 GHz.

See:

– "Center Frequency Presets" on page 1183

– "VXT Models with Radio Heads/CIU Frequency Range" on page 1185

– "RF Center Freq" on page 1185

– "Ext Mix Center Freq" on page 1186

– "I/Q Center Freq" on page 1187

Remote Command	`[:SENSe]:FREQuency:CENTer <freq>` `[:SENSe]:FREQuency:CENTer?`

Example	Set Center Frequency to 50 MHz:
	`:FREQ:CENT 50 MHz`
	Increment Center Frequency by the value of **CF Step**:
	`:FREQ:CENT UP`
	Return the current value of Center Frequency:
	`:FREQ:CENT?`

Notes	Sets the RF, External Mixing or I/Q Center Frequency depending on the selected input: – For RF input it is equivalent to `:FREQ:RF:CENT` – For I/Q input it is equivalent to `:FREQ:IQ:CENT`

	– For External Mixer it is equivalent to `:FREQ:EMIX:CENT` Preset and Max values are dependent on Hardware Options If no terminator (for example, MHz) is sent, the terminator Hz is used. If a terminator with unit other than Frequency is used, an invalid suffix error message is generated
Preset	Depends on instrument maximum frequency, mode, measurement, and selected input See "Center Frequency Presets" on page 1183, "RF Center Freq" on page 1185, "Ext Mix Center Freq" on page 1186, "I/Q Center Freq" on page 1187, and "VXT Models with Radio Heads/CIU Frequency Range" on page 1185
State Saved	Saved in instrument state
Min/Max	Depends on instrument maximum frequency, mode, measurement, and selected input See "Center Frequency Presets" on page 1183, "RF Center Freq" on page 1185, "I/Q Center Freq" on page 1187, and "VXT Models with Radio Heads/CIU Frequency Range" on page 1185
Status Bits/OPC dependencies	Non-overlapped

The following command and parameters apply only to MSR, LTE-Advanced FDD/TDD and 5G NR Modes.

Remote Command	`[:SENSe]:FREQuency:CENTer:AUTO ON | OFF | 1 | 0` `[:SENSe]:FREQuency:CENTer:AUTO?`
Example	`:FREQ:CENT:AUTO OFF` `:FREQ:CENT:AUTO?`
Dependencies	Only available for the Monitor Spectrum, Power Stat CCDF and IQ waveform measurements in MSR, LTE-Advanced FDD/TDD and 5G NR Modes
Couplings	When Center Frequency changes, state automatically changes to **Manual** (`OFF`) Center Frequency, Center Frequency Offset and Carrier Reference Frequency are coupled. When Carrier Reference Frequency changes:
Preset	`ON`
State Saved	Saved in instrument state
Range	`Auto|Man`

Center Frequency	Relationship
Auto	Center Frequency = Carrier Reference Frequency + Center Frequency Offset (fixed)
Man	Center Frequency (fixed) = Carrier Reference Frequency + Center Frequency Offset

Center Frequency Presets

The following table provides the Center Frequency Presets for the Spectrum Analyzer mode, and the Max Freq, for the various frequency options:

Freq Option	CF after Mode Preset	Stop Freq after Mode Preset	Max Freq (can't tune above)
503 (all but CXA)	1.805 GHz	3.6 GHz	3.7 GHz
503 (CXA)	1.505 GHz	3.0 GHz	3.08 GHz
507 (all but CXA)	3.505 GHz	7.0 GHz	7.1 GHz
507 (CXA)	3.755 GHz	7.5 GHz	7.58 GHz
508 (all but MXE)	1.805 GHz	3.6 GHz	8.5 GHz
508 (MXE)	4.205 GHz	8.4 GHz	8.5 GHz
513	6.805 GHz	13.6 GHz	13.8 GHz
526 (except CXA and MXE)	13.255 GHz	26.5 GHz	27.0 GHz*
526 (CXA)	13.255 GHz	26.5 GHz	26.55 GHz
526 (MXE)	1.805 GHz	3.6 GHz	27.0 GHz
532	16.005 GHz	32.0 GHz	32.5 GHz
540	20.005 GHz	40.0 GHz	40.5 GHz
543	21.505 GHz	43.0 GHz	43.0 GHz
544	22.005 GHz	44.0 GHz	45.0 GHz
550	25.005 GHz	50.0 GHz	52 GHz
F03 (CXA-m)	1.505 GHz	3.0 GHz	3.08 GHz
F07 (CXA-m)	3.755 GHz	7.5 GHz	7.575 GHz
F13 (CXA-m)	6.805 GHz	13.6 GHz	13.8 GHz
F26 (CXA-m)	13.255 GHz	26.5 GHz	26.55 GHz
504 (M9421A, M8920A)	2.145 GHz	3.88GHz	3.88 GHz
506 (M9421A, M8920A)	3.245 GHz	6.08GHz	6.08 GHz
F06 (M9410A/11A)	1.0 GHz	6.08 GHz	6.08 GHz
F06 (M9415A)	1 GHz	1.08 GHz	6.6 GHz
F08 (M9415A)	1 GHz	1.08 GHz	8.6 GHz
F12 (M9415A)	1 GHz	1.08 GHz	12.9 GHz

*For option 526, the Max CF in RTSA is 26.999999995 GHz.

N9041B Center Freq Presets

Input	CF after Mode Preset	Stop Freq after Mode Preset	Max Freq (can't tune above)
Input 1, all models	25.005 GHz	50.0 GHz	52 GHz
Input 2, opt 585	42.505 GHz	85.0 GHz	86 GHz
Input 2, opt 590	45.005 GHz	90.0 GHz	92 GHz
Input 2, opt 5CX	55.005 GHz	110.0 GHz	110 GHz

Input 2, CXA and MXE

Model	CF after Mode Preset	Stop Freq after Mode Preset	Max Freq (can't tune above)
CXA opt C75	0.7505 GHz	1.5 GHz	1.58 GHz
MXE	505 MHz	1 GHz	1.000025 GHz

Tracking Generator Frequency Limits (CXA only)

Tracking Generator Option	Min Freq (clips to this freq when turn TG on and can't tune below while TG on)	If above this Freq, Stop Freq clipped to this Freq when TG turned on	Max Freq (can't tune above) while TG on
T03	9 kHz	3.0 GHz	3.08 GHz
T06	9 kHz	6.0 GHz	6.05 GHz

Tracking Generator Frequency Limits(CXA-m only)

Tracking Generator Option	Min Freq (clips to this freq when turn TG on and can't tune below while TG on)	If above this Freq, Stop Freq clipped to this Freq when TG turned on	Max Freq (can't tune above) while TG on
T03	2 MHz	3.08 GHz	3.08 GHz
T07	2 MHz	7.575 GHz	7.575 GHz
T13	2 MHz	13.8 GHz	13.8 GHz
T26	2 MHz	26.55 GHz	26.55 GHz

VXT Models with Radio Heads/CIU Frequency Range

The following table shows the Center Frequency Presets and Range for VXT modes with Radio Heads/CIU.

Products with Radio Heads/CIU	Preset	Start frequency	Stop frequency
M9421A + CIU	6 GHz	5.9 GHz	12 GHz
M9410A + CIU	6 GHz	5.9 GHz	12 GHz
M9410A + CIU + RRH	25 GHz	24.25 GHz	43.5 GHz

RF Center Freq

Lets you specify the RF Center Frequency. Sets the Center Frequency to use when the RF input is selected, even if the RF input is not selected at the time the command is sent. Note that **Center Frequency** in the **Frequency** menu on the front panel always applies to the currently selected input.

Remote Command	`[:SENSe]:FREQuency:RF:CENTer <freq>`

	`[:SENSe]:FREQuency:RF:CENTer?`
Example	`:FREQ:RF:CENT 30 MHz` `:FREQ:RF:CENT?`
Notes	This command is the same in all Modes, but the parameter is Measurement Global, so the value is independent in each mode and common across all the measurements in the mode
Dependencies	If the electronic/soft attenuator is enabled, any attempt to set **Center Frequency** such that the Stop Frequency would be > 3.6 GHz fails and results in an advisory message If the equivalent SCPI command is sent, this same message is generated as part of a “-221, Settings conflict” warning
Preset	See "Center Frequency Presets" on page 1183
State Saved	Saved in instrument state
Min	-79.999995 MHz
Max	See "Center Frequency Presets" on page 1183. Basically, instrument maximum frequency - 5 Hz

Ext Mix Center Freq

Specifies the External Mixer Center Frequency. Sets the Center Frequency to use when the External Mixer is selected, even if the External Mixer input is not the input that is selected at the time the command is sent. Note that **Center Frequency** in the **Frequency** menu on the front panel always applies to the currently selected input.

Remote Command	`[:SENSe]:FREQuency:EMIXer:CENTer <freq>` `[:SENSe]:FREQuency:EMIXer:CENTer?`
Example	`:FREQ:EMIX:CENT 60 GHz` `:FREQ:EMIX:CENT?`
Notes	This command is the same in all Modes, but the parameter is Measurement Global, so the value is independent in each Mode and common across all the measurements in the Mode
Couplings	When returning to External Mixing after having switched to one of the other inputs (for example, RF), you will come back into the settings that you had when you left External Mixing. So, you will come back to the band you were in with the Center Frequency that you had. However, Span is not an input-dependent parameter, therefore you will bring the span over from the other input. Therefore, the instrument comes back with the span from the previous input, limited as necessary by the current mixer setup
Preset	When a Mode Preset is performed while in External Mixing, the Start frequency of the current Mode is set to the nominal Min Freq of the lowest harmonic range in the Harmonic Table for the current mixer setup. Similarly, the Stop frequency of the current Mode is set to the nominal Max Freq of the highest harmonic range in the Harmonic Table. The Center Freq thus presets to the point arithmetically equidistant from these two frequencies Note that, if the current measurement has a limited Span available to it, and cannot achieve the Span shown in the table (Span=Stop Freq – Start Freq), the instrument uses the maximum Span the measurement allows, and still sets the Center Freq to the midpoint of the Start and Stop Freq values in the Harmonic Table

	When **Restore Input/Output Defaults** is performed, the mixer presets to the 11970A, whose Start and Stop frequencies are 26.5 and 40 GHz respectively. The center of these two frequencies is 33.25 GHz Therefore, after **Restore Input/Output Defaults**, if you go to External Mixing and do a **Mode Preset** while in Spectrum Analyzer Mode, the resulting Center Freq is 33.25 GHz
State Saved	Yes
Min	The minimum frequency in the currently selected mixer band + 5 Hz
Max	The maximum frequency in the currently selected mixer band - 5 Hz

I/Q Center Freq

Specifies the I/Q Center Frequency. Sets the Center Frequency to be used when the I/Q input is selected, even if the I/Q input is not the input that is selected at the time the command is sent. Note that **Center Frequency** in the **Frequency** menu on the front panel always applies to the currently selected input.

Remote Command	`[:SENSe]:FREQuency:IQ:CENTer <freq>` `[:SENSe]:FREQuency:IQ:CENTer?`
Example	`:FREQ:IQ:CENT 30 MHz`
Notes	This command is the same in all Modes, but the parameter is Measurement Global, so the value is independent in each Mode and common across all the measurements in the Mode
Preset	0 Hz
State Saved	Saved in instrument state
Min/Max	–/+40.049995 MHz

CF Step

Changes the step size for the "Center Frequency" on page 1182 and start and stop frequency functions. Once a step size has been selected and the center frequency function is active, the step keys (and the UP|DOWN parameters for **Center Frequency** from remote commands) change the center frequency by the step-size value. The step size function is useful for finding harmonics and sidebands beyond the current frequency span of the instrument.

Note that the start and stop frequencies also step by the **CF Step** value.

Remote Command	`[:SENSe]:FREQuency:CENTer:STEP[:INCRement] <freq>` `[:SENSe]:FREQuency:CENTer:STEP[:INCRement]?`

Example	Increase the current center frequency value by 500 MHz:
	`:FREQ:CENT:STEP 500 MHz`
	`:FREQ:CENT UP`
	`:FREQ:CENT:STEP?`

Notes	Preset and Max values are depending on Hardware Options
Dependencies	*Not* available in the MSR, LTEAFDD, LTEATDD, 5GNR, and Channel Quality Modes If the electronic/soft attenuator is enabled, any attempt to change the value of the center frequency >3.6 GHz by pressing the **Up-Arrow** key, fails and results in an advisory message. If the equivalent SCPI command is sent, this same message is generated as part of a “-221, Settings conflict” warning
Couplings	When auto-coupled, the center frequency step size is set to 10% of the span
Preset	Auto
State Saved	Saved in instrument state
Min/Max	–/+ (the maximum frequency of the instrument). That is, 27 GHz max freq instrument has a CF step range of +/- 27 GHz. Note that this is the maximum frequency given the current settings of the instrument, so in External Mixing, for example, it is the maximum frequency of the current mixer band
Status Bits/OPC dependencies	non-overlapped

Auto Function

Remote Command	`[:SENSe]:FREQuency:CENTer:STEP:AUTO OFF | ON | 0 | 1` `[:SENSe]:FREQuency:CENTer:STEP:AUTO?`
Example	`:FREQ:CENT:STEP:AUTO ON` `:FREQ:CENT:STEP:AUTO?`
Preset	`ON`

Freq Offset

Enables you to set a frequency offset value to account for frequency conversions outside of the instrument. This value is added to the display readout of the marker frequency, center frequency, start frequency, stop frequency, and all other absolute frequency settings in the instrument including frequency count. When a frequency offset is entered, the value appears below the center of the graticule. To eliminate an offset, perform a Mode Preset or set the frequency offset to 0 Hz.

See "More Information" on page 1189.

Remote Command	`[:SENSe]:FREQuency:OFFSet <freq>` `[:SENSe]:FREQuency:OFFSet?`
Example	`:FREQ:OFFS 10 MHz` `:FREQ:OFFS?`
Notes	Preset and Max values are dependent on Hardware Options
Dependencies	Appears only in Spectrum Analyzer Mode Not available in External Mixing. In this case the **Freq Offset** control is grayed-out and displays a value of zero. However, the value of CF Offset that was set for the RF Input is retained and restored when you switch back to the RF Input

Preset	See "Center Frequency Presets" on page 1183
State Saved	Saved in instrument state
Min/Max	–/+500 GHz
Annotation	If Frequency Offset is not zero, "Freq Offset <value>" appears on the upper line of the annotation, below the graticule, in the center
Status Bits/OPC dependencies	Non-overlapped
Backwards Compatibility SCPI	`:DISPlay:WINDow[1]:TRACe:X[:SCALe]:OFFSet` For compatibility across platforms only. Not recommended for new development

More Information

This command does not affect any bandwidths or the settings of relative frequency parameters such as delta markers or span. It does not affect the current hardware settings of the instrument, but only the displayed frequency values. Entering an offset does not affect the trace position or display, just the value of the start and stop frequency and the values represented by the trace data. The frequency values of exported trace data, queried trace data, markers, trace data used in calculations such as N dB points, trace math, etc., are all affected by Freq Offset. Changing the offset, even on a trace that is not updating will immediately change all of the above, without taking new data.

NOTE If a trace is exported with a nonzero **Freq Offset**, the exported data will contain the trace data with the offset applied. Therefore, if that trace were to be imported back into the instrument, you would want **Freq Offset** to be 0, or the offset would be applied again to data which is already offset. No such care need be taken when saving a State+Trace file because the data and state are saved together.

3.6.7 Marker

Accesses a menu that enables you to select, set up and control the markers for the current measurement. If there are no active markers, Marker selects marker 1, sets it to Normal and places it at the center of the display. If the selected marker is Off, it is set to Normal and placed at the center of the screen on the trace determined by the Marker Trace rules.

3.6.7.1 Select Marker

Specifies the selected marker. The term "selected marker" is used throughout this document to specify which marker will be affected when you change marker settings, perform a Peak Search, etc.

The **Select Marker** control appears above the menu panel, indicating that it applies to all controls in the **Marker** menu panels. **Select Marker** is blanked if you select a tab whose controls do *not* depend on the selected marker (for example, Counter).

For any menu that includes **Select Marker**, the first control is always **Marker Frequency | Time**.

Notes	The selected marker is remembered even when not in the **Marker** menu, and is used if a search is done, or a Band Function is turned on, or for Signal Track or Continuous Peak
Preset	Marker 1
State Saved	The number of the selected marker is saved in instrument state
Annunciation	Appears in the marker results block label for **Normal** and **Delta** markers

3.6.7.2 Settings

The controls on this tab include the Marker active function and a radio button selection of the marker control mode (`Position`/**Normal**, **Delta** or **Off**) for the selected marker, as well as additional functions that help you use markers.

Marker X-Axis Value

Sets the marker X-Axis value in the current marker X-Axis Scale unit. This function has no effect if the control mode is **Off**, but is the remote command equivalent of entering an X value if the control mode is **Normal** or **Delta**.

Remote Command	`:CALCulate:PSTatistic:MARKer[1]|2|…|12:X <rel_ampl>` `:CALCulate:PSTatistic:MARKer[1]|2|…|12:X?`
Example	`:CALC:PST:MARK3:X 0` `:CALC:PST:MARK3:X?`
Notes	If no suffix is sent, uses the fundamental units for the current marker X-Axis Scale. If a suffix is sent that does not match the current marker X-Axis Scale unit, an error "Invalid suffix" is generated The query returns the marker's absolute X Axis value if the control mode is **Normal**, or the offset from the marker's reference marker if the control mode is **Delta**. The query is returned in the fundamental units for the current marker X-Axis scale: Hz for **Frequency** and **Inverse Time**, seconds for **Period** and **Time**. If the marker is **Off** the response is Not A Number
Preset	After a preset, all Markers are turned `OFF`, so Marker X-Axis Value query returns Not a Number (`NAN`)
State Saved	No
Min/Max	–/+9.9E+37
Annotation	Mkr # <X value> and <Marker value> upper right on graph

Marker Y Axis Value (Remote Command Only)

Queries the marker Y-Axis value in the current marker Y-Axis unit.

Remote Command	:CALCulate:PSTatistic:MARKer[1]|2|…|12:Y?
Example	:CALC:PST:MARK11:Y?
Notes	Returns the marker Y-Axis result, if the control mode is **Normal,** or **Delta**. If the marker is **Off**, the response is *Not a Number*
Preset	0
State Saved	No
Backwards Compatibility SCPI	:CALCulate:PSTatistic:MARKer[1]|2|…|12:FUNCtion:RESult?

Marker Mode

Sets the marker control mode to **Normal** (POSition), **Delta**, or **Off**. All interactions and dependencies detailed under the control description are enforced when the remote command is sent. If the selected marker is **Off**, pressing **Marker** sets it to **Normal** and places it at the center of the screen on the trace determined by the **Marker Trace** rules. At the same time, **Marker X Axis Value** appears on the Active Function area.

The default active function is the active function for the currently selected marker control mode. If the current control mode is OFF, there is no active function, and the active function is turned off.

Remote Command	:CALCulate:PSTatistic:MARKer[1]|2|…|12:MODE POSition | DELTa | OFF :CALCulate:PSTatistic:MARKer[1]|2|…|12:MODE?
Example	:CALC:PST:MARK:MODE POS :CALC:PST:MARK:MODE?
Preset	OFF
State Saved	Saved in instrument state
Range	POSition|DELTa|OFF
Annotation	Mkr # <X value> and <Marker value> upper right on graph When Marker Trace is Polar in WCDMA mode: Mkr # <Chip Value (RHO & QPSKEVM)/Symbol Value (CDP)>, <X value> and <Y value> upper right on graph

Backwards Compatibility SCPI Commands

Sets or queries the state of a marker. Setting a marker that is OFF to ON (1) puts it into **Normal** mode and places it at the center of the screen.

Example	`:CALC:PST:MARK3:STAT 1` `:CALC:PST:MARK3:STAT?`
Preset	`OFF`
State Saved	Saved in instrument state
Range	`OFF|ON`
Backwards Compatibility SCPI	`:CALCulate:PSTatistic:MARKer[1]|2|…|12:STATe OFF | ON | 0 | 1` `:CALCulate:PSTatistic:MARKer[1]|2|…|12:STATe?`

Delta Marker (Reset Delta)

Pressing this button has exactly the same effect as pressing **Delta** in "Marker Mode" on page 1191. The selected marker becomes a **Delta** marker. If the selected marker is already a **Delta** marker, the reference marker is moved to the current position of the selected marker, thus resetting the Delta to zero.

Marker Settings Diagram

Lets you configure the Marker system using a visual utility.

All Markers Off

Turns off all markers.

Remote Command	`:CALCulate:PSTatistic:MARKer:AOFF`
Example	`:CALC:PST:MARK:AOFF`

Couple Markers

When this function is ON, moving any marker causes an equal X-Axis movement of every other marker that is not **Off**. By "equal X-Axis movement" we mean that we preserve the difference between each marker's X-Axis value (in the fundamental x-axis units of the trace that marker is on), and the X-Axis value of the marker being moved (in the same fundamental x-axis units).

This may result in markers going off screen.

Remote Command	`:CALCulate:PSTatistic:MARKer:COUPle[:STATe] ON | OFF | 1 | 0` `:CALCulate:PSTatistic:MARKer:COUPle[:STATe]?`
Example	`:CALC:PST:MARK:COUP ON`

	`:CALC:PST:MARK:COUP?`
Preset	`OFF` Presets on **Mode Preset** and **All Markers Off**
State Saved	Saved in instrument state

3.6.7.3 Properties

The controls on this tab are used to set certain properties of the selected marker.

Marker X-Axis Value

This is the fundamental control that you use to move a marker around on the trace. This is the same as "Marker X-Axis Value" on page 1190 in **Settings**.

Relative To

Selects the marker to which the selected marker is relative (its reference marker).

Every marker has another marker to which it is relative. This marker is referred to as the “reference marker” for that marker. This attribute is set by the **Marker, Properties, Relative To** key. The marker must be a **Delta** marker to make this attribute relevant. If it is a **Delta** marker, the reference marker determines how the marker is controlled and how its value is displayed. A marker cannot be relative to itself.

Remote Command	`:CALCulate:PSTatistic:MARKer[1]|2|…|12:REFerence <integer>` `:CALCulate:PSTatistic:MARKer[1]|2|…|12:REFerence?`
Example	`:CALC:PST:MARK:REF 3` `:CALC:PST:MARK:REF?`
Notes	Causes the marker specified with the subopcode to become selected Range (for SCPI command): 1 to 12. If the range is exceeded the value is clipped A marker cannot be relative to itself so that choice is not available, and if sent from SCPI generates error -221: “Settings conflict; marker cannot be relative to itself” When queried, a single value is returned (the specified marker numbers relative marker)
Couplings	The act of specifying the selected marker’s reference marker makes the selected marker a Delta marker If the reference marker is off it is turned on in **Fixed or Normal** mode at the delta marker location
Preset	The preset default “Relative To” marker (reference marker) is the next higher numbered marker (current marker +1). For example, if marker 2 is selected, then it’s default reference marker is marker 3. The exception is marker 12, which has a default reference of marker 1 Set to the defaults by using **Restore Mode Defaults**. This is not reset by **Marker Off**, **All Markers Off**, or

	Preset
State Saved	Saved in instrument state. Not affected by Marker Off and hence not affected by Preset or power cycle
Min	1
Max	12
Annunciation	Appears in the marker label of a **Delta** marker

Marker Trace

Assigns the specified marker to the designated trace. The trace choices are:

- `MEASured`
- `GAUSsian`
- `REFerence`

Remote Command	`:CALCulate:PSTatistic:MARKer[1]|2|…|12:TRACe MEASured | GAUSsian | REFerence` `:CALCulate:PSTatistic:MARKer[1]|2|…|12:TRACe?`
Example	`:CALC:PST:MARK3:TRAC MEAS` `:CALC:PST:MARK:TRACE?`
Preset	`MEASured`
State Saved	Yes
Range	`MEASured|GAUSsian|REFerence`

Marker Settings Diagram

Lets you configure the Marker system using a visual utility. This is the same as "Marker Settings Diagram" on page 1192 in **Settings**.

3.6.8 Meas Setup

Contains functions for setting up the measurement parameters and also contains functions for setting up parameters global to all measurements in the mode.

3.6.8.1 Settings

Contains frequently used functions to which you will want the fastest access.

Counts

Sets the accumulated number of sampling points for data acquisition. The range is 1.000 kpt (k point) to 2.00000 Gpt (G point) with 1 kpt resolution.

Remote Command	`[:SENSe]:PSTatistic:COUNts <integer>` `[:SENSe]:PSTatistic:COUNts?`
Example	`:PST:COUN 5001` `:PST:COUN?`
Couplings	Coupled to "Meas Cycles" on page 1195, by: **Counts** = **Meas Cycles** * **SamplingFrequency** * "Meas Interval" on page 1195
Preset	10000000
State Saved	Saved in instrument state
Min/Max	1000/2000000000

Meas Cycles

Set the number of measurement cycles to calculate power statistic data. This number is coupled to "Counts" on page 1195, by:

Meas Cycles = **Counts** / (**Sampling Frequency** * **Meas Interval**)

When the **Counts** value cannot be divided by (**Sampling Frequency** * "Meas Interval" on page 1195), this value is displayed as a decimal fraction.

Remote Command	`[:SENSe]:PSTatistic:SWEep:CYCLes <real>` `[:SENSe]:PSTatistic:SWEep:CYCLes?`
Example	`:PST:SWE:CYCL 1001` `:PST:SWE:CYCL?`
Preset	Depends on the sampling frequency
Min	0.001
Max	Depends on the sampling frequency

Meas Interval

Sets the number of data points to be used as the measurement interval. This value couples to "Counts" on page 1195, as:

Meas Interval = **Counts** / ("Meas Cycles" on page 1195 * **Sampling Frequency**)

Remote	`[:SENSe]:PSTatistic:SWEep:TIME <time>`

Command	`[:SENSe]:PSTatistic:SWEep:TIME?`
Example	`:PST:SWE:TIME 2 ms` `:PST:SWE:TIME?`
Preset	1.0 ms !unless noted below LTEATDD, 5G NR: 500 us
Min/Max	50.0 us/10.0 ms !unless noted below LTEATDD, 5G NR: 1 us/10.0 ms

Meas Setup Summary Table

Lets you view and access many of the parameters in the **Meas Setup** menus on one screen.

Auto Couple

Immediately puts all **Auto/Man** functions into **Auto**. **Auto Couple** is confined to the current measurement only. It does not affect other measurements in the Mode.

In the **Auto** state, **Auto/Man** functions are said to be “coupled”, meaning their values change as you make changes to other values in the measurement. This helps ensure accurate measurements and optimum dynamic range. **Auto Couple** is an immediate action function, and when it is executed, all the **Auto/Man** controls for the current measurement are set to **Auto**, and all measurement settings coupled to the **Auto/Man** parameters are automatically set to their optimal values.

For further details of measurement-specific settings (if any), see "Measurement-Specific Details" on page 1197 below.

Remote Command	`:COUPle ALL`
Example	`:COUP ALL`
Backwards Compatibility SCPI	`:COUPLE ALL | NONE`
Backwards Compatibility Notes	`:COUP:NONE` puts all Auto/Man parameters in manual mode, decoupling all the coupled instrument parameters. It is retained for backwards compatibility and is *not* recommended for making measurements or new designs

All **Auto/Man** parameter couplings in the measurement are set to **Auto**. This includes couplings that may be unavailable or grayed-out due to the current state. For example, in the Swept SA measurement, there is no **Auto/Man** coupling for **RBW** while in Zero Span. Nonetheless, if **Auto Couple** were executed while in Zero Span, it would set **RBW** to Auto "behind the scenes" so that, on exit from Zero Span, it would be in **Auto**.

Any **Auto/Man** selection specific (local) to the other measurements in the current Mode are not affected by **Auto Couple**. Any functions that are *not* coupled with other instrument parameters, such as ranging or leveling variables, such as **AutoRange** or **AutoScale**, are not affected.

Executing **Auto Couple** generates the informational message, "All Auto/Man functions have been set to Auto".

Each parameter, upon being set to **Auto**, selects and sets the appropriate auto-coupled value based on that parameter's coupling rules. The Dependency Resolver orchestrates the couplings for parameters that depend on one or more other parameters. The coupling and dependency rules for each parameter are defined in the section describing that parameter.

Executing **Auto Couple***does not* affect markers, marker functions, trace or display attributes, or any other instrument setting other than those specifically mentioned above.

Measurement-Specific Details

TOI (SA Mode only)

Parameters affected by **Auto Couple** are:

- Center Frequency Step
- Resolution Bandwidth
- Span/RBW Ratio
- Sweep Time
- Video BANDwidth VBW/RBW ratio
- Upper and Lower Tone (set to Sense)
- Zero span measurement Resolution Bandwidth
- Zero span measurement Dwell Time

Harmonics (SA Mode only)

Parameters affected by **Auto Couple** are:

- Resolution Bandwidth
- Fundamental Frequency

– Dwell Time

– Range Table Resolution Bandwidths

– Range Table Dwell Times

Meas Preset

Restores all the measurement parameters to their default values.

Remote Command	`:CONFigure:PSTatistic`
Example	`:CONF:PST`
Couplings	Selecting **Meas Preset** restores all measurement parameters to their default values

3.6.8.2 Meas Standard

Contains controls that allow you to preset the PowerSuite measurements to conform to various communications standards.

Radio Standard Presets

Lets you specify the Radio Standard to be used. Spectrum Analyzer Mode supports many Radio Standards. You can select the desired Radio Standard using the **Radio Std Presets** dialog, which is a cascading list of standards. When you have the selected the desired Standard, press **OK** and the measurement settings will change to reflect that standard.

Remote Command	`[:SENSe]:RADio:STANdard[:SELect] NONE | JSTD | IS95a | IS97D | IS98D | GSM | W3GPP | C2000MC1 | C20001X | NADC | PDC | BLUEtooth | TETRa | WL802DOT11A | WL802DOT11B | WL802DOT11G | HIPERLAN2 | DVBTLSN | DVBTGPN | DVBTIPN | FCC15 | SDMBSE | UWBINDOOR | LTEB1M4 | LTEB3M | LTEB5M | LTEB10M | LTEB15M | LTEB20M | WL11N20M | WL11N40M | WL11AC20M | WL11AC40M | WL11AC80M | WL11AC160M | WL11AX20M | WL11AX40M | WL11AX80M | WL11AX160M | WL11BE20M | WL11BE40M | WL11BE80M | WL11BE160M | WL11BE320M | WL11AD2G | WL11AY2G16 | WL11AY4G32 | WL11AY6G48 | WL11AY8G64 | NR5GFR1B100M` `[:SENSe]:RADio:STANdard[:SELect]?`
Example	`:RAD:STAN NONE` `:RAD:STAN?`
Dependencies	Some selections appear only when support license is valid
Couplings	By changing the radio standard, the measurement parameters will be automatically set to an appropriate default value
State Saved	Saved in instrument state

The **Radio** column in the table lets you specify the device to be used. It is a global setting that affects the Device selection, between Mobile (MS) and Base Station (BTS) settings, for all relevant PowerSuite measurements. The Device SCPI command has the same effect as a selection in the **Radio** column:

Remote Command	`[:SENSe]:RADio:STANdard:DEVice BTS | MS` `[:SENSe]:RADio:STANdard:DEVice?`
Example	`:RAD:STAN:DEV MS` `:RAD:STAN:DEV?`
Preset	`BTS`
State Saved	Saved in instrument state
Range	`BTS|MS`

Chart for Standard and Available Measurements

Note that not every measurement in Spectrum Analyzer Mode is available for every standard. The chart below describes which measurements are available for each Radio Standard.

For TOI or Harmonics measurements, *no* Radio Standards are available.

	Swept SA	CHP	OBW	ACP	CCDF	Burst Power	Spurious Emission	SEM	List Sweep
None	X	X	X	X	X	X	X	X	(X)
3GPP 5G NR	(X)	X	X	X	X			X	(X)
3GPP LTE	(X)	X	X	X	X			X	(X)
3GPP W-CDMA	(X)	X	X	X	X	X		X	(X)
GSM/EDGE	(X)				X	X			(X)
cdma2000 1x	(X)	X	X	X	X	X			(X)
IS-95A	(X)	X	X	X	X	X			(X)
J-STD-008	(X)	X	X	X	X	X			(X)
IS-97D/98D	(X)	X	X	X	X				(X)
NADC	(X)	X	X	X	X	X			(X)
PDC	(X)	X	X	X	X	X			(X)
Bluetooth	(X)				X	X			(X)
W-LAN 802.11a	(X)							X	(X)
W-LAN 802.11b	(X)							X	(X)
W-LAN 802.11g	(X)							X	(X)
W-LAN 802.11n	(X)	X	X		X			X	(X)
W-LAN 802.11ac	(X)	X	X		X			X	(X)
W-LAN	(X)	X	X		X			X	(X)

	Swept SA	CHP	OBW	ACP	CCDF	Burst Power	Spurious Emission	SEM	List Sweep
802.11ax									
W-LAN 802.11be	(X)	X	X		X			X	(X)
W-LAN 802.11ad	(X)	X	X		X			X	(X)
W-LAN 802.11ay	(X)	X	X		X			X	(X)
W-LAN HiperLAN/2	(X)							X	(X)
TETRA	(X)	X		X					(X)
DVB-T L/SECAM/NICAM	(X)	X			X				(X)
FCC Part 15 Subpart F	(X)	X			X				(X)
DVBT-T G/PAL/NICAM	(X)	X			X				(X)
DVB-T I/PAL/NICAM	(X)						X		(X)
S-DMB System E	(X)	X	X	X					(X)
UWB Indoor	(X)						X		(X)

General Radio Standards

The table below lists the settings and provides an example for each general Radio Standard.

None	Command Example	:RAD:STAN NONE
	IBW	2 MHz
	Span	3 MHz
	RBW	Auto rules
	VBW	Auto rules

TETRA	Command Example	:RAD:STAN TETR
	IBW	18 kHz
	Span	27 kHz
	RBW	1.2 kHz
	VBW	Auto rules
	RRC Filter	On
	RRC Filter Alpha	0.35
FCC Part15 Subpart F	Command Example	:RAD:STAN FCC15

Video Radio Standards

The table below lists the settings and provides an example for each video Radio Standard.

DVB-T L/SECAM/NICAM	Command Example	:RAD:STAN DVBTLSN
	IBW	7.61 MHz
	Span	24 MHz
	RBW	3.9 kHz
	VBW	Auto rules
	Sweep Points	8001
DVB-T G/PAL/NICAM	Command Example	:RAD:STAN DVBTGPN
	IBW	7.61 MHz
	Span	24 MHz
	RBW	3.9 kHz
	VBW	Auto rules
	Sweep Points	8001
DVB-T I/PAL/NICAM	Command Example	:RAD:STAN DVBTIPN
	IBW	7.61 MHz
	Span	24 MHz
	RBW	3.9 kHz
	VBW	Auto rules
	Sweep Points	8001
S-DMB System E	Command Example	:RAD:STAN SDMBSE
	IBW	25 MHz
	Span	37.5 MHz
	RBW	360 kHz
	VBW	Auto rules
	RRC Filter	Off
	RRC Filter Alpha	0.22

Cellular Radio Standards

The table below lists the CHP settings and provides an example for each cellular Radio Standard.

GSM/EDGE	Command Example	:RAD:STAN GSM
3GPP 5G NR	Command Example	:RAD:STAN NR5GFR1B100M
	IBW	100 MHz
	Span	150 MHz
	RBW	Auto rules
	VBW	Auto rules
3GPP W-CDMA	Command Example	:RAD:STAN W3GPP
	IBW	5 MHz
	Span	7.5 MHz
	RBW	240 kHz
	VBW	Auto rules
	RRC Filter	Off
	RRC Filter Alpha	0.22
3GPP LTE 1.4 MHz	Command Example	:RAD:STAN LTEB1M4
	IBW	1.4 MHz
	Span	2.1 MHz
	RBW	Auto rules
	VBW	Auto rules
3GPP LTE 3 MHz	Command Example	:RAD:STAN LTEB3M
	IBW	3 MHz
	Span	4.5 MHz
	RBW	Auto rules
	VBW	Auto rules
3GPP LTE 5 MHz	Command Example	:RAD:STAN LTEB5M
	IBW	5 MHz
	Span	7.5 MHz
	RBW	Auto rules
	VBW	Auto rules
3GPP LTE 10 MHz	Command Example	:RAD:STAN LTEB10M
	IBW	10 MHz
	Span	15 MHz
	RBW	Auto rules
	VBW	Auto rules

3GPP LTE 15 MHz	Command Example	:RAD:STAN LTEB15M
	IBW	15 MHz
	Span	22.5 MHz
	RBW	Auto rules
	VBW	Auto rules
3GPP LTE 20 MHz	Command Example	:RAD:STAN LTEB20M
	IBW	20 MHz
	Span	30 MHz
	RBW	Auto rules
	VBW	Auto rules
cdma2000	Command Example	:RAD:STAN C20001X :RAD:STAN C2000MC1 :RAD:STAN? (Query always returns C20001X)
	IBW	1.23 MHz
	Span	1.845 MHz
	RBW	24 kHz
	VBW	Auto rules
IS-95A	Command Example	:RAD:STAN IS95
	IBW	1.23 MHz
	Span	1.845 MHz
	RBW	24 kHz
	VBW	Auto rules
J-STD-008	Command Example	:RAD:STAN JSTD
	IBW	1.23 MHz
	Span	1.845 MHz
	RBW	24 kHz
	VBW	Auto rules
NADC	Command Example	:RAD:STAN NADC
	IBW	32.8 kHz
	Span	49.2 kHz
	RBW	1.2 kHz
	VBW	Auto rules

PDC	Command Example	:RAD:STAN PDC
	IBW	21 kHz
	Span	31.5 kHz
	RBW	6.2 kHz
	VBW	Auto rules
IS-97D/98D	Command Example	:RAD:STAN IS97D :RAD:STAN IS98D :RAD:STAN IS95C :RAD:STAN? Query always returns `IS97D`
	IBW	1.23 MHz
	Span	1.845 MHz
	RBW	24kHz
	VBW	Auto rules

Band Class (IS-97D/98D only)

The following function is only available when you have selected the standard: IS-97D/98D. It lets you select the band class.

Remote Command	`[:SENSe]:RADio:STANdard:BAND:CLASs BC0 | BC1` `[:SENSe]:RADio:STANdard:BAND:CLASs?`
Example	`:RAD:STAN:BAND:CLAS BC0` `:RAD:STAN:BAND:CLAS?`
Preset	`BC0`
State Saved	Saved in instrument state
Range	0 (800 MHz Band)|1 (1900 MHz Band)

Wireless Radio Standards

The table below lists the CHP settings and provides an example for each wireless Radio Standard.

WLAN 802.11a	Command Example	:RAD:STAN WL802DOT11A
	IBW	20 MHz
	Span	30 MHz
	RBW	100 kHz
	VBW	Auto rules

WLAN 802.11g	Command Example	:RAD:STAN WL802DOT11G
	IBW	20 MHz
	Span	30 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11b	Command Example	:RAD:STAN WL802DOT11B
	IBW	25 MHz
	Span	37.5 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11n 20 MHz	Command Example	:RAD:STAN WL11N20M
	IBW	20 MHz
	Span	30 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11n 40 MHz	Command Example	:RAD:STAN WL11N40M
	IBW	40 MHz
	Span	60 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11ac 20 MHz	Command Example	:RAD:STAN WL11AC20M
	IBW	20 MHz
	Span	30 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11ac 40 MHz	Command Example	:RAD:STAN WL11AC40M
	IBW	40 MHz
	Span	60 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11ac 80 MHz	Command Example	:RAD:STAN WL11AC80M
	IBW	80 MHz
	Span	120 MHz
	RBW	100 kHz
	VBW	Auto rules

WLAN 802.11ac 160 MHz	Command Example	:RAD:STAN WL11AC160M
	IBW	160 MHz
	Span	240 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11ax 20 MHz	Command Example	:RAD:STAN WL11AX20M
	IBW	20 MHz
	Span	30 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11ax 40 MHz	Command Example	:RAD:STAN WL11AX40M
	IBW	40 MHz
	Span	60 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11ax 80 MHz	Command Example	:RAD:STAN WL11AX80M
	IBW	80 MHz
	Span	120 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11ax 160 MHz	Command Example	:RAD:STAN WL11AX160M
	IBW	160 MHz
	Span	240 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11be 20 MHz	Command Example	:RAD:STAN WL11BE20M
	IBW	20 MHz
	Span	30 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11be 40 MHz	Command Example	:RAD:STAN WL11BE40M
	IBW	40 MHz
	Span	60 MHz
	RBW	100 kHz
	VBW	Auto rules

WLAN 802.11be 80 MHz	Command Example	:RAD:STAN WL11BE80M
	IBW	80 MHz
	Span	120 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11be 160 MHz	Command Example	:RAD:STAN WL11BE160M
	IBW	160 MHz
	Span	240 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11be 320 MHz	Command Example	:RAD:STAN WL11BE320M
	IBW	320 MHz
	Span	480 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11ad 2 GHz	Command Example	:RAD:STAN WL11AD2G
	IBW	2.16 GHz
	Span	3.24 GHz
	RBW	1 MHz
	VBW	Auto rules
WLAN 802.11ay 2.16 GHz	Command Example	:RAD:STAN WL11AY2G16
	IBW	2.16 GHz
	Span	3.24 GHz
	RBW	1 MHz
	VBW	Auto rules
WLAN 802.11ay 4.32 GHz	Command Example	:RAD:STAN WL11AY4G32
	IBW	4.32 GHz
	Span	6.48 GHz
	RBW	1 MHz
	VBW	Auto rules
WLAN 802.11ay 6.48 GHz	Command Example	:RAD:STAN WL11AY6G48
	IBW	6.48 GHz
	Span	9.72 GHz
	RBW	1 MHz
	VBW	Auto rules

WLAN 802.11ay 8.64 GHz	Command Example	:RAD:STAN WL11AY8G64
	IBW	8.64 GHz
	Span	12.96 GHz
	RBW	1 MHz
	VBW	Auto rules
3GPP 5G NR 5G NR FR1 100MHz	Command Example	:RAD:STAN NR5GFR1B100M
	IBW	100 MHz
	Span	150 MHz
	RBW	Auto rules
	VBW	Auto rules
WLAN HiperLAN/2	Command Example	`:RAD:STAN HIPERLAN2`
	UWB Indoor	Command Example RAD:STAN UWBINDOOR
	Bluetooth	Command Example RAD:STAN BLUE

Packet Type (Bluetooth only)

The command below sets the packet type for the Bluetooth measurement

Remote Command	[:SENSe]:RADio:STANdard:PACKet DH1 | DH3 | DH5 [:SENSe]:RADio:STANdard:PACKet?
Example	:RAD:STAN:PACK DH1 :RAD:STAN:PACK?
Notes	The packet length is: DH1: 366 µs DH3: 1622 µs DH5: 2870 µs
Preset	DH1
State Saved	Saved in instrument state
Range	DH1|DH3|DH5

Radio Standard Presets Hierarchy

General	None	
	TETRA	BTS
		MS
	FCC Part 15 Subpart F	
	APCO-25	
	DMR	
	dPMR	
Video	DVB-T	L/SECAM/NICAM
		G/PAL/NICAM
		I/PAL/NICAM
	S-DMB System E	

Cellular	3GPP 5G NR	BTS	FR1 100 MHz
		MS	FR1 100 MHz
	3GPP LTE	BTS	1.4 MHz (6 RB)
			3 MHz (15 RB)
			5 MHz (25 RB)
			10 MHz (50 RB)
			15 MHz (75 RB)
			20 MHz (100 RB)
		MS	1.4 MHz (6 RB)
			3 MHz (15 RB)
			5 MHz (25 RB)
			10 MHz (50 RB)
			15 MHz (75 RB)
			20 MHz (100 RB)
	3GPP W-CDMA	BTS	
		MS	
	GSM/EDGE	BTS	
		MS	
	cdma2000 1x	BTS	
		MS	
	IS-95A	BTS	
		MS	
	J-STD-008	BTS	
		MS	
	IS-97D/98D	BTS	Band Class 0
			Band Class 1
		MS	Band Class 0
			Band Class 1
	NADC	BTS	
		MS	
	PDC	BTS	
		MS	

Wireless	W-LAN	802.11a	
		802.11b	
		802.11g	
		802.11n	20 MHz
			40 MHz
		802.11ac	20 MHz
			40 MHz
			80 MHz
			160 MHz
		802.11ax	20 MHz
			40 MHz
			80 MHz
			160 MHz
		802.11be	20 MHz
			40 MHz
			80 MHz
			160 MHz
			320 MHz
		802.11ad	
		802.11ay	2.16 GHz
			4.32 GHz
			6.48 GHz
			8.64 GHz
		HiperLAN/2	
	Bluetooth	DH1	
		DH3	
		DH5	
	UWB Indoor		

Each Radio Standard has the preset parameter set for the measurement.

When a standard is selected, the default value of the measurement parameters are overwritten by those preset values.

When the standard is NONE, or the standard does not specify the firm RBW requirement, then the table displays “auto”, and the following definition is used to compute the proper RBW setting:

1. Compute the guard-band = [Offset Freq A] - 0.5*([Chan Integ BW] + [Ref BW])

2. Divide by 4.5. Call the result GuardbandGoalRBW

3. Compute the greater of the Reference and Offset A integration bandwidths. Divide that result by 100 and call it the ChannelWidthGoalRBW
4. Find the smallest integration bandwidth of any of the offsets; divide it by two and call the result IntegBWGoalRBW
5. Compute AutoRBWGoal = min(IntegBWGoal, max(GuardbandGoalRBW, ChannelWidthGoalRBW))
6. Compute the RBW to be selected to be the largest available RBW that is smaller than AutoRBWGoal

Measurements that are unavailable for a particular Radio Standard are grayed-out. Radio Standards that are unavailable for the current active measurement are also grayed-out.

However, remote operations, such as `:CONF` allow the measurement to be active even if it is not a supported format. In this case, the measurement configuration should be set to `NONE`.

Enable Non-Std Meas

Lets you specify whether all measurements and radio standards are enabled or not.

By default, **Enable Non-Std Measurements** is set to `NO`, so you can select only valid combinations of preset available standards and measurements. Combinations of measurement and standard that would have no valid preset value are grayed-out.

When **Enable Non-Std Measurements** is set to `YES`, all measurements and standard selections are enabled, so you can select any combination.

NOTE **If you select an unavailable measurement or unavailable radio standard using the Enable Non-Std Meas control, the measurement results may not conform to the selected standard.**

Remote Command	`[:SENSe]:RADio:STANdard:EAMeas YES | NO` `[:SENSe]:RADio:STANdard:EAMeas?`
Example	`:RAD:STAN:EAM YES` `:RAD:STAN:EAM?`
Preset	`NO`
State Saved	Saved in instrument state
Range	`YES|NO`

3.6.8.3 Advanced

Contains controls for setting advanced functions of the instrument.

IF Gain

Used to set the IF Gain function to: Auto, Low Gain or High Gain. These settings affect sensitivity and IF overloads.

Only applies to the RF input. Does not apply to baseband I/Q input.

Remote Command	`[:SENSe]:PSTatistic:IF:GAIN[:STATe] ON | OFF | 1 | 0` `[:SENSe]:PSTatistic:IF:GAIN[:STATe]?`
Example	`:PST:IF:GAIN ON` `:PST:IF:GAIN?`
Notes	`ON` = high gain `OFF` = low gain
Dependencies	Not available when IQ Input is selected Has no effect when the U7227A USB Preamplifier is connected. This is not annotated or reflected on any control; there are no controls grayed out nor any SCPI locked out. The instrument simply behaves as though both IF Gain is set to Low regardless of the setting on the control Not available in VXT, EXM, or UXM
Couplings	Sending this command forces IF Gain Auto to `OFF` (**Man**)
Preset	`OFF`
State Saved	Saved in instrument state
Range	Low Gain | High Gain

Auto Function

Remote Command	`[:SENSe]:PSTatistic:IF:GAIN:AUTO[:STATe] ON | OFF | 1 | 0` `[:SENSe]:PSTatistic:IF:GAIN:AUTO[:STATe]?`
Example	`:PST:IF:GAIN:AUTO ON` `:PST:IF:GAIN:AUTO?`
Couplings	**Auto** sets IF Gain to High Gain if the input attenuator is set to 0 dB, or the preamp is turned on, or the Max Mixer Level is –20 dBm or lower For other conditions, **Auto** sets IF Gain to Low Gain
Preset	`OFF`

IF Upsampling Ratio

Allows you to select the upsampling ratio after data is captured for a measurement. Using this method, mitigation of peak detection error can be expected when upsampling ratio is set to > x1.

Remote Command	`[:SENSe]:PSTatistic:URATio X1 | X2 | X4 | X8 | X16 | X32`

	[:SENSe]:PSTatistic:URATio?
Example	:PST:URAT X8 :PST:URAT?
Notes	X1 is for backwards compatibility
Preset	X1
State Saved	Yes, Saved in instrument state
Range	X1|X2|X4|X8|X16|X32

3.6.8.4 Global

The controls in this menu apply to all Modes in the instrument.

Some controls (for example, "Global Center Freq" on page 2013) allow you to switch certain Meas Global parameters to a Mode Global state. These switches apply to all Modes that support global settings. For example, no matter what Mode you are in when you set **Global Center Freq** to ON, it applies to all Modes that support Global settings.

Other controls (for example, **Extend Low Band**) are actually set in this menu, but apply to all Modes.

Global Center Freq

The software maintains a Mode Global value called **Global Center Freq**.

When **Global Center Freq** is switched ON, the current Mode's center frequency is copied into the **Global Center Frequency**, and from then on all Modes that support global settings use the **Global Center Frequency**, so you can switch between any of these Modes and the **Center Frequency** remains unchanged.

Adjusting the **Center Frequency** of any Mode that supports Global Settings, while **Global Center Freq** is ON, modifies the **Global Center Freq**.

When **Global Center Freq** is switched OFF, the **Center Frequency** of the current Mode is unchanged, but now the **Center Frequency** of each Mode is once again independent.

When **Mode Preset** is pressed while **Global Center Freq** is ON, the **Global Center Freq** is preset to the preset **Center Frequency** of the current Mode.

This function resets to OFF when "Restore Defaults" on page 2016 is pressed, or when **System**, **Restore Defaults**, **All Modes** is pressed.

Remote Command	:INSTrument:COUPle:FREQuency:CENTer ALL | NONE :INSTrument:COUPle:FREQuency:CENTer?

Example	`:INST:COUP:FREQ:CENT ALL` `:INST:COUP:FREQ:CENT?`
Preset	Set to `OFF` on **Global** Settings, **Restore Defaults** and **System, Restore Defaults, All Modes**
Range	`ALL`|`NONE`

Preset	`OFF`
Backwards Compatibility SCPI	`:GLOBal:FREQuency:CENTer[:STATe] 1 | 0 | ON | OFF` `:GLOBal:FREQuency:CENTer[:STATe]?`

Global EMC Std

When this control is switched `ON`, the current Mode's EMC Std is copied into the **Global EMC Std**, and from then on all Modes that support global settings use the **Global EMC Std**, so you can switch between any of these Modes and the EMC Std remains unchanged.

Adjusting the EMC Std of any Mode that supports Global settings, while **Global EMC Std** is `ON` modifies the **Global EMC Std**.

When **Global EMC Std** is switched `OFF`, the EMC Std of the current Mode remains unchanged, but now the EMC Std of each Mode is once again independent. When **Mode Preset** is pressed while **Global EMC Std** is `ON`, **Global EMC Std** is preset to the preset EMC Std of the current Mode.

This function resets to `OFF` when "Restore Defaults" on page 2016 is pressed, or when **System, Restore Defaults, All Modes** is pressed.

Remote Command	`:INSTrument:COUPle:EMC:STANdard ALL | NONE` `:INSTrument:COUPle:EMC:STANdard?`
Example	`:INST:COUP:EMC:STAN ALL` `:INST:COUP:EMC:STAN?`
Dependencies	Only available if Option EMC is installed
Preset	Set to `OFF` on **Global** Settings, **Restore Defaults** and **System, Restore Defaults, All Modes**
Range	`ALL | NONE`

Global Limit Lines (Freq and Amptd)

When this control is set to `ALL`, the current Mode's Limit Line is copied into the **Global Limit Lines**, and from there to all Modes that support Global settings and use **Global Limit Lines**, so you can switch between any of these Modes and the Limit Lines remain unchanged.

Adjusting the Limit Lines of any Mode that supports **Global** Settings, while **Global Limit Lines** is `ALL`, modifies the **Global Limit Lines**.

When **Global Limit Lines** is set to `NONE`, the Limit Lines of the current Mode are unchanged, but now the Limit Lines of each Mode are once again independent. When **Mode Preset** is pressed while **Global Limit Lines** is `ALL`, **Global Limit Lines** is preset to the preset Limit Lines of the current Mode.

This function is reset to `NONE` when "Restore Defaults" on page 2016 is pressed, or when **System**, **Restore Defaults**, **All Modes** is pressed.

Remote Command	`:INSTrument:COUPle:LLINe ALL | NONE` `:INSTrument:COUPle:LLINe?`
Example	`:INST:COUP:LLIN ALL | NONE` `:INST:COUP:LLIN?`
Preset	Set to `OFF` on **Global** Settings, **Restore Defaults** and **System, Restore Defaults, All Modes**
Range	`ALL | NONE`

Extend Low Band

The software maintains a Mode Global value called **Extend Low Band**.

Under the current sweep configuration crossing over two bands, when **Extend Low Band** is turned `ON`, the instrument checks whether one band can cover the whole sweep frequency range or not. If it can, then the instrument locks the band; otherwise, it does nothing (the band crossover occurs).

This function does *not* work when **Band Lock** under **System** > **Service** > **Lock Functions** is not -1 (no Band Lock). In that case, **Band Lock** takes priority over **Extend Low Band**.

This function resets to `OFF` when "Restore Defaults" on page 2016 is pressed, or when **System**, **Restore Defaults**, **All Modes** is pressed.

Remote Command	`:INSTrument:COUPle:FREQuency:BAND:EXTend 0 | 1 | ON | OFF` `:INSTrument:COUPle:FREQuency:BAND:EXTend?`
Example	`:INST:COUP:FREQ:BAND:EXT 1` `:INST:COUP:FREQ:BAND:EXT?`
Preset	Set to `OFF` by **Global** Settings > **Restore Defaults** and **System** > **Restore Defaults** > **All Modes**
Range	`ON|OFF`

Restore Defaults

Resets all functions in the **Global** settings menu to `OFF`. Pressing **System**, **Restore Defaults**, **All Modes** has the same effect.

Remote Command	`:INSTrument:COUPle:DEFault`
Example	`:INST:COUP:DEF`
Backwards Compatibility SCPI	`:GLOBal:DEFault`

3.6.9 Sweep

Accesses controls to configure and control the acquisition of data, and the X-axis parameters of the instrument.

Depending on the selected mode and measurement, these controls might include: **Sweep Time**, **Continuous/Single**, **Pause/Resume**, **X Scale** and **Number of Points**.

3.6.9.1 Sweep/Control

Accesses controls that let you operate the sweep and control functions of the instrument, such as **Sweep Time** and **Continuous/Single**.

Sweep/Measure

Lets you toggle between **Continuous** and **Single** sweep or measurement operation. The single/continuous state is Meas Global, so the setting affects all measurements.

The front-panel key **Single/Cont** performs exactly the same function

See "More Information" on page 1218

Remote Command	`:INITiate:CONTinuous OFF | ON | 0 | 1` `:INITiate:CONTinuous?`

Example	Put instrument into **Single** measurement operation:
	`:INIT:CONT 0`
	`:INIT:CONT OFF`
	Put instrument into **Continuous** measurement operation:
	`:INIT:CONT 1`
	`:INIT:CONT ON`

Preset	`ON` Note that `:SYST:PRES` sets `:INIT:CONT` to `ON`, but `*RST` sets `:INIT:CONT` to `OFF`
State Saved	Saved in instrument state
Annunciation	The **Single/Continuous** icon in the Meas Bar changes depending on the setting: – A line with an arrow is **Single**

	– A loop with an arrow is **Continuous**
Backwards Compatibility Notes	X-Series A-models had **Single** and **Cont** hardkeys in place of the **SweepSingleCont** softkey. In the X-Series A-models, if in single measurement, the **Cont** hardkey (and `INIT:CONT ON`) switched to continuous measurement, but never restarted a measurement and never reset a sweep X-Series B-models have a **Cont/Single** toggle control instead of **Single** and **Cont** hardkeys, but it is still true that, if in single measurement, the **Cont/Single** toggle control never restarts a measurement and never resets a sweep

More Information

Continuous Mode	The instrument takes repetitive sweeps, averages, measurements, etc., when in continuous mode. If in average or Max/Min Hold, and the average/hold count reaches the **Average/Hold Num**, the count stops incrementing, but the instrument keeps sweeping See the **Trace** key description under **Trace Average** for the averaging formula used both before and after the **Average/Hold Num** is reached. The trigger condition must be met prior to each sweep The type of trace processing for multiple sweeps is set under the **Trace** key, with choices of **Trace Average**, **Max Hold**, or **Min Hold**
Single Mode	The instrument takes a single sweep when in **Single** mode, or if in average or Max/Min Hold, or if there is a **Waterfall** window displayed, it takes multiple sweeps until the average/hold count reaches the **Average/Hold Num**, then the count stops incrementing, and the instrument stops sweeping See the **Trace** key description under **Trace Average** for the averaging formula used. The trigger condition must be met prior to the sweep The type of trace processing for multiple sweeps is set under the **Trace** key, with choices of **Trace Average**, **Max Hold**, or **Min Hold**

If the instrument is in **Single** measurement mode, pressing the **Cont/Single** toggle control does not zero the count and does not cause the sweep to be reset; the only action is to put the instrument into Continuous measurement operation.

If the instrument is already in **Continuous** sweep:

- `:INIT:CONT 1` has no effect
- `:INIT:CONT 0` places the instrument in Single Sweep but has no effect on the current sequence until k = N, at which point the current sequence will stop and the instrument will go to the idle state

See "Restart" on page 2018 for details of `:INIT:IMMediate`.

If the instrument is already in **Single** sweep, `:INIT:CONT OFF` has no effect.

If the instrument is already in **Single** sweep, then pressing **Cont/Single** in the middle of a sweep does not restart the sweep or sequence. Similarly, pressing **Cont/Single** does not restart the sweep or sequence if the sweep is not in the idle state (for example, if you are taking a very slow sweep, or the instrument is waiting for a trigger). Even though pressing **Cont/Single** in the middle of a sweep does not restart the sweep, sending `:INIT:IMM` *does* reset it.

If the instrument is in **Single** sweep, and *not* Averaging/Holding, and you want to take one more sweep, press **Restart**.

If the instrument is in **Single** sweep, *and* Averaging/Holding, and you want to take one more sweep without resetting the Average trace or count, go to **Meas Setup** and increment the average count by 1 by pressing the **Step-Up** key while **Average/Hold Num** is the active function. You can also do this by sending `:CALC:AVER:TCON UP`.

Restart

Restarts the current sweep, or measurement, or set of averaged/held sweeps or measurements. If you are Paused, pressing **Restart** performs a Resume.

The front-panel key **Restart** performs exactly the same function.

The **Restart** function is accessed in several ways:

- Pressing the **Restart** key
- Sending `:INIT:IMM`
- Sending `:INIT:REST`

See "More Information" on page 1220

Remote Command	`:INITiate[:IMMediate]` `:INITiate:RESTart`
Example	`:INIT:IMM` `:INIT:REST`
Notes	`:INIT:REST` and `:INIT:IMM` perform exactly the same function
Couplings	Resets average/hold count k. For the first sweep overwrites all active (update = on) traces with new current data. For application modes, it resets other parameters as required by the measurement
Status Bits/OPC dependencies	This is an Overlapped command The `STATus:OPERation` register bits 0 through 8 are cleared , *except* bit 6 (Waiting for Periodic Sync). Initiating a measurement and Waiting for Periodic Sync could be asynchronous The `STATus:QUEStionable` register bit 9 (`INTegrity` sum) is cleared The `SWEEPING` bit is set The `MEASURING` bit is set
Backwards Compatibility Notes	For Spectrum Analysis Mode in ESA and PSA, the **Restart** hardkey and the `:INIT:REST` command restarted trace averages (displayed average count reset to 1) for a trace in **Clear Write**, but did not restart **Max Hold** and **Min Hold**

In X-Series, the **Restart** hardkey and the `:INIT:REST` command restart not only **Trace Average**, but **MaxHold** and **MinHold** traces as well

More Information

The **Restart** function first aborts the current sweep or measurement as quickly as possible. It then resets the sweep and trigger systems, sets up the measurement and initiates a new data measurement sequence with a new data acquisition (sweep) taken once the trigger condition is met.

If the instrument is in the process of aligning when a **Restart** is executed, the alignment finishes before the restart function is performed.

Even when set for **Single** operation, multiple sweeps may be taken when **Restart** is pressed (for example, when averaging/holding is on). Thus, when we say that **Restart** "restarts a measurement", depending on the current settings, we may mean that it:

- Restarts the current sweep
- Restarts the current measurement
- Restarts the current set of sweeps if any trace is in Trace Average, Max Hold or Min Hold
- Restarts the current set of measurements if Averaging, or Max Hold, or Min Hold is on for the measurement

If there is no Average or Max/Min Hold function (no trace in Trace Average or Hold, or **Average/Hold Num** set to 1), and no **Waterfall** window is being displayed, a single sweep is equivalent to a single measurement. A single sweep is taken after the trigger condition is met; and the instrument stops sweeping once that sweep has completed. However, with **Average/Hold Num** >1, and at least one trace set to Trace Average, Max Hold, or Min Hold, or a **Waterfall** window being displayed, multiple sweeps/data acquisitions are taken for a single measurement. The trigger condition must be met prior to each sweep. The sweep is stopped when the average count k equals the number N set for **Average/Hold Num**.

Once the full set of sweeps has been taken, the instrument goes to the idle state. To take one more sweep without resetting the average count, increment the average count by 1, by pressing the **Step-Up** key while **Average/Hold Number** is the active function, or by sending the remote command `:CALC:AVER:TCON UP`.

Trace Update

The numeric results are not blanked at any time during the restart cycle.

For slow sweeps (see **Trace Update** section in **Trace/Detector**), the traces are updated real-time during the sweep. There may be a special circumstance in application mode measurements where an exception is made and the traces and/or results need to be blanked before displaying the new results.

To summarize, the following list shows what happens to the trace data on various events:

Event	Trace Effect
Clear/Write pressed (even if already in Clear/Write)	Set to mintracevalue
Max Hold pressed (even if already in Max Hold)	Set to mintracevalue
Min Hold pressed (even if already in Min Hold)	Set to maxtracevalue
Trace Average pressed (even if already in Trace Average)	Trace data unaffected but start new sweep/avg/hold
Restart pressed	Trace data unaffected but start new sweep/avg/hold
Parameter requiring restart changed (e.g., RBW)	Trace data unaffected but start new sweep/avg/hold

Sweep and Trigger Reset

Resetting the sweep system resets the average/hold count k to 0. It also resets the set point counter to 0. Resetting the trigger system resets the internal auto trig timer to the value set by the **Auto Trig** control.

Averaging

The weighting factor used for averaging is k. This k is also the average/hold count for how many valid sweeps (data acquisitions) have been done. This k is used for comparisons with N, as those comparisons always needs to be based on valid completed sweeps.

The displayed average/hold, K, shows the count for the sweep (data acquisition) in progress. K = k + 1, with a limit of N. The displayed value K changes from its previous value to 1 as soon as the trigger condition for the first data acquisition (sweep) is met.

Pause/Resume

Pauses a measurement after the current data acquisition is complete.

When paused, the label on the control changes to **Resume**. Pressing **Resume** un-pauses the measurement. When paused, pressing **Restart** performs a Resume.

Remote Command	`:INITiate:PAUSe` `:INITiate:RESume`
Example	`:INIT:PAUS` `:INIT:RES`
Dependencies	Not displayed in Modes that do not support pausing
Annotation	Only on control

Abort (Remote Command Only)

Stops the current measurement. Aborts the current measurement as quickly as possible, resets the sweep and trigger systems, and puts the measurement into an "idle" state. If the instrument is in the process of aligning when `:ABORt` is sent, the alignment finishes *before* the abort function is performed, so `:ABORt` does not abort an alignment.

If the instrument is set for **Continuous** measurement, it sets up the measurement and initiates a new data measurement sequence with a new data acquisition (sweep) taken once the trigger condition is met.

If the instrument is set for **Single** measurement, it remains in the "idle" state until an `:INIT:IMM` command is received.

Remote Command	`:ABORt`
Example	`:ABOR`
Notes	If :`INIT:CONT` is `ON`, then a new continuous measurement will start immediately, with sweep (data acquisition) occurring once the trigger condition has been met If :`INIT:CONT` is `OFF`, then `:INIT:IMM` is used to start a single measurement, with sweep (data acquisition) occurring once the trigger condition has been met
Dependencies	For continuous measurement, `:ABORt` is equivalent to the **Restart** key Not all measurements support this command
Status Bits/OPC dependencies	The `STATus:OPERation` register bits 0 through 8 are cleared , *except* bit 6 (Waiting for Periodic Sync). Initiating a measurement and Waiting for Periodic Sync could be asynchronous The `STATus:QUEStionable` register bit 9 (`INTegrity` sum) is cleared Since all the bits that feed into OPC are cleared by `:ABORt`, the Abort command will cause the `*OPC` query to return true

3.6.9.2 X Scale

Accesses controls that enable you to set the horizontal scale parameters.

Scale/Div

Enables you to enter a time value to change the horizontal scale.

Remote Command	`:DISPlay:PSTatistic:VIEW[1]:WINDow2:TRACe:X[:SCALe]:PDIVision <rel_ampl>` `:DISPlay:PSTatistic:VIEW[1]:WINDow2:TRACe:X[:SCALe]:PDIVision?`
Example	`:DISP:PST:VIEW:WIND2:TRAC:X:PDIV 10` `:DISP:PST:VIEW:WIND2:TRAC:X:PDIV?`
Notes	The CCDF measurement has the trace display only in Window 2, because values other than “2” are *not* available as the sub-op code
Preset	2.00
State Saved	Saved in instrument state
Min	0.1
Max	20
Backwards Compatibility SCPI	`:DISPlay:PSTatistic:XSCale`

3.6.10 Trace

Lets you control the display and storage of trace data for the available traces.

3.6.10.1 Trace Control

The controls on this tab allow you to select display of the Reference Trace and the Gaussian Line, and store the Reference Trace.

Store Ref Trace

Copies the currently measured curve as the user-definable reference trace. The captured data remains until the other mode is chosen. Pressing this key also refreshes the reference trace.

No query is available.

Remote Command	`:CALCulate:PSTatistic:STORe:REFerence`
Example	`:CALC:PST:STOR:REF`
Backwards Compatibility SCPI	`[:SENSe]:PSTatistic:SRTRace`

Ref Trace

Toggles the reference trace display On or Off.

Remote Command	`:DISPlay:PSTatistic:RTRace[:STATe] OFF | ON | 0 | 1` `:DISPlay:PSTatistic:RTRace[:STATe]?`
Example	`:DISP:PST:RTR OFF` `:DISP:PST:RTR?`
Preset	`OFF`
State Saved	Saved in instrument state
Range	`OFF|ON`
Backwards Compatibility SCPI	`[:SENSe]:PSTatistic:RTRace[:STATe]`

Gaussian Line

Toggles the Gaussian trace display On or Off.

Remote Command	`:DISPlay:PSTatistic:GAUSsian[:STATe] OFF | ON | 0 | 1` `:DISPlay:PSTatistic:GAUSsian[:STATe]?`
Example	`:DISP:PST:GAUS OFF` `:DISP:PST:GAUS?`
Preset	`ON`
State Saved	Saved in instrument state
Range	`OFF|ON`
Backwards Compatibility SCPI	`[:SENSe]:PSTatistic:GAUSsian[:STATe]`

3.7 Burst Power Measurement

The Burst Power (Transmit Power) measurement (at the base transceiver station) is used to determine the power delivered to the antenna system on the radio-frequency channel under test. The Burst Power measurement verifies the accuracy of the mean transmitted RF carrier power. This can be done across the frequency range and at each power step.

Mobile stations and base transceiver stations must transmit enough power, with sufficient modulation accuracy, to maintain a call of acceptable quality without leaking power into frequency channels or timeslots allocated for others. The Burst Power measurement determines the average power for an RF signal burst at or above a specified threshold value or during the detected burst width. The threshold value may be absolute, or relative to the peak value of the signal. Burst width can be set automatically or manually.

Measurement Commands for Burst Power (Transmit Power)

NOTE: The `BPOWer` form of the commands is included for backwards compatibility only, and are not recommended for use in new designs. Use the `TXPower` keyword.

The following commands and queries are used to retrieve the measurement results:

```
:CONFigure:TXPower|BPOWer
:CONFigure:TXPower|BPOWer:NDEFault
:INITiate:TXPower|BPOWer
:FETCh:TXPower|BPOWer[n]?
:READ:TXPower|BPOWer[n]?
:MEASure:TXPower|BPOWer[n]?
```

Remote Command Results for Burst Power (Transmit Power)

For the queries listed above, the results returned depend on the value of n, as follows.

n	Results Returned
0	Returns unprocessed I/Q trace data, as a series of comma-separated trace points, in volts. The I values are listed first in each pair, using the 0 through even-indexed values. The Q values are the odd-indexed values
not specified or 1	Returns the following comma-separated scalar results: 1. **Sample time**: A floating point number representing the time between samples when using the trace queries (n=0, 2, etc.)

n	Results Returned
	2. **Power**: The mean power (in dBm) of the power value that calculated by specified method: above the threshold or measured burst width. If averaging is on, the power is for the latest acquisition 3. **Power averaged**: the power (in dBm) for N averages, if averaging is on. An average consists of N acquisitions of data which represents the current trace. If averaging is off, the value of Power averaged is the same as the Power value 4. **Number of samples**: The number of data points in the captured signal. This number is useful when performing a query on the signal (i.e. when n=0, 2, etc.) 5. **Threshold value**: The absolute threshold level (in dBm) above which the power is calculated when Meas Method is set to Above Threshold 6. **Threshold points**: The number of points that were above the threshold and were used to calculate Mean Transmit Power when "Meas Method" on page 1312 is set to Above Threshold. If it is set to Measured Burst Width, Measured Pts is returned 7. **Maximum value**: The maximum peak level of the most recently acquired trace data (in dBm) 8. **Minimum value**: The minimum peak level of the most recently acquired trace data (in dBm) 9. **Full Burst width**: The burst width of this signal regardless of the parameter value set for the current Measured width. The Burst width is determined by the Threshold Lvl when Meas Method is set to Measured Burst Width. If Meas Method is set to Above Threshold Lvl, this value is zero 10. **Measured width**: The time length that is used to calculate Mean Transmit Power when "Meas Method" on page 1312 is set to Measured Burst Width. If it is set to Above Threshold, this value is zero 11. **Measured points**: The number of points used to calculate Mean Transmit Power when Meas Method is set to Measured Burst Width. If Meas Method is set to Above Threshold, this value is 0
2	Returns comma-separated trace points of the Measure Trace data These data points are floating point numbers representing the power of the signal (in dBm). There are N data points, where N is the number of samples. The period between the samples is defined by the sample time
3	Returns comma-separated trace points of the Max Hold Trace data These data points are floating point numbers representing the power of the signal (in dBm). There are N data points, where N is the number of samples. The period between the samples is defined by the sample time
4	Returns comma-separated trace points of the Min Hold Trace data These data points are floating point numbers representing the power of the signal (in dBm). There are N data points, where N is the number of samples. The period between the samples is defined by the sample time

3.7.1 Views

The Burst Power measurement has one view, the "Normal" on page 1283 View.

3.7.1.1 Normal

Windows: "Graph" on page 1227, "Metrics" on page 1229

Dual window view of the graph and the metrics.

The **Normal** View is a multiple-window View.When in a multiple window View, you select a window by touching it.The menu controls may sometimes change depending on which window is selected.

3.7.2 Windows

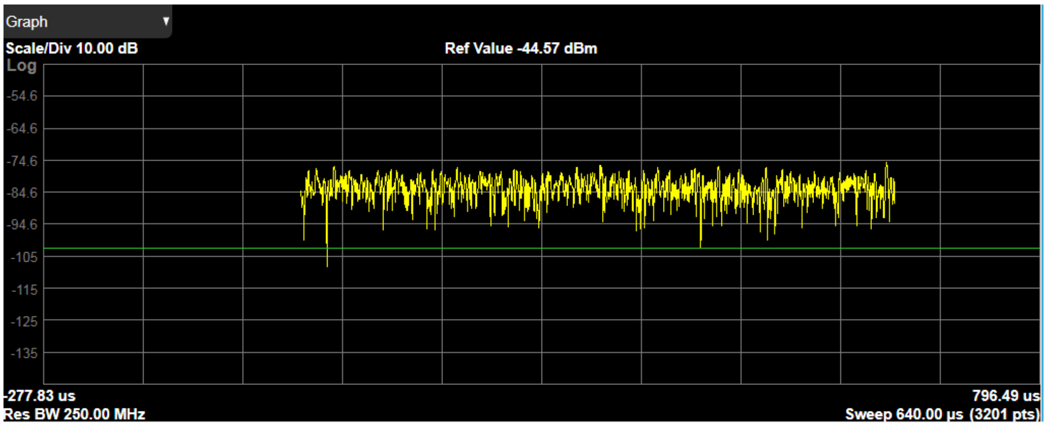
The Burst Power measurement has two windows: "Graph" on page 1227 and "Metrics" on page 1229.

3.7.2.1 Graph

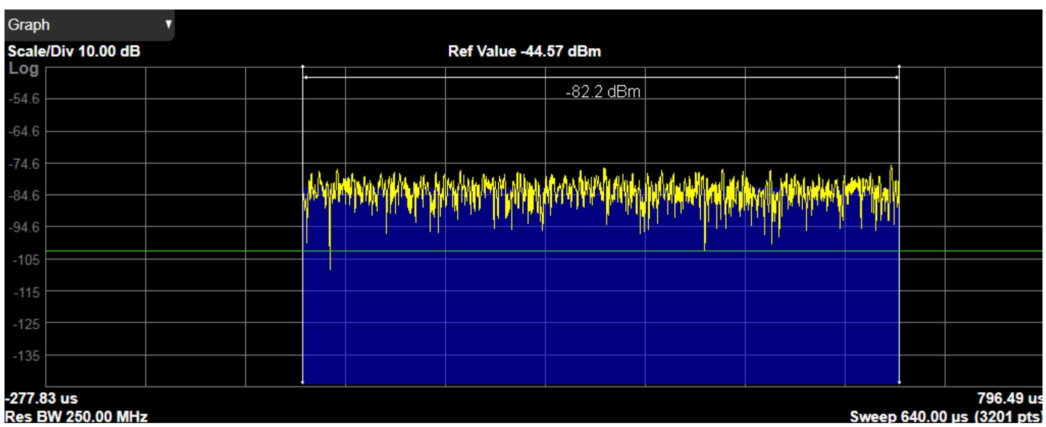
This window appears in the "Normal" on page 1283 view, as follows:

View	Size	Position
Normal	Two thirds, full width	Top

RF Envelope view



RF Envelope view with Bar Graph



The bar graph represents the measured portion of the trace. It is the blue bar in the second figure. Its state (On/Off) is controlled by "Bar Graph On/Off" on page 1282 under **Display**.

RF Envelope window

Marker Operation	Yes
Corresponding Trace	Corrected measured trace (n=2,3,4)

3.7.2.2 Metrics

Displays the textual results.

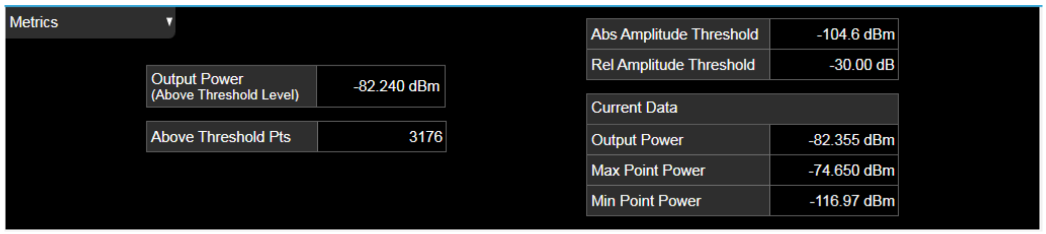
Metrics window appears in the "Normal" on page 1283 view, as follows:

View	Size	Position
Normal	One Third, full width	Bottom

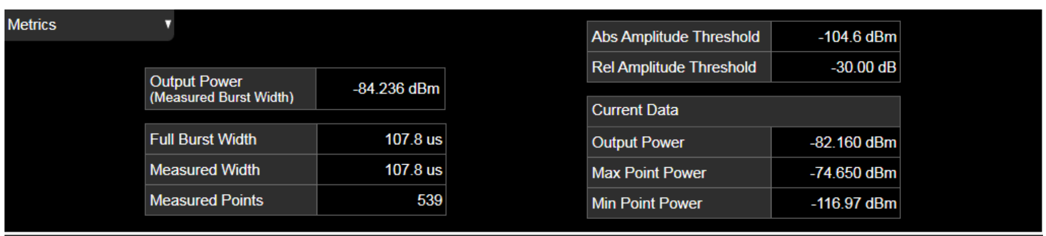
Name	Corresponding Results	Display Format
Output Power Above Threshold or Measured Burst Width	n = 1 3rd Power Value above the threshold or measured burst width for N averages, if averaging is on. An average consists of N acquisitions of data which represents the current trace. If averaging is off, the value of power averaged is the same as the Mean Transmit Power of Current Data	99.99 dBm
Full Burst Width	n = 1 9th Burst width that is determined by the "Threshold Level" on page 1308	999.9 us
Measured Width	n = 1 10th Time length that is used to calculate Mean Transmit Power when "Meas Method" on page 1312 is Measured Burst Width. If "Meas Method" on page 1312 is set to Above Threshold, disappear from the window	999.9 us
Above Threshold Pts	n = 1 6th Number of points that were above the threshold level and were used for the power calculation when "Meas Method" on page 1312 is Above Threshold Level	9999
Measured Points	n = 1 6th Number of points that were used for the power calculation when "Meas Method" on page 1312 is Measured Burst Width	9999
Abs Amplitude Threshold	n = 1 5th Threshold value is the threshold (in dBm) above which the power is calculated	99.99 dBm
Rel Amplitude Threshold	Threshold (in dB) relative to the peak carrier level above which the power is calculated	99.99 dB
Output power (Current data)	n = 1 2nd Power value above the threshold or measured burst width. If averaging is on, the power is for the latest acquisition	99.99 dBm

Name	Corresponding Results	Display Format
Max Point Power	n = 1 7th Maximum peak level of the most recently acquired trace data	99.99 dBm
Min Point Power	n = 1 8th Minimum peak level of the most recently acquired trace data	99.99 dBm

Metrics window when Meas Method is Above Threshold



Metrics window when Meas Method is Burst Width



3.7.3 Amplitude

Activates the **Amplitude** menu and selects **Reference Level** or **Reference Value** as the active function, depending on the measurement.

Some features in this menu apply to multiple measurements. Some other features apply only to specific measurements and their controls are blanked or grayed-out in measurements that do not support the feature.

3.7.3.1 Y Scale

Contains controls that pertain to the Y axis parameters of the measurement. These parameters control how data on the vertical (Y) axis is displayed and control instrument settings that affect the vertical axis.

Ref Value

Sets the value for the absolute power reference. The reference line is at the top, center, or bottom of the graticule, depending on the value of "Ref Position" on page 1238.

Remote Command	`:DISPlay:TXPower:WINDow[1]:TRACe:Y[:SCALe]:RLEVel <real>` `:DISPlay:TXPower:WINDow[1]:TRACe:Y[:SCALe]:RLEVel?`
Example	`:DISP:TXP:WIND:TRAC:Y:RLEV 5dBm` `:DISP:TXP:WIND:TRAC:Y:RLEV?`
Couplings	When "Auto Scaling" on page 1238 is ON (default), this value is automatically determined by the measurement result. When you set a value manually, **Auto Scaling** changes to `OFF` Attenuation is not coupled to **Ref Value**
Preset	10.00 dBm
State Saved	Saved in instrument state
Min/Max	-250.00 dBm / 250.00 dBm
Annotation	Ref <value> top left of graph
Backwards Compatibility SCPI	`:DISPlay:TXPower:VIEW[1]:WINDow[1]:TRACe:Y[:SCALe]:RLEVel`

Scale/Div

For measurements that support a logarithmic Y-Axis, **Scale/Div** sets the height of one division of the graticule in the current Y-Axis unit.

Scale/Div also determines the displayed amplitude range in the log plot graph. Since there are usually 10 vertical graticule division on the display, the total amplitude range of the graph is typically 10x this amount.For example, if Scale/Div is 10 dB, then the total range of the graph is 100 dB.

Remote Command	`:DISPlay:TXPower:WINDow[1]:TRACe:Y[:SCALe]:PDIVision <rel_ampl>` `:DISPlay:TXPower:WINDow[1]:TRACe:Y[:SCALe]:PDIVision?`
Example	`:DISP:TXP:WIND:TRAC:Y:PDIV 10dB` `:DISP:TXP:WIND:TRAC:Y:PDIV?`
Couplings	When "Auto Scaling" on page 1238 is ON, this value is automatically determined by the measurement result When you change a value, **Auto Scaling** automatically changes to `OFF`
Preset	10.00 dB / Div
State Saved	Saved in instrument state

Min	0.10 dB
Max	20 dB
Annotation	<value> dB/ left upper of graph
Backwards Compatibility SCPI	`:DISPlay:TXPower:VIEW[1]:WINDow[1]:TRACe:Y[:SCALe]:PDIVision`

Scale Range

Sets the Y-Axis scale range.

Remote Command	Replace `<meas>` with the identifier for the current measurement
	`:DISPlay:<meas>:WINDow[1]:TRACe:Y[:SCALe]:RANGe <rel_ampl>`
	`:DISPlay:<meas>:WINDow[1]:TRACe:Y[:SCALe]:RANGe?`

Example	`:DISP:CHP:WIND:TRAC:Y:RANG 100` `:DISP:CHP:WIND:TRAC:Y:RANG?`
Couplings	Coupled to **Scale/Div** as follows **Scale Range** = **Scale/Div** * 10 (number of divisions) When you change this value, **Auto Scaling** automatically changes to `OFF`
Preset	100 dB
State Saved	Saved in instrument state
Min	1
Max	200

Y Axis Unit

Displays a dropdown menu that enables you to change the vertical (Y) axis amplitude unit. This setting affects how the data is read over the remote interface. When using the remote interface, only numerical values are returned, so you must know what the Y Axis Unit is to interpret the results. This is described in more detail in "Amplitude Data Query and Y Axis Unit" on page 1235 below.

For measurements that support both Log and Lin scales, the instrument retains the entered Y Axis Unit separately for both Log and Lin amplitude Display Scales. For example, if Display Scale has been set to Log, and you set Y Axis Unit to dBm, pressing **Display Scale (Log)** sets the Y Axis Unit to dBm. If Display Scale has been set to Lin and you set Y Axis Unit to V, pressing **Display Scale (Lin)** sets the Y Axis Unit to V. Pressing **Display Scale (Log)** again sets the Y Axis Unit back to dBm.

If an Amplitude Correction is being applied that has an associated Transducer Unit, all selections but **Xducer Unit** are grayed-out. For more information, see "Transducer Unit" on page 1236 below.

Remote Command	`:UNIT:POWer DBM | DBMV | DBMA | V | W | A | DBUV | DBUA | DBPW | DBUVM | DBUAM | DBPT | DBG` `:UNIT:POWer?`

Example	`:UNIT:POW dBmV`
	`:UNIT:POW?`
	See also "Remote Interface Examples" on page 1234 below

Notes	The Y axis unit has either logarithmic or linear characteristics. The set of units that is logarithmic consists of dBm, dBmV, dBmA, dBmV, dBmA, dBmV/m, dBmA/m, dBpT, and dBG. The set of units that are linear consists of V, W, and A. The chosen unit will determine how the reference level and all the amplitude-related outputs like trace data, marker data, etc., read out
Dependencies	Appears only in Spectrum Analyzer Mode If an amplitude correction with a Transducer Unit other than None is applied and enabled: – The Transducer Unit selection is forced, and is the only Y Axis Unit available. The specific Transducer Unit is shown in square brackets in the dropdown, and all other Y Axis Unit choices are grayed-out – If you turn off that correction or set Apply Corrections to NO, the Y Axis Unit that existed before the Transducer Unit was applied is restored When Normalize is ON (in the **Trace**, **Normalize** menu), Y Axis Unit is grayed-out, and forced to dBm
Couplings	The instrument retains the entered Y Axis Unit separately for both Log and Lin amplitude Display Scales
Preset	dBm for log scale, V for linear. The true ‘preset’ value is dBm, since at preset the Y Display Scale is set to logarithmic
State Saved	Saved in instrument state
Annotation	The Y Axis Unit is shown after Ref Level value at the top of the graticule

Unit	Example	Notes
dBm	`:UNIT:POW DBM`	Y Axis Unit is set to dBm
dBmV	`:UNIT:POW DBMV`	Y Axis Unit is set to dBmV
dBmA	`:UNIT:POW DBMA`	Y Axis Unit is set to dBmA
W	`:UNIT:POW W`	Y Axis Unit is set to W
V	`:UNIT:POW V`	Y Axis Unit is set to V
A	`:UNIT:POW A`	Y Axis Unit is set to A
dBmV	`:UNIT:POW DBUV`	Y Axis Unit is set to dBmV
dBmA	`:UNIT:POW DBUA`	Y Axis Unit is dBmA. The unit dBuA can also appear as a Transducer Unit
dBpW	`:UNIT:POW DBPW`	Y Axis Unit is set to dBpW

Remote Interface Examples

Command examples and details appear in the table below. Note that each of the commands below sets the amplitude unit only for the *selected* amplitude scale (Log or Lin), the other scale is unaffected.

Unit	Example	Notes
dBm	`:UNIT:POW DBM`	dB relative to one milliwatt
dBmV	`:UNIT:POW DBMV`	dB relative to one millivolt
dBmA	`:UNIT:POW DBMA`	dB relative to one milliamp
W	`:UNIT:POW W`	Watts
V	`:UNIT:POW V`	Volts
A	`:UNIT:POW A`	Amperes
dBmV	`:UNIT:POW DBUV`	dB relative to one microvolt
dBmA	`:UNIT:POW DBUA`	dB relative to one microamp The unit dBuA can also appear as a "Transducer Unit" on page 1236 When querying the Y-Axis unit, you can query the Transducer Unit to distinguish between regular dBuA and the dBuA transducer unit. If `:CORR:CSET:ANT?` returns `NOC` (for No Conversion), you are using a normal Y Axis dBuA. If it returns `UA`, you are using a Transducer Unit dBuA
dBpW	`:UNIT:POW DBPW`	dB relative to one picowatt
dBmV/m (Transducer Unit)	`:UNIT:POW DBUVM`	Sets the amplitude unit for the selected amplitude scale (log/lin) to dBmV/meter. This selection is only available if a Correction is turned on, and the Transducer Unit for that Correction is not None See "Transducer Unit" on page 1236
dBmA/m (Transducer Unit)	`:UNIT:POW DBUAM`	Sets the amplitude unit for the selected amplitude scale (log/lin) to dBmA/meter. This selection is only available if a Correction is turned on, and the Transducer Unit for that Correction is not None See "Transducer Unit" on page 1236
dBpT (Transducer Unit)	`:UNIT:POW DBPT`	Sets the amplitude unit for the selected amplitude scale (log/lin) to dBpT (dB relative to one picotesla). This selection is only available if a Correction is turned on, and the Transducer Unit for that Correction is not None See "Transducer Unit" on page 1236
dBG (Transducer Unit)	`:UNIT:POW DBG`	Sets the amplitude unit for the selected amplitude scale (log/lin) to dBG (dB relative to one Gauss). This selection is only available if a Correction is turned on, and the Transducer Unit for that Correction is not None See "Transducer Unit" on page 1236
dBmA (Transducer	`:UNIT:POW DBUA`	Sets the amplitude unit for the selected amplitude scale (log/lin) to dBmA. This selection is only available as a Transducer Unit if a Correction is turned on, and the Transducer Unit for that Correction is not None

Unit	Example	Notes
Unit)		See "Transducer Unit" on page 1236 The unit dBuA can also appear as a normal Y Axis Unit (see above) dBuA as a Transducer Unit is used when using current probes, because current probes are often supplied with conversion tables that provide the transducer factors. When dBuA is used as a Transducer Unit, the normal conversion from power to amps for dBuA (based on the instrument input impedance) is not done, but instead the conversion is based solely on the Correction that contains the transducer factors. This is what distinguishes dBuA as a normal unit from dBuA as a transducer unit When querying the Y-Axis unit, you can query the Transducer Unit to distinguish between regular dBuA and the dBuA Transducer Unit. If `:CORR:CSET:ANT?` returns `NOC` (for No Conversion), you are using a normal Y-Axis dBuA. If it returns `UA`, you are using a Transducer Unit dBuA

Amplitude Data Query and Y Axis Unit

The settings of Y-Axis Unit and Display Scale affect how the data is returned over the remote interface in response to a query. When using the remote interface, no unit is returned, so you must know what the Y-Axis unit is to interpret the results:

Example 1

Set the following:

- Display Scale (Log)
- Y Axis Unit, dBm
- Scale/Div, 1 dB
- Ref Level, 10 dBm

This sets the top line to 10 dBm with each vertical division representing 1 dB. Thus, if a point on trace 1 is on the fifth graticule line from the top, it represents 5 dBm and will read out remotely as 5.

Example 2

Set the following:

- Display Scale (Lin)
- Y Axis Unit, Volts
- Ref Level, 100 mV (10 mV/div)

This sets the top line to 100 mV and the bottom line to 0 V, so each vertical division represents 10 mV. Thus, if a point on trace 1 is on the fifth graticule line from the top, it represents 50 mV and will read out remotely as 50.

NOTE **The units of current (A, dBmA, dBuA) are calculated based on 50 Ω input impedance.**

Transducer Unit

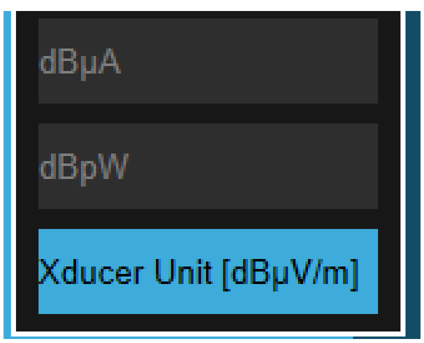
Transducer Units (formerly called Antenna Units) are units of field strength rather than amplitude, and are used when correcting the response of device such as antennas whose amplitude characteristics are measured in units of field strength. All five of the Transducer Units (dBmA/m, dBmV/m, dBG, dBpT, dBmA) are treated by the instrument exactly as though they were dBmV, when uncorrected. You must load an appropriate correction factor using Input/Output, Corrections for accurate and meaningful results.

If a remote command is sent to the instrument that uses one of the Transducer Units as a terminator, the instrument treats it as though DBUV had been sent as the terminator.

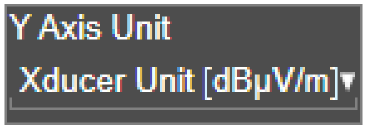
When a Correction is turned on that uses a Transducer Unit, the Y Axis Unit changes to that Transducer Unit. All of the selections in the **Y-Axis Unit** dropdown are then grayed-out, except the Transducer Unit selection. The unit being used is shown on this selection in square brackets, and appears on the control in square brackets preceded by **Xducer Unit**.

Example:

If the Transducer Unit in the Correction is dBmV/m, then the selection in the dropdown looks like this:



And on the control it looks like this:



NOTE

If a Transducer Unit is set, it is displayed as **Xducer Unit** in the **Y Axis Unit** dropdown. However, you can only *change* the Transducer Unit via the **Edit Correction** dialog in the **Input/Output**, **Corrections** menu. In that dialog, tap **Settings** then **Transducer Unit**. You can also turn off Transducer Unit from the same menu, by selecting **None**.

If a Transducer Unit is set, it is displayed as **Xducer Unit** in the **Y Axis Unit** dropdown. However, you can only *change* the Transducer Unit via the **Edit Correction** dialog in the **Input/Output**, **Corrections** menu. In that dialog, tap **Settings** then **Transducer Unit**. You can also turn off Transducer Unit from the same menu, by selecting **None**.

The Transducer Units are:

Units	Example
dBmV/m	:UNIT:POW DBUVM
dBmA/m	:UNIT:POW DBUAM
dBpT	:UNIT:POW DBPT
dBG	:UNIT:POW DBG
dBmA	:UNIT:POW DBUA
None	n/a

Ref Level Offset

Adds an offset value to the displayed reference level. The reference level is the absolute amplitude represented by the top graticule line on the display.

The on/off switch turns **Ref Level Offset** on or off.Setting a value for **Ref Level Offset** turns it ON.

Remote Command

```
:DISPlay:WINDow[1]:TRACe:Y[:SCALe]:RLEVel:OFFSet <rel_ampl>
:DISPlay:WINDow[1]:TRACe:Y[:SCALe]:RLEVel:OFFSet?
:DISPlay:WINDow[1]:TRACe:Y[:SCALe]:RLEVel:OFFSet:STATe OFF | ON | 0 | 1
:DISPlay:WINDow[1]:TRACe:Y[:SCALe]:RLEVel:OFFSet:STATe?
```

Example

```
:DISP:WIND:TRAC:Y:RLEV:OFFS 12.7
:DISP:WIND:TRAC:Y:RLEV:OFFS?
```

Sets **Ref Level Offset** to 12.7 dB. The only valid suffix is dB. If no suffix is sent, dB will be assumed

```
:DISP:WIND:TRAC:Y:RLEV:OFFS:STAT ON
```

	Turns Ref Level Offset On
Dependencies	Only in Spectrum Analyzer Mode
Preset	0 dBm OFF
State Saved	Saved in instrument state
Min	The range for **Ref Lvl Offset** is variable. It is limited to values that keep the reference level within the range of -327.6 dB to 327.6 dB
Max	327.6 dB
Annotation	The offset is displayed as "Ref Offset <value>" to the right of the reference level annotation if nonzero. When the offset is zero, no annotation is shown

Ref Position

Positions the reference level at the top, center, or bottom of the Y Scale display. Changing the reference position does not change the reference level value.

Remote Command	`:DISPlay:TXPower:VIEW[1]:WINDow[1]:TRACe:Y[:SCALe]:RPOSition TOP | CENTer | BOTTom` `:DISPlay:TXPower:VIEW[1]:WINDow[1]:TRACe:Y[:SCALe]:RPOSition?`
Example	`:DISP:TXP:WIND:TRAC:Y:RPOS CENT` `:DISP:TXP:WIND:TRAC:Y:RPOS?`
Preset	`TOP`
State Saved	Saved in instrument state
Range	`TOP|CENTer|BOTTom`
Annotation	Greater than (>) and less than (<) symbols are displayed on both sides of the graph to indicate the Reference Position
Backwards Compatibility SCPI	`:DISPlay:TXPower:VIEW[1]:WINDow[1]:TRACe:Y[:SCALe]:RPOSition`

Auto Scaling

Toggles **Auto Scaling** On or Off.

Remote Command	`:DISPlay:TXPower:WINDow[1]:TRACe:Y[:SCALe]:COUPle 0 | 1 | OFF | ON` `:DISPlay:TXPower:WINDow[1]:TRACe:Y[:SCALe]:COUPle?`
Example	`:DISP:TXP:WIND:TRAC:Y:COUP OFF` `:DISP:TXP:WIND:TRAC:Y:COUP?`
Couplings	When **Auto Scaling** is ON, and the **Restart** front-panel key is pressed, this function automatically sets the scale per division to 10 dB and determines the reference values based on the measurement results

	When you change a value of "Scale/Div" on page 1231, or "Ref Value" on page 1231, **Auto Scaling** automatically changes to `OFF`
Preset	1
State Saved	Saved in instrument state
Range	`OFF|ON`
Backwards Compatibility SCPI	`:DISPlay:TXPower:VIEW[1]:WINDow[1]:TRACe:Y[:SCALe]:COUPle`

3.7.3.2 Attenuation

Controls the attenuator functions and interactions between the attenuation system components.

There are two attenuator configurations in the X-Series. One is a Dual-Attenuator configuration consisting of a mechanical attenuator and an optional electronic attenuator. The other configuration uses a single attenuator with combined mechanical and electronic sections that controls all the attenuation functions. Different models in the X-Series come with different configurations.

- See "Dual-Attenuator Configurations" on page 1239
- See "Single-Attenuator Configuration" on page 1240

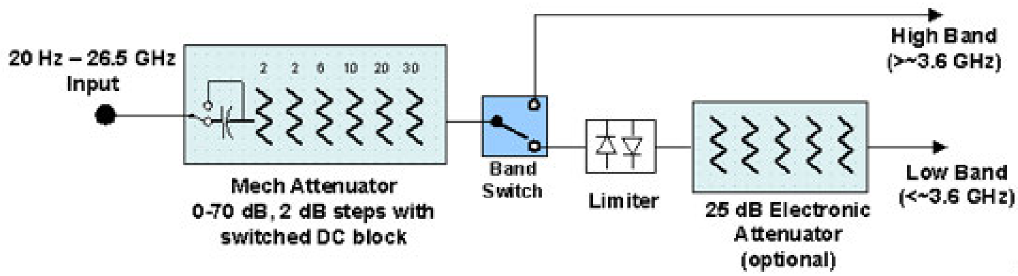
Most attenuation settings are the same for all measurements – they do not change as you change measurements. Settings like these are called “Meas Global” and are unaffected by **Meas Preset**.

Only available when the hardware set includes an input attenuator, which is typically only the case for Keysight’s benchtop instruments. For example, this tab does *not* appear in VXT models M9421A/10A/11A, nor in UXM. In UXM, all **Attenuation** and **Range** settings are disabled, as the expected input power level is handled by the Call Processing App that drives the DUT power control.

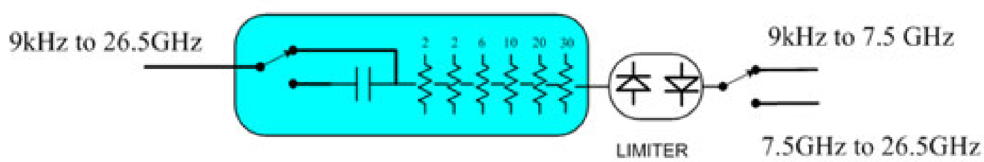
Dependencies	In measurements that support the I/Q inputs, unavailable when I/Q is the selected input. Replaced by the **Range** tab in that case

Dual-Attenuator Configurations

Configuration 1: Mechanical attenuator + optional electronic attenuator

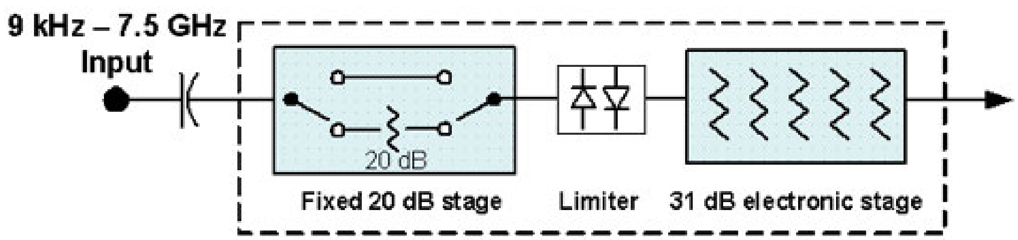


Configuration 2: Mechanical attenuator, no optional electronic attenuator



Note that Configuration 2 is not strictly speaking a dual-section attenuator, since there is no electronic section available. However, it behaves exactly like Configuration 1 without the Electronic Attenuator Option EA3, therefore for the sake of this document it is grouped into the “Dual-Attenuator” configuration.

Single-Attenuator Configuration



You can tell which attenuator configuration you have by pressing the Attenuation tab, which (in most Modes) opens the Attenuation menu. If the first control in the Attenuation menu says **Mech Atten** you have the Dual-Attenuator configuration. If the first control says **Atten** you have the Single-Attenuator configuration.

Dual Attenuator **Single Attenuator**

(Note that depending on the measurement, there may be no Auto/Man functionality on the Mech Atten control.)

In the Single-Attenuator configuration, you control the attenuation with a single control, as the fixed stage has only two states. In the Dual-Attenuator configuration, both stages have significant range, so you are given separate control of the mechanical and electronic attenuator stages.

When you have the Dual-Attenuator configuration, you may still have only a Single-Attenuator, because unless Option EA3 (the Electronic Attenuator option) is available, and you purchase it, you will have only the mechanical attenuator.

Full Range Atten

This control and **Attenuator Summary** only appear in N9041B, when the RF input is selected, the RF Input Port is set to RF Input 2, and the Full Range Attenuator is installed. The Full Range Attenuator adds a second input attenuator in front of RF Input 2, which enhances the protection and optimizes the performance of the extra internal mixers used by RF Input 2.

Remote Command	`[:SENSe]:POWer[:RF]:FRATten <rel_ampl>` `[:SENSe]:POWer[:RF]:FRATten?`
Example	`:POW:FRAT 14` `:POW:FRAT?`
Notes	When you enter an amplitude value that falls between valid values, the value will be incremented to the next smallest valid value
Dependencies	Only appears if input RF is selected, RF Input Port 2 is selected, and the Full Range Attenuator exists
Couplings	This value is never changed by any coupling, but other couplings use this value. See **Reference Level** and "Mech Atten" on page 1935 command descriptions
Preset	20 dB
State Saved	Saved in instrument state
Min	0 dB
Max	Only valid values are 0, 6, 14, 20 dB
Annotation	When the **Input** is **RF**, and the **Input Port** is **RF Input 2**, and the Full Range Attenuator is installed: On the Meas Bar, the field “Atten” displays as follows: – If the sweep is entirely < 50 GHz, the value shown after “Atten:” is equal to Mech Atten + Elec Atten + Full Range Atten – If the sweep is entirely > 50 GHz, the value shown after “Atten:” is equal to Full Range Atten – If the sweep straddles 50 GHz, the value shown after “Atten:” is preceded by the symbol “>=” and is equal to Full Range Atten

In the **Amplitude**, "Y Scale" on page 1929 menu, and the Atten **Meas Bar** dropdown menu panel, a summary is displayed as follows:

"Total Atten below 50 GHz" followed by the value of Full Range Atten + Mech Atten + Elec Atten

"Total Atten above 50 GHz" followed by the value of Full Range Atten

For example, if Mech Atten = 6 dB, Elec Atten = 4 dB, and Full Range Atten = 20 dB, the summary below is shown:

- Attenuator summary:
- Total Atten below 50 GHz: 30 dB
- Total Atten above 50 GHz: 20 dB

Mech Atten

Labeled **Mech Atten** in Dual-Attenuator models and **Atten** in Single-Attenuator models. In the Dual-Attenuator configuration, this control only affects the mechanical attenuator.

Lets you modify the attenuation applied to the RF input signal path. This value is normally auto-coupled to the Ref Level, the Internal Preamp Gain, any External Gain that is entered, and the Max Mixer Level, as described in the table below.

See "Attenuator Configurations and Auto/Man" on page 1244

Remote Command	`[:SENSe]:POWer[:RF]:ATTenuation <rel_ampl>`
	`[:SENSe]:POWer[:RF]:ATTenuation?`
	`[:SENSe]:POWer[:RF]:ATTenuation:AUTO OFF | ON | 0 | 1`
	`[:SENSe]:POWer[:RF]:ATTenuation:AUTO?`

Example	`:POW:ATT 20`
	Dual-Attenuator configuration: sets the mechanical attenuator to 20 dB
	Single-Attenuator mode: sets the main attenuation to 20 dB (see below for definition of "main" attenuation)
	In either case, if the attenuator was in Auto, it is set to Manual
	`:POW:ATT:AUTO ON`
	Turn Auto Mech Atten ON

Dependencies	Some measurements do not support Auto setting of "Mech Atten" on page 1242. In these measurements, the **Auto/Man** selection is not available, and the Auto/Man toggle function is not available In Dual-Attenuator configurations, when the electronic attenuator is enabled, the mechanical attenuator has no auto setting, and the Auto/Man toggle function is not available. The state of Auto/Man is remembered and restored when the electronic attenuator is once again disabled. This is described in more detail in "Elec Atten" on page 1937 See "Attenuator Configurations and Auto/Man" on page 1244 for more information on the Auto/Man

	functionality `:POW:ATT:AUTO` is only available in measurements that support Mech Atten Auto, such as Swept SA
Couplings	If the RF Input Port is the RF Input: – If the USB Preamp is connected to USB, use 0 dB for Mech Atten – Otherwise compute the auto-selected value of Mech Atten based on **Reference Level**, Int Preamp, External Gain, Ref Level Offset, Max Mixer Level, µW Path Control and IF Gain settings. Limit this value to be no less than 6 dB (total attenuation below 6 dB can never be chosen by Auto) – In the N9041B, if the RF Input Port is RF Input 2, use the formula above and subtract the Full Range Atten value from the result to determine the Mech Atten. Limit the value so that it is never lower than 0 dB and so that total attenuation, including Full Range Atten, is never less than 6 dB (total attenuation, including Full Range Atten below 6 dB, can never be chosen by Auto) In External Mixing and BBIQ, where the Attenuator is not in the signal path, the Attenuator setting changes as described above when "Mech Atten" on page 1242 is in Auto, but no changes are made to the actual attenuator hardware setting until the input is changed back to the RF Input For CXA-m with option FSA (Fine-Step Attenuator or 2 dB steps), the FSA-like behavior is only available when the frequency setting is <= 7.5 GHz. So, when the frequency is changed from below 7.5 GHz to above 7.5 GHz, the attenuation setting will be changed to a multiple of 10 dB which will be no smaller than the previous setting. For example, 4 dB attenuation will be changed to 10 dB
Preset	The preset for Mech Attenuation is “Auto” The Auto value of attenuation is 10 dB `ON`
State Saved	Saved in instrument state
Min	0 dB The attenuation set by this control cannot be decreased below 6 dB with the knob or step keys. Values below 6 dB must be directly entered from the keypad or via SCPI. This protects against setting a dangerously small attenuation value, which can put the instrument at risk of damage to input circuitry. If the current mechanical attenuation is below 6 dB, it can be increased with the knob and step keys, but not decreased
Max	CXA Option 503 or 507: 50 dB EXA: 60 dB All other models: 70 dB Note that in the Single-Attenuator configuration, the total of ATT and EATT cannot exceed 50 dB. So, if the EATT is set to 24 dB first, the main attenuation cannot be greater than 26 dB and will be reduced accordingly; if the main attenuator is set to 40 dB first, EATT cannot be greater than 10 dB
Annotation	The current value for Total Atten is displayed in the Measurement Bar at the top of the display. A value appears for Electronic Attenuation only if the Electronic Attenuator is enabled. The annotation appears as Atten: <total> dB (e<elec>) The e letter is in amber in Single-Attenuator configurations For example:

Dual-Attenuator configuration:

Atten: 24 dB (e14)

Indicating the total attenuation is at 24 dB and the electronic attenuation is at 14 dB

Single-Attenuator configuration:

A: 24 dB (e14)

Indicating the total attenuation is at 24 dB and the “soft” attenuation is at 14 dB (see below for definition of “soft” attenuation)

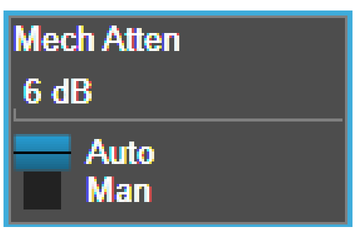
When in Manual, a # sign appears in front of Atten in the annotation

Attenuator Configurations and Auto/Man

As described under "Y Scale" on page 1929, there are two distinct attenuator configurations available in the X-Series, the single attenuator and Dual-Attenuator configurations. In Dual-Attenuator configurations, we have the mechanical attenuation and the electronic attenuation, and the current total attenuation is the sum of the electronic + mechanical attenuation. In Single-Attenuator configurations, we refer to the attenuation set using "Mech Atten" on page 1242 (or `:POW:ATT`) as the “main” attenuation; and the attenuation that is set by `:POW:EATT` as the “soft” attenuation (`:POW:EATT` is honored even in the Single-Attenuator configuration, for compatibility purposes). Then the current total attenuation is the sum of the main + soft attenuation.

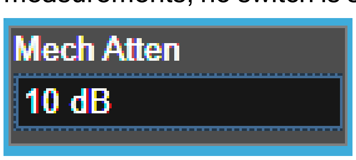
See "Elec Atten" on page 1937 for more about “soft” attenuation.

NOTE In some measurements, the **Mech Atten** control has an Auto/Man function. In these measurements, an Auto/Man switch is shown on the **Mech Atten** control:



Note that in configurations that include an Electronic Attenuator, this switch is only shown when the Electronic Attenuator is disabled.

In other measurements, **Mech Atten** has no Auto/Man function. In these measurements, no switch is shown on the **Mech Atten** control:



Mech Atten also appears with no switch, as above, in configurations that include an Electronic Attenuator but when the Electronic Attenuator is enabled.

Elec Atten

Controls the Electronic Attenuator in Dual-Attenuator configurations. Does not appear in Single-Attenuator configurations, because the control of both the mechanical and electronic stages of the Single-Attenuator is integrated into the single **Atten** control.

This control includes an **Enable/Disable** toggle switch; it is only possible to enter a value for the Electronic Attenuator when this switch is in the **Enable** position.

For more details about the Electronic Attenuator, see "More Information" on page 1246

Remote Command	`[:SENSe]:POWer[:RF]:EATTenuation <rel_ampl>`
	`[:SENSe]:POWer[:RF]:EATTenuation?`
	`[:SENSe]:POWer[:RF]:EATTenuation:STATe OFF | ON | 0 | 1`
	`[:SENSe]:POWer[:RF]:EATTenuation:STATe?`

Example	`:POW:EATT 10`
	`:POW:EATT?`
	`:POW:EATT:STAT ON`
	`:POW:EATT:STAT?`

Notes	Electronic Attenuation's specification is defined only when Mechanical Attenuation is 6 dB
Dependencies	Only appears in Dual-Attenuator models with an Electronic Attenuator installed and licensed. Does not appear in models with the Single-Attenuator configuration, because in the Single-Attenuator configuration there is no "electronic attenuator"; there is only a single integrated attenuator (which has both a mechanical and electronic stage). However, in the Single-Attenuator configuration, EATT SCPI commands are accepted for compatibility with other X-series instruments, and set a "soft" attenuation. The "soft" attenuation is treated as an addition to the "main" attenuation value set by the **Attenuation** control or `:POW:ATT`, and affects the total attenuation displayed on the **Attenuation** control and the Meas Bar The electronic attenuator, and the "soft" attenuation function provided in Single-Attenuator configurations, are unavailable above the low band (0-3.6 GHz, 0-3.4 GHz, 0-3 GHz, depending on the model). If the low band range is from 0-3.6 GHz, and Stop Frequency of the instrument is > 3.6 GHz, then the **Enabled/Disabled** section of the **Elec Atten** control will be `OFF` and grayed-out If "Internal Preamp" on page 1959 is `ON` (that is, set to Low Band or Full), the electronic attenuator (and the "soft" attenuation function provided in Single-Attenuator configurations) is unavailable. In this case the **Enabled/Disabled** section of the **Elec Atten** control will be `OFF` and grayed-out If either of the above is true, and the SCPI command is sent, an error indicating that the electronic attenuator is unavailable is returned If both the above are true, pressing the control generates error message -221, in other words, the frequency range lockout takes precedence If the electronic/soft Attenuator is enabled, then the **Stop Freq** of the instrument is limited to 3.6 GHz and **Internal Preamp** is unavailable

	If "LNA" on page 1960 is ON, the electronic attenuator (and the "soft" attenuation function provided in Single-Attenuator configurations) is unavailable. In this case the **Enabled/Disabled** section of the **Elec Atten** control will be OFF and grayed-out. This coupling works in the following modes/measurements: – Channel Power, Occupied BW, ACP, SEM, Spurious Emissions, Power Stat CCDF measurements in all Modes – Transmit On|Off Power measurement in 5GNR Mode – Power vs. Time and Transmit Power measurement in GSM/EDGE Mode – Burst Power measurement in Spectrum Analyzer Mode The SCPI-only "soft" electronic attenuation for the single-attenuator configuration is not available in all measurements; in particular, it is not available in the Swept SA measurement
Couplings	Enabling and disabling the Electronic Attenuator affects the setting of the Mechanical Attenuator (in Dual-Attenuator configurations). This is described in more detail below and in "Mechanical Attenuator Transition Rules" on page 1246
Preset	0 dB OFF (Disabled) for Swept SA measurement ON (Enabled) for all other measurements that support the electronic attenuator
State Saved	Saved in instrument state
Min	0 dB
Max	Dual-Attenuator configuration: 24 dB Single-Attenuator configuration: the total of ATT and EATT cannot exceed 50 dB. So, if the EATT is set to 24 dB first, the main attenuation cannot be greater than 26 dB and will be reduced accordingly; if the main attenuator is set to 40 dB first, EATT cannot be greater than 10 dB
Annotation	See Annotation under the **Mech Atten** control description

More Information

The electronic attenuator offers finer steps than the mechanical attenuator, has no acoustical noise, is faster, and is less subject to wear. These advantages primarily aid in remote operation and are negligible for front panel use. See "Using the Electronic Attenuator: Pros and Cons" on page 1247 for a detailed discussion of the pros and cons of using the electronic attenuator.

For the Single-Attenuator configuration, for SCPI backwards compatibility, the "soft" attenuation feature replaces the Dual-Attenuator configuration's electronic attenuator. All the same couplings and limitations apply. See "Attenuator Configurations and Auto/Man" on page 1937

Mechanical Attenuator Transition Rules

When the Electronic Attenuator is enabled, the Mechanical Attenuator transitions to a state that has no Auto function. Below are the rules for transitioning the Mechanical Attenuator. Note that the information below *only* applies to the Dual-

Attenuator configurations, and *only* when the Electronic Attenuator is installed:

When the Electronic Attenuation is enabled from a disabled state:

- The Mechanical Attenuator is initialized to 10 dB (this is its optimal performance setting). You can then set it as desired with SCPI, numeric keypad, step keys, or knob, and it behaves as it normally would in manual mode
- The Auto/Man state of (Mech) Atten is saved
- The Auto/Man toggle on the (Mech) Atten control disappears, and the auto rules are disabled
- The Electronic Attenuator is set to 10 dB less than the previous value of the Mechanical Attenuator, within the limitation that it must stay within the range of 0 to 24 dB of attenuation

Examples in the Dual-Attenuator configuration:

- Mech Atten at 20 dB. Elec Atten enabled, Mech Atten set to 10 dB, and Elec Atten set to 10 dB. New total attenuation equals the value before Elec Atten enabled
- Mech Atten at 0 dB. Elec Atten enabled, Mech Atten set to 10 dB, and Elec Atten set to 0 dB. New total attenuation does not equal the value before Elec Atten enabled
- Mech Atten at 40 dB. Elec Atten enabled, Mech Atten set to 10 dB, and Elec Atten set to 24 dB. New total attenuation does not equal the value before Elec Atten enabled

When the Electronic Attenuation is disabled from an enabled state:

- The Elec Atten control is grayed out
- The Auto/Man state of (Mech) Atten is restored
- If now in Auto, (Mech) Atten recouples
- If now in Man, (Mech) Atten is set to the value of total attenuation that existed before the Elec Atten was disabled. The resulting value is rounded up to the smallest value possible given the (Mech) Atten Step setting - (That is, 57 dB changes to 58 dB when (Mech) Atten Step is 2 dB)

Using the Electronic Attenuator: Pros and Cons

The electronic attenuator offers finer steps than the mechanical attenuator, has no acoustical noise, is faster, and is less subject to wear.

The “finer steps” advantage of the electronic attenuator is beneficial in optimizing the alignment of the instrument dynamic range to the signal power in the front panel as well as remote use. Thus, you can achieve improved relative signal measurement accuracy. Compared to a mechanical attenuator with 2 dB steps, the 1 dB resolution of the electronic attenuator only gives better resolution when the odd-decibel steps are used. Those odd-decibel steps are less accurately calibrated than the even-decibel steps, so one tradeoff for this superior relative accuracy is reduced absolute amplitude accuracy.

Another disadvantage of the electronic attenuator is that the spectrum analyzer loses its “Auto” setting, making operation less convenient.

Also, the relationship between the dynamic range specifications (TOI, SHI, compression, and noise) and instrument performance are less well-known with the electrical attenuator. With the mechanical attenuator, TOI, SHI, and compression threshold levels increase dB-for-dB with increasing attenuation, and the noise floor does as well. With the electronic attenuator, there is an excess attenuation of about 1 to 3 dB between 0 and 3.6 GHz, making the effective TOI, SHI, and so forth, less well known. Excess attenuation is the actual attenuation relative to stated attenuation. Excess attenuation is accounted for in the instrument calibration.

Adjust Atten for Min Clipping

Sets the combination of mechanical and electronic attenuation and gain based on the current measured signal level so that clipping will be at a minimum.

This is an immediate action function, that is, it executes once, when the control is pressed.

The algorithms that are used for the adjustment are documented under "Pre-Adjust for Min Clipping" on page 1942.

Remote Command	`[:SENSe]:POWer[:RF]:RANGe:OPTimize IMMediate`
Example	`:POW:RANG:OPT IMM`
Notes	Executing **Adjust Atten for Min Clipping** initiates the measurement
Dependencies	Does not appear in the Swept SA, RTSA, Monitor Spectrum and Complex Spectrum measurements Appears in the Waveform measurement in 5G NR Mode only

Adjust Atten

Allows you to select;

- Electric attenuator only
- Combination of Electric attenuator and Mechanical attenuator

when [:SENSe]:POWer[:RF]:RANGe:OPTimize IMMediate is executed.

Remote Command	[:SENSe]:POWer[:RF]:RANGe:OPTimize:TYPE EONLy | COMBined [:SENSe]:POWer[:RF]:RANGe:OPTimize:TYPE?
Example	:POW:RANG:OPT:TYPE EONL :POW:RANG:OPT:TYPE?
Dependencies	Does not appear in the Swept SA, RTSA, Monitor Spectrum and Complex Spectrum measurements Appears in the Waveform measurement in 5G NR Mode only
Preset	COMBined
State Saved	Saved in instrument state

Pre-Adjust for Min Clipping

If this function is ON, it applies the adjustment described under "Adjust Atten for Min Clipping" on page 1941 each time a measurement restarts. Therefore, in Continuous measurement mode, it only executes before the first measurement.

In Dual-Attenuator models, you can set **Elec+Mech Atten**, in which case both attenuators participate in the autoranging, or **Elec Atten Only**, in which case the mechanical attenuator does not participate in the autoranging. This latter case results in less wear on the mechanical attenuator and is usually faster.

See "Adjustment Algorithm" on page 1250

Selection	SCPI	Note
Off	OFF	This is the default setting
On	ON	Available in Single-Attenuator instruments. For compatibility with models that do not have an input attenuator, the ON parameter is supported and mapped to COMBined
Elec Atten Only	ELECtrical	Selects only the electric attenuator to participate in auto ranging. This offers less wear on the mechanical attenuator and is usually faster
Elec+Mech Atten	COMBined	In Dual-Attenuator models, this selects both attenuators to participate in the autoranging

Remote Command	[:SENSe]:POWer[:RF]:RANGe:OPTimize:ATTenuation OFF | ON | ELECtrical | COMBined [:SENSe]:POWer[:RF]:RANGe:OPTimize:ATTenuation?
Example	:POW:RANG:OPT:ATT OFF :POW:RANG:OPT:ATT?
Notes	The parameter option ELECtrical sets this function to ON in Single-Attenuator models The parameter option COMBined is mapped to ELECtrical in Single-Attenuator models. If you send COMBined, it sets the function to ON and returns ELEC to a query

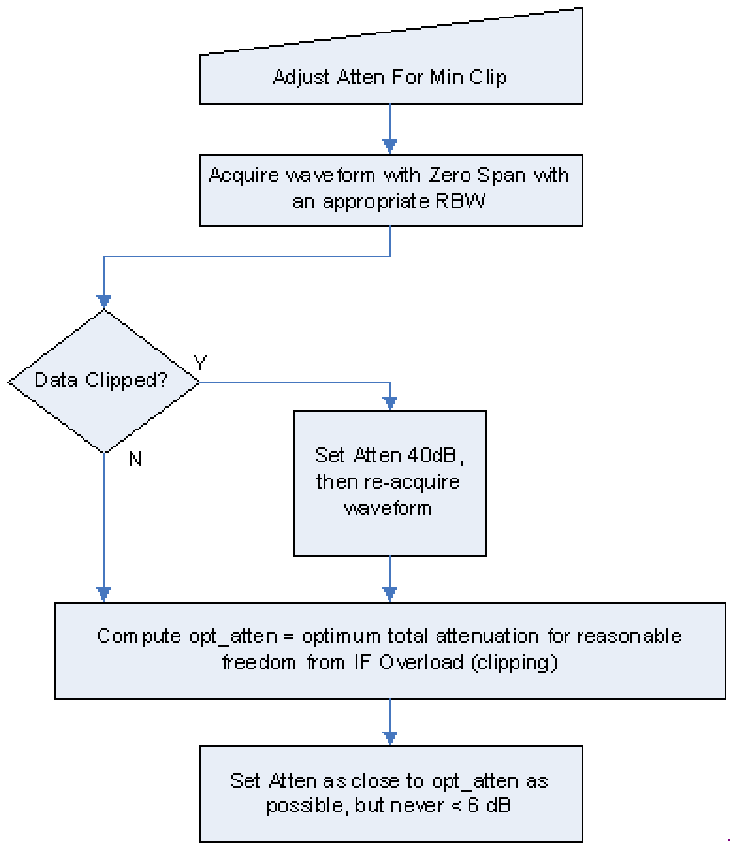
	For SCPI compatibility with models that do not have an input attenuator, the ON parameter is honored and mapped to COMBined
Dependencies	Only appears in Dual-Attenuator models with an Electronic Attenuator installed In instruments with Dual-Attenuator model, when "Elec Atten" on page 1937 is OFF or grayed-out, "Pre-Adjust for Min Clipping" on page 1249 is grayed-out Does not appear in the Swept SA, RTSA, Monitor Spectrum and Complex Spectrum measurements For the Waveform measurement, available only in 5G NR Mode
Preset	OFF when Elec Atten is Disabled at preset, otherwise ELEC
State Saved	Saved in instrument state
Range	Dual-Attenuator models: Off | Elec Atten Only | Mech + Elec Atten Single-Attenuator models: Off | On

Notes	ON aliases to "Elec Atten Only" (:POW:RANG:OPT:ATT ELEC) OFF aliases to "Off" (:POW:RANG:OPT:ATT OFF) :POW:RANG:AUTO? returns true if :POW:RANG:OPT:ATT is not OFF
Backwards Compatibility SCPI	[:SENSe]:POWer[:RF]:RANGe:AUTO ON | OFF | 1 | 0 [:SENSe]:POWer[:RF]:RANGe:AUTO?

Adjustment Algorithm

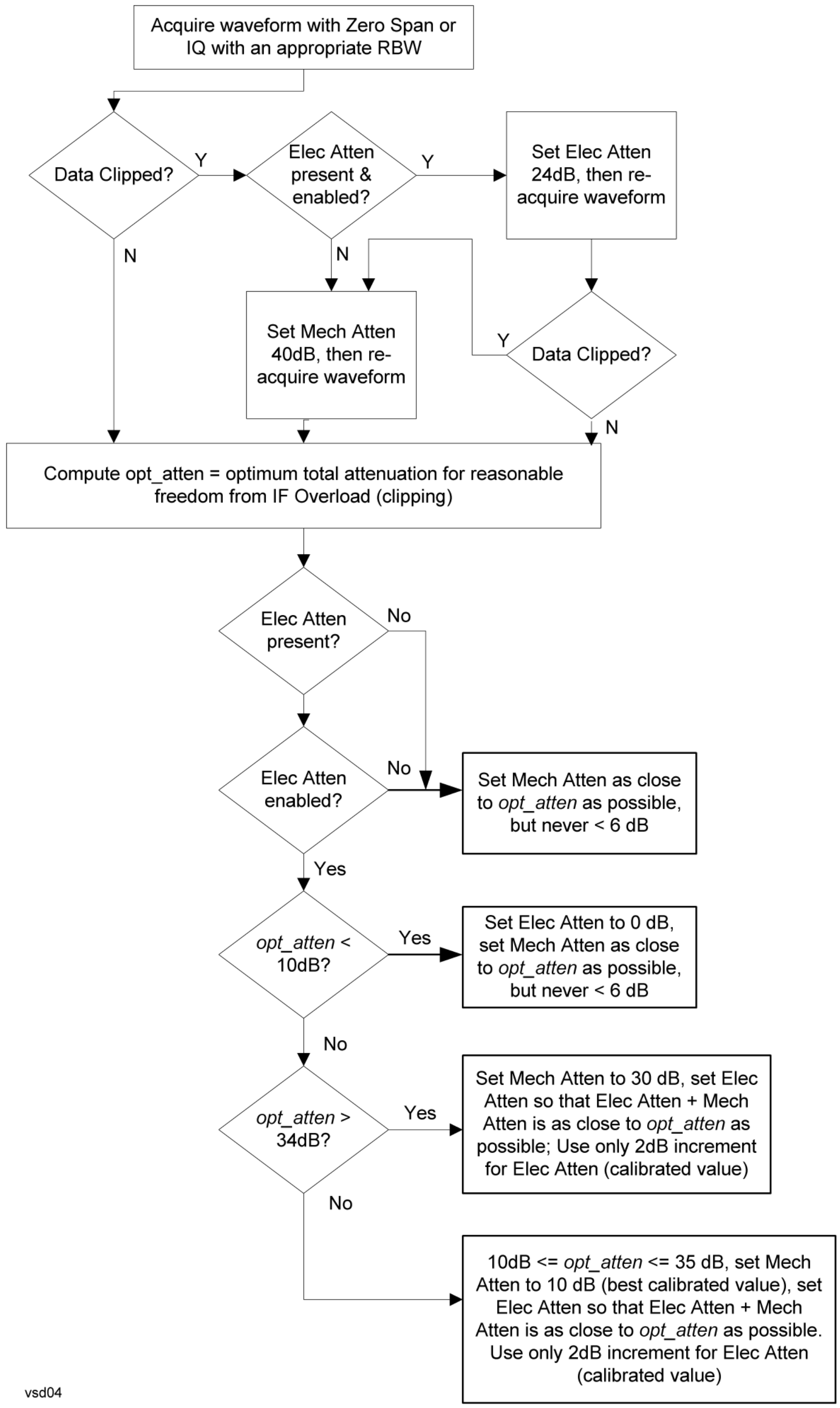
The algorithms for the adjustment are documented below:

Single-Attenuator Models



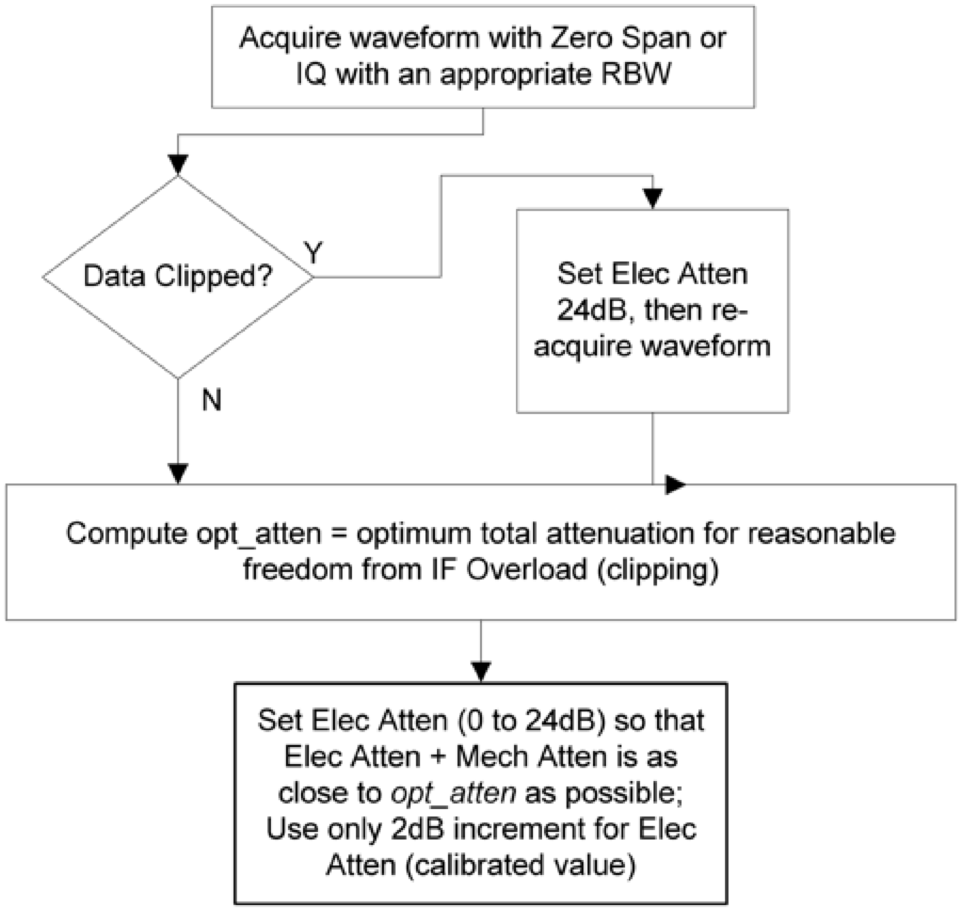
Dual-Attenuator models

"Adjust Atten for Min Clipping" on page 1941 or "Pre-Adjust for Min Clipping" on page 1249 selection is Mech + Elec Atten:


Acquire waveform with Zero Span or IQ with an appropriate RBW
Data Clipped?
Y
N
Elec Atten present & enabled?
Y
N
Set Elec Atten 24dB, then re-acquire waveform
Set Mech Atten 40dB, then re-acquire waveform
Y
Data Clipped?
N
Compute opt_atten = optimum total attenuation for reasonable freedom from IF Overload (clipping)
Elec Atten present?
No
Elec Atten enabled?
No
Set Mech Atten as close to opt_atten as possible, but never < 6 dB
Yes
opt_atten < 10dB?
Yes
Set Elec Atten to 0 dB, set Mech Atten as close to opt_atten as possible, but never < 6 dB
No
opt_atten > 34dB?
Yes
Set Mech Atten to 30 dB, set Elec Atten so that Elec Atten + Mech Atten is as close to opt_atten as possible; Use only 2dB increment for Elec Atten (calibrated value)
No
10dB <= opt_atten <= 35 dB, set Mech Atten to 10 dB (best calibrated value), set Elec Atten so that Elec Atten + Mech Atten is as close to opt_atten as possible. Use only 2dB increment for Elec Atten (calibrated value)
vsd04

"Pre-Adjust for Min Clipping" on page 1249 selection is Elec Only.

Note that the **Mech Atten** value is not adjusted, and the value previously set is used. Therefore, there is a case that IF Overload is still observed depending on the input signal level and the Mech Atten setting.



Mech Atten Step

Controls the step size used when making adjustments to the input attenuation.

Labeled **Mech Atten Step** in Dual-Attenuator models and **Atten Step** in Single-Attenuator models. In the Dual-Attenuator configuration, only affects the step size of the mechanical attenuator.

Remote Command	`[:SENSe]:POWer[:RF]:ATTenuation:STEP[:INCRement] 10 dB | 2 dB`

	`[:SENSe]:POWer[:RF]:ATTenuation:STEP[:INCRement]?`
Example	`:POW:ATT:STEP 2` `:POW:ATT:STEP?`
Notes	Has a toggle control on the front panel, but takes a specific value (in dB) when used remotely. The only valid values are 2 and 10
Dependencies	Blanked in EXA, CXA and CXA-m if option FSA (2 dB steps) is not present. If blanked, attempts to set it via SCPI yield an error
Couplings	When the attenuation step size changes, the current mechanical attenuation value is adjusted (if necessary) to be quantized to the new step size. That is, if step is set to 10 dB, mech atten is increased if necessary so it is a multiple of 10 dB
Preset	EXA, CXA and CXA-m: 10 dB (2 dB with option FSA) All other models: 2 dB
State Saved	Saved in instrument state

3.7.3.3 Range (Baseband Input models)

Only available when Option BBA is present (I/Q Baseband Inputs), the current measurement supports option BBA, and I/Q is the selected input. In these cases, replaces the **Attenuation** tab.

Each input channel (I and Q) has four internal gain ranges. The maximum allowed voltage in each gain range is slightly more than the nominal value, so the break point between ranges is a few millivolts higher than the nominal (setting a peak voltage of 0.502 mV will still map to the 0.5 V Peak range).

Gain Setting	Volts RMS	Volts Peak	Volts Peak - Peak	dBm (50Ω)	Break Point
0 dB	0.7071	1.0	2.0	10	n/a
6 dB	0.3536	0.5	1.0	4	0.502 V Peak
12 dB	0.1768	0.25	0.5	-2	0.252 V Peak
18 dB	0.0884	0.125	0.25	-8	0.127 V Peak

Dependencies	Available only when the selected input is I/Q. If the current measurement does not support baseband inputs, an error will be displayed: “No result; Meas invalid with I/Q inputs”
State Saved	No

Range Auto/Man

The **Auto** setting for **Range** causes the range to be set based on the Y Scale settings. When **Range** is **Auto**, the I & Q Range are set based on the top of the Y Scale when the Y scale is in dB units (for example, power), or to the max(abs(top), abs(bottom)) when the Y scale reference is not at the top of the screen.

Not all measurements support **Range Auto/Man**. If **Auto** is not supported in the current measurement, this control is grayed-out, displaying **Man**, and MAN is returned to a SCPI query, but this does *not* change the Auto/Man setting for **Range**. When you switch to a measurement that supports **Auto**, it goes back to **Auto** if it was previously in **Auto** mode.

Remote Command	`[:SENSe]:VOLTage:IQ:RANGe:AUTO OFF | ON | 0 | 1` `[:SENSe]:VOLTage:IQ:RANGe:AUTO?`

Example	Put the I Range and Q Range in manual
	`:VOLT:IQ:RANG:AUTO OFF`
	`:VOLT:IQ:RANG:AUTO?`

Dependencies	If **Auto** is not supported, sending the SCPI command generates an error
Couplings	When in **Auto**, both I Range and Q Range are set to the same value, computed as follows: Maximum absolute value is computed for the Y Scale. The top and bottom of the graph are computed based on Ref Value, Scale/Div, and Ref Position. Formula: YMax = max(abs(top), abs(bottom)) The I Range and Q Range are then set to YMax
Preset	ON
State Saved	Saved in instrument state
Annotation	When in Man, the Range annotation is preceded by "#"

This is an alternate form of the command to match the POWer form of the I Range and Q Range SCPI.

Remote Command	`[:SENSe]:POWer:IQ:RANGe:AUTO OFF | ON | 0 | 1` `[:SENSe]:POWer:IQ:RANGe:AUTO?`

Example	Put the I Range and Q Range in manual
	`:POW:IQ:RANG:AUTO OFF`
	`:POW:IQ:RANG:AUTO?`

Notes	`:POW:IQ:RANG:AUTO` is an alternate form of `:VOLT:IQ:RANG:AUTO`, to maintain consistency with I Range and Q Range, which support both the POWer and VOLTage forms of the command
Preset	ON
Range	Auto | Man

I Range

The internal gain range for the I channel when the Input Path is I Only or I and I/Q. Used for both the I and Q channels when the Input Path is I+jQ.

Remote Command	`[:SENSe]:VOLTage:IQ[:I]:RANGe[:UPPer] <voltage>` `[:SENSe]:VOLTage:IQ[:I]:RANGe[:UPPer]?`
Example	Set the I Range to 0.5 V Peak `:VOLT:IQ:RANG 0.5 V`

	:VOLT:IQ:RANG?
Notes	The numeric entries are mapped to the smallest gain range whose break point is greater than or equal to the value, or 1 V Peak if the value is greater than 1 V
Couplings	When "Q Same as I" on page 1953 is On, the **I Range** value will be copied to "Q Range" on page 1951 Changing the value also sets Range = Man
Preset	Complex SPECtrum Measurement: 0.5 V Peak All others: 1 V Peak
State Saved	Saved in instrument state
Range	1 V Peak (10 dBm @ 50 Ω) | 0.5 V Peak (4 dBm @ 50Ω) | 0.25 V Peak (-2 dBm @ 50Ω) | 0.125 V Peak (-8 dBm @ 50Ω)
Min	0.125 V
Max	1 V
Annotation	The Range annotation replaces the RF Input context's "Atten" annotation "Rng: <I Range>". When Range = Man the annotation is preceded by "#" The I Range is not annotated in Input Path Q Only. When I Range and Q Range are the same, the annotation is "Rng: <Range>". When I Range and Q Range are different and the Input Path is Ind I/Q, the annotation is "Rng: <I Range>, <Q Range>" and "Peak" is removed from the text. Examples: "Rng: 1 V Peak" the I Range is 1 V Peak "Rng: 1 V, 0.5 V " the I Range is 1 V Peak and the Q Range is 0.5 V Peak

This is an alternate form of the command to allow entry as a power.

Remote Command	[:SENSe]:POWer:IQ[:I]:RANGe[:UPPer] <ampl> [:SENSe]:POWer:IQ[:I]:RANGe[:UPPer]?
Example	Set the I Range to 0.5 V Peak when Reference Z is 50 Ω, and to 1.0 V Peak when Reference Z is 75 **Ω** :POW:IQ:RANG 4 dBm :POW:IQ:RANG?
Notes	The POWer form of the command is provided for convenience. It maps to the same underlying gain range parameter as the VOLTage form The Reference Z (not the I channel Input Z) is used to convert the power to peak voltage, which is then used to set the I Range as with the VOLTage form of the command. The power values of the 4 range states (1V Peak, 0.5V Peak, 0.25V Peak, and 0.125V Peak) will vary with Reference Z. Here are some examples: 50 Ω: 10, 4, -2, -8 75 Ω: 8.2, 2.2, -3.8, -9.8 600 Ω: -0.8, -6.8, -12.8, -18.9
Preset	10.0 dBm
Range	-20 dBm to 10 dBm
Min	-20 dBm
Max	10 dBm

Q Range

The internal gain range for the Q channel. **Q Range** only applies to Input Path Q Only and Ind I/Q. For input I+jQ "I Range" on page 1950 determines both I and Q channel range settings.

Remote Command	`[:SENSe]:VOLTage:IQ:Q:RANGe[:UPPer] <voltage>` `[:SENSe]:VOLTage:IQ:Q:RANGe[:UPPer]?`

Example	Set the Q Range to 0.5 V Peak:
	`:VOLT:IQ:Q:RANG 0.5 V`
	`:VOLT:IQ:Q:RANG?`

Notes	The numeric entries are mapped to the smallest gain range whose break point is greater than or equal to the value, or 1 V Peak if the value is greater than 1 V **Q Range** is only used for Input Path Q Only and Ind I/Q. For input I+jQ, "I Range" on page 1950 determines both I and Q channel range settings
Couplings	When "Q Same as I" on page 1953 is On, the "I Range" on page 1950 value is copied to **Q Range** and the range value keys are disabled Changing the value also sets Range = Man
Preset	1 V Peak
State Saved	Saved in instrument state
Range	1 V Peak (10 dBm @ 50Ω) | 0.5 V Peak (4 dBm @ 50Ω) | 0.25 V Peak (-2 dBm @ 50Ω) | 0.125 V Peak (-8 dBm @ 50Ω)
Min	0.125 V
Max	1 V
Annotation	The Range annotation replaces the RF Input context's "Atten" annotation "Rng: <Q Range>". When Range = Man the annotation is preceded by "#" The Q Range is not annotated in Input Path I Only or I+jQ. When I Range and Q Range are the same, the annotation is "Rng: <Range>". When I Range and Q Range are different and the Input Path is Ind I/Q, the annotation is "Rng: <I Range>, <Q Range>" and "Peak" is removed from the text. Examples: "Rng: 1 V Peak" the Q Range is 1 V Peak "Rng: 1 V, 0.5 V " the I Range is 1 V Peak and the Q Range is 0.5 V Peak

This is an alternate form of the command to allow entry as a power.

Remote Command	`[:SENSe]:POWer:IQ:Q:RANGe[:UPPer] <ampl>` `[:SENSe]:POWer:IQ:Q:RANGe[:UPPer]?`

Example	Sets the Q Range to 0.5 V Peak when Reference Z is 50 Ω, and to 1.0 V Peak when Reference Z is 75 Ω:
	`:POW:IQ:Q:RANG 4 dBm`
	`:POW:IQ:Q:RANG?`

Notes	The `POWer` form of the command is provided for convenience. It maps to the same underlying gain range parameter as the `VOLTage` form of the command

	The Reference Z (not the Q channel Input Z) is used to convert the power to peak voltage, which is then used to set the Q Range as with the VOLTage form of the command. The power values of the 4 range states (1V Peak, 0.5V Peak, 0.25V Peak, and 0.125V Peak) will vary with Reference Z. Here are some examples: 50 Ω: 10, 4, -2, -8 75 Ω: 8.2, 2.2, -3.8, -9.8 600 Ω: -0.8, -6.8, -12.8, -18.9
Preset	10.0 dBm
Range	-20 dBm to 10 dBm
Min	-20 dBm
Max	10 dBm

Q Same as I

Many, but not all, usages require the I and Q channels to have an identical setup. To simplify channel setup, **Q Same as I** causes the Q channel range to be mirrored from the I channel. That way, you only need to set up one channel (the I channel). The I channel values are copied to the Q channel, so at the time **Q Same as I** is Off, the I and Q channel setups will be identical.

Remote Command	`[:SENSe]:VOLTage|POWer:IQ:MIRRored OFF | ON | 0 | 1` `[:SENSe]:VOLTage|POWer:IQ:MIRRored?`

Example	Turn off the mirroring of I Range to Q Range
	`:VOLT:IQ:MIRR OFF`
	`:POW:IQ:MIRR OFF`

Couplings	When ON, the "I Range" on page 1950 value is mirrored (copied) to the "Q Range" on page 1951
Preset	ON
State Saved	Saved in instrument state
Range	OFF | ON

3.7.3.4 Range (Non-attenuator models)

Only available for Keysight's modular signal analyzers and certain other Keysight products, such as VXT

State Saved	No

Range

Represents the amplitude of the largest sinusoidal signal that could be present within the IF without being clipped by the ADC. For signals with high peak-to-average ratios, the range may need to exceed the rms signal power by a significant amount to avoid clipping.

This is a measurement global setting.

Remote Command	`[:SENSe]:POWer[:RF]:RANGe <real>` `[:SENSe]:POWer[:RF]:RANGe?`
Example	`:POW:RANG 10 dBm` `:POW:RANG?`
Notes	The MIN and MAX values are affected by the External Gain parameters, and by the **Center Frequency** The hardware compensates for frequency response and alters the Range setting
Preset	0 dBm
State Saved	Yes
Min	-100
Max	100
Annotation	Meas Bar

Adjust Range for Min Clipping

Sets the combination of attenuation and gain based on the current measured signal level so that clipping will be at a minimum.

This is an "immediate action" function, that is, it executes once, when the key is pressed.

This key does not appear in measurements that do not support this functionality.

Remote Command	`[:SENSe]:POWer[:RF]:RANGe:OPTimize IMMediate`
Notes	Executing Adjust Range for Min Clipping initiates the measurement
Dependencies	Does not appear in the Swept SA and Monitor Spectrum measurements

Pre-Adjust for Min Clipping

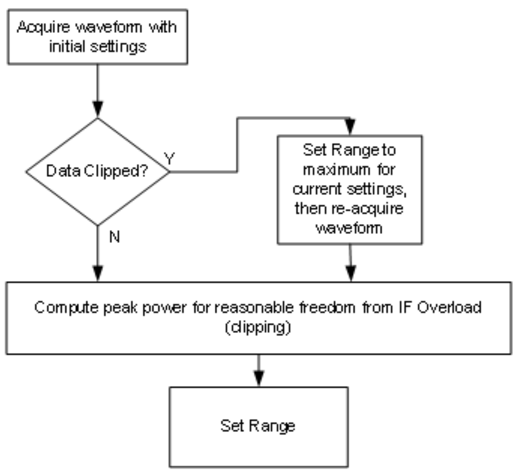
If this function is ON, it applies the adjustment described under Adjust Range For Min Clipping each time a measurement restarts. Therefore, in Continuous measurement mode, it only executes before the first measurement.

Remote Command	`[:SENSe]:POWer[:RF]:RANGe:OPTimize:ATTenuation OFF | ON | ELECtrical |`

	COMBined [:SENSe]:POWer[:RF]:RANGe:OPTimize:ATTenuation?
Notes	Because there is no attenuator control available in these models, the control displays only ON and OFF choices. However, for SCPI compatibility with other platforms, all three parameters (ELECtrical, COMBined, and ON) are honored and all are mapped to ELECtrical, so if any of these three parameters is sent, a subsequent query will return ELEC
Dependencies	Does not appear in the Swept SA and Monitor Spectrum measurements
Preset	OFF for Swept SA measurement; ON for all other measurements that support **Pre-Adjust for Min Clipping**
State Saved	Saved in instrument state

Adjustment Algorithm

The algorithm for the adjustment is documented below:



Peak-to-Average Ratio

Used with "Range (Non-attenuator models)" on page 1953 to optimize the level control in the instrument. The value is the ratio, in dB, of the peak power to the average power of the signal to be measured. A ratio of 0 should be used for sinusoidal signals; for 802.11g OFDM signals use 9 dB.

All Modes show the current value of Peak-to-Average ratio on the control. However, some Modes do not permit changing the value. In these situations, the control is grayed-out.

Remote Command	[:SENSe]:POWer[:RF]:RANGe:PARatio <real> [:SENSe]:POWer[:RF]:RANGe:PARatio?

Example	`:POW:RANG:PAR 12 dB`
Notes	In some Modes, this parameter is read-only; meaning the value will appear on the control and query via SCPI, but is not changeable. In such applications the control is grayed-out. Attempting to change the value via SCPI will be ignored but no error message will be generated
Dependencies	Does not appear in Spectrum Analyzer Mode
Preset	10 dB VXT Models M9410A/11A: 0 dB
State Saved	Saved in instrument state
Min	0 dB
Max	20 dB VXT Models M9410A/11A: 50 dB

Mixer Lvl Offset

This is an advanced setting to adjust target Range at the input mixer, which in turn affects the signal level in the instrument's IF. This setting can be used when additional optimization is needed after setting "Peak-to-Average Ratio" on page 1955. Positive values of offset optimize noise performance over distortion, negative values optimize distortion performance over noise.

Remote Command	`[:SENSe]:POWer[:RF]:RANGe:MIXer:OFFSet <real>` `[:SENSe]:POWer[:RF]:RANGe:MIXer:OFFSet?`
Example	`:POW:RANG:MIX:OFFS -5 dB`
Preset	0 dB
State Saved	Saved in instrument state
Min	-35 dB VXT Models M9410A/11A: -34 dB
Max	30 dB

3.7.3.5 Signal Path

Contains controls that pertain to the routing of the signal through the frontend of the instrument.

In general, only appears in instruments whose hardware supports this signal routing. For example, this tab does not appear in many of the modular instrument products, including VXT Model M9421A, or UXM.

This tab *does* appear in VXT Models M9410A/11A, because "Software Preselection" on page 1971 is under this tab, and VXT Models M9410A/11A implement a version of Software Preselection.

Presel Center

Adjusts the centering of the preselector filter to optimize the amplitude accuracy at the frequency of the selected marker. If the selected marker is not on when **Presel Center** is pressed, the instrument turns on the selected marker, performs a peak search, and then performs centering on the marker's center frequency. If the selected marker is already on and between the start and stop frequencies of the instrument, the instrument performs the preselector calibration on that marker's frequency. If the selected marker is already on, but outside the frequency range between **Start Freq** and **Stop Freq**, the instrument first performs a peak search, and then performs centering on the marker's center frequency.

The value displayed on "Preselector Adjust" on page 1958 changes to reflect the new preselector tuning.

Certain considerations should be observed to ensure proper operation, as detailed in "Proper Preselector Operation" on page 1263.

Remote Command	`[:SENSe]:POWer[:RF]:PCENter`
Example	`:POW:PCEN`
Notes	The rules outlined above under the control description apply for the remote command as well as the key. The result of the command depends on marker position, etc. Any message generated by the control press is also generated in response to the remote command
Dependencies	Does not appear in CXA-m, nor in VXT Models M9410A/11A Grayed-out if the microwave preselector is off – If the selected marker's frequency is below Band 1, an advisory message is generated "Preselector not used in this frequency range" and no action is taken – Grayed-out if entirely in Band 0, that is, if **Stop Freq** is below about 3.6 GHz Grayed-out if entirely above 50 GHz, that is, if **Start Freq** is above 50 GHz – Blanked in models that do not include a preselector, such as Option 503. If the remote command is sent in these instruments, accepted without error, and the query always returns 0 – Grayed-out in the Spectrogram View
Couplings	The active marker position determines where the centering will be attempted If the instrument is in a measurement such as averaging when centering is initiated, the act of centering the preselector restarts averaging, but the first average trace will not be taken until the centering is completed The offset applied to do the centering appears in "Preselector Adjust" on page 1958
Status Bits/OPC dependencies	When centering the preselector, `*OPC` does not return true until the process is complete and a subsequent measurement has completed, nor are results returned in response to `:READ` or `:MEASure` queries The `Measuring` bit remains set (true) while this command is operating, and does not go false until the subsequent sweep/measurement has completed

Proper Preselector Operation

Certain considerations should be observed to ensure proper operation:

1. If the selected marker is **Off**, the instrument turns on a marker, performs a peak search, and adjusts the preselector using the selected marker's frequency. It uses the "highest peak" peak search method unqualified by threshold or excursion, so that there is no chance of a 'no peak found' error. It continues with that peak, even if it is the peak of just noise. Therefore, for this operation to work properly, there should be a signal on-screen in a preselected range for the peak search to find
2. If the selected marker is already **On**, the instrument attempts the centering at that marker's frequency. There is no preselector for signals below about 3.6 GHz, so if the marker is on a signal below 3.6 GHz, no centering is attempted, and an advisory message is generated
3. In some models, the preselector can be bypassed. If it is bypassed, no centering is attempted in that range and a message is generated

Preselector Adjust

Lets you manually adjust the preselector filter frequency to optimize its response to the signal of interest. Only available when "Presel Center" on page 1956 is available.

For general purpose signal analysis, using **Presel Center** is recommended. Centering the filter minimizes the impact of long-term preselector drift. **Preselector Adjust** can be used instead to manually optimize the preselector. One application of manual optimization would be to peak the preselector response, which both optimizes the signal-to-noise ratio and minimizes amplitude variations due to small (short-term) preselector drifting.

When **Presel Center** is performed, the offset applied to do the centering becomes the new value of **Preselector Adjust**.

Remote Command	`[:SENSe]:POWer[:RF]:PADJust <freq>` `[:SENSe]:POWer[:RF]:PADJust?`
Example	`:POW:PADJ 100KHz` `:POW:PADJ?`
Notes	The value on the control is displayed to 0.1 MHz resolution
Dependencies	– Does not appear in CXA-m – Does not appear in VXT Models M9410A/11A – Grayed-out if microwave preselector is off – Grayed-out if entirely in Band 0, that is, if Stop Freq is lower than about 3.6 GHz

	– Grayed-out if entirely above 50 GHz, that is, if Start Freq is higher than 50 GHz – Blank in models that do not include a preselector, such as Option 503. If the command is sent in these instruments, it is accepted without error, and the query always returns 0 – Grayed-out in the Spectrogram View
Preset	0 MHz
State Saved	The **Preselector Adjust** value set by "Presel Center" on page 1956, or by manually adjusting **Preselector Adjust** Not saved in instrument state, and does not survive a Preset or power cycle
Min	-500 MHz
Max	500 MHz
Backwards Compatibility SCPI	`[:SENSe]:POWer[:RF]:MW:PADJust` `[:SENSe]:POWer[:RF]:MMW:PADJust`

Notes	The command has no effect, and the query always returns `MWAVe`
Backwards Compatibility SCPI	`[:SENSe]:POWer[:RF]:PADJust:PRESelector MWAVe | MMWave | EXTernal` `[:SENSe]:POWer[:RF]:PADJust:PRESelector?`

Internal Preamp

Accesses a menu of controls for the internal preamps. Turning on the preamp gives a better noise figure, but a poorer inter-modulation distortion (TOI) to noise floor dynamic range. You can optimize this setting for your measurement.

The instrument takes the preamp gain into account as it sweeps. If you sweep outside of the range of the preamp, the instrument will also account for that. The displayed result always reflects the correct gain.

For some measurements, when the preamp is on and any part of the displayed frequency range is below the lowest frequency for which the preamp has specifications, a warning condition message appears in the status line. For example, for a preamp with a 9 kHz lowest specified frequency: "Preamp: Accy unspec'd below 9 kHz".

Selection	Example	Note
Off	`:POW:GAIN OFF`	
Low Band	`:POW:GAIN ON` `:POW:GAIN:BAND LOW`	Sets the internal preamp to use only the low band. The frequency range of the installed (optional) low-band preamp is displayed in square brackets on the Low Band selection in the dropdown
Full Range	`:POW:GAIN ON` `:POW:GAIN:BAND`	Sets the internal preamp to use its full range. The low band (0-3.6 GHz, 0-3.4 GHz, 0-3 GHz, depending on the

Selection	Example	Note
	FULL	model) is supplied by the low band preamp and the frequencies above low band are supplied by the high band preamp The frequency range of the installed (optional) low-band preamp is displayed in square brackets on the Full Range selection in the dropdown. If the high band option is not installed the Full Range selection does not appear

NOTE The maximum **Center Frequency** for Low Band, displayed in square brackets, can change based on the selected IFBW for measurements that support IFBW (for example, Waveform measurement across all Modes that support it). In certain models (such as N9042B & N9032B), IFBW values <= 40 MHz have a maximum Low Band frequency of 3.6 GHz, while 40 MHz < IFBW <= 1 GHz have a maximum of 3.3 GHz, and 1 GHz < IFBW <= 1.5 GHz have a maximum of 3.5 GHz. IFBW values > 1.5 GHz do not support a **Center Frequency** that can reach the Low Band maximum frequency. In these cases, **N/A** is displayed in the square brackets for Low Band.

Remote Command	`[:SENSe]:POWer[:RF]:GAIN:BAND LOW | FULL`
	`[:SENSe]:POWer[:RF]:GAIN:BAND?`
	`[:SENSe]:POWer[:RF]:GAIN[:STATe] OFF | ON | 0 | 1`
	`[:SENSe]:POWer[:RF]:GAIN[:STATe]?`

Example	`:POW:GAIN:BAND LOW`
	`:POW:GAIN:BAND?`
	`:POW:GAIN OFF`
	`:POW:GAIN?`

Dependencies	Not available on all hardware platforms. If the preamp is not present or is unlicensed, this control is not shown Does not appear in VXT Models M9410A/11A/15A/16A If `:POW:GAIN:BAND FULL` is sent when a low band preamp is available, the preamp band parameter is set to `LOW` instead of `FULL`, and an "Option not installed" message is generated Not available when the electronic/soft attenuator is enabled
Preset	LOW OFF
State Saved	Saved in instrument state
Annotation	When the USB Preamp is not connected to USB, the Preamp annotation in the Meas Bar says “Off” if the preamp is off and displays the frequency range of the low band or full range preamp depending on the setting. For example, if the Preamp is set to Low Band and the Low Band is 3.6 GHz the annotation says “3.6 GHz”. If it is a 13.6 GHz preamp and it is set to Full Range the annotation says “13.6 GHz”

When the USB Preamp is connected to USB, the Preamp annotation says “Preamp: USB” if the internal preamp is off or “Preamp: USB, Int” if the internal preamp is on (only for measurements that support the USB preamp)

LNA

Lets you turn the Low Noise Amplifier (**LNA**) on or off.

LNA is an additional preamplifier that provides superior DANL and frequency range compared to "Internal Preamp" on page 1959. LNA provides lower system noise figure, especially at frequencies above 100 MHz, and can be operated up to the full range of 50 GHz instruments.

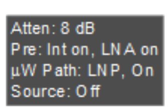
For best possible sensitivity, **LNA** can be turned on *together* with "Internal Preamp" on page 1959, although if you operate both preamps together, note that the TOI (distortion) specifications are impacted. The sensitivity improvement of this combination is substantial when operating in high band (frequencies above 3.6 GHz).

For more details about annotation, see "More Information" on page 1266

Remote Command	`[:SENSe]:POWer[:RF]:GAIN:LNA[:STATe] OFF | ON | 0 | 1` `[:SENSe]:POWer[:RF]:GAIN:LNA[:STATe]?`
Example	`:POW:GAIN:LNA ON`
Dependencies	Requires Option LNA, except for VXT models M9415A/16A Does not appear in VXT models M9421A/10A/11A May not appear in some measurements **LNA** is not available when the electronic/soft attenuator is enabled
Preset	`OFF`
State Saved	Saved in State

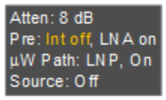
More Information

When **LNA** is installed, the preamp annotation changes to show the state of both **LNA** and **Internal Preamp**. Below is an example:



Note that when operating entirely in the low band (below about 3.6 GHz), if **LNA** is on, **Internal Preamp** is switched off (even if you have its switch set to `ON`). This is because the noise performance is actually degraded in low band if both preamps are on. In this case, the annotation reflects the actual state of the two preamps, but the

Internal Preamp annotation displays in amber, to warn you that the actual state of **Internal Preamp** does not match its switch control display:



µW Path Control

Options for this control include **µW Preselector Bypass** (Option MPB), **Low Noise Path** (Option LNP) and **Full Bypass Enable** in the High Band path circuits.

When the µW Preselector is bypassed, flatness is improved, but will be subject to spurs from out of band interfering signals. When **Low Noise Path Enable** is selected, the instrument automatically bypasses certain circuitry in the high frequency bands that can contribute to noise, when it is appropriate based on other instrument settings.

For most applications, the preset state is **Standard Path**, which provides the best remote-control throughput, minimizes acoustic noise from switching and minimizes the risk of wear in the hardware switches, particularly in remote test scenarios where both low band and high band setups will follow in rapid succession. In this path, the bypass of the low band/high band switch and microwave preamp is never activated, which can cause some noise degradation but preserves the life of the bypass switch.

For applications that utilize the wideband IF paths, the preset state is **µW Preselector Bypas**s, if option MPB is present. This is because, when using a wideband IF such as the 140 MHz IF, the µW Preselector's bandwidth can be narrower than the available IF bandwidth, causing degraded amplitude flatness and phase linearity, so it is desirable to bypass the preselector in the default case.

You may choose **Low Noise Path Enable** for a lower noise floor, especially in the 21-26.5 GHz region, though without improving many measures of dynamic range, and without giving the best possible noise floor. The preamp, if purchased and used, gives better noise floor than does **Low Noise Path Enable**, but the preamp's compression threshold and third-order intercept are much poorer than that of **Low Noise Path Enable**.

A fourth choice is **Full Bypass Enable**, which combines **µW Preselector Bypass** and **Low Noise Path Enable**. Because this can bypass most of the circuitry between the input and the first mixer, care should be taken when using this setting to avoid damaging the mixer. **Full Bypass Enable** is only available if both options LNP and MPB are present, as well as option FBP.

Path	Example	Note
Standard Path	`:POW:MW:PATH STD`	Normal setting for most measurements. µW Preselector in circuit, Low Noise Path disabled

Path	Example	Note
Low Noise Path Enable	`:POW:MW:PATH LNP`	See "Low Noise Path Enable" on page 1271
µW Preselector Bypass	`:POW:MW:PATH MPB`	See "µW Preselector Bypass" on page 1273
Full Bypass Enable	`:POW:MW:PATH FULL`	See "Full Bypass Enable" on page 1274

Remote Command	`[:SENSe]:POWer[:RF]:MW:PATH STD | LNPath | MPBypass | FULL` `[:SENSe]:POWer[:RF]:MW:PATH?`

Example	`:POW:MW:PATH LNP`
	Enables the Low Noise path
	`:POW:MW:PATH?`

Notes	If "Presel Center" on page 1956 is performed, the instrument will momentarily switch to the Standard Path, regardless of the setting of **µW Path Control** The DC Block will always be switched in when the low noise path is switched in, to protect succeeding circuitry from DC. Note that this does not mean “when the low noise path is enabled” but when, based on the Low Noise Path rules, the path is actually switched in. This can happen when the selection is **Low Noise Path Enable** or **Full Bypass Enable**. In the case where the DC Block is switched in the instrument is now AC coupled. However, if you selected DC coupling, the UI would still behave as though it were DC coupled, including all annunciation, warnings, status bits, and responses to SCPI queries. This is because, based on other settings, the instrument could switch out the low noise path at any time and hence go back to being DC coupled Alignment switching ignores the settings in this menu, and restores them when finished
Dependencies	Does not appear in CXA-m, VXT Models M9410A/11A, nor in BBIQ and External Mixing – The **Low Noise Path Enable** selection does not appear unless Option LNP is present and licensed – The **µW Preselector Bypass** selection does not appear unless Option MPB is present and licensed – The **Full Bypass Enable** selection does not appear unless options LNP and MPB are both present as well as option FBP In any of these cases, if the required options are not present and the SCPI command is sent, error -241, "Hardware missing; Option not installed" is generated **Low Noise Path Enable** and **Full Bypass Enable** are grayed-out if the current measurement does not support them **Low Noise Path Enable** and **Full Bypass Enable** are not supported in Avionics and MMR Modes (non-modulation measurements). In any of these cases (that is, the feature is not supported in either measurement or Mode), if the SCPI command is sent, the following error is generated: -221, “Setting Conflict; Feature not supported for this measurement”
Preset	(see table below)

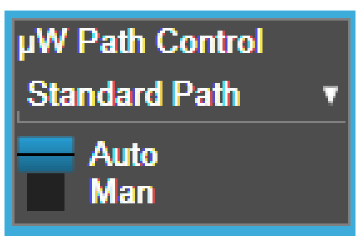
Mode	Value
IQ Analyzer	MPB option present and licensed: `MPB`
Pulse	MPB option not present and licensed: `STD`

Mode	Value
Avionics	
All other Modes	STD

State Saved	Save in instrument state
Range	Standard Path | Low Noise Path Enable | µW Presel Bypass | Full Bypass Enable
Annotation	In the Meas Bar, if the Standard path is chosen: µW Path: Standard If Low Noise Path is enabled but the LNP switch is not thrown: µW Path: LNP,Off If the Low Noise Path is enabled and the LNP switch *is* thrown: µW Path: LNP,On If the preselector is bypassed: µW Path: Bypass If Full Bypass Enable is selected but the LNP switch is not thrown: µW Path: FByp,Off If Full Bypass Enable is selected and the LNP switch *is* thrown: µW Path: FByp,On

µW Path Control Auto

In VMA, WLAN, 5G NR, CQM Modes, an **Auto/Man** switch is added to **µW Path Control**:



This allows the function to automatically switch based on certain Auto Rules as shown below:

VMA Mode

Measurement	When µW Path Control is in Auto
Digital Demod	Use Standard Path unless tuned frequency > 3.6 GHz and IFBW > 15 MHz, in which case choose Preselector Bypass
Monitor Spectrum	Always Presel Bypass
IQ Waveform	Use Standard Path unless tuned frequency > 3.6 GHz and IFBW > 15 MHz, in which case choose Preselector Bypass
Custom OFDM	Use Standard Path unless tuned frequency > 3.6 GHz and IFBW > 15 MHz, in

Measurement	When µW Path Control is in Auto
	which case choose Preselector Bypass
Channel Power	Always Presel Bypass
Occupied BW	Always Presel Bypass
CCDF	Use Standard Path unless tuned frequency > 3.6 GHz and IFBW > 15 MHz, in which case choose Preselector Bypass
ACP	Always Presel Bypass
SEM	Always Presel Bypass
Spurious Emissions	Always Standard Path

WLAN Mode

Measurement	When µW Path Control is in Auto
Modulation Analysis	Always Presel Bypass
Spectral Flatness	Always Presel Bypasss
Power vs Time	Always Presel Bypass
Monitor Spectrum	Always Presel Bypass
IQ Waveform	Always Presel Bypass
Channel Power	Always Presel Bypass
Occupied BW	Always Presel Bypass
CCDF	Always Presel Bypass
SEM	For 11be 320M, when ‘Enabled Wideband IF for FFT’ is OFF or ‘Sweep Type Rule’ is Best Dynamic Range, auto µW path is standard For other cases, auto µW path is presel bypass if presel bypass is enabled, auto µW path is standard if presel bypass is not enabled
Spurious Emissions	Always Standard Path

5G NR Mode

Measurement	When µW Path Control is in Auto
Modulation Analysis	Use Standard Path unless tuned frequency > 3.6 GHz and IFBW > 15 MHz, in which case choose Full Bypass if conditions warrant(FBP Option is available and “Allow Full Bypass in Auto” is On), otherwise choose Preselector Bypass
Monitor Spectrum	Always Standard Path
IQ Waveform	Use Standard Path unless tuned frequency > 3.6 GHz and IFBW > 15 MHz, in which case choose Full Bypass if conditions warrant(FBP Option is available and “Allow Full Bypass in Auto” is On), otherwise choose Preselector Bypass
Channel Power	Always Standard Path

Measurement	When µW Path Control is in Auto
Occupied BW	Always Standard Path
CCDF	Use Standard Path unless tuned frequency > 3.6 GHz and IFBW > 15 MHz, in which case choose Preselector Bypass
ACP	Always Standard Path
SEM	Always Standard Path
Spurious Emissions	Always Standard Path
Transmit On|Off Power	Use Standard Path unless tuned frequency > 3.6 GHz and Info BW > 15 MHz, in which case choose Preselector Bypass

Channel Quality Mode

Measurement	When µW Path Control is in Auto
Group Delay	Use Standard Path unless tuned frequency > 3.6 GHz and IFBW > 15 MHz, in which case choose Full Bypass if conditions warrant(FBP Option is available and "Allow Full Bypass in Auto" is On), otherwise choose Preselector Bypass
Monitor Spectrum	Always Standard Path
IQ Waveform	Use Standard Path unless tuned frequency > 3.6 GHz and IFBW > 15 MHz, in which case choose Preselector Bypass
CCDF	Use Standard Path unless tuned frequency > 3.6 GHz and IFBW > 15 MHz, in which case choose Preselector Bypass

Remote Command	`[:SENSe]:POWer[:RF]:MW:PATH:AUTO ON | OFF | 1 | 0` `[:SENSe]:POWer[:RF]:MW:PATH:AUTO?`
Example	`:POW:MW:PATH:AUTO ON` `:POW:MW:PATH:AUTO?`
Dependencies	Only appears in VMA, WLAN, 5G NR and CQM Modes
Couplings	See the tables above
Preset	`ON`
Range	`ON|OFF`

Low Noise Path Enable

Low Noise Path Enable provides a lower noise floor under some circumstances, particularly when operating in the 21–26.5 GHz region. With the Low Noise Path enabled, the low band/high band switch and microwave preamp are bypassed whenever *all* the following are true:

- The instrument is not in the Low Band, meaning:
- the start frequency is above 3.5 GHz and

- the stop frequency is above 3.6 GHz
- The internal preamp is not installed, or if installed, is set to **Off** or **Low Band**

Note that this means that, when any part of a sweep is done in Low Band, the Low Noise Path is not used, whether or not the **Low Noise Path Enable** is selected in the user interface. Also, if the preamp is turned on, the Low Noise Path is not used, whether or not the **Low Noise Path Enable** is selected in the user interface. The only time the Low Noise Path is used is when **Low Noise Path Enable** is selected, the sweep is completely in High Band (> 3.6 GHz) and no preamp is in use.

For measurements that use IQ acquisition, the low noise path is used when **Center Frequency** is in High Band (> 3.6 GHz) and no preamp is in use. In other words, the rules above are modified to use only the center frequency to qualify which path to switch in. This is not the case for FFTs in the Swept SA measurement; they use the same rules as swept measurements.

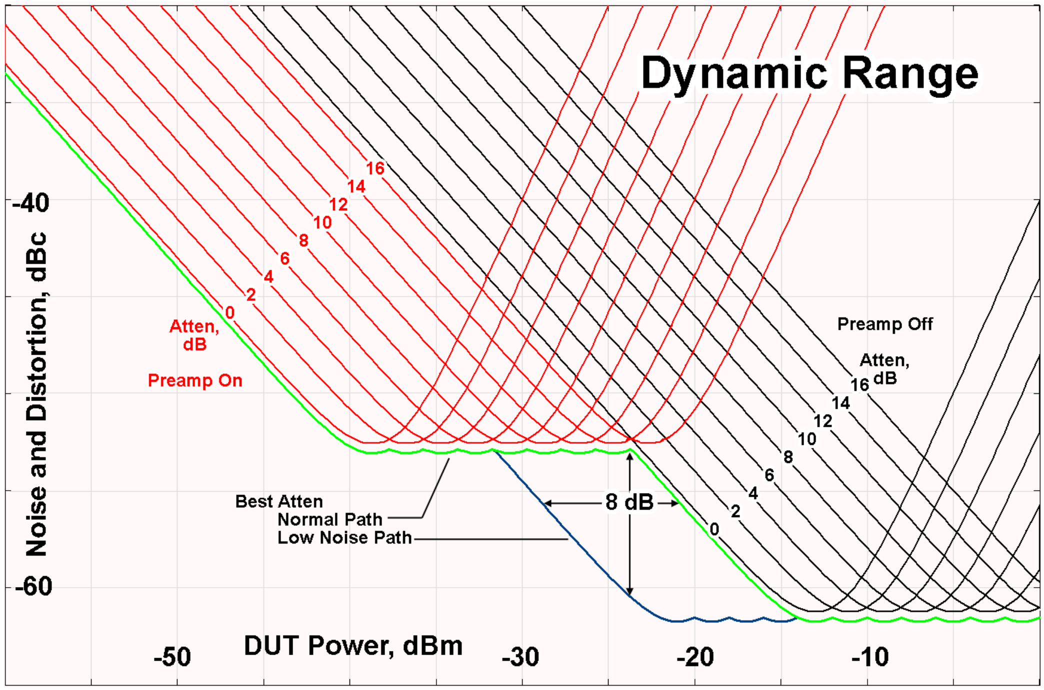
Note that the Low Noise Path, while giving improved DANL, has the disadvantage of decreased TOI performance and decreased gain compression performance relative to the standard path.

Note also that the bypass switch is a mechanical switch and has finite life, so if the **Low Noise Path Enable** is selected, it is possible to cause frequent cycling of this switch by frequently changing instrument settings such that the above conditions hold true only some of the time. A user making tests of this nature should consider opting for the **Standard Path**, which will never throw the bypass switch, at the expense of some degraded noise performance.

The low noise path is useful for situations where the signal level is so low that the instrument performance is dominated by noise even with 0 dB attenuation, but still high enough that the preamp option would have excessive third-order intermodulation or compression. The preamp, if purchased and used, gives better noise floor than does the “Low Noise Path.” However, its compression threshold and third-order intercept are much poorer than that of the non-preamp path.

There are some applications, typically for signals around –30 dBm, for which the third-order dynamic range of the standard path is good enough, but the noise floor is not low enough even with 0 dB input attenuation. When the third-order dynamic range of the preamp path is too little and the noise floor of the standard path is too high, the Low Noise Path can provide the best dynamic range

The graph below illustrates the concept. It shows, in red, the performance of an instrument at different attenuation settings, both with the preamp on and off, in a measurement that is affected by both instrument noise and instrument TOI. The green shows the best available dynamic range, offset by 0.5 dB for clarity. The blue shows how the best available dynamic range improves for moderate signal levels with the low noise path switched in. In this illustration, the preamp improves the noise floor by 15 dB while degrading the third-order intercept by 30 dB, and the low noise path reduces loss by 8 dB. The attenuator step size is 2 dB.



There are other times where selecting the low noise path improves performance, too. Compression-limited measurements such as finding the nulls in a pulsed-RF spectrum can profit from the low noise path in a way similar to the TOI-limited measurement illustrated. Accuracy can be improved when the low noise path allows the optimum attenuation to increase from a small amount like 0, 2 or 4 dB to a larger amount, giving better return loss at the instrument input. Harmonic measurements, such as second and third harmonic levels, are much improved using the low noise path because of the superiority of that path for harmonic (though not intermodulation) distortion performance.

µW Preselector Bypass

Toggles the preselector bypass switch for band 1 and higher. When the microwave presel is on, the signal path is preselected. When the microwave preselector is off, the signal path is not preselected. The preselected path is the normal path for the instrument.

The preselector is a tunable bandpass filter which prevents signals away from the frequency of interest from combining in the mixer to generate in-band spurious signals (images). The consequences of using a preselector filter are its limited bandwidth, the amplitude and phase ripple in its passband, and any amplitude and phase instability due to center frequency drift.

Option MPB or pre-selector bypass provides an unpreselected input mixer path for certain X-Series signal analyzers with frequency ranges above 3.6 GHz. This signal path allows a wider bandwidth and less amplitude variability, which is an advantage when doing modulation analysis and broadband signal analysis. The disadvantage is that, without the preselector, image signals will be displayed. Another disadvantage of bypassing the preselector is increased LO emission levels at the front panel input port.

Image responses are separated from the real signal by twice the 1st IF. For IF Paths of 10 MHz and 25 MHz, the 1st IF is 322.5 MHz, so the image response and the real signal will be separated by 645 MHz. The 1st IF will be different for other IF Path settings. When viewing a real signal and its corresponding image response in internal mixing, the image response will be to the left of the real signal.

Also, the image response and the real signal typically have the same amplitude and exhibit the same shape factor.

However, if Option FS1 (Fast Sweep Capability) is enabled, the image response in the Swept SA measurement appears lower in amplitude and has a much wider shape factor compared to the real signal.

Full Bypass Enable

With **Full Bypass Enable** selected, the microwave preselector is bypassed. In addition, the low band/high band switch and microwave preamp are bypassed whenever *all* the following are true:

- The instrument is not in the Low Band, meaning:
- the start frequency is above 3.5 GHz and
- the stop frequency is above 3.6 GHz.
- the internal preamp is not installed or if installed, is set to **Off** or **Low Band**

Note that this means that, when any part of a sweep is done in Low Band, the Low Noise Path is not used, whether or not the **Full Bypass Enable** is selected in the user interface. Also, if the preamp is turned on, the Low Noise Path is not used, whether or not the **Full Bypass Enable** is selected in the user interface. The only time the Low Noise Path is used is when **Full Bypass Enable** is selected, the sweep is completely in High Band (> 3.6 GHz) and no preamp is in use.

CAUTION: When **Full Bypass Enable** is selected, and "Y Scale" on page 1929 is set to 0 dB, there will be a direct AC connection between the input and the first converter when the Low Noise Path switches in (when Start Freq >3.6 GHz and the Preamp is either not licensed, set to Low Band, or Off). This puts the first converter at considerable risk to be damaged by high AC power. Consequently, whenever **Full Bypass Enable** is selected, a warning message appears in the status bar:

"Full Bypass Enabled, maximum safe input power reduced"

Microwave Preselector Bypass Backwards Compatibility

Example	`:POW:MW:PRES OFF` Bypasses the microwave preselector
Notes	Included for Microwave Preselector Bypass backwards compatibility The `ON` parameter sets the `STD` path (`:POW:MW:PATH STD`) The `OFF` parameter sets path `MPB` (`:POW:MW:PATH MPB`)
Preset	`ON`
Backwards Compatibility SCPI	`[:SENSe]:POWer[:RF]:MW:PRESelector[:STATe] ON | OFF | 0 | 1` `[:SENSe]:POWer[:RF]:MW:PRESelector[:STATe]?`

Frequency Extender Preselection Bypass

Only applies to the high frequency path of the Frequency Extender, and only if the Frequency Extender allows it. For example, the V3050A high frequency path is 50 – 110 GHz and *does* allow control of the preselector bypass.

When the Frequency Extender's preselection is bypassed, flatness is improved, but will be subject to spurs from out-of-band interfering signals. For bandwidths greater than 2.5 [GHz], it is recommended that the signal bypass the Frequency Extender Preselector since the max bandwidth of the Preselector can be as narrow as 2.5 [GHz].

For most applications, the preset state is `OFF`, which gives the best remote-control throughput, minimizes acoustic noise from switching, minimizes out of band spurs, and minimizes the risk of wear in the hardware switches.

Preselector and Bandwidth Conflict

When the Frequency Extender Preselector is applied and the signal bandwidth is greater than 2.5 [GHz], then a settings alert message will show to warn the user that the signal may be distorted due to the limitation of the Frequency Extender Preselector bandwidth.

An example of the settings alert message is shown below.

Settings Alert message in the Status Bar at the bottom of the display.

Settings Alert message in the error queue

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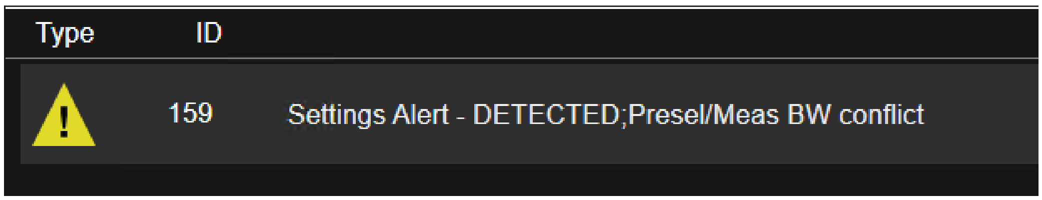


Software Preselection

Provided in some instruments, either to compensate for issues with provided hardware preselection or to provide the preselection function when there is no hardware preselector.

N9041B

Software Preselection compensates for the frequency range limit of the microwave preselector. Since the microwave preselector only goes up to 50 GHz, software preselection must be used to suppress and separate images above 50 GHz. The specific algorithm used for software preselection is specified by the SW Preselection Type selection – Normal or Advanced.

In N9041B, **Software Preselection** only applies for frequencies above 50 GHz, therefore it is only used for RF Input 2. Even if turned on, it is not used for other inputs, and never for frequencies below 50 GHz. This is why the label of this control contains the parenthetical note "(>~50 GHz)".

Note that in N9041B, in Swept SA measurement, **Software Preselection** works even if the measurement is using an FFT Sweep Type. In measurements other than Swept SA, Software Preselection is not used if the measurement is using an FFT sweep type.

N9042B+V3050A

Software Preselection compensates for the frequency range limit of the microwave preselector. Since the microwave preselector only goes up to 50 GHz, software preselection must be used to suppress and separate images above 50 GHz. The specific algorithm used for software preselection is specified by the SW Preselection Type selection – Normal or Advanced.

For N9042B+V3050A, Software Preselection only applies for frequencies above 50 GHz, therefore it is only used for External RF. Even if it is turned on, it will not be used for other inputs and never for frequencies below 50 GHz. This is why the label of this control contains the parenthetical note "(>~50 GHz)".

Note that for N9042B+V3050A, in the Swept SA measurement, Software Preselection works even if the measurement is using an FFT Sweep Type. In measurements other than Swept SA, Software Preselection is not used if the measurement is using an FFT Sweep Type.

VXT models M9410A/11A

Software Preselection is used to provide the preselection function, as there is no hardware preselector in these models. Two background traces are taken and compared point by point, and the point with the lowest amplitude from the two traces is used. This provides a method to reduce spurs that are internally generated within the VXT, but you should note the following when using Software Preselection:

- There is some speed cost due to the need to take multiple captures
- Taking the point with the lowest amplitude in each trace will make the average noise level lower at all points that do not have a spur. This can reduce the accuracy of the measurement of noise and noise-like signals

Because of the difficulty in identifying spurs manually, you are recommended to leave Software Preselection ON at all times in VXT models M9410A/11A. If you turn it off in order to speed up your measurement or improve noise accuracy, be aware of unwanted onscreen spurs.

Remote Command	`[:SENSe]:POWer[:RF]:SWPResel:STATe 0 | 1 | ON | OFF` `[:SENSe]:POWer[:RF]:SWPresel:STAT?`
Example	`:POW:SWPR:STAT 1` `:POW:SWPR:STAT?`
Dependencies	Only appears in N9041B, N9042B+V2050A, and VXT models M9410A/11A. Does not appear in all measurements
Couplings	Affects **Sweep Time** **Auto Tune** supports **Software Preselection**, so **Auto Tune** should be performed after setting the **Software Preselection** state
Preset	N9041B: OFF N9042B+V3050A: ON M9410A/11A: ON
State Saved	Saved in instrument state

SW Preselection Type

Specifies the algorithm used for software preselection.

Two hidden sweeps occur in succession. The second sweep is offset in LO frequency by 2 * IF / N. For each point in each trace, the smaller amplitude from the two traces is taken and placed in that point in the selected trace. The Peak detector is auto-selected to improve the image suppression effectiveness. Responses of each trace that lie on top of one another will remain and are valid signals. Other signals are images, which are suppressed. The action of taking the smaller of the two traces will make the average noise level lower in all points that do not have an image, thus reducing the accuracy of the measurement of noise and noise-like signals.

- `NORMal` - mathematically removes all image and multiple responses of signals present at the input
- `ADVanced` - any trace processing (such as “max hold” or trace averaging) is performed on the points of both candidate traces before the “select minimum” operation occurs. This form of processing works better for non-stationary signals, such as pulsed-RF signals

Remote Command	`[:SENSe]:POWer[:RF]:SWPResel NORMal | ADVanced` `[:SENSe]:POWer[:RF]:SWPResel?`
Example	`:POW:SWPR NORM` `:POW:SWPR?`
Dependencies	Only appears in N9041B and N9042B+V3050A. Only appears in measurements that use the Swept method Grayed-out when "Software Preselection" on page 1971 is `OFF`. The grayout message is “Unavailable unless SW Presel enabled”
Preset	N9041B: `ADVanced` N9042B+V3050A: `NORMal`
State Saved	Saved in instrument state

SW Preselection BW

Specifies the effective bandwidth to be used for Software Preselection.

The options are:

- `NORMal` – when making Swept measurements, a software preselection algorithm is used which takes up to 4 background acquisitions, then post-processes the result. This algorithm can remove images from signals with an occupied

bandwidth up to around 3 GHz. (Default/Preset setting). When making FFT measurements, this algorithm is not used, instead the same algorithm is used as for NARRow (below)

– NARRow– a software preselection algorithm is used which takes two background acquisitions, then post-processes the result to detect and remove images from wideband signals with occupied bandwidths up to 2 GHz. This increases the risk of images failing to be rejected, but improves the measurement speed

Remote Command	`[:SENSe]:POWer[:RF]:SWPResel:BW NORMal | NARRow` `[:SENSe]:POWer[:RF]:SWPResel:BW?`
Example	`:POW:SWPR:BW NARR`
Dependencies	Only appears in N9041B and N9042B+V3050A. Only appears in measurements that use the Swept method Grayed-out when "Software Preselection" on page 1971 is OFF. The grayout message is “Unavailable unless SW Presel enabled” For N9042B+V3050A, the parameter is SCPI-only, and always set to NARRow when **Software Preselection** is enabled
Preset	N9041B: NORMal N9042B+V3050A: NARRow
State Saved	Saved in instrument state

High Freq Prefilter

Lets you set the state of Prefilter for center frequencies above 1310 MHz.

In VXT Models M9410A/11A, the Receiver RF path has a bank of filters that come after the RF Attenuator in the signal path. Since this bank of filters precedes the mixer they are known as the “Prefilter” bank. Their purpose is to eliminate unwanted in-band mixing products by filtering out all but the desired frequencies before the signals get to the mixer. There are 13 prefilter bands to cover the frequencies between 9 kHz and 6000 MHz. The Prefilter provides the necessary rejection of the unwanted signal.

Remote Command	`[:SENSe]:<measurement>:PFILter[:STATe] ON | OFF | 1 | 0` `[:SENSe]:<measurement>:PFILter[:STATe]?`

Example	Enable High Freq Prefilter for the Complex Spectrum Measurement in BASIC Mode:
	`:SPEC:PFIL ON`
	Enable High Freq Prefilter for the IQ Waveform Measurement, in multiple Modes:
	`:WAV:PFIL ON`
	Enable High Freq Prefilter for the Swept SA Measurement in SA Mode:

	:SAN:PFIL ON
Dependencies	Only appears in VXT models M9410A/11A with center frequency above 1310 MHz
Preset	See "Prefilter Presets" on page 1280 below
State Saved	Saved in instrument state

Prefilter Presets

Meas	Mode	Preset
SPEC	BASIC	OFF
WAV	BASIC, WCDMA, WLAN, LTEAFDD, LTEATDD, 5GNR, VMA	OFF
MON	WCDMA, WLAN, LTEAFDD, LTEATDD, 5GNR, VMA	OFF
RHO	WCDMA	OFF
CDP	WCDMA	OFF
PCON	WCDMA	OFF
EVMQ	WCDMA	OFF
CHP	WCDMA, WLAN, LTEAFDD, LTEATDD, 5GNR, VMA, SA	OFF
OBW	WCDMA, WLAN, LTEAFDD, LTEATDD, 5GNR, VMA, SA	OFF
ACP	WCDMA, LTEAFDD, LTEATDD, 5GNR, VMA, SA	OFF
SEM	WCDMA, WLAN, LTEAFDD, LTEATDD, 5GNR, VMA, SA	OFF
PST	WCDMA, WLAN, LTEAFDD, LTEATDD, 5GNR, VMA, SA	OFF
PVT	WLAN, LTEAFDD, LTEATDD, 5GNR	OFF
EVM	WLAN, LTEAFDD, LTEATDD, 5GNR	OFF
FLAT	WLAN	OFF
EVMM	WLAN	OFF
CEVM	LTEAFDD, LTEATDD	OFF
PAVT	5GNR, VMA	OFF
DDEM	VMA	OFF
OFDM	VMA	OFF
SAN	SA	ON
HARM	SA	ON

3.7.4 BW

Opens the **BW** (Bandwidth) menu, which contains controls for the Resolution Bandwidth functions of the instrument.

The Resolution BW functions control filter bandwidth and filter type. There are two filter types, Gaussian and Flattop. The Gaussian filters have a response curve that is parabolic on a log scale. The Flattop filter shape is a close approximation of a rectangular filter.

3.7.4.1 Settings

Contains the basic Bandwidth functions.It is the only tab under BW.

Res BW

Sets the Resolution Bandwidth. This is the bandwidth used for the power measurement. The bandwidth is ideally wide enough to pass all the power of the bursted signal, while not being so wide that it passes noise that reduces dynamic range and the accuracy of low level measurements.

Remote Command	`[:SENSe]:TXPower:BANDwidth[:RESolution] <bandwidth>` `[:SENSe]:TXPower:BANDwidth[:RESolution]?`
Example	`:TXP:BAND 1000` `:TXP:BAND?`
Preset	GSM: 510 kHz SA: 3 MHz
State Saved	Yes
Min	1 kHz
Max	Hardware Dependent: – RF Input: – No Option = 10 MHz – WB (25 MHz or wider) = Hardware Option Limit – I/Q Input (for I+jQ): – No Option = 20 MHz – Option B25 = 50 MHz
Annotation	In the lower left corner of the screen, “Res BW <value>” indicates the current setting of resolution bandwidth
Backwards Compatibility SCPI	`[:SENSe]:TXPower:BWIDth[:RESolution]`

RBW Filter Type

Besides the familiar Gaussian filter shape, there are certain special filter types, such as Flat Top, that are desirable under certain conditions.

Remote	`[:SENSe]:TXPower:BANDwidth:TYPE GAUSsian | FLATtop`

Command	[:SENSe]:TXPower:BANDwidth:TYPE?
Example	:TXP:BAND:TYPE GAUS :TXP:BAND:TYPE?
Notes	Selects the type of filter: either GAUSsian or Flat (FLATtop). Gaussian is the best choice when looking at the overall burst or the rising and falling edges, as it has excellent pulse response. This measurement does not trade off time domain accuracy vs. noise, just total power accuracy vs. noise level. If you want to precisely examine just the useful part of the burst, choose Flat. This is an advanced control that normally does not need to be changed. Setting this to a value other than the factory default may cause invalid measurement results – FLATtop – a filter with a flat amplitude response, which provides the best amplitude accuracy – GAUSsian – a filter with Gaussian characteristics, which provides the best pulse response
Preset	GAUSsian
State Saved	Yes
Range	GAUSsian|FLATtop
Backwards Compatibility SCPI	[:SENSe]:TXPower:BWIDth:TYPE

3.7.5 Display

Opens the **Display** Menu, which lets you configure display items for the current Mode, Measurement View or Window.

3.7.5.1 Meas Display

Contains controls for setting up the display for the current Measurement, View or Window.

Bar Graph On/Off

Turns the Bar Graph On or Off.

Remote Command	:DISPlay:TXPower:BARGraph[:STATe] ON | OFF | 1 | 0 :DISPlay:TXPower:BARGraph[:STATe]?
Example	:DISP:TXP:BARG ON :DISP:TXP:BARG?
Preset	OFF
State Saved	Yes
Range	ON|OFF

3.7.5.2 View

Contains controls for selecting the current **View**, and for editing User Views.

Views

The Burst Power measurement has one view, the "Normal" on page 1283 View.

Normal

Windows: "Graph" on page 1227, "Metrics" on page 1229

Dual window view of the graph and the metrics.

The **Normal** View is a multiple-window View.When in a multiple window View, you select a window by touching it.The menu controls may sometimes change depending on which window is selected.

User View

Lets you choose a View from the saved User Views for the current measurement. This panel only appears if a User View exists for the current measurement.

Remote Command	`:DISPlay:VIEW:ADVanced:SELect <alphanumeric>` `:DISPlay:VIEW:ADVanced:SELect?`
Example	Select Baseband as the current View `:DISP:VIEW:ADV:SEL “Baseband”`

Notes	You must be in the measurement whose View you are trying to set to send the command. You can only set Views for the current measurement using this command
	For predefined views, the parameter is derived from the view name that is shown in the View list in the user interface. For example, if you are trying to select the Trace Zoom view in the Swept SA measurement, you send:
	`:DISP:VIEW:ADV:SEL "Trace Zoom"`
	because “Trace Zoom” is the name of the View as seen in the Mode/Meas dialog or in the Display, View menu
	You *cannot* use the legacy View parameter (which in this case would be `TZOom`) with `:DISP:VIEW:ADV:SEL`
	`<alphanumeric>` is case insensitive; you can specify mixed case, however the name will be evaluated on a single case. Thus, both of the following forms work:
	`:DISP:VIEW:ADV:SEL "Trace Zoom"`
	`:DISP:VIEW:ADV:SEL "TRACE ZOOM"`
	If the specified view is not a valid View, the query returns the error message “-224, Illegal parameter

	value; View with the name <alphanumeric> does not exist" If the display is disabled (via `:DISP:ENAB OFF`) then the error message "-221, Settings conflict; View SCPI cannot be used while Display is disabled" is generated
Backwards Compatibility SCPI	The legacy node `:DISPlay:VIEW[:SELect]` is retained for backwards compatibility, but it only supports predefined views

Restore Layout to Default

Restores the Layout to the default for Basic.

Modified Views are very temporary; if you exit the current measurement they are discarded, and they are not saved in State. To retain this View for later use, and to be able to return easily to your original Basic View, you can save your edited View as a "User View".

Save Layout as New View

Saves your new View as a User View. An alpha keyboard appears, which lets you name your new View; the default is the old View name plus a number.

Remote Command	`:DISPlay:VIEW:ADVanced:NAME <alphanumeric>`
Example	`:DISP:VIEW:ADV:NAME "Baseband"` Creates a new View named `Baseband` from the current View, and selects it as the current View
Notes	`<alphanumeric>` is case insensitive; you can specify mixed case, however the name will be evaluated on a single case If `<alphanumeric>` name already exists as a View, the error message "-224, Illegal parameter value; View <alphanumeric> already exists" is generated If the display is disabled (via `:DISP:ENAB OFF`) then the error message "-221, Settings conflict; User View SCPI cannot be used while Display is disabled" is generated

Re-Save User View

You can re-edit a User View; if you make changes, then an asterisk will appear next to the User View's name. You can then tap **Re-Save User View** to save it back to its existing name, or **Save Layout as New View** to add another, new User View.

This is a front panel function only, there is no remote command available to perform this function. To do this remotely, you must first perform **Save Layout as New View**, then delete the old User View and rename the new one with the name of the View you just deleted.

Rename User View

You can rename the current View by giving it a new unique name. Only User Views can be renamed, if the current View is a Predefined View, an error occurs.

Remote Command	`:DISPlay:VIEW:ADVanced:REName <alphanumeric>`
Example	`:DISP:VIEW:ADV:REN "Baseband"`
Notes	`<alphanumeric>` is case insensitive; you can specify mixed case, however the name will be evaluated on a single case If the `<alphanumeric>` specifying the new name is already present in the list of View names, the error message "-224, Illegal parameter value; View <alphanumeric> already exists" is generated If the current View is a Predefined View, the error message "-224, Illegal parameter value; Cannot rename a Predefined View" is generated If the display is disabled (via `:DISP:ENAB OFF`) then the error message "-221, Settings conflict; View SCPI cannot be used while Display is disabled" is generated

Delete User View

You can delete the current View if it is a User View. The default view becomes the current view for the Measurement.

Remote Command	`:DISPlay:VIEW:ADVanced:DELete`
Example	`:DISP:VIEW:ADV:DEL`
Notes	`<alphanumeric>` is case insensitive; you can specify mixed case, however the name will be evaluated on a single case If the `<alphanumeric>` is not present in the list of View names, the error message "-224, Illegal parameter value; View <alphanumeric> does not exist" is generated If the current View is a Predefined View, the error message "-224, Illegal parameter value; Cannot delete a Predefined View" is generated If the display is disabled (via `:DISP:ENAB OFF`) then the error message "-221, Settings conflict; View SCPI cannot be used while Display is disabled" is generated

Delete All User Views

Deletes all previously saved User Views. The default view becomes the current view for the Measurement if a User View was the current view when this command was executed.

Remote Command	`:DISPlay:VIEW:ADVanced:DELete:ALL`

Example	:DISP:VIEW:ADV:DEL:ALL
Notes	Disabled if there are no User Views

View Editor Remote Commands

The following remote commands help you manage Views and User Views. Note that the SCPI node for User Views handles both Predefined and User Views. The legacy nodes, :DISPlay:VIEW[:SELect] and :DISPlay:VIEW:NSEL, are retained for backwards compatibility, but they only support predefined views.

View Listing Query

Returns a string containing a comma-separated list of names for *all* the Views, including User Views, available for the current Measurement.

Remote Command	:DISPlay:VIEW:ADVanced:CATalog?
Example	:DISP:VIEW:ADV:CAT?
Notes	Returns a quoted string of the available Views for the current measurement, separated by commas. The list includes names for *all* the Views, including User Views, available for the current Measurement Example: "Normal,Trace Zoom,Spectrogram,Baseband,myView1,yourView1" No distinction is made between Predefined and User Views If you switch measurements with the display disabled (via :DISP:ENAB OFF), then query the list of available Views, the result is undefined

User View Listing Query

Returns a string containing a comma-separated list of names for *only* the User Views available for the current Measurement.

Remote Command	:DISPlay:VIEW:ADVanced:USER:CATalog?
Example	:DISP:VIEW:ADV:USER:CAT?
Notes	Returns a quoted string of the available User Views for the current measurement, separated by commas. Example: "Baseband,myView1,yourView1" If you switch measurements with the display disabled (see "Display Enable (Remote Command Only)" on page 1983), then query the list of available Views, the result is undefined

3.7.5.3 Annotation

Contains controls for setting up the annotation for the current Mode or Measurement.

Graticule

Turns the display graticule On or Off for all windows with graticules in all measurements in the current Mode. Also turns the graticule Y-Axis annotation on and off.

Remote Command	`:DISPlay:GRATicule[:STATe] OFF | ON | 0 | 1` `:DISPlay:GRATicule[:STATe]?`
Example	`:DISP:GRAT OFF`
Notes	The graticule is the set of horizontal and vertical lines that make up the grid/divisions for the X-Axis and Y-Axis
Preset	`ON`
State Saved	Saved in instrument state

Backwards Compatibility SCPI	`:DISPlay:WINDow[1]:TRACe:GRATicule:GRID[:STATe] OFF | ON | 0 | 1`
	`:DISPlay:WINDow[1]:TRACe:GRATicule:GRID[:STATe]?`
	This command is accepted for backwards compatibility with older instruments, but the `WINDow`, `TRACe` and `GRID` parameters are ignored

Screen Annotation

Controls the display of the annunciation and annotation around the graticule, including any annotation on lines (such as the display line, the threshold line, etc.) and the Y-Axis annotation, for all windows with screen annotation in all measurements in the current Mode.

This does *not* include marker annotation (or the N dB result). When `OFF`, the graticule expands to fill the entire graticule area, leaving only the 1.5% gap above the graticule, as described in the **Trace** section.

Remote Command	`:DISPlay:ANNotation:SCReen[:STATe] OFF | ON | 0 | 1` `:DISPlay:ANNotation:SCReen[:STATe]?`
Example	`:DISP:ANN:SCR OFF`
Dependencies	Grayed-out and forced to `OFF` when **System Display Settings**, **Annotation** is `OFF`
Preset	`ON` This remains `OFF` through a Preset when **System Display Settings**, **Annotation** is set to `OFF`
State Saved	Saved in instrument state

Trace Annotation

Turns on and off the labels on the traces, showing their detector (or their Math Mode) as described in the **Trace** section, for all windows in all measurements in the current Mode for which Trace Annotation on/off is supported.

If Trace Math is being performed on a trace, then the Trace Math annotation replaces the detector annotation.

For measurements that support limit lines, this key also turns on and off the labels on the Limit Lines. The label is the Limit number annotation and Limit Comment displayed on the graph. If the length of the comment is greater than 20 characters, the first 8 characters and the last 8 characters are displayed, joined with ….

Remote Command	`:DISPlay:ANNotation:TRACe[:STATe] ON | OFF | 1 | 0` `:DISPlay:ANNotation:TRACe[:STATe]?`
Example	`:DISP:ANN:TRAC OFF`
Preset	`OFF`
State Saved	Saved in instrument state

Control Annotation

Turns on and off the display of values on the Active Function controls for all measurements in the current Mode. This is a security feature.

Remote Command	`:DISPlay:ACTivefunc[:STATe] ON | OFF | 1 | 0` `:DISPlay:ACTivefunc[:STATe]?`
Example	`:DISP:ACT OFF`
Dependencies	Grayed out and forced to `OFF` when **System Display Settings**, **Annotation** is `OFF`
Preset	`ON` This remains `OFF` through a Preset when **System Display Settings**, **Annotation** is set to `OFF`
State Saved	Saved in instrument state

Frequency Annotation

Turns on and off the absolute frequency annotation in the main display for all windows in all measurements in the current Mode for which Frequency Annotation on/off is supported.

The affected annotations include Center Frequency, Start/Stop Frequency, Frequency Offset, Marker Frequency. Any relative frequency annotation such as Span and Marker Delta are not affected.

The frequency annotations in any other associated display, such as in Active Function, Softkey label, Limit Editor, Amp Corr Editor and Marker Table are not changed.

Frequency annotations that are not associated with the spectrum, such as RBW, IBW, Sweep Time, are excluded and they are shown regardless of this selection.

Remote Command	`:DISPlay:ANNotation:FREQuency[:STATe] ON | OFF | 1 | 0` `:DISPlay:ANNotation:FREQuency[:STATe]?`
Example	`:DISP:ANN:FREQ OFF`
Dependencies	Only appears in the Swept SA measurement in Spectrum Analyzer Mode
Preset	`ON`

Meas Bar

Turns the Measurement Bar at the top of the screen on and off for all measurements in the current Mode. When `OFF`, the graticule area expands to fill the area formerly occupied by the Measurement Bar.

Remote Command	`:DISPlay:ANNotation:MBAR[:STATe] OFF | ON | 0 | 1` `:DISPlay:ANNotation:MBAR[:STATe]?`
Example	`:DISP:ANN:MBAR OFF`
Dependencies	Grayed out and forced to `OFF` when **System Display Settings**, **Annotation** is `OFF`
Preset	`ON` This remains `OFF` through a Preset when **System Display Settings**, **Annotation** is set to `OFF`
State Saved	Saved in instrument state

Display Enable (Remote Command Only)

Turns the display on/off, including the display drive circuitry. The backlight stays lit to confirm that the instrument is on. The display enable setting is mode global. Theare three reasons for turning the display off:

1. To increase speed as much as possible by freeing the instrument from having to update the display
2. To reduce emissions from the display, drive circuitry
3. For security purposes

If you have turned off the display:

– and you are in local operation, the display can be turned back on by pressing any key or by sending `:SYSTem:DEFaults MISC` or `:DISPlay:ENABle ON` (neither

*RST nor :SYSTem:PRESet enable the display)

- and you are in remote operation, the display can be turned back on by pressing the **Local** or **Esc** keys, or by sending `:SYSTem:DEFaults MISC` or `:DISPlay:ENABle ON` (neither `*RST` nor `:SYSTem:PRESet` enable the display)
- and you are using either the `:SYSTem:KLOCk` command or GPIB local lockout, then *no* front-panel key press will turn the display back on. You must turn it back on remotely.

If the display is `OFF`, many SCPI commands related to User Views and Multiscreen functionality do not work, and return the error messages "-221, Settings conflict; Screen SCPI cannot be used when Display is disabled" or "221, Settings conflict; View SCPI cannot be used while Display is disabled". These commands include:

Name	Command
Select User View	`:DISPlay:VIEW:ADVanced:SELect`
Rename User View	`:DISPlay:VIEW:ADVanced:REName`
Delete User View	`:DISPlay:VIEW:ADVanced:DELete`
Create User View	`:DISPlay:VIEW:ADVanced:NAME`
Select Screen	`:INSTrument:SCReen:SELect`
Delete Screen	`:INSTrument:SCReen:DELete`
Delete All But This Screen	`:INSTrument:SCReen:DELete:ALL`
Add Screen	`:INSTrument:SCReen:CREate`
Rename Screen	`:INSTrument:SCReen:REName`
Sequencer On/Off	`:SYSTem:SEQuencer`

Remote Command	`:DISPlay:ENABle OFF | ON | 0 | 1` `:DISPlay:ENABle?`
Example	`:DISP:ENAB OFF`
Couplings	`:DISP:ENAB OFF` turns Backlight `OFF` and `:DISP:ENAB ON` turns Backlight `ON`, but changing Backlight settings does *not* change the state of `:DISP:ENAB`
Preset	`ON` Set by `:SYST:DEF MISC`, but not affected by `*RST` or `:SYSTem:PRESet`
State Saved	Not saved in instrument state
Backwards Compatibility Notes	`:SYST:PRES` no longer turns on `:DISPlay:ENABle` as it did in legacy analyzers

3.7.6 Freq

Contains controls that allow you to control the Frequency and Channel parameters of the instrument.

Some features in the **Frequency** menu are the same for all measurements in the current Mode – they do not change as you change measurements.Settings like these are called “Meas Global” and are unaffected by Meas Preset.For example, the Center Freq setting is the same for all measurements - it does not change as you change measurements.

3.7.6.1 Settings

Contains controls that pertain to the X-Axis parameters of the measurement. These parameters control how data on the vertical (X) axis is displayed and control instrument settings that affect the horizontal axis.

Center Frequency

Sets the frequency that corresponds to the horizontal center of the graticule. While adjusting the Center Frequency the Span is held constant.

The **Center Frequency** setting is the same for all measurements within a mode, that is, it is Meas Global. Some modes are also able to share a Mode Global center frequency value. If this is the case, there will be a **Global** tab in the "Meas Setup" on page 1306 menu.

Center Frequency sets (and queries) the Center Frequency for the currently selected input. If your instrument has multiple inputs, and you select another input, the Center Freq changes to the value for that input. SCPI commands are available to directly set the Center Freq for a specific input.

Center Frequency is remembered as you go from input to input. Thus you can set a Center Freq of 10 GHz with the RF Input selected, change to BBIQ and set a Center Freq of 20 MHz, then switch to External Mixing and set a Center Freq of 60 GHz. When you go back to the RF Input the Center Freq will go back to 10 GHz; back to BBIQ and it is 20 MHz; back to External Mixing and it is 60 GHz.

See:

– "RF Center Freq" on page 1294

– "Ext Mix Center Freq" on page 1295

– "I/Q Center Freq" on page 1296

– "Center Frequency Presets" on page 1292

Remote Command	`[:SENSe]:FREQuency:CENTer <freq>` `[:SENSe]:FREQuency:CENTer?`

Example	`:FREQ:CENT 50 MHz`
	Sets Center Frequency to 50 MHz
	`:FREQ:CENT UP`
	Increments the Center Frequency by the value of CF Step
	`:FREQ:CENT?`
	Returns the current value of Center Frequency

Notes	This command sets the RF, External Mixing or I/Q Center Frequency depending on the selected input: For RF input it is equivalent to `:FREQ:RF:CENT` For I/Q input it is equivalent to `:FREQ:IQ:CENT` For External Mixer it is equivalent to `:FREQ:EMIX:CENT` Preset and Max values are dependent on Hardware Options (5xx) If no terminator (e.g. MHz) is sent the terminator Hz is used. If a terminator with unit other than Frequency is used, an invalid suffix error message is generated
Preset	Depends on instrument maximum frequency, mode, measurement, and selected input See "Center Frequency Presets" on page 1292 and "RF Center Freq" on page 1294 and "Ext Mix Center Freq" on page 1295 and "I/Q Center Freq" on page 1296
State Saved	Saved in instrument state
Min/Max	Depends on instrument maximum frequency, mode, measurement, and selected input See "Center Frequency Presets" on page 1292 and "RF Center Freq" on page 1294 and "I/Q Center Freq" on page 1296
Status Bits/OPC dependencies	Non-overlapped

Center Frequency Presets

The following table provides the Center Frequency Presets for the Spectrum Analyzer mode, and the Max Freq, for the various frequency options:

Freq Option	CF after Mode Preset	Stop Freq after Mode Preset	Max Freq (can't tune above)
503 (all but CXA)	1.805 GHz	3.6 GHz	3.7 GHz
503 (CXA)	1.505 GHz	3.0 GHz	3.08 GHz
507 (all but CXA)	3.505 GHz	7.0 GHz	7.1 GHz
507 (CXA)	3.755 GHz	7.5 GHz	7.58 GHz

Freq Option	CF after Mode Preset	Stop Freq after Mode Preset	Max Freq (can't tune above)
508 (all but MXE)	1.805 GHz	3.6 GHz	8.5 GHz
508 (MXE)	4.205 GHz	8.4 GHz	8.5 GHz
513	6.805 GHz	13.6 GHz	13.8 GHz
526 (except CXA and MXE)	13.255 GHz	26.5 GHz	27.0 GHz*
526 (CXA)	13.255 GHz	26.5 GHz	26.55 GHz
526 (MXE)	1.805 GHz	3.6 GHz	27.0 GHz
532	16.005 GHz	32.0 GHz	32.5 GHz
540	20.005 GHz	40.0 GHz	40.5 GHz
543	21.505 GHz	43.0 GHz	43.0 GHz
544	22.005 GHz	44.0 GHz	45.0 GHz
550	25.005 GHz	50.0 GHz	52 GHz
F03 (CXA-m)	1.505 GHz	3.0 GHz	3.08 GHz
F07 (CXA-m)	3.755 GHz	7.5 GHz	7.575 GHz
F13 (CXA-m)	6.805 GHz	13.6 GHz	13.8 GHz
F26 (CXA-m)	13.255 GHz	26.5 GHz	26.55 GHz
504 (M9421A, M8920A)	2.145 GHz	3.88GHz	3.88 GHz
506 (M9421A, M8920A)	3.245 GHz	6.08GHz	6.08 GHz
F06 (M9410A/11A)	1.0 GHz	6.08 GHz	6.08 GHz
F06 (M9415A)	1 GHz	1.08 GHz	6.6 GHz
F08 (M9415A)	1 GHz	1.08 GHz	8.6 GHz
F12 (M9415A)	1 GHz	1.08 GHz	12.9 GHz

*For option 526, the Max CF in RTSA is 26.999999995 GHz.

N9041B Center Freq Presets

Input	CF after Mode Preset	Stop Freq after Mode Preset	Max Freq (can't tune above)
Input 1, all models	25.005 GHz	50.0 GHz	52 GHz
Input 2, opt 585	42.505 GHz	85.0 GHz	86 GHz
Input 2, opt 590	45.005 GHz	90.0 GHz	92 GHz
Input 2, opt 5CX	55.005 GHz	110.0 GHz	110 GHz

Input 2, CXA and MXE

Model	CF after Mode Preset	Stop Freq after Mode Preset	Max Freq (can't tune above)
CXA opt C75	0.7505 GHz	1.5 GHz	1.58 GHz
MXE	505 MHz	1 GHz	1.000025 GHz

Tracking Generator Frequency Limits (CXA only)

Tracking Generator Option	Min Freq (clips to this freq when turn TG on and can't tune below while TG on)	If above this Freq, Stop Freq clipped to this Freq when TG turned on	Max Freq (can't tune above) while TG on
T03	9 kHz	3.0 GHz	3.08 GHz
T06	9 kHz	6.0 GHz	6.05 GHz

Tracking Generator Frequency Limits(CXA-m only)

Tracking Generator Option	Min Freq (clips to this freq when turn TG on and can't tune below while TG on)	If above this Freq, Stop Freq clipped to this Freq when TG turned on	Max Freq (can't tune above) while TG on
T03	2 MHz	3.08 GHz	3.08 GHz
T07	2 MHz	7.575 GHz	7.575 GHz
T13	2 MHz	13.8 GHz	13.8 GHz
T26	2 MHz	26.55 GHz	26.55 GHz

RF Center Freq

Specifies the RF Center Frequency. Sets the Center Frequency to be used when the RF input is selected, even if the RF input is not the input that is selected at the time the command is sent. Note that **Center Frequency** in the **Frequency** menu on the front panel always applies to the currently selected input.

Remote Command	`[:SENSe]:FREQuency:RF:CENTer <freq>` `[:SENSe]:FREQuency:RF:CENTer?`
Example	`:FREQ:RF:CENT 30 MHz` `:FREQ:RF:CENT?`
Notes	This command is the same in all modes, but the parameter is Measurement Global, so the value is independent in each mode and common across all the measurements in the mode
Dependencies	If the electronic/soft attenuator is enabled, any attempt to set Center Frequency such that the Stop Frequency would be >3.6 GHz fails and results in an advisory message. If the equivalent SCPI command is sent, this same message is generated as part of a "-221, Settings conflict" warning
Preset	See tables in "Center Frequency Presets" on page 1292 above
State Saved	Saved in instrument state

Min	-79.999995 MHz
Max	See tables in "Center Frequency Presets" on page 1292 above Basically instrument maximum frequency - 5 Hz

Ext Mix Center Freq

Specifies the External Mixer Center Frequency. Sets the Center Frequency to be used when the External Mixer is selected, even if the External Mixer input is not the input which is selected at the time the command is sent. Note that **Center Frequency** in the **Frequency** menu on the front panel always applies to the currently selected input.

Remote Command	`[:SENSe]:FREQuency:EMIXer:CENTer <freq>` `[:SENSe]:FREQuency:EMIXer:CENTer?`
Example	`:FREQ:EMIX:CENT 60 GHz` `:FREQ:EMIX:CENT?`
Notes	This command is the same in all modes, but the parameter is Measurement Global, so the value is independent in each mode and common across all the measurements in the mode
Couplings	When returning to External Mixing after having been switched to one of the other inputs (for example, RF), you will return to the settings that you had when you left External Mixing. So you will return to the band you were in with the Center Frequency that you had.However, Span is not an input-dependent parameter, so the span setting from the other input will be retained. Therefore, the instrument returns to the span setting from the previous input, limited as necessary by the current mixer setup
Preset	When a Mode Preset is performed while in External Mixing, the Start frequency of the current Mode is set to the nominal Min Freq of the lowest harmonic range in the Harmonic Table for the current mixer setup. Similarly, the Stop frequency of the current Mode is set to the nominalMax Freq of the highest harmonic range in the Harmonic Table. The Center Frequency thus presets to the point arithmetically equidistant from these two frequencies Note that, if the current measurement has a limited Span available to it, and cannot achieve the Span shown in the table (Span=Stop Freq – Start Freq), the instrument uses the maximum Span the measurement allows, and still sets the Center Freq to the midpoint of the Start and Stop Freq values in the Harmonic Table When Restore Input/Output Defaults is performed, the mixer presets to the 11970A, whose Start and Stop frequencies are 26.5 and 40 GHz respectively. The center of these two frequencies is 33.25 GHz Therefore, after a Restore Input/Output Defaults, if you go into External Mixing and do a Mode Preset while in the Spectrum Analyzer Mode, the resulting Center Freq is 33.25 GHz
State Saved	Yes
Min	The minimum frequency in the currently selected mixer band + 5 Hz
Max	The maximum frequency in the currently selected mixer band - 5 Hz

I/Q Center Freq

Specifies the I/Q Center Frequency. Sets the Center Frequency to be used when the I/Q input is selected, even if the I/Q input is not the input which is selected at the time the command is sent. Note that **Center Frequency** in the **Frequency** menu on the front panel always applies to the currently selected input.

Remote Command	`[:SENSe]:FREQuency:IQ:CENTer <freq>` `[:SENSe]:FREQuency:IQ:CENTer?`
Example	`:FREQ:IQ:CENT 30 MHz`
Notes	This command is the same in all Modes, but the parameter is Measurement Global. So the value is independent in each Mode and common across all the measurements in the Mode
Preset	0 Hz
State Saved	Saved in instrument state
Min	-40.049995 MHz
Max	40.049995 MHz

CF Step

Changes the step size for "Center Frequency" on page 1291 and start and stop frequency functions. Once a step size has been selected and the Center Frequency function is active, the step keys (and the UP|DOWN parameters for Center Frequency from remote commands) change the center frequency by the step-size value. The step size function is useful for finding harmonics and sidebands beyond the current frequency span of the instrument.

Note that the start and stop frequencies also step by the **CF Step** value.

Remote Command	`[:SENSe]:FREQuency:CENTer:STEP[:INCRement] <freq>`
	`[:SENSe]:FREQuency:CENTer:STEP[:INCRement]?`
	`[:SENSe]:FREQuency:CENTer:STEP:AUTO OFF | ON | 0 | 1`
	`[:SENSe]:FREQuency:CENTer:STEP:AUTO?`

Example	`:FREQ:CENT:STEP 500 MHz`
	`:FREQ:CENT UP`
	increases the current center frequency value by 500 MHz
	`:FREQ:CENT:STEP?`
	`:FREQ:CENT:STEP:AUTO ON`
	`:FREQ:CENT:STEP:AUTO?`

Notes	Preset and Max values are depending on Hardware Options
Dependencies	If the electronic/soft attenuator is enabled, any attempt to change the value of the center frequency >3.6 GHz by pressing the Up-arrow key, fails and results in an advisory message. If the equivalent SCPI command is sent, this same message is generated as part of a “-221, Settings conflict” warning

Couplings	When auto-coupled, the center frequency step size is set to 10% of the span
Preset	Auto ON
State Saved	Saved in instrument state
Min/Max	–/+ (the maximum frequency of the instrument). That is, 27 GHz max freq instrument has a CF step range of +/- 27 GHz Note that this is the maximum frequency given the current settings of the instrument, so in External Mixing, for example, it is the maximum frequency of the current mixer band
Status Bits/OPC dependencies	non-overlapped

Freq Offset

Enables you to set a frequency offset value to account for frequency conversions outside of the instrument. This value is added to the display readout of the marker frequency, center frequency, start frequency, stop frequency, and all other absolute frequency settings in the instrument including frequency count. When a frequency offset is entered, the value appears below the center of the graticule. To eliminate an offset, perform a Mode Preset or set the frequency offset to 0 Hz.

See "More Information" on page 1298

Remote Command	`[:SENSe]:FREQuency:OFFSet <freq>` `[:SENSe]:FREQuency:OFFSet?`
Example	`:FREQ:OFFS 10 MHz` `:FREQ:OFFS?`
Notes	Preset and Max values are dependent on Hardware Options
Dependencies	Only appears in Spectrum Analyzer Mode Freq Offset is not available in External Mixing. In this case the Freq Offset control is grayed-out and displays a value of zero. However, the value of CF Offset that was set for the RF Input is retained and restored when you switch back to the RF Input
Preset	See "Center Frequency Presets" on page 1292
State Saved	Saved in instrument state
Min	-500 GHz
Max	500 GHz
Annotation	If Frequency Offset is not zero, “Freq Offset <value>” appears on the upper line of the annotation, below the graticule, in the center
Status Bits/OPC dependencies	Non-overlapped
Backwards Compatibility SCPI	`:DISPlay:WINDow[1]:TRACe:X[:SCALe]:OFFSet` This version of the command is in the instrument for compatibility across platforms and is not recommended for new development

More Information

This command does not affect any bandwidths or the settings of relative frequency parameters such as delta markers or span. It does not affect the current hardware settings of the instrument, but only the displayed frequency values. Entering an offset does not affect the trace position or display, just the value of the start and stop frequency and the values represented by the trace data. The frequency values of exported trace data, queried trace data, markers, trace data used in calculations such as N dB points, trace math, etc., are all affected by Freq Offset. Changing the offset, even on a trace that is not updating will immediately change all of the above, without taking new data.

NOTE **If a trace is exported with a nonzero Freq Offset, the exported data will contain the trace data with the offset applied. Therefore, if that trace were to be imported back into the instrument, you would want Freq Offset to be 0, otherwise the offset would be applied again to data that is already offset. No such care need be taken when saving a State+Trace file because the data and state are saved together.**

3.7.7 Marker

Accesses a menu that enables you to select, set up and control the markers for the current measurement. If there are no active markers, **Marker** selects marker 1, sets it to **Normal** and places it at the center of the display. If the selected marker is **Off**, it is set to **Normal** and placed it at the center of the screen on the trace determined by the **Marker Trace** rules.

3.7.7.1 Select Marker

Specifies the selected marker. The term “selected marker” is used throughout this document to specify which marker will be affected when you change marker settings, perform a Peak Search, etc.

The **Select Marker** control appears above the menu panel, indicating that it applies to all controls in the **Marker** menu panels.**Select Marker** is blanked if you select a tab whose controls do *not* depend on the selected marker (for example, **Counter**).

In any menu tab that displays **Select Marker**, the first control is always **Marker Frequency|Time**.

Notes	The selected marker is remembered even when not in the **Marker** menu and is used if a Search is performed, or a Band Function is turned on, or for Signal Track or Continuous Peak
Preset	Marker 1
State Saved	The number of the selected marker is saved in instrument state
Annunciation	Appears in the marker results block label for **Normal** and **Delta** markers

3.7.7.2 Settings

The controls on this tab include the Marker active function and a radio button selection of the marker control mode (Normal, Delta, or Off) for the selected marker, as well as additional functions that help you use markers.

Marker Time

Sets the Marker Time in the current marker X-Axis Scale unit. It has no effect if the control mode is **Off,** but is the SCPI equivalent of entering an X value if the control mode is **Normal** or **Delta**.

Remote Command	`:CALCulate:TXPower:MARKer[1]|2|...|12:X <real>` `:CALCulate:TXPower:MARKer[1]|2|...|12:X?`
Example	`:CALC:TXP:MARK3:X 0` `:CALC:TXP:MARK3:X?`
Notes	If no suffix is sent, uses the fundamental units for the current marker X-Axis Scale. If a suffix is sent that does not match the current marker X-Axis Scale unit, an error “Invalid suffix” is generated The query returns the marker’s absolute X-Axis value if the control mode is **Normal**, or the offset from the marker’s reference marker if the control mode is **Delta**. The query is returned in the fundamental units for the current marker X Axis scale: Hz for **Frequency** and **Inverse Time**, seconds for **Period** and **Time**. If the marker is **Off** the response is Not A Number (NAN)
Couplings	Max value would be changed by Sweep Time parameter value
Preset	After a preset, all Markers are turned `OFF`, so a Marker X Axis Value query will return Not A Number (NAN)
State Saved	No
Min	-9.9E+37
Max	9.9E+37
Annotation	Mkr # <X value> and <Marker value> upper right on graph
Backwards Compatibility SCPI	`:CALCulate:BPOWer:MARKer[1]|2|...|12:X` Included for backwards compatibility. Not recommended for use in new designs

Marker X Axis Position (Remote Command Only)

Sets the marker X position in trace points. It has no effect if the control mode is **Off,** but is the SCPI equivalent of entering a value if the control mode is **Normal** or **Delta** except in trace points rather than X-Axis Scale units. The entered value is immediately translated into the current X-Axis Scale units for setting the value of the marker.

Remote	`:CALCulate:TXPower:MARKer[1]|2|...|12:X:POSition <real>`

Command	`:CALCulate:TXPower:MARKer[1]|2|...|12:X:POSition?`
Example	`:CALC:TXP:MARK10:X:POS 500` `:CALC:TXP:MARK10:X:POS?`
Notes	The query returns the marker's absolute X-Axis value in trace points if the control mode is **Normal**, or the offset from the marker's reference marker in trace points if the control mode is **Delta**. If the marker is **Off** the response is not a number
Couplings	Max value would be changed by Sweep/Meas Time parameter value
Preset	After a preset, all Markers are turned OFF, so Marker X Axis Value query will return a not a number (NAN)
State Saved	No
Min	-9.9E+37
Max	9.9E+37
Backwards Compatibility SCPI	`:CALCulate:BPOWer:MARKer[1]|2|...|12:X:POSition` Included for backwards compatibility only. Not recommended for use in new designs

Marker Y Axis Value (Remote Command Only)

Returns the marker Y-Axis value in the current marker Y-Axis unit.

The “result” of a marker is the value that is displayed on the second line of the Marker Result block. To properly interpret the returned value, the remote programmer must also know what the instrument's Y-Axis Unit is set to as described below.

A marker can have up to two results, only one of which is displayed or returned on a query, as follows:

Absolute result	Every marker has an absolute result and it is simply: – For Normal and Delta markers, the Y Axis value of the trace point the marker is currently on – The absolute result is displayed in the result block or returned on a query unless the marker control mode is **Delta**
Relative result	If a marker's control mode is **Delta**, the relative result is displayed in the result block or returned on a query. This is the ratio of the Absolute Result of a delta marker to the Absolute Result of its reference marker. The ratio is expressed in dB

Remote Command	`:CALCulate:TXPower:MARKer[1]|2|...|12:Y?`
Example	`:CALC:TXP:MARK11:Y?`
Notes	Returns the marker Y-Axis result. If the marker is **Off** the response is Not A Number

Preset	0
State Saved	No
Backwards Compatibility SCPI	:CALCulate:TXPower:MARKer[1]|2|...|12:FUNCtion:RESult? :CALCulate:BPOWer:MARKer[1]|2|...|12:FUNCtion:RESult? :CALCulate:BPOWer:MARKer[1]|2|...|12:Y? Included for backwards compatibility only. Not recommended for use in new designs

Marker Mode

Sets the marker control mode to **Normal**, **Delta**, or **Off**. All interactions and dependencies detailed under the control description are enforced when the remote command is sent. If the selected marker is Off, pressing Marker sets it to Normal and places it at the center of the screen on the trace determined by the **Marker Trace** rules. At the same time, **Marker X Axis Value** appears on the Active Function area.

The default active function is the active function for the currently selected marker control mode. If the current control mode is Off, there is no active function and the active function is turned off.

Remote Command	:CALCulate:TXPower:MARKer[1]|2|...|12:MODE POSition | DELTa | OFF :CALCulate:TXPower:MARKer[1]|2|...|12:MODE?
Example	:CALC:TXP:MARK:MODE OFF :CALC:TXP:MARK:MODE?
Preset	OFF
State Saved	Saved in instrument state
Range	POSition|DELTa|OFF
Annotation	Mkr # <X value> and <Marker value> upper right on graph When Marker Trace is Polar in WCDMA mode: Mkr # <Chip Value (RHO & QPSKEVM)/Symbol Value (CDP)>, <X value> and <Y value> upper right on graph
Backwards Compatibility SCPI	:CALCulate:BPOWer:MARKer[1]|2|...|12:MODE Included for backwards compatibility. Not recommended for use in new designs

Backwards Compatibility SCPI Commands

Sets or queries the state of a marker. Setting a marker that is OFF to ON (1) puts it in **Normal** mode and places it at the center of the screen.

Example	:CALC:TXP:MARK3:STAT ON

	:CALC:TXP:MARK3:STAT?
Preset	OFF
State Saved	Saved in instrument state
Range	OFF|ON
Backwards Compatibility SCPI	:CALCulate:BPOWer:MARKer[1]|2|...|12:STATe Included for backwards compatibility only. Not recommended for use in new designs :CALCulate:TXPower:MARKer[1]|2|...|12:STATe OFF | ON | 0 | 1 :CALCulate:TXPower:MARKer[1]|2|...|12:STATe?

Delta Marker (Reset Delta)

Pressing this control has exactly the same effect as pressing the **Delta** selection on the "Marker Mode" on page 1301 radio button.The selected marker becomes a Delta Marker.If the selected marker is already a Delta marker, the reference marker is moved to the current position of the selected marker, thus resetting the Delta to zero.

Marker Settings Diagram

Lets you configure the Marker system using a visual utility.

All Markers Off

Turns off all markers.

Remote Command	:CALCulate:TXPower:MARKer:AOFF
Example	:CALC:TXP:MARK:AOFF
Backwards Compatibility SCPI	:CALCulate:BPOWer:MARKer:AOFF Included for backwards compatibility only. Not recommended for use in new designs

Couple Markers

When this function is ON, moving any marker causes an equal X-Axis movement of every other marker that is not OFF.By “equal X-Axis movement” we mean that we preserve the difference between each marker’s X-Axis value (in the fundamental x-axis units of the trace that marker is on) and the X-Axis value of the marker being moved (in the same fundamental x-axis units).

This may result in markers going off screen.

Remote Command	`:CALCulate:TXPower:MARKer:COUPle[:STATe] ON | OFF | 1 | 0` `:CALCulate:TXPower:MARKer:COUPle[:STATe]?`
Example	`:CALC:TXP:MARK:COUP ON` `:CALC:TXP:MARK:COUP?`
Preset	`OFF` Presets on Mode Preset and All Markers Off
State Saved	Saved in instrument state

3.7.7.3 Peak Search

The controls on this tab allow you to move the marker to selected peaks of the signal, giving you enormous analysis capabilities, particularly when combined with the Delta Marker function.

NOTE: Pressing the **Peak Search** hardkey automatically moves you to the **Peak Search** page of the **Marker** menu *and* performs a Peak Search.

Pressing the **Peak Search** tab once you are already *in* the **Marker** menu does *not* perform a Peak Search.

Marker Time

Sets the marker time in the current marker X-Axis Scale unit. It has no effect if the control mode is **Off,** but is the SCPI equivalent of entering an X value if the control mode is **Normal** or **Delta**.

This is the same as "Marker Time" on page 1299 on the **Settings** tab.

Peak Search

Pressing this control moves the selected marker to the trace point that has the maximum y-axis value for that marker’s trace.

NOTE: Pressing the **Peak Search** hardkey automatically moves you to the **Peak Search** page of the **Marker** menu *and* performs a Peak Search.

Remote Command	`:CALCulate:TXPower:MARKer[1]|2|...|12:MAXimum`

Example	`:CALC:TXP:MARK2:MAX`
	`:SYST:ERR?`
	can be used to query the errors to determine if a peak is found. The message “No peak found” (-200)

	will be returned after an unsuccessful search
Notes	Sending this command selects the subopcoded marker In WCDMA Mode, this command does not work when the selected marker is located on the polar trace. In this case, the command is ignored

Marker Delta

Pressing this control has exactly the same effect as pressing the “Delta” selection on the "Marker Mode" on page 1301 radio button on the **Settings** tab.The selected marker becomes a Delta Marker.If the selected marker is already a Delta marker, the reference marker is moved to the current position of the selected marker, thus resetting the Delta to zero.

The control is duplicated here to allow you to conveniently perform a peak search and change the marker’s control mode to Delta without having to access two separate menus.

3.7.7.4 Properties

The controls on this tab are used to set certain properties of the selected marker.

Marker Time

Sets the Marker Time in the current marker X-Axis Scale unit. It has no effect if the control mode is **Off,** but is the SCPI equivalent of entering an X value if the control mode is **Normal** or **Delta**.

This is the same as the "Marker Time" on page 1299 control on the **Settings** tab.

Relative To

Selects the marker to which the selected marker is relative (its reference marker).

Every marker has another marker to which it is relative. This marker is referred to as the “reference marker” for that marker. This attribute is set by the **Marker, Properties, Relative To** key. The marker must be a **Delta** marker to make this attribute relevant. If it is a **Delta** marker, the reference marker determines how the marker is controlled and how its value is displayed. A marker cannot be relative to itself.

Remote Command	`:CALCulate:TXPower:MARKer[1]|2|...|12:REFerence <integer>` `:CALCulate:TXPower:MARKer[1]|2|...|12:REFerence?`
Example	`:CALC:TXP:MARK:REF 10`

	`:CALC:TXP:MARK:REF?`
Notes	Causes the marker specified with the subopcode to become selected Range (for SCPI command): 1 to 12. If the range is exceeded the value is clipped A marker cannot be relative to itself so that choice is not available, and if sent from SCPI generates error -221: "Settings conflict; marker cannot be relative to itself" The query returns a single value (the specified marker numbers relative marker)
Couplings	The act of specifying the selected marker's reference marker makes the selected marker a Delta marker If the reference marker is off it is turned on in **Fixed or Normal** mode at the delta marker location
Preset	The preset default "Relative To" marker (reference marker) is the next higher numbered marker (current marker +1). For example, if marker 2 is selected, then it's default reference marker is marker 3. The exception is marker 12, which has a default reference of marker 1 Set to the defaults by **Restore Mode Defaults**. This is not reset by **Marker Off**, **All Markers Off**, or **Preset**
State Saved	Saved in instrument state. Not affected by Marker Off and hence not affected by Preset or power cycle
Min	1
Max	12
Annunciation	Appears in the marker label of a **Delta** marker

Marker Trace

Assigns the specified marker to the designated trace.

Remote Command	`:CALCulate:TXPower:MARKer[1]|2|...|12:TRACe RFENvelope | MAXHold | MINHold` `:CALCulate:TXPower:MARKer[1]|2|...|12:TRACe?`
Example	`:CALC:TXP:MARK:TRAC MAXH` `:CALC:TXP:MARK:TRAC?`
Dependencies	If Max Hold under Trace is Off, Max Hold is grayed out
Preset	`RFENvelope`
State Saved	Yes
Range	RF Envelope|Max Hold RF Envelope|Min Hold RF Envelope
Backwards Compatibility SCPI	`:CALCulate:BPOWer:MARKer[1]|2|...|12:TRACe` Included for backwards compatibility only. Not recommended for use in new designs

Marker Settings Diagram

Lets you configure the Marker system using a visual utility. This is the same as the "Marker Settings Diagram" on page 1302 control on the **Settings** tab.

3.7.8 Meas Setup

Contains functions for setting up the measurement parameters and also contains functions for setting up parameters global to all measurements in the mode.

3.7.8.1 Settings

Contains frequently used Meas Setup functions to which you will want the fastest access.

Avg/Hold Num

Specifies the number of data acquisition that will be averaged. After the specified number of average counts, the averaging mode (terminal control) setting determines the averaging action.

Remote Command	`[:SENSe]:TXPower:AVERage:COUNt <integer>` `[:SENSe]:TXPower:AVERage:COUNt?`
Example	`:TXP:AVER:COUN 100` `:TXP:AVER:COUN?`
Preset	50
State Saved	Yes
Min/Max	1/10000
Backwards Compatibility SCPI	`[:SENSe]:BPOWer:AVERage:COUNt` Included for backwards compatibility. Not recommended for use in new designs

Averaging On/Off

Turns averaging on or off for the Burst Power measurement

Remote Command	`[:SENSe]:TXPower:AVERage[:STATe] OFF | ON | 0 | 1` `[:SENSe]:TXPower:AVERage[:STATe]?`
Example	`:TXP:AVER:0` `:TXP:AVER?`
Preset	ON
Range	OFF|ON
Backwards Compatibility SCPI	`[:SENSe]:BPOWer:AVERage[:STATe]`

Avg Mode

Selects the type of termination control used for the averaging function. This determines the averaging action after the specified number of data acquisitions (average count) is reached.

Control	SCPI	Mode
Exponential	EXPonential	After the average count is reached, each successive data acquisition is exponentially weighted and combined with the existing average
Repeat	REPeat	After reaching the average count, the averaging is reset and a new average is started

Remote Command	[:SENSe]:TXPower:AVERage:TCONtrol EXPonential | REPeat [:SENSe]:TXPower:AVERage:TCONtrol?
Example	:TXP:AVER:TCON REP :TXP:AVER:TCON?
Preset	EXPonential
State Saved	Yes
Range	EXPonential|REPeat
Backwards Compatibility SCPI	[:SENSe]:BPOWer:AVERage:TCONtrol Included for backwards compatibility. Not recommended for use in new designs

Avg Type

Specifies the type of trace and result averaging to use.

Control Selection	SCPI	Type
Power Average (RMS)	RMS	True power averaging that is equivalent to taking the RMS value of the voltage. It is the most accurate type of averaging
Log-Power Average (Video)	LOG	Simulates the traditional spectrum analyzer type of averaging by averaging the log of the power
None	MAXimum	The maximum values are retained during the averaging cycle
None	MINimum	The minimum values are retained during the averaging cycle

SA, GSM Mode

Remote	[:SENSe]:TXPower:AVERage:TYPE LOG | MAXimum | MINimum | RMS

Command	[:SENSe]:TXPower:AVERage:TYPE?
Example	:TXP:AVER:TYPE LOG :TXP:AVER:TYPE?
Notes	Maximum|Minimum are selected only via SCPI
Couplings	Selecting MAXimum|MINimum forces Max Hold Trace or|and Min Hold Trace to be visible. Measure Trace stays in RMS or Video average state
Preset	RMS
State Saved	Yes
Range	Power Average(RMS)|Log-Power Average (Video)
Backwards Compatibility SCPI	[:SENSe]:BPOWer:AVERage:TYPE Included for backwards compatibility. Not recommended for use in new designs

Threshold Level

When "Meas Method" on page 1312 is set to Above Threshold Lvl, the mean carrier power is calculated based on the trace above the threshold level. The threshold level is displayed in dB (relative to the measured carrier) or dBm (absolute).

A green line in the grid is displayed at the Y position associated with the current threshold level value. Its state is controlled by the On/Off state of the 'Display Line' under "Display" on page 1282.

Remote Command	[:SENSe]:TXPower:THReshold <real> [:SENSe]:TXPower:THReshold?
Example	:TXP:THR 0 :TXP:THR?
Notes	Use "Threshold Type" on page 1309 to specify whether this command sets an absolute or a relative power level Suffixes dB and dBm are allowed, but do not change the state of Threshold Type
Preset	SA: -30.0 GSM: -20.0
State Saved	Yes
Min/Max	SA, GSM Relative: -100/0 dB Absolute: -100/100 dBm
Annotation	Both (Rel|Abs) threshold level are displayed on the 2nd window If Threshold Type is set to Absolute, relative value is calculated from reference power level If Threshold Type is set to Relative, absolute value is calculated from reference power level
Backwards	[:SENSe]:BPOWer:THReshold

Compatibility SCPI	Included for backward compatibility. Not recommended for use in new designs

Threshold Type

Remote Command	`[:SENSe]:TXPower:THReshold:TYPE ABSolute | RELative` `[:SENSe]:TXPower:THReshold:TYPE?`
Example	`:TXP:THR:TYPE ABS` `:TXP:THR:TYPE?`
Preset	`RELative`
Range	`ABSolute|RELative`
Backwards Compatibility SCPI	`[:SENSe]:BPOWer:THReshold:TYPE`

IF Gain

Used to set the IF Gain function to Auto, Low Gain or High Gain. These settings affect sensitivity and IF overloads.

This only applies to the RF input. It does not apply to baseband I/Q input.

Remote Command	`[:SENSe]:TXPower:IF:GAIN[:STATe] ON | OFF | 1 | 0`
	`[:SENSe]:TXPower:IF:GAIN[:STATe]?`
	`[:SENSe]:TXPower:IF:GAIN:AUTO[:STATe] ON | OFF | 1 | 0`
	`[:SENSe]:TXPower:IF:GAIN:AUTO[:STATe]?`

Example	`:TXP:IF:GAIN ON`
	`:TXP:IF:GAIN?`
	`:TXP:IF:GAIN:AUTO OFF`
	`:TXP:IF:GAIN:AUTO?`

Notes	`ON` = high gain `OFF` = low gain
Dependencies	IF Gain is not available when IQ Input is selected The IF Gain control has no effect when the U7227A USB Preamplifier is connected. This is not annotated or reflected on any control; there are no controls grayed out nor any SCPI locked out. The instrument simply behaves as though both IF Gain is set to Low regardless of the setting on the control This control is not available in VXT models M9421A/10A/11A, EXM, or UXM
Couplings	Sending this command sets this function to Man Auto sets IF Gain to High Gain under any of the following conditions: The input attenuator is set to 0 dB, or the preamp is turned on or the Max Mixer Level is –20 dBm or lower

	For other conditions, Auto sets IF Gain to Low Gain
Preset	`OFF` `OFF`
State Saved	Saved in instrument state
Range	Low Gain|High Gain

Meas Setup Summary Table

Lets you view and access many of the parameters in the **Meas Setup** menus on one screen.

Dependencies	Does not appear in GSM/EDGE Mode

Auto Couple

Immediately puts all **Auto/Man** functions into **Auto**. **Auto Couple** is confined to the current measurement only. It does not affect other measurements in the Mode.

In the **Auto** state, **Auto/Man** functions are said to be “coupled”, meaning their values change as you make changes to other values in the measurement. This helps ensure accurate measurements and optimum dynamic range. **Auto Couple** is an immediate action function, and when it is executed, all the **Auto/Man** controls for the current measurement are set to **Auto**, and all measurement settings coupled to the **Auto/Man** parameters are automatically set to their optimal values.

For further details of measurement-specific settings (if any), see "Measurement-Specific Details" on page 1311 below.

Remote Command	`:COUPle ALL`
Example	`:COUP ALL`
Backwards Compatibility SCPI	`:COUPLE ALL | NONE`
Backwards Compatibility Notes	`:COUP:NONE` puts all Auto/Man parameters in manual mode, decoupling all the coupled instrument parameters. It is retained for backwards compatibility and is *not* recommended for making measurements or new designs

All **Auto/Man** parameter couplings in the measurement are set to **Auto**. This includes couplings that may be unavailable or grayed-out due to the current state. For example, in the Swept SA measurement, there is no **Auto/Man** coupling for **RBW** while in Zero Span. Nonetheless, if **Auto Couple** were executed while in Zero Span, it would set **RBW** to Auto "behind the scenes" so that, on exit from Zero Span, it would be in **Auto**.

Any **Auto/Man** selection specific (local) to the other measurements in the current Mode are not affected by **Auto Couple**. Any functions that are *not* coupled with other instrument parameters, such as ranging or leveling variables, such as **AutoRange** or **AutoScale**, are not affected.

Executing **Auto Couple** generates the informational message, "All Auto/Man functions have been set to Auto".

Each parameter, upon being set to **Auto**, selects and sets the appropriate auto-coupled value based on that parameter's coupling rules. The Dependency Resolver orchestrates the couplings for parameters that depend on one or more other parameters. The coupling and dependency rules for each parameter are defined in the section describing that parameter.

Executing **Auto Couple***does not* affect markers, marker functions, trace or display attributes, or any other instrument setting other than those specifically mentioned above.

Measurement-Specific Details

TOI (SA Mode only)

Parameters affected by **Auto Couple** are:

- Center Frequency Step
- Resolution Bandwidth
- Span/RBW Ratio
- Sweep Time
- Video BANDwidth VBW/RBW ratio
- Upper and Lower Tone (set to Sense)
- Zero span measurement Resolution Bandwidth
- Zero span measurement Dwell Time

Harmonics (SA Mode only)

Parameters affected by **Auto Couple** are:

- Resolution Bandwidth
- Fundamental Frequency

- Dwell Time
- Range Table Resolution Bandwidths
- Range Table Dwell Times

Meas Preset

Returns parameters for this measurement to their factory default settings.

Remote Command	:CONFigure:TXPower
Example	:CONF:TXP

3.7.8.2 Meas Method

Lets you choose and configure the Measurement Method.

Meas Method

There are two options for this parameter:

Above Threshold Level	THReshold	This measurement algorithm is used to capture a time record, and average only those points in the time record that exceed the user-specified threshold level. No attempt is made to position the burst, or to calculate/display burst widths. This can be used to measure continuous signals, or bursted signals where the Measured Burst Width algorithm is too restrictive
Measured Burst Width	BWIDth	This measurement algorithm uses the threshold level to calculate the burst center, and average those points that lie within a user-specified burst width that is centered upon the burst. The burst width parameter is described in more detail below

Remote Command	[:SENSe]:TXPower:METHod THReshold | BWIDth [:SENSe]:TXPower:METHod?
Example	:TXP:METH BWID :TXP:METH?
Dependencies	Only appears in Spectrum Analyzer and GSM/EDGE Modes
Preset	THReshold
State Saved	Yes

Range	Above Threshold Lvl|Burst Width
Backwards Compatibility SCPI	[:SENSe]:BPOWer:METHod

Burst Width Auto Detection

Turns Burst Width Auto Detection on or off.

Remote Command	[:SENSe]:TXPower:BURSt:AUTO ON | OFF | 1 | 0 [:SENSe]:TXPower:BURSt:AUTO?
Example	:TXP:BURS:AUTO 1 :TXP:BURS:AUTO?
Preset	ON
State Saved	Yes
Backwards Compatibility SCPI	[:SENSe]:BPOWer:BURSt:AUTO

Burst Width

When "Burst Width Auto Detection" on page 1313 is OFF, you may enter a fixed-time value in seconds, or alternatively specify the burst width as a percentage of the last measured burst width (result in bottom-left corner of second window).

Remote Command	[:SENSe]:TXPower:BURSt:WIDTh <time> [:SENSe]:TXPower:BURSt:WIDTh?
Example	:TXP:BURS:WIDT 10 :TXP:BURS:WIDT? :TXP:BURS:AUTO 0 :TXP:BURS:AUTO?
Dependencies	Grayed-out if "Meas Method" on page 1312 is 'Above Threshold Lvl' Gray-out message: 'Settings Conflict; Meas Method must be Measured Burst Width'
Couplings	Max value depends on Sweep Time, Res BW and RBW filter type
Preset	SA, GSM: 255.6 us
State Saved	Yes
Min/Max	100.0 ns/50 s

3.7.8.3 Meas Standard

Contains controls that allow you to preset the PowerSuite measurements to conform to various communications standards.

Radio Standard Presets

Lets you specify the Radio Standard to be used. Spectrum Analyzer Mode supports many Radio Standards. You can select the desired Radio Standard using the **Radio Std Presets** dialog, which is a cascading list of standards. When you have the selected the desired Standard, press **OK** and the measurement settings will change to reflect that standard.

Remote Command	`[:SENSe]:RADio:STANdard[:SELect] NONE | JSTD | IS95a | IS97D | IS98D | GSM | W3GPP | C2000MC1 | C20001X | NADC | PDC | BLUEtooth | TETRa | WL802DOT11A | WL802DOT11B | WL802DOT11G | HIPERLAN2 | DVBTLSN | DVBTGPN | DVBTIPN | FCC15 | SDMBSE | UWBINDOOR | LTEB1M4 | LTEB3M | LTEB5M | LTEB10M | LTEB15M | LTEB20M | WL11N20M | WL11N40M | WL11AC20M | WL11AC40M | WL11AC80M | WL11AC160M | WL11AX20M | WL11AX40M | WL11AX80M | WL11AX160M | WL11BE20M | WL11BE40M | WL11BE80M | WL11BE160M | WL11BE320M | WL11AD2G | WL11AY2G16 | WL11AY4G32 | WL11AY6G48 | WL11AY8G64 | NR5GFR1B100M` `[:SENSe]:RADio:STANdard[:SELect]?`
Example	`:RAD:STAN NONE` `:RAD:STAN?`
Dependencies	Some selections appear only when support license is valid
Couplings	By changing the radio standard, the measurement parameters will be automatically set to an appropriate default value
State Saved	Saved in instrument state

The **Radio** column in the table lets you specify the device to be used. It is a global setting that affects the Device selection, between Mobile (MS) and Base Station (BTS) settings, for all relevant PowerSuite measurements. The Device SCPI command has the same effect as a selection in the **Radio** column:

Remote Command	`[:SENSe]:RADio:STANdard:DEVice BTS | MS` `[:SENSe]:RADio:STANdard:DEVice?`
Example	`:RAD:STAN:DEV MS` `:RAD:STAN:DEV?`
Preset	`BTS`
State Saved	Saved in instrument state
Range	`BTS|MS`

Chart for Standard and Available Measurements

Note that not every measurement in Spectrum Analyzer Mode is available for every standard. The chart below describes which measurements are available for each Radio Standard.

For TOI or Harmonics measurements, *no* Radio Standards are available.

	Swept SA	CHP	OBW	ACP	CCDF	Burst Power	Spurious Emission	SEM	List Sweep
None	X	X	X	X	X	X	X	X	(X)
3GPP 5G NR	(X)	X	X	X	X			X	(X)
3GPP LTE	(X)	X	X	X	X			X	(X)
3GPP W-CDMA	(X)	X	X	X	X	X		X	(X)
GSM/EDGE	(X)				X	X			(X)
cdma2000 1x	(X)	X	X	X	X	X			(X)
IS-95A	(X)	X	X	X	X	X			(X)
J-STD-008	(X)	X	X	X	X	X			(X)
IS-97D/98D	(X)	X	X	X	X				(X)
NADC	(X)	X	X	X	X	X			(X)
PDC	(X)	X	X	X	X	X			(X)
Bluetooth	(X)				X	X			(X)
W-LAN 802.11a	(X)							X	(X)
W-LAN 802.11b	(X)							X	(X)
W-LAN 802.11g	(X)							X	(X)
W-LAN 802.11n	(X)	X	X		X			X	(X)
W-LAN 802.11ac	(X)	X	X		X			X	(X)
W-LAN 802.11ax	(X)	X	X		X			X	(X)
W-LAN 802.11be	(X)	X	X		X			X	(X)
W-LAN 802.11ad	(X)	X	X		X			X	(X)
W-LAN 802.11ay	(X)	X	X		X			X	(X)
W-LAN HiperLAN/2	(X)							X	(X)
TETRA	(X)	X		X					(X)
DVB-T L/SECAM/NICAM	(X)	X			X				(X)

	Swept SA	CHP	OBW	ACP	CCDF	Burst Power	Spurious Emission	SEM	List Sweep
FCC Part 15 Subpart F	(X)	X			X				(X)
DVBT-T G/PAL/NICAM	(X)	X			X				(X)
DVB-T I/PAL/NICAM	(X)						X		(X)
S-DMB System E	(X)	X	X	X					(X)
UWB Indoor	(X)						X		(X)

General Radio Standards

The table below lists the settings and provides an example for each general Radio Standard.

None	Command Example	:RAD:STAN NONE
	IBW	2 MHz
	Span	3 MHz
	RBW	Auto rules
	VBW	Auto rules
TETRA	Command Example	:RAD:STAN TETR
	IBW	18 kHz
	Span	27 kHz
	RBW	1.2 kHz
	VBW	Auto rules
	RRC Filter	On
	RRC Filter Alpha	0.35
FCC Part15 Subpart F	Command Example	:RAD:STAN FCC15

Video Radio Standards

The table below lists the settings and provides an example for each video Radio Standard.

DVB-T L/SECAM/NICAM	Command Example	:RAD:STAN DVBTLSN
	IBW	7.61 MHz
	Span	24 MHz
	RBW	3.9 kHz
	VBW	Auto rules
	Sweep Points	8001
DVB-T G/PAL/NICAM	Command Example	:RAD:STAN DVBTGPN
	IBW	7.61 MHz
	Span	24 MHz
	RBW	3.9 kHz
	VBW	Auto rules
	Sweep Points	8001
DVB-T I/PAL/NICAM	Command Example	:RAD:STAN DVBTIPN
	IBW	7.61 MHz
	Span	24 MHz
	RBW	3.9 kHz
	VBW	Auto rules
	Sweep Points	8001
S-DMB System E	Command Example	:RAD:STAN SDMBSE
	IBW	25 MHz
	Span	37.5 MHz
	RBW	360 kHz
	VBW	Auto rules
	RRC Filter	Off
	RRC Filter Alpha	0.22

Cellular Radio Standards

The table below lists the CHP settings and provides an example for each cellular Radio Standard.

GSM/EDGE	Command Example	:RAD:STAN GSM
3GPP 5G NR	Command Example	:RAD:STAN NR5GFR1B100M
	IBW	100 MHz
	Span	150 MHz
	RBW	Auto rules
	VBW	Auto rules

3GPP W-CDMA	Command Example	:RAD:STAN W3GPP
	IBW	5 MHz
	Span	7.5 MHz
	RBW	240 kHz
	VBW	Auto rules
	RRC Filter	Off
	RRC Filter Alpha	0.22
3GPP LTE 1.4 MHz	Command Example	:RAD:STAN LTEB1M4
	IBW	1.4 MHz
	Span	2.1 MHz
	RBW	Auto rules
	VBW	Auto rules
3GPP LTE 3 MHz	Command Example	:RAD:STAN LTEB3M
	IBW	3 MHz
	Span	4.5 MHz
	RBW	Auto rules
	VBW	Auto rules
3GPP LTE 5 MHz	Command Example	:RAD:STAN LTEB5M
	IBW	5 MHz
	Span	7.5 MHz
	RBW	Auto rules
	VBW	Auto rules
3GPP LTE 10 MHz	Command Example	:RAD:STAN LTEB10M
	IBW	10 MHz
	Span	15 MHz
	RBW	Auto rules
	VBW	Auto rules
3GPP LTE 15 MHz	Command Example	:RAD:STAN LTEB15M
	IBW	15 MHz
	Span	22.5 MHz
	RBW	Auto rules
	VBW	Auto rules

3GPP LTE 20 MHz	Command Example	:RAD:STAN LTEB20M
	IBW	20 MHz
	Span	30 MHz
	RBW	Auto rules
	VBW	Auto rules
cdma2000	Command Example	:RAD:STAN C20001X :RAD:STAN C2000MC1 :RAD:STAN? (Query always returns C20001X)
	IBW	1.23 MHz
	Span	1.845 MHz
	RBW	24 kHz
	VBW	Auto rules
IS-95A	Command Example	:RAD:STAN IS95
	IBW	1.23 MHz
	Span	1.845 MHz
	RBW	24 kHz
	VBW	Auto rules
J-STD-008	Command Example	:RAD:STAN JSTD
	IBW	1.23 MHz
	Span	1.845 MHz
	RBW	24 kHz
	VBW	Auto rules
NADC	Command Example	:RAD:STAN NADC
	IBW	32.8 kHz
	Span	49.2 kHz
	RBW	1.2 kHz
	VBW	Auto rules
PDC	Command Example	:RAD:STAN PDC
	IBW	21 kHz
	Span	31.5 kHz
	RBW	6.2 kHz
	VBW	Auto rules
IS-97D/98D	Command Example	:RAD:STAN IS97D :RAD:STAN IS98D :RAD:STAN IS95C :RAD:STAN?

	Query always returns `IS97D`
IBW	1.23 MHz
Span	1.845 MHz
RBW	24kHz
VBW	Auto rules

Band Class (IS-97D/98D only)

The following function is only available when you have selected the standard: IS-97D/98D. It lets you select the band class.

Remote Command	`[:SENSe]:RADio:STANdard:BAND:CLASs BC0 | BC1` `[:SENSe]:RADio:STANdard:BAND:CLASs?`
Example	`:RAD:STAN:BAND:CLAS BC0` `:RAD:STAN:BAND:CLAS?`
Preset	`BC0`
State Saved	Saved in instrument state
Range	0 (800 MHz Band)|1 (1900 MHz Band)

Wireless Radio Standards

The table below lists the CHP settings and provides an example for each wireless Radio Standard.

WLAN 802.11a	Command Example	:RAD:STAN WL802DOT11A
	IBW	20 MHz
	Span	30 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11g	Command Example	:RAD:STAN WL802DOT11G
	IBW	20 MHz
	Span	30 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11b	Command Example	:RAD:STAN WL802DOT11B
	IBW	25 MHz
	Span	37.5 MHz
	RBW	100 kHz
	VBW	Auto rules

WLAN 802.11n 20 MHz	Command Example	:RAD:STAN WL11N20M
	IBW	20 MHz
	Span	30 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11n 40 MHz	Command Example	:RAD:STAN WL11N40M
	IBW	40 MHz
	Span	60 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11ac 20 MHz	Command Example	:RAD:STAN WL11AC20M
	IBW	20 MHz
	Span	30 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11ac 40 MHz	Command Example	:RAD:STAN WL11AC40M
	IBW	40 MHz
	Span	60 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11ac 80 MHz	Command Example	:RAD:STAN WL11AC80M
	IBW	80 MHz
	Span	120 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11ac 160 MHz	Command Example	:RAD:STAN WL11AC160M
	IBW	160 MHz
	Span	240 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11ax 20 MHz	Command Example	:RAD:STAN WL11AX20M
	IBW	20 MHz
	Span	30 MHz
	RBW	100 kHz
	VBW	Auto rules

WLAN 802.11ax 40 MHz	Command Example	:RAD:STAN WL11AX40M
	IBW	40 MHz
	Span	60 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11ax 80 MHz	Command Example	:RAD:STAN WL11AX80M
	IBW	80 MHz
	Span	120 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11ax 160 MHz	Command Example	:RAD:STAN WL11AX160M
	IBW	160 MHz
	Span	240 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11be 20 MHz	Command Example	:RAD:STAN WL11BE20M
	IBW	20 MHz
	Span	30 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11be 40 MHz	Command Example	:RAD:STAN WL11BE40M
	IBW	40 MHz
	Span	60 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11be 80 MHz	Command Example	:RAD:STAN WL11BE80M
	IBW	80 MHz
	Span	120 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11be 160 MHz	Command Example	:RAD:STAN WL11BE160M
	IBW	160 MHz
	Span	240 MHz
	RBW	100 kHz
	VBW	Auto rules

WLAN 802.11be 320 MHz	Command Example	:RAD:STAN WL11BE320M
	IBW	320 MHz
	Span	480 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11ad 2 GHz	Command Example	:RAD:STAN WL11AD2G
	IBW	2.16 GHz
	Span	3.24 GHz
	RBW	1 MHz
	VBW	Auto rules
WLAN 802.11ay 2.16 GHz	Command Example	:RAD:STAN WL11AY2G16
	IBW	2.16 GHz
	Span	3.24 GHz
	RBW	1 MHz
	VBW	Auto rules
WLAN 802.11ay 4.32 GHz	Command Example	:RAD:STAN WL11AY4G32
	IBW	4.32 GHz
	Span	6.48 GHz
	RBW	1 MHz
	VBW	Auto rules
WLAN 802.11ay 6.48 GHz	Command Example	:RAD:STAN WL11AY6G48
	IBW	6.48 GHz
	Span	9.72 GHz
	RBW	1 MHz
	VBW	Auto rules
WLAN 802.11ay 8.64 GHz	Command Example	:RAD:STAN WL11AY8G64
	IBW	8.64 GHz
	Span	12.96 GHz
	RBW	1 MHz
	VBW	Auto rules
3GPP 5G NR 5G NR FR1 100MHz	Command Example	:RAD:STAN NR5GFR1B100M
	IBW	100 MHz
	Span	150 MHz
	RBW	Auto rules
	VBW	Auto rules

WLAN HiperLAN/2	Command Example	`:RAD:STAN HIPERLAN2`
	UWB Indoor	Command Example RAD:STAN UWBINDOOR
	Bluetooth	Command Example RAD:STAN BLUE

Packet Type (Bluetooth only)

The command below sets the packet type for the Bluetooth measurement

Remote Command	`[:SENSe]:RADio:STANdard:PACKet DH1 | DH3 | DH5` `[:SENSe]:RADio:STANdard:PACKet?`
Example	`:RAD:STAN:PACK DH1` `:RAD:STAN:PACK?`
Notes	The packet length is: DH1 366 µs

	DH3	1622 µs
	DH5	2870 µs
Preset	DH1	
State Saved	Saved in instrument state	
Range	DH1 | DH3 | DH5	

Radio Standard Presets Hierarchy

General	None	
	TETRA	BTS
		MS
	FCC Part 15 Subpart F	
	APCO-25	
	DMR	
	dPMR	
Video	DVB-T	L/SECAM/NICAM
		G/PAL/NICAM
		I/PAL/NICAM
	S-DMB System E	

Cellular	3GPP 5G NR	BTS	FR1 100 MHz
		MS	FR1 100 MHz
	3GPP LTE	BTS	1.4 MHz (6 RB)
			3 MHz (15 RB)
			5 MHz (25 RB)
			10 MHz (50 RB)
			15 MHz (75 RB)
			20 MHz (100 RB)
		MS	1.4 MHz (6 RB)
			3 MHz (15 RB)
			5 MHz (25 RB)
			10 MHz (50 RB)
			15 MHz (75 RB)
			20 MHz (100 RB)
	3GPP W-CDMA	BTS	
		MS	
	GSM/EDGE	BTS	
		MS	
	cdma2000 1x	BTS	
		MS	
	IS-95A	BTS	
		MS	
	J-STD-008	BTS	
		MS	
	IS-97D/98D	BTS	Band Class 0
			Band Class 1
		MS	Band Class 0
			Band Class 1
	NADC	BTS	
		MS	
	PDC	BTS	
		MS	

Wireless	W-LAN	802.11a	
		802.11b	
		802.11g	
		802.11n	20 MHz
			40 MHz
		802.11ac	20 MHz
			40 MHz
			80 MHz
			160 MHz
		802.11ax	20 MHz
			40 MHz
			80 MHz
			160 MHz
		802.11be	20 MHz
			40 MHz
			80 MHz
			160 MHz
			320 MHz
		802.11ad	
		802.11ay	2.16 GHz
			4.32 GHz
			6.48 GHz
			8.64 GHz
		HiperLAN/2	
	Bluetooth	DH1	
		DH3	
		DH5	
	UWB Indoor		

Each Radio Standard has the preset parameter set for the measurement.

When a standard is selected, the default value of the measurement parameters are overwritten by those preset values.

When the standard is NONE, or the standard does not specify the firm RBW requirement, then the table displays “auto”, and the following definition is used to compute the proper RBW setting:

1. Compute the guard-band = [Offset Freq A] - 0.5*([Chan Integ BW] + [Ref BW])

2. Divide by 4.5. Call the result GuardbandGoalRBW

3. Compute the greater of the Reference and Offset A integration bandwidths. Divide that result by 100 and call it the ChannelWidthGoalRBW
4. Find the smallest integration bandwidth of any of the offsets; divide it by two and call the result IntegBWGoalRBW
5. Compute AutoRBWGoal = min(IntegBWGoal, max(GuardbandGoalRBW, ChannelWidthGoalRBW))
6. Compute the RBW to be selected to be the largest available RBW that is smaller than AutoRBWGoal

Measurements that are unavailable for a particular Radio Standard are grayed-out. Radio Standards that are unavailable for the current active measurement are also grayed-out.

However, remote operations, such as `:CONF` allow the measurement to be active even if it is not a supported format. In this case, the measurement configuration should be set to `NONE`.

Enable Non-Std Meas

Lets you specify whether all measurements and radio standards are enabled or not.

By default, **Enable Non-Std Measurements** is set to `NO`, so you can select only valid combinations of preset available standards and measurements. Combinations of measurement and standard that would have no valid preset value are grayed-out.

When **Enable Non-Std Measurements** is set to `YES`, all measurements and standard selections are enabled, so you can select any combination.

NOTE **If you select an unavailable measurement or unavailable radio standard using the Enable Non-Std Meas control, the measurement results may not conform to the selected standard.**

Remote Command	`[:SENSe]:RADio:STANdard:EAMeas YES | NO` `[:SENSe]:RADio:STANdard:EAMeas?`
Example	`:RAD:STAN:EAM YES` `:RAD:STAN:EAM?`
Preset	`NO`
State Saved	Saved in instrument state
Range	`YES|NO`

3.7.8.4 Global

The controls in this menu apply to all Modes in the instrument.

Some controls (for example, "Global Center Freq" on page 2013) allow you to switch certain Meas Global parameters to a Mode Global state. These switches apply to all Modes that support global settings. For example, no matter what Mode you are in when you set **Global Center Freq** to ON, it applies to all Modes that support Global settings.

Other controls (for example, **Extend Low Band**) are actually set in this menu, but apply to all Modes.

Global Center Freq

The software maintains a Mode Global value called **Global Center Freq**.

When **Global Center Freq** is switched ON, the current Mode's center frequency is copied into the **Global Center Frequency**, and from then on all Modes that support global settings use the **Global Center Frequency**, so you can switch between any of these Modes and the **Center Frequency** remains unchanged.

Adjusting the **Center Frequency** of any Mode that supports Global Settings, while **Global Center Freq** is ON, modifies the **Global Center Freq**.

When **Global Center Freq** is switched OFF, the **Center Frequency** of the current Mode is unchanged, but now the **Center Frequency** of each Mode is once again independent.

When **Mode Preset** is pressed while **Global Center Freq** is ON, the **Global Center Freq** is preset to the preset **Center Frequency** of the current Mode.

This function resets to OFF when "Restore Defaults" on page 2016 is pressed, or when **System**, **Restore Defaults**, **All Modes** is pressed.

Remote Command	`:INSTrument:COUPle:FREQuency:CENTer ALL | NONE` `:INSTrument:COUPle:FREQuency:CENTer?`
Example	`:INST:COUP:FREQ:CENT ALL` `:INST:COUP:FREQ:CENT?`
Preset	Set to OFF on **Global** Settings, **Restore Defaults** and **System, Restore Defaults, All Modes**
Range	ALL|NONE

Preset	OFF
Backwards Compatibility SCPI	`:GLOBal:FREQuency:CENTer[:STATe] 1 | 0 | ON | OFF` `:GLOBal:FREQuency:CENTer[:STATe]?`

Global EMC Std

When this control is switched ON, the current Mode's EMC Std is copied into the **Global EMC Std**, and from then on all Modes that support global settings use the

Global EMC Std, so you can switch between any of these Modes and the EMC Std remains unchanged.

Adjusting the EMC Std of any Mode that supports Global settings, while **Global EMC Std** is ON modifies the **Global EMC Std**.

When **Global EMC Std** is switched OFF, the EMC Std of the current Mode remains unchanged, but now the EMC Std of each Mode is once again independent. When **Mode Preset** is pressed while **Global EMC Std** is ON, **Global EMC Std** is preset to the preset EMC Std of the current Mode.

This function resets to OFF when "Restore Defaults" on page 2016 is pressed, or when **System, Restore Defaults, All Modes** is pressed.

Remote Command	:INSTrument:COUPle:EMC:STANdard ALL | NONE :INSTrument:COUPle:EMC:STANdard?
Example	:INST:COUP:EMC:STAN ALL :INST:COUP:EMC:STAN?
Dependencies	Only available if Option EMC is installed
Preset	Set to OFF on **Global** Settings, **Restore Defaults** and **System, Restore Defaults, All Modes**
Range	ALL | NONE

Global Limit Lines (Freq and Amptd)

When this control is set to ALL, the current Mode's Limit Line is copied into the **Global Limit Lines**, and from there to all Modes that support Global settings and use **Global Limit Lines**, so you can switch between any of these Modes and the Limit Lines remain unchanged.

Adjusting the Limit Lines of any Mode that supports **Global** Settings, while **Global Limit Lines** is ALL, modifies the **Global Limit Lines**.

When **Global Limit Lines** is set to NONE, the Limit Lines of the current Mode are unchanged, but now the Limit Lines of each Mode are once again independent. When **Mode Preset** is pressed while **Global Limit Lines** is ALL, **Global Limit Lines** is preset to the preset Limit Lines of the current Mode.

This function is reset to NONE when "Restore Defaults" on page 2016 is pressed, or when **System**, **Restore Defaults**, **All Modes** is pressed.

Remote Command	:INSTrument:COUPle:LLINe ALL | NONE :INSTrument:COUPle:LLINe?
Example	:INST:COUP:LLIN ALL | NONE :INST:COUP:LLIN?
Preset	Set to OFF on **Global** Settings, **Restore Defaults** and **System, Restore Defaults, All Modes**
Range	ALL | NONE

Extend Low Band

The software maintains a Mode Global value called **Extend Low Band**.

Under the current sweep configuration crossing over two bands, when **Extend Low Band** is turned `ON`, the instrument checks whether one band can cover the whole sweep frequency range or not. If it can, then the instrument locks the band; otherwise, it does nothing (the band crossover occurs).

This function does *not* work when **Band Lock** under **System** > **Service** > **Lock Functions** is not -1 (no Band Lock). In that case, **Band Lock** takes priority over **Extend Low Band**.

This function resets to `OFF` when "Restore Defaults" on page 2016 is pressed, or when **System**, **Restore Defaults**, **All Modes** is pressed.

Remote Command	`:INSTrument:COUPle:FREQuency:BAND:EXTend 0 | 1 | ON | OFF` `:INSTrument:COUPle:FREQuency:BAND:EXTend?`
Example	`:INST:COUP:FREQ:BAND:EXT 1` `:INST:COUP:FREQ:BAND:EXT?`
Preset	Set to `OFF` by **Global** Settings > **Restore Defaults** and **System** > **Restore Defaults** > **All Modes**
Range	`ON|OFF`

Restore Defaults

Resets all functions in the **Global** settings menu to `OFF`. Pressing **System**, **Restore Defaults**, **All Modes** has the same effect.

Remote Command	`:INSTrument:COUPle:DEFault`
Example	`:INST:COUP:DEF`
Backwards Compatibility SCPI	`:GLOBal:DEFault`

3.7.9 Sweep

Accesses controls to configure and control the acquisition of data, and the X-axis parameters of the instrument.

Depending on the selected mode and measurement, these controls might include: **Sweep Time**, **Continuous/Single**, **Pause/Resume**, **X Scale** and **Number of Points**.

3.7.9.1 Sweep/Control

Accesses controls that let you operate the sweep and control functions of the instrument, such as **Sweep Time** and **Continuous/Single**.

Sweep Time

Sets the sweep time to capture and show on screen.

Remote Command	`[:SENSe]:TXPower:SWEep:TIME <time>` `[:SENSe]:TXPower:SWEep:TIME?`
Example	`:TXP:SWE:TIME 10` `:TXP:SWE:TIME?`
Dependencies	Only appears in Spectrum Analyzer Mode
Preset	640 us
State Saved	Yes
Min	1.0e-6
Max	50

Sweep/Measure

Lets you toggle between **Continuous** and **Single** sweep or measurement operation. The single/continuous state is Meas Global, so the setting affects all measurements.

The front-panel key **Single/Cont** performs exactly the same function

See "More Information" on page 1333

Remote Command	`:INITiate:CONTinuous OFF | ON | 0 | 1` `:INITiate:CONTinuous?`

Example	Put instrument into **Single** measurement operation:
	`:INIT:CONT 0`
	`:INIT:CONT OFF`
	Put instrument into **Continuous** measurement operation:
	`:INIT:CONT 1`
	`:INIT:CONT ON`

Preset	`ON` Note that `:SYST:PRES` sets `:INIT:CONT` to `ON`, but `*RST` sets `:INIT:CONT` to `OFF`
State Saved	Saved in instrument state
Annunciation	The **Single/Continuous** icon in the Meas Bar changes depending on the setting:

	– A line with an arrow is **Single** – A loop with an arrow is **Continuous**
Backwards Compatibility Notes	X-Series A-models had **Single** and **Cont** hardkeys in place of the **SweepSingleCont** softkey. In the X-Series A-models, if in single measurement, the **Cont** hardkey (and `INIT:CONT ON`) switched to continuous measurement, but never restarted a measurement and never reset a sweep X-Series B-models have a **Cont/Single** toggle control instead of **Single** and **Cont** hardkeys, but it is still true that, if in single measurement, the **Cont/Single** toggle control never restarts a measurement and never resets a sweep

More Information

Continuous Mode	The instrument takes repetitive sweeps, averages, measurements, etc., when in continuous mode. If in average or Max/Min Hold, and the average/hold count reaches the **Average/Hold Num**, the count stops incrementing, but the instrument keeps sweeping See the **Trace** key description under **Trace Average** for the averaging formula used both before and after the **Average/Hold Num** is reached. The trigger condition must be met prior to each sweep The type of trace processing for multiple sweeps is set under the **Trace** key, with choices of **Trace Average**, **Max Hold**, or **Min Hold**
Single Mode	The instrument takes a single sweep when in **Single** mode, or if in average or Max/Min Hold, or if there is a **Waterfall** window displayed, it takes multiple sweeps until the average/hold count reaches the **Average/Hold Num**, then the count stops incrementing, and the instrument stops sweeping See the **Trace** key description under **Trace Average** for the averaging formula used. The trigger condition must be met prior to the sweep The type of trace processing for multiple sweeps is set under the **Trace** key, with choices of **Trace Average**, **Max Hold**, or **Min Hold**

If the instrument is in **Single** measurement mode, pressing the **Cont/Single** toggle control does not zero the count and does not cause the sweep to be reset; the only action is to put the instrument into Continuous measurement operation.

If the instrument is already in **Continuous** sweep:

– `:INIT:CONT 1` has no effect

– `:INIT:CONT 0` places the instrument in Single Sweep but has no effect on the current sequence until k = N, at which point the current sequence will stop and the instrument will go to the idle state

See "Restart" on page 2018 for details of `:INIT:IMMediate`.

If the instrument is already in **Single** sweep, `:INIT:CONT OFF` has no effect.

If the instrument is already in **Single** sweep, then pressing **Cont/Single** in the middle of a sweep does not restart the sweep or sequence. Similarly, pressing **Cont/Single** does not restart the sweep or sequence if the sweep is not in the idle state (for example, if you are taking a very slow sweep, or the instrument is waiting for a trigger). Even though pressing **Cont/Single** in the middle of a sweep does not restart the sweep, sending `:INIT:IMM` *does* reset it.

If the instrument is in **Single** sweep, and *not* Averaging/Holding, and you want to take one more sweep, press **Restart**.

If the instrument is in **Single** sweep, *and* Averaging/Holding, and you want to take one more sweep without resetting the Average trace or count, go to **Meas Setup** and increment the average count by 1 by pressing the **Step-Up** key while **Average/Hold Num** is the active function. You can also do this by sending `:CALC:AVER:TCON UP`.

Restart

Restarts the current sweep, or measurement, or set of averaged/held sweeps or measurements. If you are Paused, pressing **Restart** performs a Resume.

The front-panel key **Restart** performs exactly the same function.

The **Restart** function is accessed in several ways:

- Pressing the **Restart** key
- Sending `:INIT:IMM`
- Sending `:INIT:REST`

See "More Information" on page 1335

Remote Command	`:INITiate[:IMMediate]` `:INITiate:RESTart`
Example	`:INIT:IMM` `:INIT:REST`
Notes	`:INIT:REST` and `:INIT:IMM` perform exactly the same function
Couplings	Resets average/hold count k. For the first sweep overwrites all active (update = on) traces with new current data. For application modes, it resets other parameters as required by the measurement
Status Bits/OPC dependencies	This is an Overlapped command The `STATus:OPERation` register bits 0 through 8 are cleared , *except* bit 6 (Waiting for Periodic Sync). Initiating a measurement and Waiting for Periodic Sync could be asynchronous The `STATus:QUEStionable` register bit 9 (`INTegrity` sum) is cleared The `SWEEPING` bit is set The `MEASURING` bit is set
Backwards Compatibility	For Spectrum Analysis Mode in ESA and PSA, the **Restart** hardkey and the `:INIT:REST` command restarted trace averages (displayed average count reset to 1) for a trace in **Clear Write**, but did not

Notes	restart **Max Hold** and **Min Hold** In X-Series, the **Restart** hardkey and the `:INIT:REST` command restart not only **Trace Average**, but **MaxHold** and **MinHold** traces as well

More Information

The **Restart** function first aborts the current sweep or measurement as quickly as possible. It then resets the sweep and trigger systems, sets up the measurement and initiates a new data measurement sequence with a new data acquisition (sweep) taken once the trigger condition is met.

If the instrument is in the process of aligning when a **Restart** is executed, the alignment finishes before the restart function is performed.

Even when set for **Single** operation, multiple sweeps may be taken when **Restart** is pressed (for example, when averaging/holding is on). Thus, when we say that **Restart** "restarts a measurement", depending on the current settings, we may mean that it:

- Restarts the current sweep
- Restarts the current measurement
- Restarts the current set of sweeps if any trace is in Trace Average, Max Hold or Min Hold
- Restarts the current set of measurements if Averaging, or Max Hold, or Min Hold is on for the measurement

If there is no Average or Max/Min Hold function (no trace in Trace Average or Hold, or **Average/Hold Num** set to 1), and no **Waterfall** window is being displayed, a single sweep is equivalent to a single measurement. A single sweep is taken after the trigger condition is met; and the instrument stops sweeping once that sweep has completed. However, with **Average/Hold Num** >1, and at least one trace set to Trace Average, Max Hold, or Min Hold, or a **Waterfall** window being displayed, multiple sweeps/data acquisitions are taken for a single measurement. The trigger condition must be met prior to each sweep. The sweep is stopped when the average count k equals the number N set for **Average/Hold Num**.

Once the full set of sweeps has been taken, the instrument goes to the idle state. To take one more sweep without resetting the average count, increment the average count by 1, by pressing the **Step-Up** key while **Average/Hold Number** is the active function, or by sending the remote command `:CALC:AVER:TCON UP`.

Trace Update

The numeric results are not blanked at any time during the restart cycle.

For slow sweeps (see **Trace Update** section in **Trace/Detector**), the traces are updated real-time during the sweep. There may be a special circumstance in application mode measurements where an exception is made and the traces and/or results need to be blanked before displaying the new results.

To summarize, the following list shows what happens to the trace data on various events:

Event	Trace Effect
Clear/Write pressed (even if already in Clear/Write)	Set to mintracevalue
Max Hold pressed (even if already in Max Hold)	Set to mintracevalue
Min Hold pressed (even if already in Min Hold)	Set to maxtracevalue
Trace Average pressed (even if already in Trace Average)	Trace data unaffected but start new sweep/avg/hold
Restart pressed	Trace data unaffected but start new sweep/avg/hold
Parameter requiring restart changed (e.g., RBW)	Trace data unaffected but start new sweep/avg/hold

Sweep and Trigger Reset

Resetting the sweep system resets the average/hold count k to 0. It also resets the set point counter to 0. Resetting the trigger system resets the internal auto trig timer to the value set by the **Auto Trig** control.

Averaging

The weighting factor used for averaging is k. This k is also the average/hold count for how many valid sweeps (data acquisitions) have been done. This k is used for comparisons with N, as those comparisons always needs to be based on valid completed sweeps.

The displayed average/hold, K, shows the count for the sweep (data acquisition) in progress. K = k + 1, with a limit of N. The displayed value K changes from its previous value to 1 as soon as the trigger condition for the first data acquisition (sweep) is met.

Pause/Resume

Pauses a measurement after the current data acquisition is complete.

When paused, the label on the control changes to **Resume**. Pressing **Resume** un-pauses the measurement. When paused, pressing **Restart** performs a Resume.

Remote Command	:INITiate:PAUSe :INITiate:RESume
Example	:INIT:PAUS :INIT:RES
Dependencies	Not displayed in Modes that do not support pausing
Annotation	Only on control

Abort (Remote Command Only)

Stops the current measurement. Aborts the current measurement as quickly as possible, resets the sweep and trigger systems, and puts the measurement into an "idle" state. If the instrument is in the process of aligning when :ABORt is sent, the alignment finishes *before* the abort function is performed, so :ABORt does not abort an alignment.

If the instrument is set for **Continuous** measurement, it sets up the measurement and initiates a new data measurement sequence with a new data acquisition (sweep) taken once the trigger condition is met.

If the instrument is set for **Single** measurement, it remains in the "idle" state until an :INIT:IMM command is received.

Remote Command	:ABORt
Example	:ABOR
Notes	If :INIT:CONT is ON, then a new continuous measurement will start immediately, with sweep (data acquisition) occurring once the trigger condition has been met If :INIT:CONT is OFF, then :INIT:IMM is used to start a single measurement, with sweep (data acquisition) occurring once the trigger condition has been met
Dependencies	For continuous measurement, :ABORt is equivalent to the **Restart** key Not all measurements support this command
Status Bits/OPC dependencies	The STATus:OPERation register bits 0 through 8 are cleared , *except* bit 6 (Waiting for Periodic Sync). Initiating a measurement and Waiting for Periodic Sync could be asynchronous The STATus:QUEStionable register bit 9 (INTegrity sum) is cleared Since all the bits that feed into OPC are cleared by :ABORt, the Abort command will cause the *OPC query to return true

3.7.9.2 X Scale

Accesses controls that enable you to set the horizontal scale parameters.

Ref Value

Enables you to set the display X Reference Value.

Remote Command	`:DISPlay:TXPower:WINDow[1]:TRACe:X[:SCALe]:RLEVel <time>` `:DISPlay:TXPower:WINDow[1]:TRACe:X[:SCALe]:RLEVel?`
Example	`:DISP:TXP:WIND:TRAC:X:RLEV 1s` `:DISP:TXP:WIND:TRAC:X:RLEV?`
Couplings	If X "Auto Scaling" on page 1339 is ON, this value is automatically determined by the measurement result. When you set a value manually, X **Auto Scaling** automatically changes to OFF
Preset	0.000 s
State Saved	Saved in instrument state
Min/Max	-10.0 s / 10.0s
Annotation	<value> s bottom left of graph
Backwards Compatibility SCPI	`:DISPlay:TXPower:VIEW[1]:WINDow[1]:TRACe:X[:SCALe]:RLEVel`

Scale/Div

Enables you to set the display X scale/division value.

Remote Command	`:DISPlay:TXPower:WINDow[1]:TRACe:X[:SCALe]:PDIVision <time>` `:DISPlay:TXPower:WINDow[1]:TRACe:X[:SCALe]:PDIVision?`
Example	`:DISP:TXP:WIND:TRAC:X:PDIV 1ms` `:DISP:TXP:WIND:TRAC:X:PDIV?`
Couplings	If X "Auto Scaling" on page 1339 is ON, this value is automatically determined by the measurement result. When you set a value manually, X **Auto Scaling** automatically changes to OFF
Preset	640.0 us
State Saved	Saved in instrument state
Min	1.00 ns
Max	1.0 s
Backwards Compatibility SCPI	`:DISPlay:TXPower:VIEW[1]:WINDow[1]:TRACe:X[:SCALe]:PDIVision`

Ref Position

Sets the reference position for the X axis to Left, Center or Right.

Remote Command	`:DISPlay:TXPower:WINDow[1]:TRACe:X[:SCALe]:RPOSition LEFT | CENTer | RIGHt` `:DISPlay:TXPower:WINDow[1]:TRACe:X[:SCALe]:RPOSition?`
Example	`:DISP:TXP:WIND:TRAC:X:RPOS LEFT` `:DISP:TXP:WIND:TRAC:X:RPOS?`
Preset	`LEFT`
State Saved	Saved in instrument state
Range	`LEFT|CENTer|RIGHt`
Backwards Compatibility SCPI	`:DISPlay:TXPower:VIEW[1]:WINDow[1]:TRACe:X[:SCALe]:RPOSition`

Auto Scaling

Toggles the scale coupling function On or Off.

Remote Command	`:DISPlay:TXPower:WINDow[1]:TRACe:X[:SCALe]:COUPle 0 | 1 | OFF | ON` `:DISPlay:TXPower:WINDow[1]:TRACe:X[:SCALe]:COUPle?`
Example	`:DISP:TXP:WIND:TRAC:X:COUP OFF` `:DISP:TXP:WIND:TRAC:X:COUP?`
Couplings	When `ON`, and the **Restart** front-panel key is pressed, this function automatically determines the scale per division and reference values based on the measurement results When you set the value of either "Scale/Div" on page 1231 or "Ref Value" on page 1231 manually, **Auto Scaling** automatically changes to `OFF`
Preset	`ON`
State Saved	Saved in instrument state
Range	`OFF|ON`
Backwards Compatibility SCPI	`:DISPlay:TXPower:VIEW[1]:WINDow[1]:TRACe:X[:SCALe]:COUPle`

3.7.10 Trace

Lets you control the acquisition, display, storage, detection and manipulation of trace data for the available traces.

3.7.10.1 Trace Control

The controls on this tab allow you to select display of the Max Hold trace and the Min Hold Trace.

Max Hold Trace

Enables you to select visible/invisible Max Hold Trace.

Remote Command	`:DISPlay:TXPower:WINDow[1]:TRACe:MAXHold[:STATe] ON | OFF | 1 | 0` `:DISPlay:TXPower:WINDow[1]:TRACe:MAXHold[:STATe]?`
Example	`:DISP:TXP:WIND:TRAC:MAXH ON` `:DISP:TXP:WIND:TRAC:MAXH?`
Couplings	Selecting `[:SENSe]:TXPower:AVERage:TYPE MAXimum` forces this parameter to ON
Preset	OFF
State Saved	Yes
Range	ON|OFF
Backwards Compatibility SCPI	`:DISPlay:TXPower:VIEW[1]:WINDow[1]:TRACe:MAXHold[:STATe]`

Min Hold Trace

Enables you to select visible/invisible Min Hold Trace.

Remote Command	`:DISPlay:TXPower:WINDow[1]:TRACe:MINHold[:STATe] ON | OFF | 1 | 0` `:DISPlay:TXPower:WINDow[1]:TRACe:MINHold[:STATe]?`
Example	`:DISP:TXP:WIND:TRAC:MINH ON` `:DISP:TXP:WIND:TRAC:MINH?`
Couplings	Selecting `[:SENSe]:TXPower:AVERage:TYPE MINimum` forces this parameter to ON
Preset	OFF
State Saved	Yes
Range	ON|OFF
Backwards Compatibility SCPI	`:DISPlay:TXPower:VIEW[1]:WINDow[1]:TRACe:MINHold[:STATe]`

3.8 Spurious Emissions Measurement

The Spurious Emissions measurement identifies and determines the power level of spurious emissions in certain frequency bands.

Spurious Emissions Measurement Commands

The following commands can be used to retrieve the measurement results:

:CONFigure:SPURious

:CONFigure:SPURious:NDEFault

:INITiate:SPURious

:FETCh:SPURious[n]?

:READ:SPURious[n]?

:MEASure:SPURious[n]?

Remote Command Results for Spurious Emissions Measurement

The following table describes the results returned by the `:FETCh`, `:MEASure`, and `:READ` queries listed above, according to the index value `n`. Note that these queries are not available when viewing the Range Table.

The value of the constant `SCPI_NAN`, mentioned below, is 9.91E37.

n	Return Value
1 or omitted	Returns a variable-length (1+6*Spurs – up to 1201 entries) comma separated list containing detailed information in the following format: Number of spurs in following list (Integer) *[Repeat the following for each spur]* – Spur # – Range # Spur was located (Integer) – Frequency of Spur (Hz, Float64) – Amplitude of Spur (dBm, Float32) – Absolute Limit (dBm, Float32) – Pass or Fail (1|0, Boolean)
2 – 21 (Average Trace)	Regardless of the Trace selection, returns a comma separated list of the average trace data for the selected range (where range number = n - 1) using Detector 1. If selected range is not active, `SCPI_NAN` is returned for each trace data element

n	Return Value
22	Returns the number of spurs found for the selected Measured Trace
23 – 42 (Average Trace)	Regardless of the Trace selection, returns a comma separated list of the average trace data for the selected range (where range number = n - 22) using Detector 2. If selected range is not active or Detector 2 selection is off, SCPI_NAN is returned for each trace data element
43 – 62 (Maximum Hold Trace)	Regardless of the Trace selection, returns a comma separated list of the maximum hold trace data for the selected range (where range number = n - 42) using Detector 1. If selected range is not active, SCPI_NAN is returned for each trace data element
63 – 82 (Minimum Hold Trace)	Regardless of the Trace selection, returns a comma separated list of the minimum hold trace data for the selected range (where range number = n - 62) using Detector 1. If selected range is not active, SCPI_NAN is returned for each trace data element
83-102	Reserved
103-122	Reserved
123-142 (Clear/Write Trace)	Regardless of the Trace selection, returns a comma separated list of the clear/write trace data for the selected range (where range number = n - 122) using Detector 1. If selected range is not active, SCPI_NAN is returned for each trace data element
143-162 (Clear/Write Trace)	Regardless of the Trace selection, returns a comma separated list of the clear/write trace data for the selected range (where range number = n - 142) using Detector 2. If selected range is not active or Detector 2 selection is off, SCPI_NAN is returned for each trace data element
163-182 (Trace 1)	Returns a comma separated list of the trace data of Trace 1 for the selected range (where range number = n - 162). If selected range is not active, SCPI_NAN is returned for each trace data element
183-202 (Trace 2)	Returns a comma separated list of the trace data of Trace 2 for the selected range (where range number = n - 182). If selected range is not active, SCPI_NAN is returned for each trace data element
203-222 (Trace 3)	Returns a comma separated list of the trace data of Trace 3 for the selected range (where range number = n - 202). If selected range is not active, SCPI_NAN is returned for each trace data element

3.8.1 Views

The Spurious Emissions measurement has two views:

1. Graph + Metrics (RESult)
2. ALL Ranges

These Views are multiple-window Views. When in a multiple window View, you select a window by touching it. The menu controls may sometimes change depending on which window is selected.

Remote Command	`:DISPlay:SPURious:VIEW[:SELect] RESult | ALL` `:DISPlay:SPURious:VIEW[:SELect]?`
Example	`:DISP:SPUR:VIEW RANG` `:DISP:SPUR:VIEW?`
Preset	`RESult`
State Saved	No
Range	Graph + Metrics | All Ranges

3.8.1.1 Graph + Metrics

Windows: "Graph" on page 1344,"Table" on page 1345

Select Graph + Metrics to view measurement results.

- The upper window displays a trace of the range that contains the currently selected spur
- The lower window displays a list of spurs detected in a measurement cycle. The currently selected spur, which is highlighted, can be changed by the Spur control in the Meas Setup menu

Example	`:DISP:SPUR:VIEW RES`

3.8.1.2 All Ranges

Windows: "Graph" on page 1344,"All Range Table" on page 1346

Select All Ranges to view measurement results for all the ranges.

- The upper window displays a merged trace of all the ranges
- The lower window displays a list of spurs detected in a measurement cycle. The currently selected spur, which is highlighted, can be changed by the Spur control in the Meas Setup menu

Example	`:DISP:SPUR:VIEW ALL`

3.8.2 Windows

Four windows are available in the Spurious Emissions measurement:

1. "Graph" on page 1344
2. "Table" on page 1345
3. "All Range Table" on page 1346
4. "Gate" on page 1346

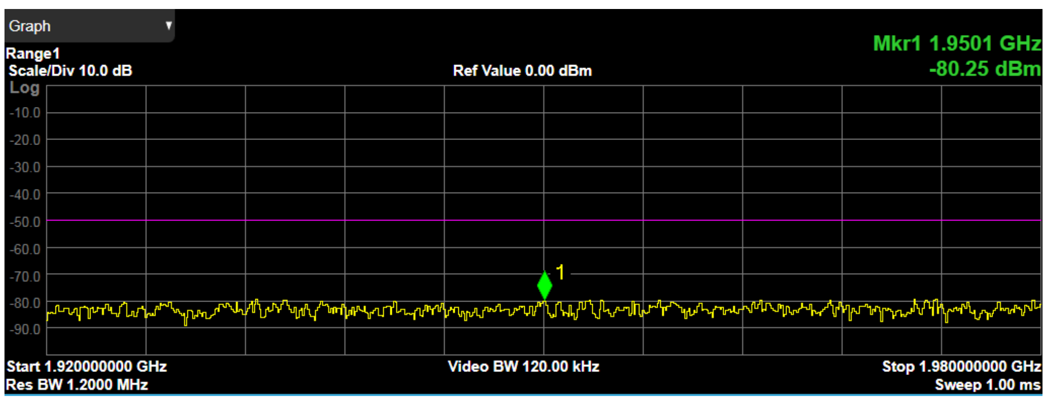
The Gate Window is available only when Gate View is ON in **Gate Settings** under **Trigger**.

3.8.2.1 Graph

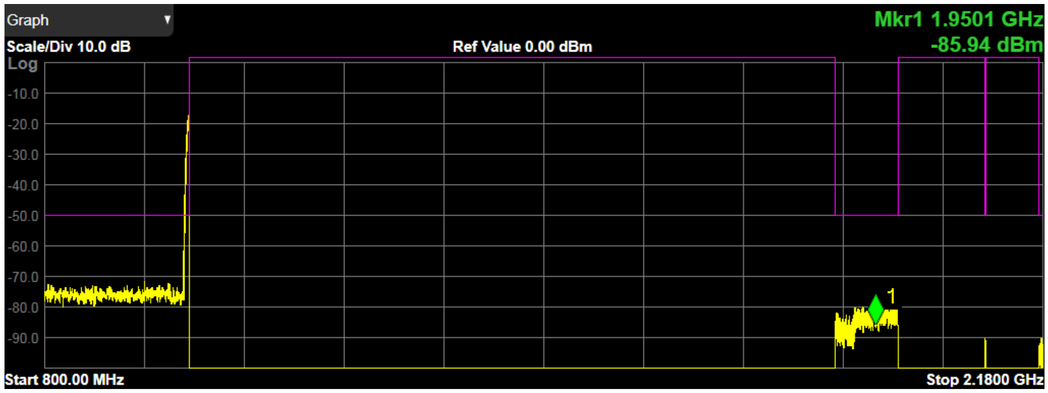
Appears in several Views, as follows:

View	Size	Position
Graph + Metrics	Three fifth, full width	Top
All Ranges	Three fifth, full width	Top
Gate View	One third, full width	Middle

When Graph + Metrics is selected



When All Ranges is selected



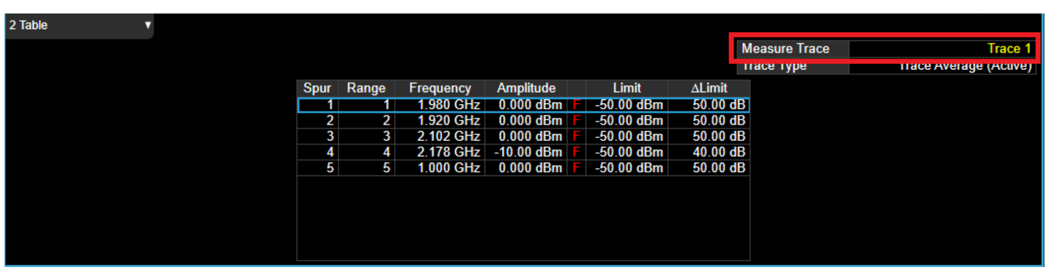
3.8.2.2 Table

The spurs listed are within the current value of the Marker Peak Excursion setting of the absolute limit. All of the spurs listed passed. Any spur that has failed the absolute limit will have an ‘F’ beside it.

Result	Units	Min	Max
Spur	N/A	0	200
Range	N/A	1	20
Frequency	Hz	Analyzer Min	Analyzer Max
Amplitude	dBm	Analyzer Min	Analyzer Max
Limit	dBm	-200	50
ΔLimit	dBm	(Limit - Amplitude)	

Views in which the Table window appears:

View	Size	Position
Graph + Metrics	Two fifth, full width	Bottom
Gate View	One third, full width	Bottom



Spur	Range	Frequency	Amplitude		Limit	ΔLimit
1	1	1.980 GHz	0.000 dBm	F	-50.00 dBm	50.00 dB
2	2	1.920 GHz	0.000 dBm	F	-50.00 dBm	50.00 dB
3	3	2.102 GHz	0.000 dBm	F	-50.00 dBm	50.00 dB
4	4	2.178 GHz	-10.00 dBm	F	-50.00 dBm	40.00 dB
5	5	1.000 GHz	0.000 dBm	F	-50.00 dBm	50.00 dB

Measure Trace

See "Measure Trace" on page 1508

Trace Type

This is the trace type (and view/blank parameter) of a trace specified by Measure Trace.

3.8.2.3 All Range Table

The spurs listed are within the current value of the Marker Peak Excursion setting of the absolute limit. All of the spurs listed passed. Any spur that has failed the absolute limit will have an ‘F’ beside it.

Result	Units	Min	Max
Spur	N/A	0	200
Range	N/A	1	20
Start Freq	See "Start Freq" on page 1426 under Meas Setup		
Stop Freq	See "Stop Freq" on page 1427 under Meas Setup		
RBW	See "Res BW" on page 1429 under Meas Setup		
Frequency	Hz	Analyzer Min	Analyzer Max
Amplitude	dBm	Analyzer Min	Analyzer Max
Limit	dBm	-200	50
ΔLimit	dBm	(Limit - Amplitude)	

Views in which the Table window appears:

View	Size	Position
All Ranges	Two fifth, full width	Bottom
Gate View	One third, full width	Bottom

3.8.2.4 Gate

Turning on Gate View shows the Gate Window, which allows you to see your Gating signal at the same time as the measured data.

Views in which the Gate window appears:

View	Size	Position
Gate View	One third, full width	Top

3.8.3 Amplitude

Activates the **Amplitude** menu and selects **Reference Level** or **Reference Value** as the active function, depending on the measurement.

Some features in this menu apply to multiple measurements. Some other features apply only to specific measurements and their controls are blanked or grayed-out in measurements that do not support the feature.

3.8.3.1 Y Scale

Contains controls that pertain to the Y axis parameters of the measurement. These parameters control how data on the vertical (Y) axis is displayed and control instrument settings that affect the vertical axis.

Ref Value

Sets the value for the absolute power reference. The reference line is at the top, center, or bottom of the graticule, depending on the value of the Ref Position function.

Remote Command	`:DISPlay:SPURious:WINDow[1]:TRACe:Y[:SCALe]:RLEVel <real>` `:DISPlay:SPURious:WINDow[1]:TRACe:Y[:SCALe]:RLEVel?`
Example	`:DISP:SPUR:WIND:TRAC:Y:RLEV 10 dBm` `:DISP:SPUR:WIND:TRAC:Y:RLEV?`
Couplings	When "Auto Scaling" on page 1354 is ON (default), this value is automatically determined by the measurement result. When you set a value manually, **Auto Scaling** changes to OFF Attenuation is not coupled to "Ref Value" on page 1347
Preset	10.00 dBm
State Saved	Saved in instrument state
Min/Max	-250.00 dBm / 250.00 dBm
Annotation	Ref <value> top left of graph
Backwards Compatibility SCPI	`[:SENSe]:SPURious:POWer[:RF]:LEVel` `:DISPlay:SPURious:VIEW[1]:WINDow[1]:TRACe:Y[:SCALe]:RLEVel`

Scale/Div

For measurements that support a logarithmic Y-Axis, **Scale/Div** sets the height of one division of the graticule in the current Y-Axis unit.

Scale/Div also determines the displayed amplitude range in the log plot graph. Since there are usually 10 vertical graticule division on the display, the total amplitude range of the graph is typically 10x this amount. For example, if Scale/Div is 10 dB, then the total range of the graph is 100 dB.

Remote Command	`:DISPlay:SPURious:WINDow[1]:TRACe:Y[:SCALe]:PDIVision <rel_ampl>` `:DISPlay:SPURious:WINDow[1]:TRACe:Y[:SCALe]:PDIVision?`

Example	:DISP:SPUR:WIND:TRAC:Y:PDIV 10 dB :DISP:SPUR:WIND:TRAC:Y:PDIV?
Couplings	Coupled to "Scale Range" on page 1538 as follows Scale/Div = Scale Range/10 (number of divisions) When **"Auto Scaling" on page 1354** is ON, this value is automatically determined by the measurement result When you change a value, **Auto Scaling** automatically changes to OFF
Preset	Automatically calculated
State Saved	Saved in instrument state
Min	0.10 dB
Max	20 dB
Annotation	<value> dB/ left upper of graph
Backwards Compatibility SCPI	:DISPlay:SPURious:VIEW[1]:WINDow[1]:TRACe:Y[:SCALe]:PDIVision

Scale Range

Sets the Y-Axis scale range.

Remote Command	Replace <meas> with the identifier for the current measurement :DISPlay:<meas>:WINDow[1]:TRACe:Y[:SCALe]:RANGe <rel_ampl> :DISPlay:<meas>:WINDow[1]:TRACe:Y[:SCALe]:RANGe?
Example	:DISP:CHP:WIND:TRAC:Y:RANG 100 :DISP:CHP:WIND:TRAC:Y:RANG?
Couplings	Coupled to **Scale/Div** as follows **Scale Range** = **Scale/Div** * 10 (number of divisions) When you change this value, **Auto Scaling** automatically changes to OFF
Preset	100 dB
State Saved	Saved in instrument state
Min	1
Max	200

Y Axis Unit

Displays a dropdown menu that enables you to change the vertical (Y) axis amplitude unit. This setting affects how the data is read over the remote interface. When using the remote interface, only numerical values are returned, so you must know what the Y Axis Unit is to interpret the results. This is described in more detail in "Amplitude Data Query and Y Axis Unit" on page 1351 below.

For measurements that support both Log and Lin scales, the instrument retains the entered Y Axis Unit separately for both Log and Lin amplitude Display Scales. For example, if Display Scale has been set to Log, and you set Y Axis Unit to dBm, pressing **Display Scale (Log)** sets the Y Axis Unit to dBm. If Display Scale has been set to Lin and you set Y Axis Unit to V, pressing **Display Scale (Lin)** sets the Y Axis Unit to V. Pressing **Display Scale (Log)** again sets the Y Axis Unit back to dBm.

If an Amplitude Correction is being applied that has an associated Transducer Unit, all selections but **Xducer Unit** are grayed-out. For more information, see "Transducer Unit" on page 1352 below.

Remote Command	`:UNIT:POWer DBM | DBMV | DBMA | V | W | A | DBUV | DBUA | DBPW | DBUVM | DBUAM | DBPT | DBG` `:UNIT:POWer?`

Example	`:UNIT:POW dBmV`
	`:UNIT:POW?`
	See also "Remote Interface Examples" on page 1350 below

Notes	The Y axis unit has either logarithmic or linear characteristics. The set of units that is logarithmic consists of dBm, dBmV, dBmA, dBmV, dBmA, dBmV/m, dBmA/m, dBpT, and dBG. The set of units that are linear consists of V, W, and A. The chosen unit will determine how the reference level and all the amplitude-related outputs like trace data, marker data, etc., read out
Dependencies	Appears only in Spectrum Analyzer Mode If an amplitude correction with a Transducer Unit other than None is applied and enabled: – The Transducer Unit selection is forced, and is the only Y Axis Unit available. The specific Transducer Unit is shown in square brackets in the dropdown, and all other Y Axis Unit choices are grayed-out – If you turn off that correction or set Apply Corrections to NO, the Y Axis Unit that existed before the Transducer Unit was applied is restored When Normalize is ON (in the **Trace**, **Normalize** menu), Y Axis Unit is grayed-out, and forced to dBm
Couplings	The instrument retains the entered Y Axis Unit separately for both Log and Lin amplitude Display Scales
Preset	dBm for log scale, V for linear. The true ‘preset’ value is dBm, since at preset the Y Display Scale is set to logarithmic
State Saved	Saved in instrument state
Annotation	The Y Axis Unit is shown after Ref Level value at the top of the graticule

Unit	Example	Notes
dBm	`:UNIT:POW DBM`	Y Axis Unit is set to dBm
dBmV	`:UNIT:POW DBMV`	Y Axis Unit is set to dBmV

Unit	Example	Notes
dBmA	:UNIT:POW DBMA	Y Axis Unit is set to dBmA
W	:UNIT:POW W	Y Axis Unit is set to W
V	:UNIT:POW V	Y Axis Unit is set to V
A	:UNIT:POW A	Y Axis Unit is set to A
dBmV	:UNIT:POW DBUV	Y Axis Unit is set to dBmV
dBmA	:UNIT:POW DBUA	Y Axis Unit is dBmA. The unit dBuA can also appear as a Transducer Unit
dBpW	:UNIT:POW DBPW	Y Axis Unit is set to dBpW

Remote Interface Examples

Command examples and details appear in the table below. Note that each of the commands below sets the amplitude unit only for the *selected* amplitude scale (Log or Lin), the other scale is unaffected.

Unit	Example	Notes
dBm	:UNIT:POW DBM	dB relative to one milliwatt
dBmV	:UNIT:POW DBMV	dB relative to one millivolt
dBmA	:UNIT:POW DBMA	dB relative to one milliamp
W	:UNIT:POW W	Watts
V	:UNIT:POW V	Volts
A	:UNIT:POW A	Amperes
dBmV	:UNIT:POW DBUV	dB relative to one microvolt
dBmA	:UNIT:POW DBUA	dB relative to one microamp The unit dBuA can also appear as a "Transducer Unit" on page 1352 When querying the Y-Axis unit, you can query the Transducer Unit to distinguish between regular dBuA and the dBuA transducer unit. If :CORR:CSET:ANT? returns NOC (for No Conversion), you are using a normal Y Axis dBuA. If it returns UA, you are using a Transducer Unit dBuA
dBpW	:UNIT:POW DBPW	dB relative to one picowatt
dBmV/m (Transducer Unit)	:UNIT:POW DBUVM	Sets the amplitude unit for the selected amplitude scale (log/lin) to dBmV/meter. This selection is only available if a Correction is turned on, and the Transducer Unit for that Correction is not None See "Transducer Unit" on page 1352
dBmA/m	:UNIT:POW DBUAM	Sets the amplitude unit for the selected amplitude scale (log/lin) to dBmA/meter.

Unit	Example	Notes
(Transducer Unit)		This selection is only available if a Correction is turned on, and the Transducer Unit for that Correction is not None See "Transducer Unit" on page 1352
dBpT (Transducer Unit)	:UNIT:POW DBPT	Sets the amplitude unit for the selected amplitude scale (log/lin) to dBpT (dB relative to one picotesla). This selection is only available if a Correction is turned on, and the Transducer Unit for that Correction is not None See "Transducer Unit" on page 1352
dBG (Transducer Unit)	:UNIT:POW DBG	Sets the amplitude unit for the selected amplitude scale (log/lin) to dBG (dB relative to one Gauss). This selection is only available if a Correction is turned on, and the Transducer Unit for that Correction is not None See "Transducer Unit" on page 1352
dBmA (Transducer Unit)	:UNIT:POW DBUA	Sets the amplitude unit for the selected amplitude scale (log/lin) to dBmA. This selection is only available as a Transducer Unit if a Correction is turned on, and the Transducer Unit for that Correction is not None See "Transducer Unit" on page 1352 The unit dBuA can also appear as a normal Y Axis Unit (see above) dBuA as a Transducer Unit is used when using current probes, because current probes are often supplied with conversion tables that provide the transducer factors. When dBuA is used as a Transducer Unit, the normal conversion from power to amps for dBuA (based on the instrument input impedance) is not done, but instead the conversion is based solely on the Correction that contains the transducer factors. This is what distinguishes dBuA as a normal unit from dBuA as a transducer unit When querying the Y-Axis unit, you can query the Transducer Unit to distinguish between regular dBuA and the dBuA Transducer Unit. If :CORR:CSET:ANT? returns NOC (for No Conversion), you are using a normal Y-Axis dBuA. If it returns UA, you are using a Transducer Unit dBuA

Amplitude Data Query and Y Axis Unit

The settings of Y-Axis Unit and Display Scale affect how the data is returned over the remote interface in response to a query. When using the remote interface, no unit is returned, so you must know what the Y-Axis unit is to interpret the results:

Example 1

Set the following:

- Display Scale (Log)
- Y Axis Unit, dBm
- Scale/Div, 1 dB
- Ref Level, 10 dBm

This sets the top line to 10 dBm with each vertical division representing 1 dB. Thus, if a point on trace 1 is on the fifth graticule line from the top, it represents 5 dBm and will read out remotely as 5.

Example 2

Set the following:

- Display Scale (Lin)
- Y Axis Unit, Volts
- Ref Level, 100 mV (10 mV/div)

This sets the top line to 100 mV and the bottom line to 0 V, so each vertical division represents 10 mV. Thus, if a point on trace 1 is on the fifth graticule line from the top, it represents 50 mV and will read out remotely as 50.

NOTE **The units of current (A, dBmA, dBuA) are calculated based on 50 Ω input impedance.**

Transducer Unit

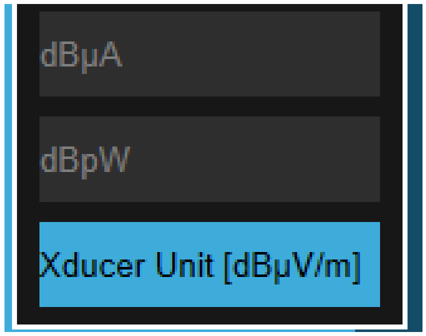
Transducer Units (formerly called Antenna Units) are units of field strength rather than amplitude, and are used when correcting the response of device such as antennas whose amplitude characteristics are measured in units of field strength. All five of the Transducer Units (dBmA/m, dBmV/m, dBG, dBpT, dBmA) are treated by the instrument exactly as though they were dBmV, when uncorrected. You must load an appropriate correction factor using Input/Output, Corrections for accurate and meaningful results.

If a remote command is sent to the instrument that uses one of the Transducer Units as a terminator, the instrument treats it as though DBUV had been sent as the terminator.

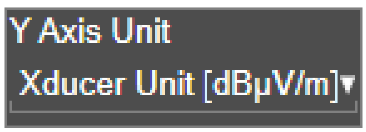
When a Correction is turned on that uses a Transducer Unit, the Y Axis Unit changes to that Transducer Unit. All of the selections in the **Y-Axis Unit** dropdown are then grayed-out, except the Transducer Unit selection. The unit being used is shown on this selection in square brackets, and appears on the control in square brackets preceded by **Xducer Unit**.

Example:

If the Transducer Unit in the Correction is dBmV/m, then the selection in the dropdown looks like this:



And on the control it looks like this:



NOTE

If a Transducer Unit is set, it is displayed as **Xducer Unit** in the **Y Axis Unit** dropdown. However, you can only *change* the Transducer Unit via the **Edit Correction** dialog in the **Input/Output**, **Corrections** menu. In that dialog, tap **Settings** then **Transducer Unit**. You can also turn off Transducer Unit from the same menu, by selecting **None**.

If a Transducer Unit is set, it is displayed as **Xducer Unit** in the **Y Axis Unit** dropdown. However, you can only *change* the Transducer Unit via the **Edit Correction** dialog in the **Input/Output**, **Corrections** menu. In that dialog, tap **Settings** then **Transducer Unit**. You can also turn off Transducer Unit from the same menu, by selecting **None**.

The Transducer Units are:

Units	Example
dBmV/m	`:UNIT:POW DBUVM`
dBmA/m	`:UNIT:POW DBUAM`
dBpT	`:UNIT:POW DBPT`
dBG	`:UNIT:POW DBG`
dBmA	`:UNIT:POW DBUA`
None	n/a

Ref Level Offset

Adds an offset value to the displayed reference level. The reference level is the absolute amplitude represented by the top graticule line on the display.

The on/off switch turns the **Ref Level Offset** on and off. Setting a value for Ref Level Offset turns Ref Level Offset ON.

Remote Command	:DISPlay:WINDow[1]:TRACe:Y[:SCALe]:RLEVel:OFFSet <rel_ampl> :DISPlay:WINDow[1]:TRACe:Y[:SCALe]:RLEVel:OFFSet? :DISPlay:WINDow[1]:TRACe:Y[:SCALe]:RLEVel:OFFSet:STATe OFF | ON | 0 | 1 :DISPlay:WINDow[1]:TRACe:Y[:SCALe]:RLEVel:OFFSet:STATe?
Example	:DISP:WIND:TRAC:Y:RLEV:OFFS 12.7 :DISP:WIND:TRAC:Y:RLEV:OFFS? Sets the Ref Level Offset to 12.7 dB. The only valid suffix is dB. If no suffix is sent, dB will be assumed :DISP:WIND:TRAC:Y:RLEV:OFFS:STAT ON Turns the Ref Level Offset On
Dependencies	This control appears only in Spectrum Analyzer Mode
Preset	0 dBm OFF
State Saved	Saved in instrument state
Min	The range for Ref Lvl Offset is variable. It is limited to values that keep the reference level within the range of -327.6 dB to 327.6 dB
Max	327.6 dB
Annotation	The offset is displayed as “Ref Offset <value>” to the right of the reference level annotation if nonzero. When the offset is zero, no annotation is shown

Ref Position

Positions the reference level at the top, center, or bottom of the Y Scale display. Changing the reference position does not change the reference level value.

Preset	TOP
State Saved	Saved in instrument state
Range	Top|Center|Bottom
Annotation	The greater than (>) and less than (<) symbols are displayed on both sides of the graph to indicate the Reference Position

Auto Scaling

Toggles **Auto Scaling** On or Off.

Remote Command	:DISPlay:SPURious:WINDow[1]:TRACe:Y[:SCALe]:COUPle 0 | 1 | OFF | ON :DISPlay:SPURious:WINDow[1]:TRACe:Y[:SCALe]:COUPle?
Example	:DISP:SPUR:WIND:TRAC:Y:COUP OFF

	:DISP:SPUR:WIND:TRAC:Y:COUP?
Couplings	When **Auto Scaling** is ON, and the **Restart** front-panel key is pressed, this function automatically sets the scale per division to 10 dB and determines the reference values based on the measurement results When you change the value of "Scale/Div" on page 1347, "Ref Value" on page 1347 or "Scale Range" on page 1538, **Auto Scaling** automatically changes to OFF When **Auto Scaling** is OFF, the measurement uses the current reference level settings When **Auto Scaling** is ON, the instrument automatically sets the reference level such that the absolute limit is positioned two divisions down from the top of the display. This is the most useful setting when searching for spurs. The algorithm used for determining the ref level is Ref Level = Absolute Limit + (2 * Scale/Div). All other reference level settings are left as the current base instrument settings
Preset	1
State Saved	Saved in instrument state
Range	OFF|ON
Backwards Compatibility SCPI	[:SENSe]:SPURious:POWer[:RF]:RANGe:AUTO :DISPlay:SPURious:VIEW[1]:WINDow[1]:TRACe:Y[:SCALe]:COUPle

3.8.3.2 Attenuation

Controls the attenuator functions and interactions between the attenuation system components.

There are two attenuator configurations in the X-Series. One is a Dual-Attenuator configuration consisting of a mechanical attenuator and an optional electronic attenuator. The other configuration uses a single attenuator with combined mechanical and electronic sections that controls all the attenuation functions. Different models in the X-Series come with different configurations.

- See "Dual-Attenuator Configurations" on page 1356
- See "Single-Attenuator Configuration" on page 1356

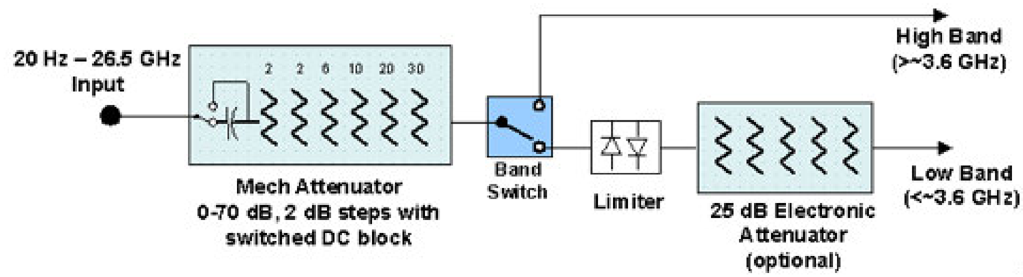
Most attenuation settings are the same for all measurements – they do not change as you change measurements. Settings like these are called “Meas Global” and are unaffected by **Meas Preset**.

Only available when the hardware set includes an input attenuator, which is typically only the case for Keysight’s benchtop instruments. For example, this tab does *not* appear in VXT models M9421A/10A/11A, nor in UXM. In UXM, all **Attenuation** and **Range** settings are disabled, as the expected input power level is handled by the Call Processing App that drives the DUT power control.

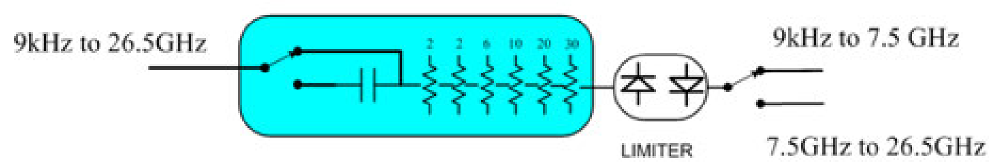
Dependencies	In measurements that support the I/Q inputs, unavailable when I/Q is the selected input. Replaced by the **Range** tab in that case

Dual-Attenuator Configurations

Configuration 1: Mechanical attenuator + optional electronic attenuator

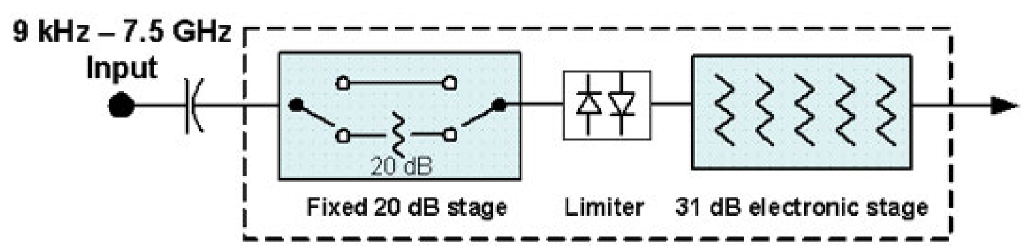


Configuration 2: Mechanical attenuator, no optional electronic attenuator



Note that Configuration 2 is not strictly speaking a dual-section attenuator, since there is no electronic section available. However, it behaves exactly like Configuration 1 without the Electronic Attenuator Option EA3, therefore for the sake of this document it is grouped into the “Dual-Attenuator” configuration.

Single-Attenuator Configuration



You can tell which attenuator configuration you have by pressing the Attenuation tab, which (in most Modes) opens the Attenuation menu. If the first control in the Attenuation menu says **Mech Atten** you have the Dual-Attenuator configuration. If the first control says **Atten** you have the Single-Attenuator configuration.

Dual Attenuator **Single Attenuator**

(Note that depending on the measurement, there may be no Auto/Man functionality on the Mech Atten control.)

In the Single-Attenuator configuration, you control the attenuation with a single control, as the fixed stage has only two states. In the Dual-Attenuator configuration, both stages have significant range, so you are given separate control of the mechanical and electronic attenuator stages.

When you have the Dual-Attenuator configuration, you may still have only a Single-Attenuator, because unless Option EA3 (the Electronic Attenuator option) is available, and you purchase it, you will have only the mechanical attenuator.

Full Range Atten

This control and **Attenuator Summary** only appear in N9041B, when the RF input is selected, the RF Input Port is set to RF Input 2, and the Full Range Attenuator is installed. The Full Range Attenuator adds a second input attenuator in front of RF Input 2, which enhances the protection and optimizes the performance of the extra internal mixers used by RF Input 2.

Remote Command	`[:SENSe]:POWer[:RF]:FRATten <rel_ampl>` `[:SENSe]:POWer[:RF]:FRATten?`
Example	`:POW:FRAT 14` `:POW:FRAT?`
Notes	When you enter an amplitude value that falls between valid values, the value will be incremented to the next smallest valid value
Dependencies	Only appears if input RF is selected, RF Input Port 2 is selected, and the Full Range Attenuator exists
Couplings	This value is never changed by any coupling, but other couplings use this value. See **Reference Level** and "Mech Atten" on page 1935 command descriptions
Preset	20 dB
State Saved	Saved in instrument state
Min	0 dB
Max	Only valid values are 0, 6, 14, 20 dB
Annotation	When the **Input** is **RF**, and the **Input Port** is **RF Input 2**, and the Full Range Attenuator is installed:

On the Meas Bar, the field “Atten” displays as follows:

- If the sweep is entirely < 50 GHz, the value shown after “Atten:” is equal to Mech Atten + Elec Atten + Full Range Atten
- If the sweep is entirely > 50 GHz, the value shown after “Atten:” is equal to Full Range Atten
- If the sweep straddles 50 GHz, the value shown after “Atten:” is preceded by the symbol “>=” and is equal to Full Range Atten

In the **Amplitude**, "Y Scale" on page 1929 menu, and the Atten **Meas Bar** dropdown menu panel, a summary is displayed as follows:

“Total Atten below 50 GHz” followed by the value of Full Range Atten + Mech Atten + Elec Atten

“Total Atten above 50 GHz” followed by the value of Full Range Atten

For example, if Mech Atten = 6 dB, Elec Atten = 4 dB, and Full Range Atten = 20 dB, the summary below is shown:

- Attenuator summary:
- Total Atten below 50 GHz: 30 dB
- Total Atten above 50 GHz: 20 dB

Mech Atten

Labeled **Mech Atten** in Dual-Attenuator models and **Atten** in Single-Attenuator models. In the Dual-Attenuator configuration, this control only affects the mechanical attenuator.

Lets you modify the attenuation applied to the RF input signal path. This value is normally auto-coupled to the Ref Level, the Internal Preamp Gain, any External Gain that is entered, and the Max Mixer Level, as described in the table below.

See "Attenuator Configurations and Auto/Man" on page 1360

Remote Command	`[:SENSe]:POWer[:RF]:ATTenuation <rel_ampl>`
	`[:SENSe]:POWer[:RF]:ATTenuation?`
	`[:SENSe]:POWer[:RF]:ATTenuation:AUTO OFF | ON | 0 | 1`
	`[:SENSe]:POWer[:RF]:ATTenuation:AUTO?`

Example	`:POW:ATT 20`
	Dual-Attenuator configuration: sets the mechanical attenuator to 20 dB
	Single-Attenuator mode: sets the main attenuation to 20 dB (see below for definition of “main” attenuation)
	In either case, if the attenuator was in Auto, it is set to Manual
	`:POW:ATT:AUTO ON`
	Turn Auto Mech Atten ON

Dependencies	Some measurements do not support Auto setting of "Mech Atten" on page 1358. In these measurements, the **Auto/Man** selection is not available, and the Auto/Man toggle function is not available In Dual-Attenuator configurations, when the electronic attenuator is enabled, the mechanical attenuator has no auto setting, and the Auto/Man toggle function is not available. The state of Auto/Man is remembered and restored when the electronic attenuator is once again disabled. This is described in more detail in "Elec Atten" on page 1937 See "Attenuator Configurations and Auto/Man" on page 1360 for more information on the Auto/Man functionality `:POW:ATT:AUTO` is only available in measurements that support Mech Atten Auto, such as Swept SA
Couplings	If the RF Input Port is the RF Input: – If the USB Preamp is connected to USB, use 0 dB for Mech Atten – Otherwise compute the auto-selected value of Mech Atten based on **Reference Level**, Int Preamp, External Gain, Ref Level Offset, Max Mixer Level, µW Path Control and IF Gain settings. Limit this value to be no less than 6 dB (total attenuation below 6 dB can never be chosen by Auto) – In the N9041B, if the RF Input Port is RF Input 2, use the formula above and subtract the Full Range Atten value from the result to determine the Mech Atten. Limit the value so that it is never lower than 0 dB and so that total attenuation, including Full Range Atten, is never less than 6 dB (total attenuation, including Full Range Atten below 6 dB, can never be chosen by Auto) In External Mixing and BBIQ, where the Attenuator is not in the signal path, the Attenuator setting changes as described above when "Mech Atten" on page 1358 is in Auto, but no changes are made to the actual attenuator hardware setting until the input is changed back to the RF Input For CXA-m with option FSA (Fine-Step Attenuator or 2 dB steps), the FSA-like behavior is only available when the frequency setting is <= 7.5 GHz. So, when the frequency is changed from below 7.5 GHz to above 7.5 GHz, the attenuation setting will be changed to a multiple of 10 dB which will be no smaller than the previous setting. For example, 4 dB attenuation will be changed to 10 dB
Preset	The preset for Mech Attenuation is “Auto” The Auto value of attenuation is 10 dB `ON`
State Saved	Saved in instrument state
Min	0 dB The attenuation set by this control cannot be decreased below 6 dB with the knob or step keys. Values below 6 dB must be directly entered from the keypad or via SCPI. This protects against setting a dangerously small attenuation value, which can put the instrument at risk of damage to input circuitry. If the current mechanical attenuation is below 6 dB, it can be increased with the knob and step keys, but not decreased
Max	CXA Option 503 or 507: 50 dB EXA: 60 dB All other models: 70 dB Note that in the Single-Attenuator configuration, the total of ATT and EATT cannot exceed 50 dB. So, if the EATT is set to 24 dB first, the main attenuation cannot be greater than 26 dB and will be reduced

	accordingly; if the main attenuator is set to 40 dB first, EATT cannot be greater than 10 dB
Annotation	The current value for Total Atten is displayed in the Measurement Bar at the top of the display. A value appears for Electronic Attenuation only if the Electronic Attenuator is enabled. The annotation appears as Atten: <total> dB (e<elec>) The e letter is in amber in Single-Attenuator configurations For example: Dual-Attenuator configuration: Atten: 24 dB (e14) Indicating the total attenuation is at 24 dB and the electronic attenuation is at 14 dB Single-Attenuator configuration: A: 24 dB (e14) Indicating the total attenuation is at 24 dB and the “soft” attenuation is at 14 dB (see below for definition of “soft” attenuation) When in Manual, a # sign appears in front of Atten in the annotation

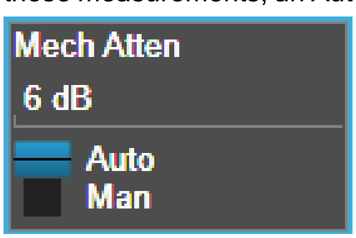
Attenuator Configurations and Auto/Man

As described under "Y Scale" on page 1929, there are two distinct attenuator configurations available in the X-Series, the single attenuator and Dual-Attenuator configurations. In Dual-Attenuator configurations, we have the mechanical attenuation and the electronic attenuation, and the current total attenuation is the sum of the electronic + mechanical attenuation. In Single-Attenuator configurations, we refer to the attenuation set using "Mech Atten" on page 1358 (or `:POW:ATT`) as the “main” attenuation; and the attenuation that is set by `:POW:EATT` as the “soft” attenuation (`:POW:EATT` is honored even in the Single-Attenuator configuration, for compatibility purposes). Then the current total attenuation is the sum of the main + soft attenuation.

See "Elec Atten" on page 1937 for more about “soft” attenuation.

NOTE

In some measurements, the **Mech Atten** control has an Auto/Man function. In these measurements, an Auto/Man switch is shown on the **Mech Atten** control:



Note that in configurations that include an Electronic Attenuator, this switch is only shown when the Electronic Attenuator is disabled.

In other measurements, **Mech Atten** has no Auto/Man function. In these measurements, no switch is shown on the **Mech Atten** control:

Mech Atten also appears with no switch, as above, in configurations that include an Electronic Attenuator but when the Electronic Attenuator is enabled.

Elec Atten

Controls the Electronic Attenuator in Dual-Attenuator configurations. Does not appear in Single-Attenuator configurations, because the control of both the mechanical and electronic stages of the Single-Attenuator is integrated into the single **Atten** control.

This control includes an **Enable/Disable** toggle switch; it is only possible to enter a value for the Electronic Attenuator when this switch is in the **Enable** position.

For more details about the Electronic Attenuator, see "More Information" on page 1362

Remote Command	[:SENSe]:POWer[:RF]:EATTenuation <rel_ampl> [:SENSe]:POWer[:RF]:EATTenuation? [:SENSe]:POWer[:RF]:EATTenuation:STATe OFF | ON | 0 | 1 [:SENSe]:POWer[:RF]:EATTenuation:STATe?
Example	:POW:EATT 10 :POW:EATT? :POW:EATT:STAT ON :POW:EATT:STAT?
Notes	Electronic Attenuation's specification is defined only when Mechanical Attenuation is 6 dB
Dependencies	Only appears in Dual-Attenuator models with an Electronic Attenuator installed and licensed. Does not appear in models with the Single-Attenuator configuration, because in the Single-Attenuator configuration there is no "electronic attenuator"; there is only a single integrated attenuator (which has both a mechanical and electronic stage). However, in the Single-Attenuator configuration, EATT SCPI commands are accepted for compatibility with other X-series instruments, and set a "soft" attenuation. The "soft" attenuation is treated as an addition to the "main" attenuation value set by the **Attenuation** control or :POW:ATT, and affects the total attenuation displayed on the **Attenuation** control and the Meas Bar The electronic attenuator, and the "soft" attenuation function provided in Single-Attenuator configurations, are unavailable above the low band (0-3.6 GHz, 0-3.4 GHz, 0-3 GHz, depending on the

	model). If the low band range is from 0-3.6 GHz, and Stop Frequency of the instrument is > 3.6 GHz, then the **Enabled/Disabled** section of the **Elec Atten** control will be OFF and grayed-out If "Internal Preamp" on page 1959 is ON (that is, set to Low Band or Full), the electronic attenuator (and the "soft" attenuation function provided in Single-Attenuator configurations) is unavailable. In this case the **Enabled/Disabled** section of the **Elec Atten** control will be OFF and grayed-out If either of the above is true, and the SCPI command is sent, an error indicating that the electronic attenuator is unavailable is returned If both the above are true, pressing the control generates error message -221, in other words, the frequency range lockout takes precedence If the electronic/soft Attenuator is enabled, then the **Stop Freq** of the instrument is limited to 3.6 GHz and **Internal Preamp** is unavailable If "LNA" on page 1960 is ON, the electronic attenuator (and the "soft" attenuation function provided in Single-Attenuator configurations) is unavailable. In this case the **Enabled/Disabled** section of the **Elec Atten** control will be OFF and grayed-out. This coupling works in the following modes/measurements: – Channel Power, Occupied BW, ACP, SEM, Spurious Emissions, Power Stat CCDF measurements in all Modes – Transmit On|Off Power measurement in 5GNR Mode – Power vs. Time and Transmit Power measurement in GSM/EDGE Mode – Burst Power measurement in Spectrum Analyzer Mode The SCPI-only "soft" electronic attenuation for the single-attenuator configuration is not available in all measurements; in particular, it is not available in the Swept SA measurement
Couplings	Enabling and disabling the Electronic Attenuator affects the setting of the Mechanical Attenuator (in Dual-Attenuator configurations). This is described in more detail below and in "Mechanical Attenuator Transition Rules" on page 1363
Preset	0 dB OFF (Disabled) for Swept SA measurement ON (Enabled) for all other measurements that support the electronic attenuator
State Saved	Saved in instrument state
Min	0 dB
Max	Dual-Attenuator configuration: 24 dB Single-Attenuator configuration: the total of ATT and EATT cannot exceed 50 dB. So, if the EATT is set to 24 dB first, the main attenuation cannot be greater than 26 dB and will be reduced accordingly; if the main attenuator is set to 40 dB first, EATT cannot be greater than 10 dB
Annotation	See Annotation under the **Mech Atten** control description

More Information

The electronic attenuator offers finer steps than the mechanical attenuator, has no acoustical noise, is faster, and is less subject to wear. These advantages primarily aid in remote operation and are negligible for front panel use. See "Using the Electronic Attenuator: Pros and Cons" on page 1364 for a detailed discussion of the pros and cons of using the electronic attenuator.

For the Single-Attenuator configuration, for SCPI backwards compatibility, the “soft” attenuation feature replaces the Dual-Attenuator configuration’s electronic attenuator. All the same couplings and limitations apply. See "Attenuator Configurations and Auto/Man" on page 1937

Mechanical Attenuator Transition Rules

When the Electronic Attenuator is enabled, the Mechanical Attenuator transitions to a state that has no Auto function. Below are the rules for transitioning the Mechanical Attenuator. Note that the information below *only* applies to the Dual-Attenuator configurations, and *only* when the Electronic Attenuator is installed:

When the Electronic Attenuation is enabled from a disabled state:

- The Mechanical Attenuator is initialized to 10 dB (this is its optimal performance setting). You can then set it as desired with SCPI, numeric keypad, step keys, or knob, and it behaves as it normally would in manual mode
- The Auto/Man state of (Mech) Atten is saved
- The Auto/Man toggle on the (Mech) Atten control disappears, and the auto rules are disabled
- The Electronic Attenuator is set to 10 dB less than the previous value of the Mechanical Attenuator, within the limitation that it must stay within the range of 0 to 24 dB of attenuation

Examples in the Dual-Attenuator configuration:

- Mech Atten at 20 dB. Elec Atten enabled, Mech Atten set to 10 dB, and Elec Atten set to 10 dB. New total attenuation equals the value before Elec Atten enabled
- Mech Atten at 0 dB. Elec Atten enabled, Mech Atten set to 10 dB, and Elec Atten set to 0 dB. New total attenuation does not equal the value before Elec Atten enabled
- Mech Atten at 40 dB. Elec Atten enabled, Mech Atten set to 10 dB, and Elec Atten set to 24 dB. New total attenuation does not equal the value before Elec Atten enabled

When the Electronic Attenuation is disabled from an enabled state:

- The Elec Atten control is grayed out
- The Auto/Man state of (Mech) Atten is restored
- If now in Auto, (Mech) Atten recouples

- If now in Man, (Mech) Atten is set to the value of total attenuation that existed before the Elec Atten was disabled. The resulting value is rounded up to the smallest value possible given the (Mech) Atten Step setting - (That is, 57 dB changes to 58 dB when (Mech) Atten Step is 2 dB)

Using the Electronic Attenuator: Pros and Cons

The electronic attenuator offers finer steps than the mechanical attenuator, has no acoustical noise, is faster, and is less subject to wear.

The “finer steps” advantage of the electronic attenuator is beneficial in optimizing the alignment of the instrument dynamic range to the signal power in the front panel as well as remote use. Thus, you can achieve improved relative signal measurement accuracy. Compared to a mechanical attenuator with 2 dB steps, the 1 dB resolution of the electronic attenuator only gives better resolution when the odd-decibel steps are used. Those odd-decibel steps are less accurately calibrated than the even-decibel steps, so one tradeoff for this superior relative accuracy is reduced absolute amplitude accuracy.

Another disadvantage of the electronic attenuator is that the spectrum analyzer loses its “Auto” setting, making operation less convenient.

Also, the relationship between the dynamic range specifications (TOI, SHI, compression, and noise) and instrument performance are less well-known with the electrical attenuator. With the mechanical attenuator, TOI, SHI, and compression threshold levels increase dB-for-dB with increasing attenuation, and the noise floor does as well. With the electronic attenuator, there is an excess attenuation of about 1 to 3 dB between 0 and 3.6 GHz, making the effective TOI, SHI, and so forth, less well known. Excess attenuation is the actual attenuation relative to stated attenuation. Excess attenuation is accounted for in the instrument calibration.

Adjust Atten for Min Clipping

Sets the combination of mechanical and electronic attenuation and gain based on the current measured signal level so that clipping will be at a minimum.

This is an immediate action function, that is, it executes once, when the control is pressed.

The algorithms that are used for the adjustment are documented under "Pre-Adjust for Min Clipping" on page 1942.

Remote Command	`[:SENSe]:POWer[:RF]:RANGe:OPTimize IMMediate`
Example	`:POW:RANG:OPT IMM`
Notes	Executing **Adjust Atten for Min Clipping** initiates the measurement
Dependencies	Does not appear in the Swept SA, RTSA, Monitor Spectrum and Complex Spectrum measurements Appears in the Waveform measurement in 5G NR Mode only

Adjust Atten

Allows you to select;

- Electric attenuator only
- Combination of Electric attenuator and Mechanical attenuator

when [:SENSe]:POWer[:RF]:RANGe:OPTimize IMMediate is executed.

Remote Command	[:SENSe]:POWer[:RF]:RANGe:OPTimize:TYPE EONLy | COMBined [:SENSe]:POWer[:RF]:RANGe:OPTimize:TYPE?
Example	:POW:RANG:OPT:TYPE EONL :POW:RANG:OPT:TYPE?
Dependencies	Does not appear in the Swept SA, RTSA, Monitor Spectrum and Complex Spectrum measurements Appears in the Waveform measurement in 5G NR Mode only
Preset	COMBined
State Saved	Saved in instrument state

Pre-Adjust for Min Clipping

If this function is ON, it applies the adjustment described under "Adjust Atten for Min Clipping" on page 1941 each time a measurement restarts. Therefore, in Continuous measurement mode, it only executes before the first measurement.

In Dual-Attenuator models, you can set **Elec+Mech Atten**, in which case both attenuators participate in the autoranging, or **Elec Atten Only**, in which case the mechanical attenuator does not participate in the autoranging. This latter case results in less wear on the mechanical attenuator and is usually faster.

See "Adjustment Algorithm" on page 1366

Selection	SCPI	Note
Off	OFF	This is the default setting
On	ON	Available in Single-Attenuator instruments. For compatibility with models that do not have an input attenuator, the ON parameter is supported and mapped to COMBined
Elec Atten Only	ELECtrical	Selects only the electric attenuator to participate in auto ranging. This offers less wear on the mechanical attenuator and is usually faster
Elec+Mech Atten	COMBined	In Dual-Attenuator models, this selects both attenuators to participate in the autoranging

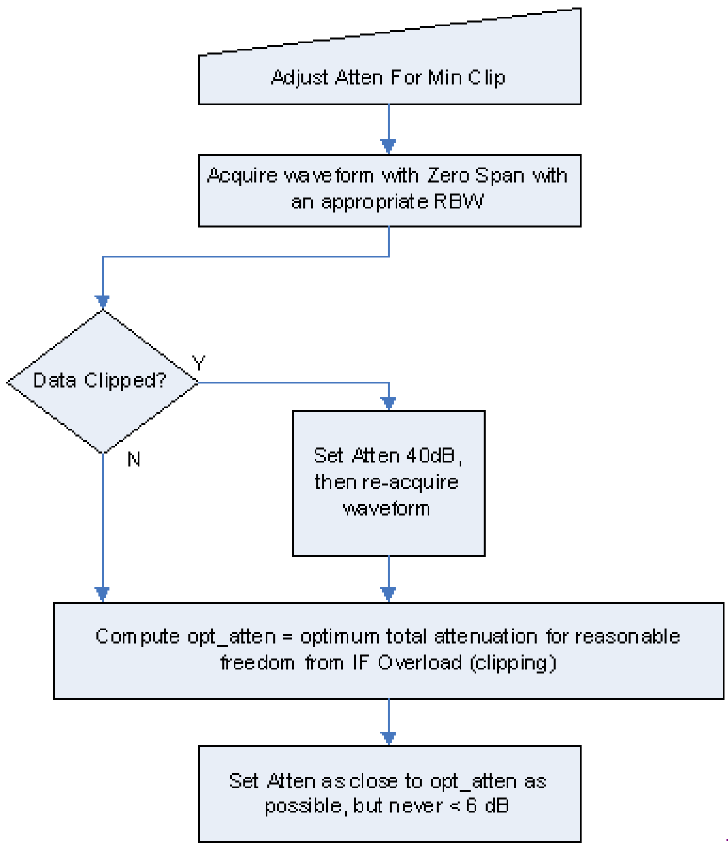
Remote Command	[:SENSe]:POWer[:RF]:RANGe:OPTimize:ATTenuation OFF | ON | ELECtrical | COMBined [:SENSe]:POWer[:RF]:RANGe:OPTimize:ATTenuation?
Example	:POW:RANG:OPT:ATT OFF :POW:RANG:OPT:ATT?
Notes	The parameter option ELECtrical sets this function to ON in Single-Attenuator models The parameter option COMBined is mapped to ELECtrical in Single-Attenuator models. If you send COMBined, it sets the function to ON and returns ELEC to a query For SCPI compatibility with models that do not have an input attenuator, the ON parameter is honored and mapped to COMBined
Dependencies	Only appears in Dual-Attenuator models with an Electronic Attenuator installed In instruments with Dual-Attenuator model, when "Elec Atten" on page 1937 is OFF or grayed-out, "Pre-Adjust for Min Clipping" on page 1365 is grayed-out Does not appear in the Swept SA, RTSA, Monitor Spectrum and Complex Spectrum measurements For the Waveform measurement, available only in 5G NR Mode
Preset	OFF when Elec Atten is Disabled at preset, otherwise ELEC
State Saved	Saved in instrument state
Range	Dual-Attenuator models: Off | Elec Atten Only | Mech + Elec Atten Single-Attenuator models: Off | On

Notes	ON aliases to "Elec Atten Only" (:POW:RANG:OPT:ATT ELEC) OFF aliases to "Off" (:POW:RANG:OPT:ATT OFF) :POW:RANG:AUTO? returns true if :POW:RANG:OPT:ATT is not OFF
Backwards Compatibility SCPI	[:SENSe]:POWer[:RF]:RANGe:AUTO ON | OFF | 1 | 0 [:SENSe]:POWer[:RF]:RANGe:AUTO?

Adjustment Algorithm

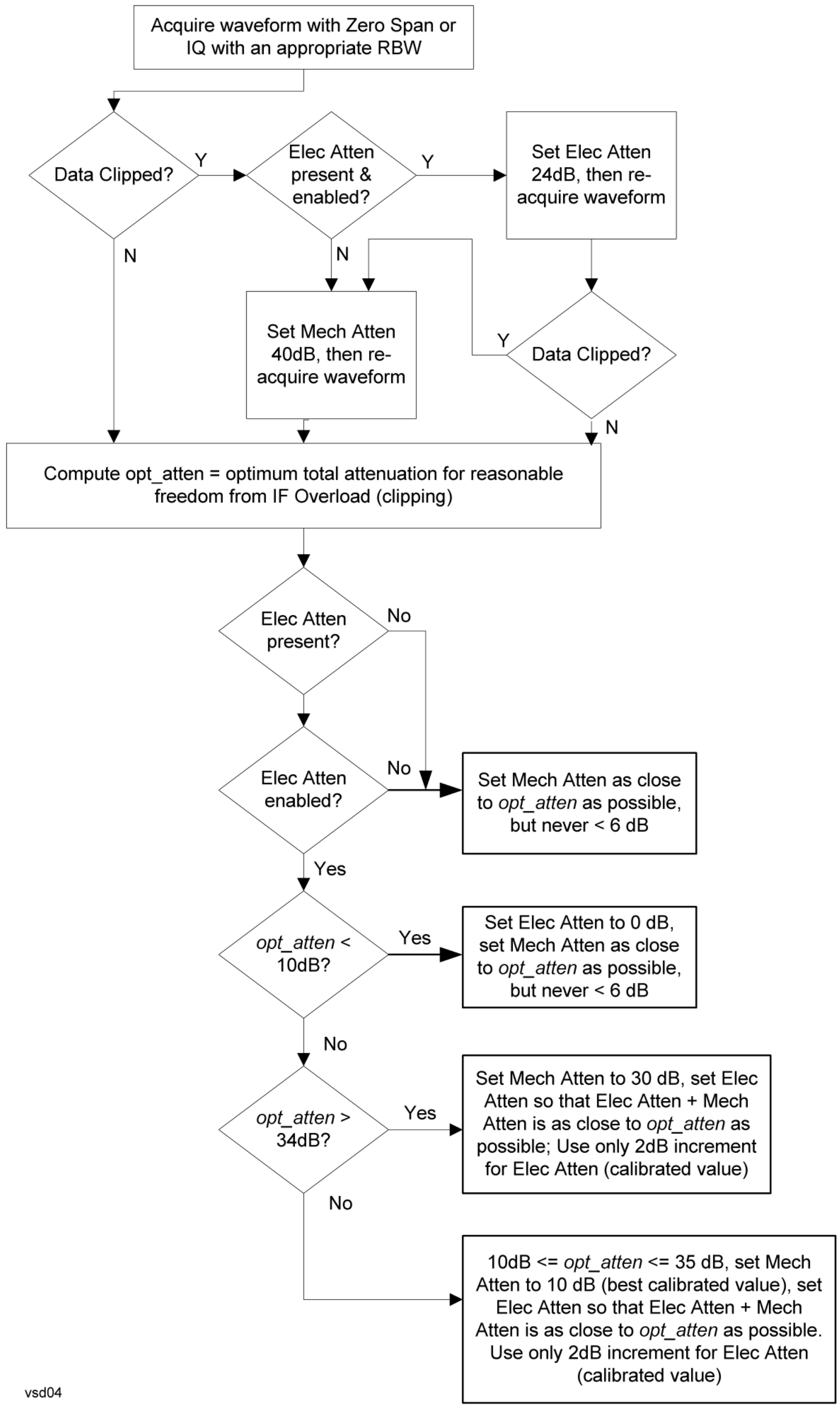
The algorithms for the adjustment are documented below:

Single-Attenuator Models



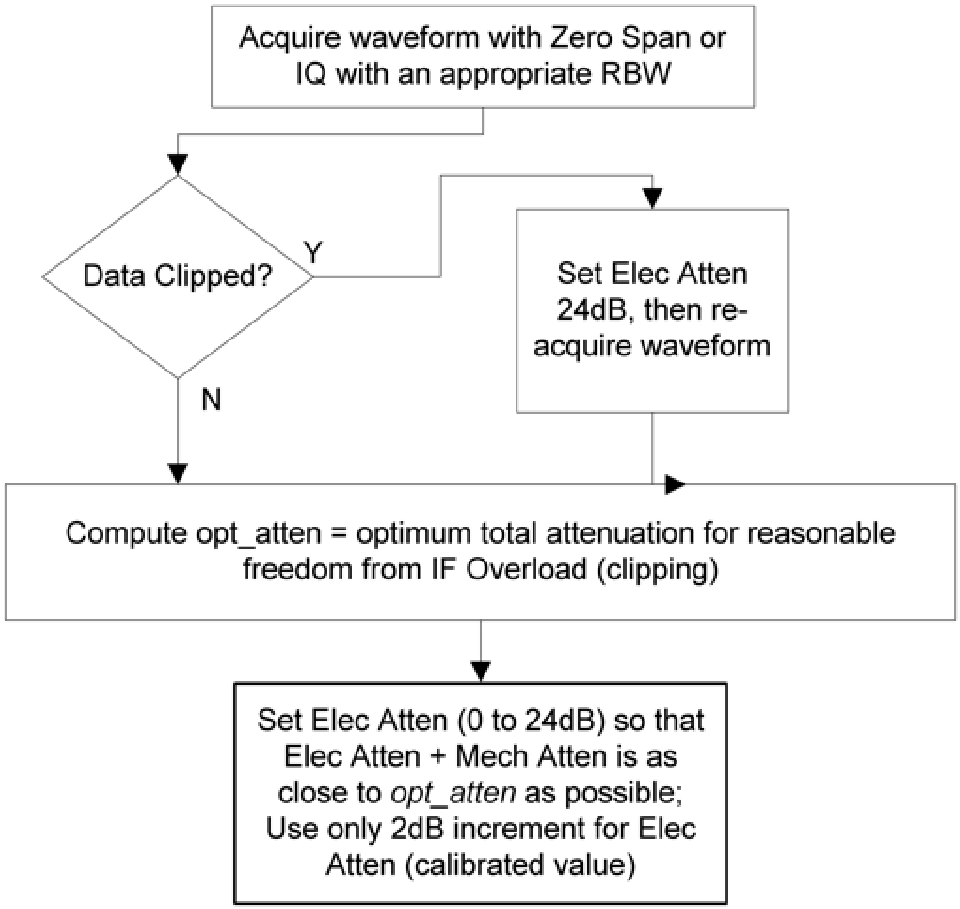
Dual-Attenuator models

"Adjust Atten for Min Clipping" on page 1941 or "Pre-Adjust for Min Clipping" on page 1365 selection is Mech + Elec Atten:


Acquire waveform with Zero Span or IQ with an appropriate RBW
Data Clipped?
Y
N
Elec Atten present & enabled?
Y
N
Set Elec Atten 24dB, then re-acquire waveform
Set Mech Atten 40dB, then re-acquire waveform
Y
Data Clipped?
N
Compute opt_atten = optimum total attenuation for reasonable freedom from IF Overload (clipping)
Elec Atten present?
No
Elec Atten enabled?
No
Set Mech Atten as close to opt_atten as possible, but never < 6 dB
Yes
opt_atten < 10dB?
Yes
Set Elec Atten to 0 dB, set Mech Atten as close to opt_atten as possible, but never < 6 dB
No
opt_atten > 34dB?
Yes
Set Mech Atten to 30 dB, set Elec Atten so that Elec Atten + Mech Atten is as close to opt_atten as possible; Use only 2dB increment for Elec Atten (calibrated value)
No
10dB <= opt_atten <= 35 dB, set Mech Atten to 10 dB (best calibrated value), set Elec Atten so that Elec Atten + Mech Atten is as close to opt_atten as possible. Use only 2dB increment for Elec Atten (calibrated value)
vsd04

"Pre-Adjust for Min Clipping" on page 1365 selection is Elec Only.

Note that the **Mech Atten** value is not adjusted, and the value previously set is used. Therefore, there is a case that IF Overload is still observed depending on the input signal level and the Mech Atten setting.



Mech Atten Step

Controls the step size used when making adjustments to the input attenuation.

Labeled **Mech Atten Step** in Dual-Attenuator models and **Atten Step** in Single-Attenuator models. In the Dual-Attenuator configuration, only affects the step size of the mechanical attenuator.

Remote Command	`[:SENSe]:POWer[:RF]:ATTenuation:STEP[:INCRement] 10 dB | 2 dB`

	`[:SENSe]:POWer[:RF]:ATTenuation:STEP[:INCRement]?`
Example	`:POW:ATT:STEP 2` `:POW:ATT:STEP?`
Notes	Has a toggle control on the front panel, but takes a specific value (in dB) when used remotely. The only valid values are 2 and 10
Dependencies	Blanked in EXA, CXA and CXA-m if option FSA (2 dB steps) is not present. If blanked, attempts to set it via SCPI yield an error
Couplings	When the attenuation step size changes, the current mechanical attenuation value is adjusted (if necessary) to be quantized to the new step size. That is, if step is set to 10 dB, mech atten is increased if necessary so it is a multiple of 10 dB
Preset	EXA, CXA and CXA-m: 10 dB (2 dB with option FSA) All other models: 2 dB
State Saved	Saved in instrument state

Max Mixer Level

Allows you to set the maximum level to be applied to the mixer for a signal at the top of the screen. By setting this value up or down you can allow more or less signal through the system.

The major impact of changes to **Max Mixer Level** is seen in changes to the value to which **Reference Level** is limited. Max Ref Level depends on Max Mixer Level and Attenuation, and therefore a higher Max Mixer Level may let you set Ref Level higher. However, changing this value can impact your TOI, compression, or dynamic range. The preset value of this function is best for most measurements.

See also "Max Mixer Lvl Rules" on page 1948.

Remote Command	`[:SENSe]:POWer[:RF]:MIXer:RANGe[:UPPer] <real>` `[:SENSe]:POWer[:RF]:MIXer:RANGe[:UPPer]?`
Example	`:POW:MIX:RANG -15 dBm` `:POW:MIX:RANG?`
Dependencies	Only appears in Swept SA and RTSA measurements
Preset	-10 dBm
State Saved	Saved in instrument state
Min	-50 dBm
Max	0 dBm

Max Mixer Lvl Rules

Allows you to optimize the Max Mixer Level setting for certain kinds of measurements.

NORMal	The historical, and thus backwards compatible, setting range (–50 to 0 dBm) and default setting (–10 dBm). The instrument has been designed so that, at the default setting, any signal below the Reference Level is extremely unlikely to create ADC overloads. At this mixer level the scale fidelity will be within specifications, thus compression with be negligible
TOI	Allows a range of settings of the "Max Mixer Level" on page 1947, –50 to –10 dBm, that can be optimum for measurements limited by the instrument third-order dynamic range. The default setting, –25 dBm, is commonly appropriate but RBW affects this. A good setting for Max Mixer Level would be higher than the optimum mixer level by half of the attenuator step size
COMPression	Allows a range of settings of the Max Mixer Level, –10 to +10 dBm or more, that can be optimum for measurements limited by the tradeoffs between instrument accuracy due to compression, and dynamic range due to the noise floor. The default setting, –3 dBm, is commonly appropriate, representing mixer drive levels that cause 1 dB or less compression at most carrier frequencies Typical measurements that would be optimized by this setting are the measurement of low sideband levels, including nulls, in angle-modulated signals (FM and PM). Also pulsed-RF measurements, including finding nulls to estimate pulse width, which are often best done with significant overdrive (compression) of the front end

Setting Name (readback)	Setting Name (verbose)	Max Mixer Level Preset Value, dBm	Max Mixer Level minimum value, dBm	Max Mixer Level maximum value, dBm
NORMal	Normal – balance TOI, noise, and compression	–10	–50	0
TOI	TOI-limited dynamic range	–25	–50	–10
COMPression	Compression-limited dynamic range	–3	–10	+30

Remote Command	[:SENSe]:POWer[:RF]:MIXer:RULEs NORMal | TOI | COMPression [:SENSe]:POWer[:RF]:MIXer:RULEs?
Example	:POW:MIX:RULE:COMP
Dependencies	Only appears in the Swept SA and RTSA measurements
Preset	NORM

3.8.3.3 Range (Non-attenuator models)

Only available for Keysight's modular signal analyzers and certain other Keysight products, such as VXT

State Saved	No

Range

Represents the amplitude of the largest sinusoidal signal that could be present within the IF without being clipped by the ADC. For signals with high peak-to-average ratios, the range may need to exceed the rms signal power by a significant amount to avoid clipping.

This is a measurement global setting.

Remote Command	`[:SENSe]:POWer[:RF]:RANGe <real>` `[:SENSe]:POWer[:RF]:RANGe?`
Example	`:POW:RANG 10 dBm` `:POW:RANG?`
Notes	The MIN and MAX values are affected by the External Gain parameters, and by the **Center Frequency** The hardware compensates for frequency response and alters the Range setting
Preset	0 dBm
State Saved	Yes
Min	-100
Max	100
Annotation	Meas Bar

Adjust Range for Min Clipping

Sets the combination of attenuation and gain based on the current measured signal level so that clipping will be at a minimum.

This is an "immediate action" function, that is, it executes once, when the key is pressed.

This key does not appear in measurements that do not support this functionality.

Remote Command	`[:SENSe]:POWer[:RF]:RANGe:OPTimize IMMediate`
Notes	Executing Adjust Range for Min Clipping initiates the measurement
Dependencies	Does not appear in the Swept SA and Monitor Spectrum measurements

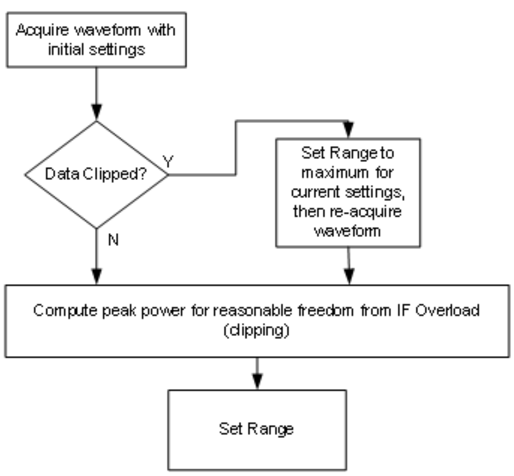
Pre-Adjust for Min Clipping

If this function is ON, it applies the adjustment described under Adjust Range For Min Clipping each time a measurement restarts. Therefore, in Continuous measurement mode, it only executes before the first measurement.

Remote Command	`[:SENSe]:POWer[:RF]:RANGe:OPTimize:ATTenuation OFF | ON | ELECtrical | COMBined` `[:SENSe]:POWer[:RF]:RANGe:OPTimize:ATTenuation?`
Notes	Because there is no attenuator control available in these models, the control displays only ON and OFF choices. However, for SCPI compatibility with other platforms, all three parameters (ELECtrical, COMBined, and ON) are honored and all are mapped to ELECtrical, so if any of these three parameters is sent, a subsequent query will return ELEC
Dependencies	Does not appear in the Swept SA and Monitor Spectrum measurements
Preset	OFF for Swept SA measurement; ON for all other measurements that support **Pre-Adjust for Min Clipping**
State Saved	Saved in instrument state

Adjustment Algorithm

The algorithm for the adjustment is documented below:



Peak-to-Average Ratio

Used with "Range (Non-attenuator models)" on page 1953 to optimize the level control in the instrument. The value is the ratio, in dB, of the peak power to the average power of the signal to be measured. A ratio of 0 should be used for sinusoidal signals; for 802.11g OFDM signals use 9 dB.

All Modes show the current value of Peak-to-Average ratio on the control. However, some Modes do not permit changing the value. In these situations, the control is grayed-out.

Remote Command	`[:SENSe]:POWer[:RF]:RANGe:PARatio <real>` `[:SENSe]:POWer[:RF]:RANGe:PARatio?`
Example	`:POW:RANG:PAR 12 dB`
Notes	In some Modes, this parameter is read-only; meaning the value will appear on the control and query via SCPI, but is not changeable. In such applications the control is grayed-out. Attempting to change the value via SCPI will be ignored but no error message will be generated
Dependencies	Does not appear in Spectrum Analyzer Mode
Preset	10 dB VXT Models M9410A/11A: 0 dB
State Saved	Saved in instrument state
Min	0 dB
Max	20 dB VXT Models M9410A/11A: 50 dB

Mixer Lvl Offset

This is an advanced setting to adjust target Range at the input mixer, which in turn affects the signal level in the instrument's IF. This setting can be used when additional optimization is needed after setting "Peak-to-Average Ratio" on page 1955. Positive values of offset optimize noise performance over distortion, negative values optimize distortion performance over noise.

Remote Command	`[:SENSe]:POWer[:RF]:RANGe:MIXer:OFFSet <real>` `[:SENSe]:POWer[:RF]:RANGe:MIXer:OFFSet?`
Example	`:POW:RANG:MIX:OFFS -5 dB`
Preset	0 dB
State Saved	Saved in instrument state
Min	-35 dB VXT Models M9410A/11A: -34 dB
Max	30 dB

3.8.3.4 Signal Path

Contains controls that pertain to the routing of the signal through the frontend of the instrument.

In general, only appears in instruments whose hardware supports this signal routing. For example, this tab does not appear in many of the modular instrument products, including VXT Model M9421A, or UXM.

This tab *does* appear in VXT Models M9410A/11A, because "Software Preselection" on page 1971 is under this tab, and VXT Models M9410A/11A implement a version of Software Preselection.

Presel Center

Adjusts the centering of the preselector filter to optimize the amplitude accuracy at the frequency of the selected marker. If the selected marker is not on when **Presel Center** is pressed, the instrument turns on the selected marker, performs a peak search, and then performs centering on the marker's center frequency. If the selected marker is already on and between the start and stop frequencies of the instrument, the instrument performs the preselector calibration on that marker's frequency. If the selected marker is already on, but outside the frequency range between **Start Freq** and **Stop Freq**, the instrument first performs a peak search, and then performs centering on the marker's center frequency.

The value displayed on "Preselector Adjust" on page 1958 changes to reflect the new preselector tuning.

Certain considerations should be observed to ensure proper operation, as detailed in "Proper Preselector Operation" on page 1376.

Remote Command	`[:SENSe]:POWer[:RF]:PCENter`
Example	`:POW:PCEN`
Notes	The rules outlined above under the control description apply for the remote command as well as the key. The result of the command depends on marker position, etc. Any message generated by the control press is also generated in response to the remote command
Dependencies	Does not appear in CXA-m, nor in VXT Models M9410A/11A Grayed-out if the microwave preselector is off – If the selected marker's frequency is below Band 1, an advisory message is generated "Preselector not used in this frequency range" and no action is taken – Grayed-out if entirely in Band 0, that is, if **Stop Freq** is below about 3.6 GHz Grayed-out if entirely above 50 GHz, that is, if **Start Freq** is above 50 GHz – Blanked in models that do not include a preselector, such as Option 503. If the remote command is sent in these instruments, accepted without error, and the query always returns 0 – Grayed-out in the Spectrogram View
Couplings	The active marker position determines where the centering will be attempted If the instrument is in a measurement such as averaging when centering is initiated, the act of centering the preselector restarts averaging, but the first average trace will not be taken until the centering is completed

	The offset applied to do the centering appears in "Preselector Adjust" on page 1958
Status Bits/OPC dependencies	When centering the preselector, `*OPC` does not return true until the process is complete and a subsequent measurement has completed, nor are results returned in response to `:READ` or `:MEASure` queries The `Measuring` bit remains set (true) while this command is operating, and does not go false until the subsequent sweep/measurement has completed

Proper Preselector Operation

Certain considerations should be observed to ensure proper operation:

1. If the selected marker is **Off**, the instrument turns on a marker, performs a peak search, and adjusts the preselector using the selected marker's frequency. It uses the "highest peak" peak search method unqualified by threshold or excursion, so that there is no chance of a 'no peak found' error. It continues with that peak, even if it is the peak of just noise. Therefore, for this operation to work properly, there should be a signal on-screen in a preselected range for the peak search to find
2. If the selected marker is already **On**, the instrument attempts the centering at that marker's frequency. There is no preselector for signals below about 3.6 GHz, so if the marker is on a signal below 3.6 GHz, no centering is attempted, and an advisory message is generated
3. In some models, the preselector can be bypassed. If it is bypassed, no centering is attempted in that range and a message is generated

Preselector Adjust

Lets you manually adjust the preselector filter frequency to optimize its response to the signal of interest. Only available when "Presel Center" on page 1956 is available.

For general purpose signal analysis, using **Presel Center** is recommended. Centering the filter minimizes the impact of long-term preselector drift. **Preselector Adjust** can be used instead to manually optimize the preselector. One application of manual optimization would be to peak the preselector response, which both optimizes the signal-to-noise ratio and minimizes amplitude variations due to small (short-term) preselector drifting.

When **Presel Center** is performed, the offset applied to do the centering becomes the new value of **Preselector Adjust**.

Remote Command	`[:SENSe]:POWer[:RF]:PADJust <freq>` `[:SENSe]:POWer[:RF]:PADJust?`
Example	`:POW:PADJ 100KHz` `:POW:PADJ?`

Notes	The value on the control is displayed to 0.1 MHz resolution
Dependencies	– Does not appear in CXA-m – Does not appear in VXT Models M9410A/11A – Grayed-out if microwave preselector is off – Grayed-out if entirely in Band 0, that is, if Stop Freq is lower than about 3.6 GHz – Grayed-out if entirely above 50 GHz, that is, if Start Freq is higher than 50 GHz – Blank in models that do not include a preselector, such as Option 503. If the command is sent in these instruments, it is accepted without error, and the query always returns 0 – Grayed-out in the Spectrogram View
Preset	0 MHz
State Saved	The **Preselector Adjust** value set by "Presel Center" on page 1956, or by manually adjusting **Preselector Adjust** Not saved in instrument state, and does not survive a Preset or power cycle
Min	-500 MHz
Max	500 MHz
Backwards Compatibility SCPI	`[:SENSe]:POWer[:RF]:MW:PADJust` `[:SENSe]:POWer[:RF]:MMW:PADJust`

Notes	The command has no effect, and the query always returns `MWAVe`
Backwards Compatibility SCPI	`[:SENSe]:POWer[:RF]:PADJust:PRESelector MWAVe | MMWave | EXTernal` `[:SENSe]:POWer[:RF]:PADJust:PRESelector?`

Internal Preamp

Accesses a menu of controls for the internal preamps. Turning on the preamp gives a better noise figure, but a poorer inter-modulation distortion (TOI) to noise floor dynamic range. You can optimize this setting for your measurement.

The instrument takes the preamp gain into account as it sweeps. If you sweep outside of the range of the preamp, the instrument will also account for that. The displayed result always reflects the correct gain.

For some measurements, when the preamp is on and any part of the displayed frequency range is below the lowest frequency for which the preamp has specifications, a warning condition message appears in the status line. For example, for a preamp with a 9 kHz lowest specified frequency: "Preamp: Accy unspec'd below 9 kHz".

Selection	Example	Note
Off	`:POW:GAIN OFF`	
Low Band	`:POW:GAIN ON` `:POW:GAIN:BAND LOW`	Sets the internal preamp to use only the low band. The frequency range of the installed (optional) low-band preamp is displayed in square brackets on the Low Band selection in the dropdown
Full Range	`:POW:GAIN ON` `:POW:GAIN:BAND FULL`	Sets the internal preamp to use its full range. The low band (0-3.6 GHz, 0-3.4 GHz, 0-3 GHz, depending on the model) is supplied by the low band preamp and the frequencies above low band are supplied by the high band preamp The frequency range of the installed (optional) low-band preamp is displayed in square brackets on the Full Range selection in the dropdown. If the high band option is not installed the Full Range selection does not appear

NOTE The maximum **Center Frequency** for Low Band, displayed in square brackets, can change based on the selected IFBW for measurements that support IFBW (for example, Waveform measurement across all Modes that support it). In certain models (such as N9042B & N9032B), IFBW values <= 40 MHz have a maximum Low Band frequency of 3.6 GHz, while 40 MHz < IFBW <= 1 GHz have a maximum of 3.3 GHz, and 1 GHz < IFBW <= 1.5 GHz have a maximum of 3.5 GHz. IFBW values > 1.5 GHz do not support a **Center Frequency** that can reach the Low Band maximum frequency. In these cases, **N/A** is displayed in the square brackets for Low Band.

Remote Command	`[:SENSe]:POWer[:RF]:GAIN:BAND LOW | FULL`
	`[:SENSe]:POWer[:RF]:GAIN:BAND?`
	`[:SENSe]:POWer[:RF]:GAIN[:STATe] OFF | ON | 0 | 1`
	`[:SENSe]:POWer[:RF]:GAIN[:STATe]?`

Example	`:POW:GAIN:BAND LOW`
	`:POW:GAIN:BAND?`
	`:POW:GAIN OFF`
	`:POW:GAIN?`

Dependencies	Not available on all hardware platforms. If the preamp is not present or is unlicensed, this control is not shown Does not appear in VXT Models M9410A/11A/15A/16A If `:POW:GAIN:BAND FULL` is sent when a low band preamp is available, the preamp band parameter is set to `LOW` instead of `FULL`, and an "Option not installed" message is generated Not available when the electronic/soft attenuator is enabled
Preset	`LOW`

	OFF
State Saved	Saved in instrument state
Annotation	When the USB Preamp is not connected to USB, the Preamp annotation in the Meas Bar says "Off" if the preamp is off and displays the frequency range of the low band or full range preamp depending on the setting. For example, if the Preamp is set to Low Band and the Low Band is 3.6 GHz the annotation says "3.6 GHz". If it is a 13.6 GHz preamp and it is set to Full Range the annotation says "13.6 GHz" When the USB Preamp is connected to USB, the Preamp annotation says "Preamp: USB" if the internal preamp is off or "Preamp: USB, Int" if the internal preamp is on (only for measurements that support the USB preamp)

LNA

Lets you turn the Low Noise Amplifier (**LNA**) on or off.

LNA is an additional preamplifier that provides superior DANL and frequency range compared to "Internal Preamp" on page 1959. LNA provides lower system noise figure, especially at frequencies above 100 MHz, and can be operated up to the full range of 50 GHz instruments.

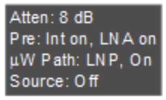
For best possible sensitivity, **LNA** can be turned on *together* with "Internal Preamp" on page 1959, although if you operate both preamps together, note that the TOI (distortion) specifications are impacted. The sensitivity improvement of this combination is substantial when operating in high band (frequencies above 3.6 GHz).

For more details about annotation, see "More Information" on page 1379

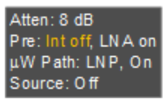
Remote Command	`[:SENSe]:POWer[:RF]:GAIN:LNA[:STATe] OFF | ON | 0 | 1` `[:SENSe]:POWer[:RF]:GAIN:LNA[:STATe]?`
Example	`:POW:GAIN:LNA ON`
Dependencies	Requires Option LNA, except for VXT models M9415A/16A Does not appear in VXT models M9421A/10A/11A May not appear in some measurements **LNA** is not available when the electronic/soft attenuator is enabled
Preset	OFF
State Saved	Saved in State

More Information

When **LNA** is installed, the preamp annotation changes to show the state of both **LNA** and **Internal Preamp**. Below is an example:



Note that when operating entirely in the low band (below about 3.6 GHz), if **LNA** is on, **Internal Preamp** is switched off (even if you have its switch set to ON). This is because the noise performance is actually degraded in low band if both preamps are on. In this case, the annotation reflects the actual state of the two preamps, but the **Internal Preamp** annotation displays in amber, to warn you that the actual state of **Internal Preamp** does not match its switch control display:



µW Path Control

Options for this control include **µW Preselector Bypass** (Option MPB), **Low Noise Path** (Option LNP) and **Full Bypass Enable** in the High Band path circuits.

When the µW Preselector is bypassed, flatness is improved, but will be subject to spurs from out of band interfering signals. When **Low Noise Path Enable** is selected, the instrument automatically bypasses certain circuitry in the high frequency bands that can contribute to noise, when it is appropriate based on other instrument settings.

For most applications, the preset state is **Standard Path**, which provides the best remote-control throughput, minimizes acoustic noise from switching and minimizes the risk of wear in the hardware switches, particularly in remote test scenarios where both low band and high band setups will follow in rapid succession. In this path, the bypass of the low band/high band switch and microwave preamp is never activated, which can cause some noise degradation but preserves the life of the bypass switch.

For applications that utilize the wideband IF paths, the preset state is **µW Preselector Bypas**s, if option MPB is present. This is because, when using a wideband IF such as the 140 MHz IF, the µW Preselector's bandwidth can be narrower than the available IF bandwidth, causing degraded amplitude flatness and phase linearity, so it is desirable to bypass the preselector in the default case.

You may choose **Low Noise Path Enable** for a lower noise floor, especially in the 21-26.5 GHz region, though without improving many measures of dynamic range, and without giving the best possible noise floor. The preamp, if purchased and used, gives better noise floor than does **Low Noise Path Enable**, but the preamp's compression threshold and third-order intercept are much poorer than that of **Low Noise Path Enable**.

A fourth choice is **Full Bypass Enable**, which combines **µW Preselector Bypass** and **Low Noise Path Enable**. Because this can bypass most of the circuitry between the input and the first mixer, care should be taken when using this setting to avoid damaging the mixer. **Full Bypass Enable** is only available if both options LNP and MPB are present, as well as option FBP.

Path	Example	Note
Standard Path	`:POW:MW:PATH STD`	Normal setting for most measurements. µW Preselector in circuit, Low Noise Path disabled
Low Noise Path Enable	`:POW:MW:PATH LNP`	See "Low Noise Path Enable" on page 1384
µW Preselector Bypass	`:POW:MW:PATH MPB`	See "µW Preselector Bypass" on page 1386
Full Bypass Enable	`:POW:MW:PATH FULL`	See "Full Bypass Enable" on page 1387

Remote Command	`[:SENSe]:POWer[:RF]:MW:PATH STD | LNPath | MPBypass | FULL` `[:SENSe]:POWer[:RF]:MW:PATH?`

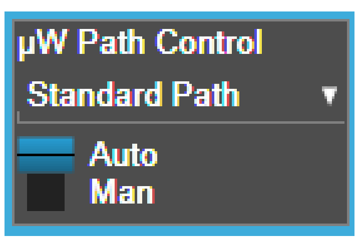
Example	`:POW:MW:PATH LNP`
	Enables the Low Noise path
	`:POW:MW:PATH?`

Notes	If "Presel Center" on page 1956 is performed, the instrument will momentarily switch to the Standard Path, regardless of the setting of **µW Path Control** The DC Block will always be switched in when the low noise path is switched in, to protect succeeding circuitry from DC. Note that this does not mean “when the low noise path is enabled” but when, based on the Low Noise Path rules, the path is actually switched in. This can happen when the selection is **Low Noise Path Enable** or **Full Bypass Enable**. In the case where the DC Block is switched in the instrument is now AC coupled. However, if you selected DC coupling, the UI would still behave as though it were DC coupled, including all annunciation, warnings, status bits, and responses to SCPI queries. This is because, based on other settings, the instrument could switch out the low noise path at any time and hence go back to being DC coupled Alignment switching ignores the settings in this menu, and restores them when finished
Dependencies	Does not appear in CXA-m, VXT Models M9410A/11A, nor in BBIQ and External Mixing – The **Low Noise Path Enable** selection does not appear unless Option LNP is present and licensed – The **µW Preselector Bypass** selection does not appear unless Option MPB is present and licensed – The **Full Bypass Enable** selection does not appear unless options LNP and MPB are both present as well as option FBP In any of these cases, if the required options are not present and the SCPI command is sent, error -241, "Hardware missing; Option not installed" is generated **Low Noise Path Enable** and **Full Bypass Enable** are grayed-out if the current measurement does not support them **Low Noise Path Enable** and **Full Bypass Enable** are not supported in Avionics and MMR Modes (non-modulation measurements). In any of these cases (that is, the feature is not supported in either measurement or Mode), if the SCPI command is sent, the following error is generated: -221, “Setting Conflict; Feature not supported for this measurement”

Preset	**Mode** / **Value** IQ Analyzer, Pulse, Avionics: MPB option present and licensed: `MPB` MPB option not present and licensed: `STD` All other Modes: `STD`
State Saved	Save in instrument state
Range	Standard Path | Low Noise Path Enable | µW Presel Bypass | Full Bypass Enable
Annotation	In the Meas Bar, if the Standard path is chosen: µW Path: Standard If Low Noise Path is enabled but the LNP switch is not thrown: µW Path: LNP,Off If the Low Noise Path is enabled and the LNP switch *is* thrown: µW Path: LNP,On If the preselector is bypassed: µW Path: Bypass If Full Bypass Enable is selected but the LNP switch is not thrown: µW Path: FByp,Off If Full Bypass Enable is selected and the LNP switch *is* thrown: µW Path: FByp,On

µW Path Control Auto

In VMA, WLAN, 5G NR, CQM Modes, an **Auto/Man** switch is added to **µW Path Control**:



This allows the function to automatically switch based on certain Auto Rules as shown below:

VMA Mode

Measurement	When µW Path Control is in Auto
Digital Demod	Use Standard Path unless tuned frequency > 3.6 GHz and IFBW > 15 MHz, in which case choose Preselector Bypass
Monitor Spectrum	Always Presel Bypass

Measurement	When µW Path Control is in Auto
IQ Waveform	Use Standard Path unless tuned frequency > 3.6 GHz and IFBW > 15 MHz, in which case choose Preselector Bypass
Custom OFDM	Use Standard Path unless tuned frequency > 3.6 GHz and IFBW > 15 MHz, in which case choose Preselector Bypass
Channel Power	Always Presel Bypass
Occupied BW	Always Presel Bypass
CCDF	Use Standard Path unless tuned frequency > 3.6 GHz and IFBW > 15 MHz, in which case choose Preselector Bypass
ACP	Always Presel Bypass
SEM	Always Presel Bypass
Spurious Emissions	Always Standard Path

WLAN Mode

Measurement	When µW Path Control is in Auto
Modulation Analysis	Always Presel Bypass
Spectral Flatness	Always Presel Bypasss
Power vs Time	Always Presel Bypass
Monitor Spectrum	Always Presel Bypass
IQ Waveform	Always Presel Bypass
Channel Power	Always Presel Bypass
Occupied BW	Always Presel Bypass
CCDF	Always Presel Bypass
SEM	For 11be 320M, when ‘Enabled Wideband IF for FFT’ is OFF or ‘Sweep Type Rule’ is Best Dynamic Range, auto µW path is standard For other cases, auto µW path is presel bypass if presel bypass is enabled, auto µW path is standard if presel bypass is not enabled
Spurious Emissions	Always Standard Path

5G NR Mode

Measurement	When µW Path Control is in Auto
Modulation Analysis	Use Standard Path unless tuned frequency > 3.6 GHz and IFBW > 15 MHz, in which case choose Full Bypass if conditions warrant(FBP Option is available and “Allow Full Bypass in Auto” is On), otherwise choose Preselector Bypass
Monitor Spectrum	Always Standard Path
IQ Waveform	Use Standard Path unless tuned frequency > 3.6 GHz and IFBW > 15 MHz, in which case choose Full Bypass if conditions warrant(FBP Option is available

Measurement	When µW Path Control is in Auto
	and “Allow Full Bypass in Auto” is On), otherwise choose Preselector Bypass
Channel Power	Always Standard Path
Occupied BW	Always Standard Path
CCDF	Use Standard Path unless tuned frequency > 3.6 GHz and IFBW > 15 MHz, in which case choose Preselector Bypass
ACP	Always Standard Path
SEM	Always Standard Path
Spurious Emissions	Always Standard Path
Transmit On|Off Power	Use Standard Path unless tuned frequency > 3.6 GHz and Info BW > 15 MHz, in which case choose Preselector Bypass

Channel Quality Mode

Measurement	When µW Path Control is in Auto
Group Delay	Use Standard Path unless tuned frequency > 3.6 GHz and IFBW > 15 MHz, in which case choose Full Bypass if conditions warrant(FBP Option is available and “Allow Full Bypass in Auto” is On), otherwise choose Preselector Bypass
Monitor Spectrum	Always Standard Path
IQ Waveform	Use Standard Path unless tuned frequency > 3.6 GHz and IFBW > 15 MHz, in which case choose Preselector Bypass
CCDF	Use Standard Path unless tuned frequency > 3.6 GHz and IFBW > 15 MHz, in which case choose Preselector Bypass

Remote Command	`[:SENSe]:POWer[:RF]:MW:PATH:AUTO ON | OFF | 1 | 0` `[:SENSe]:POWer[:RF]:MW:PATH:AUTO?`
Example	`:POW:MW:PATH:AUTO ON` `:POW:MW:PATH:AUTO?`
Dependencies	Only appears in VMA, WLAN, 5G NR and CQM Modes
Couplings	See the tables above
Preset	`ON`
Range	`ON|OFF`

Low Noise Path Enable

Low Noise Path Enable provides a lower noise floor under some circumstances, particularly when operating in the 21–26.5 GHz region. With the Low Noise Path enabled, the low band/high band switch and microwave preamp are bypassed whenever *all* the following are true:

– The instrument is not in the Low Band, meaning:

– the start frequency is above 3.5 GHz and

– the stop frequency is above 3.6 GHz

– The internal preamp is not installed, or if installed, is set to **Off** or **Low Band**

Note that this means that, when any part of a sweep is done in Low Band, the Low Noise Path is not used, whether or not the **Low Noise Path Enable** is selected in the user interface. Also, if the preamp is turned on, the Low Noise Path is not used, whether or not the **Low Noise Path Enable** is selected in the user interface. The only time the Low Noise Path is used is when **Low Noise Path Enable** is selected, the sweep is completely in High Band (> 3.6 GHz) and no preamp is in use.

For measurements that use IQ acquisition, the low noise path is used when **Center Frequency** is in High Band (> 3.6 GHz) and no preamp is in use. In other words, the rules above are modified to use only the center frequency to qualify which path to switch in. This is not the case for FFTs in the Swept SA measurement; they use the same rules as swept measurements.

Note that the Low Noise Path, while giving improved DANL, has the disadvantage of decreased TOI performance and decreased gain compression performance relative to the standard path.

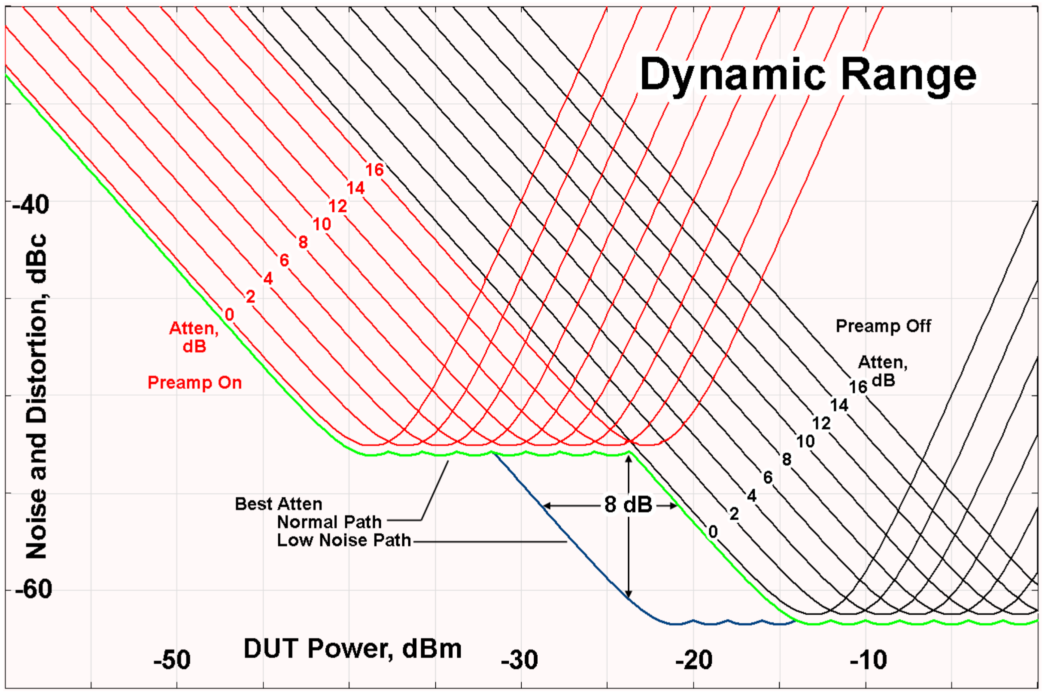
Note also that the bypass switch is a mechanical switch and has finite life, so if the **Low Noise Path Enable** is selected, it is possible to cause frequent cycling of this switch by frequently changing instrument settings such that the above conditions hold true only some of the time. A user making tests of this nature should consider opting for the **Standard Path**, which will never throw the bypass switch, at the expense of some degraded noise performance.

The low noise path is useful for situations where the signal level is so low that the instrument performance is dominated by noise even with 0 dB attenuation, but still high enough that the preamp option would have excessive third-order intermodulation or compression. The preamp, if purchased and used, gives better noise floor than does the “Low Noise Path.” However, its compression threshold and third-order intercept are much poorer than that of the non-preamp path.

There are some applications, typically for signals around –30 dBm, for which the third-order dynamic range of the standard path is good enough, but the noise floor is not low enough even with 0 dB input attenuation. When the third-order dynamic range of the preamp path is too little and the noise floor of the standard path is too high, the Low Noise Path can provide the best dynamic range

The graph below illustrates the concept. It shows, in red, the performance of an instrument at different attenuation settings, both with the preamp on and off, in a measurement that is affected by both instrument noise and instrument TOI. The green shows the best available dynamic range, offset by 0.5 dB for clarity. The blue

shows how the best available dynamic range improves for moderate signal levels with the low noise path switched in. In this illustration, the preamp improves the noise floor by 15 dB while degrading the third-order intercept by 30 dB, and the low noise path reduces loss by 8 dB. The attenuator step size is 2 dB.



There are other times where selecting the low noise path improves performance, too. Compression-limited measurements such as finding the nulls in a pulsed-RF spectrum can profit from the low noise path in a way similar to the TOI-limited measurement illustrated. Accuracy can be improved when the low noise path allows the optimum attenuation to increase from a small amount like 0, 2 or 4 dB to a larger amount, giving better return loss at the instrument input. Harmonic measurements, such as second and third harmonic levels, are much improved using the low noise path because of the superiority of that path for harmonic (though not intermodulation) distortion performance.

µW Preselector Bypass

Toggles the preselector bypass switch for band 1 and higher. When the microwave presel is on, the signal path is preselected. When the microwave preselector is off, the signal path is not preselected. The preselected path is the normal path for the instrument.

The preselector is a tunable bandpass filter which prevents signals away from the frequency of interest from combining in the mixer to generate in-band spurious

signals (images). The consequences of using a preselector filter are its limited bandwidth, the amplitude and phase ripple in its passband, and any amplitude and phase instability due to center frequency drift.

Option MPB or pre-selector bypass provides an unpreselected input mixer path for certain X-Series signal analyzers with frequency ranges above 3.6 GHz. This signal path allows a wider bandwidth and less amplitude variability, which is an advantage when doing modulation analysis and broadband signal analysis. The disadvantage is that, without the preselector, image signals will be displayed. Another disadvantage of bypassing the preselector is increased LO emission levels at the front panel input port.

Image responses are separated from the real signal by twice the 1st IF. For IF Paths of 10 MHz and 25 MHz, the 1st IF is 322.5 MHz, so the image response and the real signal will be separated by 645 MHz. The 1st IF will be different for other IF Path settings. When viewing a real signal and its corresponding image response in internal mixing, the image response will be to the left of the real signal.

Also, the image response and the real signal typically have the same amplitude and exhibit the same shape factor.

However, if Option FS1 (Fast Sweep Capability) is enabled, the image response in the Swept SA measurement appears lower in amplitude and has a much wider shape factor compared to the real signal.

Full Bypass Enable

With **Full Bypass Enable** selected, the microwave preselector is bypassed. In addition, the low band/high band switch and microwave preamp are bypassed whenever *all* the following are true:

- The instrument is not in the Low Band, meaning:
- the start frequency is above 3.5 GHz and
- the stop frequency is above 3.6 GHz.
- the internal preamp is not installed or if installed, is set to **Off** or **Low Band**

Note that this means that, when any part of a sweep is done in Low Band, the Low Noise Path is not used, whether or not the **Full Bypass Enable** is selected in the user interface. Also, if the preamp is turned on, the Low Noise Path is not used, whether or not the **Full Bypass Enable** is selected in the user interface. The only time the Low Noise Path is used is when **Full Bypass Enable** is selected, the sweep is completely in High Band (> 3.6 GHz) and no preamp is in use.

CAUTION

When **Full Bypass Enable** is selected, and "Y Scale" on page 1929 is set to 0 dB, there will be a direct AC connection between the input and the first converter when the Low Noise Path switches in (when Start Freq >3.6 GHz and the Preamp is either not licensed, set to Low Band, or Off). This puts the first converter at considerable risk to be damaged by high AC power. Consequently, whenever **Full Bypass Enable** is selected, a warning message appears in the status bar:

"Full Bypass Enabled, maximum safe input power reduced"

Microwave Preselector Bypass Backwards Compatibility

Example	`:POW:MW:PRES OFF` Bypasses the microwave preselector
Notes	Included for Microwave Preselector Bypass backwards compatibility The `ON` parameter sets the `STD` path (`:POW:MW:PATH STD`) The `OFF` parameter sets path `MPB` (`:POW:MW:PATH MPB`)
Preset	`ON`
Backwards Compatibility SCPI	`[:SENSe]:POWer[:RF]:MW:PRESelector[:STATe] ON | OFF | 0 | 1` `[:SENSe]:POWer[:RF]:MW:PRESelector[:STATe]?`

Frequency Extender Preselection Bypass

Only applies to the high frequency path of the Frequency Extender, and only if the Frequency Extender allows it. For example, the V3050A high frequency path is 50 – 110 GHz and *does* allow control of the preselector bypass.

When the Frequency Extender's preselection is bypassed, flatness is improved, but will be subject to spurs from out-of-band interfering signals. For bandwidths greater than 2.5 [GHz], it is recommended that the signal bypass the Frequency Extender Preselector since the max bandwidth of the Preselector can be as narrow as 2.5 [GHz].

For most applications, the preset state is `OFF`, which gives the best remote-control throughput, minimizes acoustic noise from switching, minimizes out of band spurs, and minimizes the risk of wear in the hardware switches.

Preselector and Bandwidth Conflict

When the Frequency Extender Preselector is applied and the signal bandwidth is greater than 2.5 [GHz], then a settings alert message will show to warn the user that the signal may be distorted due to the limitation of the Frequency Extender Preselector bandwidth.

An example of the settings alert message is shown below.

Settings Alert message in the Status Bar at the bottom of the display.

Settings Alert message in the error queue

.

Software Preselection

Provided in some instruments, either to compensate for issues with provided hardware preselection or to provide the preselection function when there is no hardware preselector.

N9041B

Software Preselection compensates for the frequency range limit of the microwave preselector. Since the microwave preselector only goes up to 50 GHz, software preselection must be used to suppress and separate images above 50 GHz. The specific algorithm used for software preselection is specified by the SW Preselection Type selection – Normal or Advanced.

In N9041B, **Software Preselection** only applies for frequencies above 50 GHz, therefore it is only used for RF Input 2. Even if turned on, it is not used for other inputs, and never for frequencies below 50 GHz. This is why the label of this control contains the parenthetical note “(>~50 GHz)”.

Note that in N9041B, in Swept SA measurement, **Software Preselection** works even if the measurement is using an FFT Sweep Type. In measurements other than Swept SA, Software Preselection is not used if the measurement is using an FFT sweep type.

N9042B+V3050A

Software Preselection compensates for the frequency range limit of the microwave preselector. Since the microwave preselector only goes up to 50 GHz, software preselection must be used to suppress and separate images above 50 GHz. The specific algorithm used for software preselection is specified by the SW Preselection

Type selection – Normal or Advanced.

For N9042B+V3050A, Software Preselection only applies for frequencies above 50 GHz, therefore it is only used for External RF. Even if it is turned on, it will not be used for other inputs and never for frequencies below 50 GHz. This is why the label of this control contains the parenthetical note “(>~50 GHz)”.

Note that for N9042B+V3050A, in the Swept SA measurement, Software Preselection works even if the measurement is using an FFT Sweep Type. In measurements other than Swept SA, Software Preselection is not used if the measurement is using an FFT Sweep Type.

VXT models M9410A/11A

Software Preselection is used to provide the preselection function, as there is no hardware preselector in these models. Two background traces are taken and compared point by point, and the point with the lowest amplitude from the two traces is used. This provides a method to reduce spurs that are internally generated within the VXT, but you should note the following when using Software Preselection:

- There is some speed cost due to the need to take multiple captures
- Taking the point with the lowest amplitude in each trace will make the average noise level lower at all points that do not have a spur. This can reduce the accuracy of the measurement of noise and noise-like signals

Because of the difficulty in identifying spurs manually, you are recommended to leave Software Preselection ON at all times in VXT models M9410A/11A. If you turn it off in order to speed up your measurement or improve noise accuracy, be aware of unwanted onscreen spurs.

Remote Command	`[:SENSe]:POWer[:RF]:SWPResel:STATe 0 | 1 | ON | OFF` `[:SENSe]:POWer[:RF]:SWPresel:STAT?`
Example	`:POW:SWPR:STAT 1` `:POW:SWPR:STAT?`
Dependencies	Only appears in N9041B, N9042B+V2050A, and VXT models M9410A/11A. Does not appear in all measurements
Couplings	Affects **Sweep Time** **Auto Tune** supports **Software Preselection**, so **Auto Tune** should be performed after setting the **Software Preselection** state
Preset	N9041B: OFF N9042B+V3050A: ON M9410A/11A: ON
State Saved	Saved in instrument state

SW Preselection Type

Specifies the algorithm used for software preselection.

Two hidden sweeps occur in succession. The second sweep is offset in LO frequency by 2 * IF / N. For each point in each trace, the smaller amplitude from the two traces is taken and placed in that point in the selected trace. The Peak detector is auto-selected to improve the image suppression effectiveness. Responses of each trace that lie on top of one another will remain and are valid signals. Other signals are images, which are suppressed. The action of taking the smaller of the two traces will make the average noise level lower in all points that do not have an image, thus reducing the accuracy of the measurement of noise and noise-like signals.

- `NORMal` - mathematically removes all image and multiple responses of signals present at the input
- `ADVanced` - any trace processing (such as "max hold" or trace averaging) is performed on the points of both candidate traces before the "select minimum" operation occurs. This form of processing works better for non-stationary signals, such as pulsed-RF signals

Remote Command	`[:SENSe]:POWer[:RF]:SWPResel NORMal | ADVanced` `[:SENSe]:POWer[:RF]:SWPResel?`
Example	`:POW:SWPR NORM` `:POW:SWPR?`
Dependencies	Only appears in N9041B and N9042B+V3050A. Only appears in measurements that use the Swept method Grayed-out when "Software Preselection" on page 1971 is `OFF`. The grayout message is "Unavailable unless SW Presel enabled"
Preset	N9041B: `ADVanced` N9042B+V3050A: `NORMal`
State Saved	Saved in instrument state

SW Preselection BW

Specifies the effective bandwidth to be used for Software Preselection.

The options are:

- `NORMal` – when making Swept measurements, a software preselection algorithm is used which takes up to 4 background acquisitions, then post-processes the result. This algorithm can remove images from signals with an occupied

bandwidth up to around 3 GHz. (Default/Preset setting). When making FFT measurements, this algorithm is not used, instead the same algorithm is used as for NARRow (below)

- NARRow– a software preselection algorithm is used which takes two background acquisitions, then post-processes the result to detect and remove images from wideband signals with occupied bandwidths up to 2 GHz. This increases the risk of images failing to be rejected, but improves the measurement speed

Remote Command	`[:SENSe]:POWer[:RF]:SWPResel:BW NORMal | NARRow` `[:SENSe]:POWer[:RF]:SWPResel:BW?`
Example	`:POW:SWPR:BW NARR`
Dependencies	Only appears in N9041B and N9042B+V3050A. Only appears in measurements that use the Swept method Grayed-out when "Software Preselection" on page 1971 is OFF. The grayout message is “Unavailable unless SW Presel enabled” For N9042B+V3050A, the parameter is SCPI-only, and always set to NARRow when **Software Preselection** is enabled
Preset	N9041B: NORMal N9042B+V3050A: NARRow
State Saved	Saved in instrument state

High Freq Prefilter

Lets you set the state of Prefilter for center frequencies above 1310 MHz.

In VXT Models M9410A/11A, the Receiver RF path has a bank of filters that come after the RF Attenuator in the signal path. Since this bank of filters precedes the mixer they are known as the “Prefilter” bank. Their purpose is to eliminate unwanted in-band mixing products by filtering out all but the desired frequencies before the signals get to the mixer. There are 13 prefilter bands to cover the frequencies between 9 kHz and 6000 MHz. The Prefilter provides the necessary rejection of the unwanted signal.

Remote Command	`[:SENSe]:<measurement>:PFILter[:STATe] ON | OFF | 1 | 0` `[:SENSe]:<measurement>:PFILter[:STATe]?`

Example	Enable High Freq Prefilter for the Complex Spectrum Measurement in BASIC Mode:
	`:SPEC:PFIL ON`
	Enable High Freq Prefilter for the IQ Waveform Measurement, in multiple Modes:
	`:WAV:PFIL ON`
	Enable High Freq Prefilter for the Swept SA Measurement in SA Mode:

	`:SAN:PFIL ON`
Dependencies	Only appears in VXT models M9410A/11A with center frequency above 1310 MHz
Preset	See "Prefilter Presets" on page 1393 below
State Saved	Saved in instrument state

Prefilter Presets

Meas	Mode	Preset
SPEC	BASIC	OFF
WAV	BASIC, WCDMA, WLAN, LTEAFDD, LTEATDD, 5GNR, VMA	OFF
MON	WCDMA, WLAN, LTEAFDD, LTEATDD, 5GNR, VMA	OFF
RHO	WCDMA	OFF
CDP	WCDMA	OFF
PCON	WCDMA	OFF
EVMQ	WCDMA	OFF
CHP	WCDMA, WLAN, LTEAFDD, LTEATDD, 5GNR, VMA, SA	OFF
OBW	WCDMA, WLAN, LTEAFDD, LTEATDD, 5GNR, VMA, SA	OFF
ACP	WCDMA, LTEAFDD, LTEATDD, 5GNR, VMA, SA	OFF
SEM	WCDMA, WLAN, LTEAFDD, LTEATDD, 5GNR, VMA, SA	OFF
PST	WCDMA, WLAN, LTEAFDD, LTEATDD, 5GNR, VMA, SA	OFF
PVT	WLAN, LTEAFDD, LTEATDD, 5GNR	OFF
EVM	WLAN, LTEAFDD, LTEATDD, 5GNR	OFF
FLAT	WLAN	OFF
EVMM	WLAN	OFF
CEVM	LTEAFDD, LTEATDD	OFF
PAVT	5GNR, VMA	OFF
DDEM	VMA	OFF
OFDM	VMA	OFF
SAN	SA	ON
HARM	SA	ON

3.8.4 BW

There is no **BW** functionality in the Spurious Emissions Measurement.

3.8.5 Display

Opens the **Display** menu, which lets you configure display items for the current Mode, Measurement View or Window.

3.8.5.1 View

Contains controls for selecting the current **View**, and for editing User Views.

Views

The Spurious Emissions measurement has two views:

1. Graph + Metrics (RESult)
2. ALL Ranges

These Views are multiple-window Views. When in a multiple window View, you select a window by touching it. The menu controls may sometimes change depending on which window is selected.

Remote Command	`:DISPlay:SPURious:VIEW[:SELect] RESult | ALL` `:DISPlay:SPURious:VIEW[:SELect]?`
Example	`:DISP:SPUR:VIEW RANG` `:DISP:SPUR:VIEW?`
Preset	`RESult`
State Saved	No
Range	Graph + Metrics | All Ranges

Graph + Metrics

Windows: "Graph" on page 1344,"Table" on page 1345

Select Graph + Metrics to view measurement results.

- The upper window displays a trace of the range that contains the currently selected spur
- The lower window displays a list of spurs detected in a measurement cycle. The currently selected spur, which is highlighted, can be changed by the Spur control in the Meas Setup menu

Example	`:DISP:SPUR:VIEW RES`

All Ranges

Windows: "Graph" on page 1344,"All Range Table" on page 1346

Select All Ranges to view measurement results for all the ranges.

  - The upper window displays a merged trace of all the ranges
  - The lower window displays a list of spurs detected in a measurement cycle. The currently selected spur, which is highlighted, can be changed by the Spur control in the Meas Setup menu

Example	`:DISP:SPUR:VIEW ALL`

User View

Lets you choose a View from the saved User Views for the current measurement. This panel only appears if a User View exists for the current measurement.

Remote Command	`:DISPlay:VIEW:ADVanced:SELect <alphanumeric>` `:DISPlay:VIEW:ADVanced:SELect?`
Example	Select Baseband as the current View `:DISP:VIEW:ADV:SEL “Baseband”`

Notes	You must be in the measurement whose View you are trying to set to send the command. You can only set Views for the current measurement using this command
	For predefined views, the parameter is derived from the view name that is shown in the View list in the user interface. For example, if you are trying to select the Trace Zoom view in the Swept SA measurement, you send:
	`:DISP:VIEW:ADV:SEL "Trace Zoom"`
	because “Trace Zoom” is the name of the View as seen in the Mode/Meas dialog or in the Display, View menu
	You *cannot* use the legacy View parameter (which in this case would be `TZOom`) with `:DISP:VIEW:ADV:SEL`
	`<alphanumeric>` is case insensitive; you can specify mixed case, however the name will be evaluated on a single case. Thus, both of the following forms work:
	`:DISP:VIEW:ADV:SEL "Trace Zoom"`
	`:DISP:VIEW:ADV:SEL "TRACE ZOOM"`
	If the specified view is not a valid View, the query returns the error message “-224, Illegal parameter value; View with the name <alphanumeric> does not exist”
	If the display is disabled (via `:DISP:ENAB OFF`) then the error message “-221, Settings conflict; View SCPI cannot be used while Display is disabled” is generated

Backwards Compatibility SCPI	The legacy node `:DISPlay:VIEW[:SELect]` is retained for backwards compatibility, but it only supports predefined views

Restore Layout to Default

Restores the Layout to the default for Basic.

Modified Views are very temporary; if you exit the current measurement they are discarded, and they are not saved in State. To retain this View for later use, and to be able to return easily to your original Basic View, you can save your edited View as a “User View”.

Save Layout as New View

Saves your new View as a User View. An alpha keyboard appears, which lets you name your new View; the default is the old View name plus a number.

Remote Command	`:DISPlay:VIEW:ADVanced:NAME <alphanumeric>`
Example	`:DISP:VIEW:ADV:NAME “Baseband”` Creates a new View named `Baseband` from the current View, and selects it as the current View
Notes	`<alphanumeric>` is case insensitive; you can specify mixed case, however the name will be evaluated on a single case If `<alphanumeric>` name already exists as a View, the error message “-224, Illegal parameter value; View <alphanumeric> already exists” is generated If the display is disabled (via `:DISP:ENAB OFF`) then the error message “-221, Settings conflict; User View SCPI cannot be used while Display is disabled” is generated

Re-Save User View

You can re-edit a User View; if you make changes, then an asterisk will appear next to the User View’s name. You can then tap **Re-Save User View** to save it back to its existing name, or **Save Layout as New View** to add another, new User View.

This is a front panel function only, there is no remote command available to perform this function. To do this remotely, you must first perform **Save Layout as New View**, then delete the old User View and rename the new one with the name of the View you just deleted.

Rename User View

You can rename the current View by giving it a new unique name. Only User Views can be renamed, if the current View is a Predefined View, an error occurs.

Remote Command	`:DISPlay:VIEW:ADVanced:REName <alphanumeric>`
Example	`:DISP:VIEW:ADV:REN “Baseband”`
Notes	`<alphanumeric>` is case insensitive; you can specify mixed case, however the name will be evaluated on a single case If the `<alphanumeric>` specifying the new name is already present in the list of View names, the error message “-224, Illegal parameter value; View <alphanumeric> already exists” is generated

	If the current View is a Predefined View, the error message “-224, Illegal parameter value; Cannot rename a Predefined View” is generated If the display is disabled (via `:DISP:ENAB OFF`) then the error message “-221, Settings conflict; View SCPI cannot be used while Display is disabled” is generated

Delete User View

You can delete the current View if it is a User View. The default view becomes the current view for the Measurement.

Remote Command	`:DISPlay:VIEW:ADVanced:DELete`
Example	`:DISP:VIEW:ADV:DEL`
Notes	`<alphanumeric>` is case insensitive; you can specify mixed case, however the name will be evaluated on a single case If the `<alphanumeric>` is not present in the list of View names, the error message “-224, Illegal parameter value; View <alphanumeric> does not exist” is generated If the current View is a Predefined View, the error message “-224, Illegal parameter value; Cannot delete a Predefined View” is generated If the display is disabled (via `:DISP:ENAB OFF`) then the error message “-221, Settings conflict; View SCPI cannot be used while Display is disabled” is generated

Delete All User Views

Deletes all previously saved User Views. The default view becomes the current view for the Measurement if a User View was the current view when this command was executed.

Remote Command	`:DISPlay:VIEW:ADVanced:DELete:ALL`
Example	`:DISP:VIEW:ADV:DEL:ALL`
Notes	Disabled if there are no User Views

View Editor Remote Commands

The following remote commands help you manage Views and User Views. Note that the SCPI node for User Views handles both Predefined and User Views. The legacy nodes, `:DISPlay:VIEW[:SELect]` and `:DISPlay:VIEW:NSEL`, are retained for backwards compatibility, but they only support predefined views.

View Listing Query

Returns a string containing a comma-separated list of names for *all* the Views, including User Views, available for the current Measurement.

Remote Command	`:DISPlay:VIEW:ADVanced:CATalog?`
Example	`:DISP:VIEW:ADV:CAT?`
Notes	Returns a quoted string of the available Views for the current measurement, separated by commas. The list includes names for *all* the Views, including User Views, available for the current Measurement Example: `"Normal,Trace Zoom,Spectrogram,Baseband,myView1,yourView1"` No distinction is made between Predefined and User Views If you switch measurements with the display disabled (via `:DISP:ENAB OFF`), then query the list of available Views, the result is undefined

User View Listing Query

Returns a string containing a comma-separated list of names for *only* the User Views available for the current Measurement.

Remote Command	`:DISPlay:VIEW:ADVanced:USER:CATalog?`
Example	`:DISP:VIEW:ADV:USER:CAT?`
Notes	Returns a quoted string of the available User Views for the current measurement, separated by commas. Example: `"Baseband,myView1,yourView1"` If you switch measurements with the display disabled (see "Display Enable (Remote Command Only)" on page 1983), then query the list of available Views, the result is undefined

3.8.5.2 Annotation

Contains controls for setting up the annotation for the current Mode or Measurement.

Graticule

Turns the display graticule On or Off for all windows with graticules in all measurements in the current Mode. Also turns the graticule Y-Axis annotation on and off.

Remote Command	:DISPlay:GRATicule[:STATe] OFF | ON | 0 | 1 :DISPlay:GRATicule[:STATe]?
Example	:DISP:GRAT OFF
Notes	The graticule is the set of horizontal and vertical lines that make up the grid/divisions for the X-Axis and Y-Axis
Preset	ON
State Saved	Saved in instrument state
Backwards Compatibility SCPI	:DISPlay:WINDow[1]:TRACe:GRATicule:GRID[:STATe] OFF | ON | 0 | 1 :DISPlay:WINDow[1]:TRACe:GRATicule:GRID[:STATe]? This command is accepted for backwards compatibility with older instruments, but the WINDow, TRACe and GRID parameters are ignored

Screen Annotation

Controls the display of the annunciation and annotation around the graticule, including any annotation on lines (such as the display line, the threshold line, etc.) and the Y-Axis annotation, for all windows with screen annotation in all measurements in the current Mode.

This does *not* include marker annotation (or the N dB result). When OFF, the graticule expands to fill the entire graticule area, leaving only the 1.5% gap above the graticule, as described in the **Trace** section.

Remote Command	:DISPlay:ANNotation:SCReen[:STATe] OFF | ON | 0 | 1 :DISPlay:ANNotation:SCReen[:STATe]?
Example	:DISP:ANN:SCR OFF
Dependencies	Grayed-out and forced to OFF when **System Display Settings**, **Annotation** is OFF
Preset	ON This remains OFF through a Preset when **System Display Settings**, **Annotation** is set to OFF
State Saved	Saved in instrument state

Trace Annotation

Turns on and off the labels on the traces, showing their detector (or their Math Mode) as described in the **Trace** section, for all windows in all measurements in the current Mode for which Trace Annotation on/off is supported.

If Trace Math is being performed on a trace, then the Trace Math annotation replaces the detector annotation.

For measurements that support limit lines, this key also turns on and off the labels on the Limit Lines. The label is the Limit number annotation and Limit Comment displayed on the graph. If the length of the comment is greater than 20 characters, the first 8 characters and the last 8 characters are displayed, joined with ....

Remote Command	`:DISPlay:ANNotation:TRACe[:STATe] ON | OFF | 1 | 0` `:DISPlay:ANNotation:TRACe[:STATe]?`
Example	`:DISP:ANN:TRAC OFF`
Preset	`OFF`
State Saved	Saved in instrument state

Control Annotation

Turns on and off the display of values on the Active Function controls for all measurements in the current Mode. This is a security feature.

Remote Command	`:DISPlay:ACTivefunc[:STATe] ON | OFF | 1 | 0` `:DISPlay:ACTivefunc[:STATe]?`
Example	`:DISP:ACT OFF`
Dependencies	Grayed out and forced to `OFF` when **System Display Settings**, **Annotation** is `OFF`
Preset	`ON` This remains `OFF` through a Preset when **System Display Settings**, **Annotation** is set to `OFF`
State Saved	Saved in instrument state

Frequency Annotation

Turns on and off the absolute frequency annotation in the main display for all windows in all measurements in the current Mode for which Frequency Annotation on/off is supported.

The affected annotations include Center Frequency, Start/Stop Frequency, Frequency Offset, Marker Frequency. Any relative frequency annotation such as Span and Marker Delta are not affected.

The frequency annotations in any other associated display, such as in Active Function, Softkey label, Limit Editor, Amp Corr Editor and Marker Table are not changed.

Frequency annotations that are not associated with the spectrum, such as RBW, IBW, Sweep Time, are excluded and they are shown regardless of this selection.

Remote Command	`:DISPlay:ANNotation:FREQuency[:STATe] ON | OFF | 1 | 0` `:DISPlay:ANNotation:FREQuency[:STATe]?`
Example	`:DISP:ANN:FREQ OFF`
Dependencies	Only appears in the Swept SA measurement in Spectrum Analyzer Mode
Preset	`ON`

Meas Bar

Turns the Measurement Bar at the top of the screen on and off for all measurements in the current Mode. When OFF, the graticule area expands to fill the area formerly occupied by the Measurement Bar.

Remote Command	:DISPlay:ANNotation:MBAR[:STATe] OFF | ON | 0 | 1 :DISPlay:ANNotation:MBAR[:STATe]?
Example	:DISP:ANN:MBAR OFF
Dependencies	Grayed out and forced to OFF when **System Display Settings**, **Annotation** is OFF
Preset	ON This remains OFF through a Preset when **System Display Settings**, **Annotation** is set to OFF
State Saved	Saved in instrument state

Display Enable (Remote Command Only)

Turns the display on/off, including the display drive circuitry. The backlight stays lit to confirm that the instrument is on. The display enable setting is mode global. Theare three reasons for turning the display off:

1. To increase speed as much as possible by freeing the instrument from having to update the display
2. To reduce emissions from the display, drive circuitry
3. For security purposes

If you have turned off the display:

– and you are in local operation, the display can be turned back on by pressing any key or by sending :SYSTem:DEFaults MISC or :DISPlay:ENABle ON (neither *RST nor :SYSTem:PRESet enable the display)

– and you are in remote operation, the display can be turned back on by pressing the **Local** or **Esc** keys, or by sending :SYSTem:DEFaults MISC or :DISPlay:ENABle ON (neither *RST nor :SYSTem:PRESet enable the display)

– and you are using either the :SYSTem:KLOCk command or GPIB local lockout, then *no* front-panel key press will turn the display back on. You must turn it back on remotely.

If the display is OFF, many SCPI commands related to User Views and Multiscreen functionality do not work, and return the error messages “-221, Settings conflict; Screen SCPI cannot be used when Display is disabled” or “221, Settings conflict; View SCPI cannot be used while Display is disabled”. These commands include:

Name	Command
Select User View	`:DISPlay:VIEW:ADVanced:SELect`
Rename User View	`:DISPlay:VIEW:ADVanced:REName`
Delete User View	`:DISPlay:VIEW:ADVanced:DELete`
Create User View	`:DISPlay:VIEW:ADVanced:NAME`
Select Screen	`:INSTrument:SCReen:SELect`
Delete Screen	`:INSTrument:SCReen:DELete`
Delete All But This Screen	`:INSTrument:SCReen:DELete:ALL`
Add Screen	`:INSTrument:SCReen:CREate`
Rename Screen	`:INSTrument:SCReen:REName`
Sequencer On/Off	`:SYSTem:SEQuencer`

Remote Command	`:DISPlay:ENABle OFF | ON | 0 | 1` `:DISPlay:ENABle?`
Example	`:DISP:ENAB OFF`
Couplings	`:DISP:ENAB OFF` turns Backlight `OFF` and `:DISP:ENAB ON` turns Backlight `ON`, but changing Backlight settings does *not* change the state of `:DISP:ENAB`
Preset	`ON` Set by `:SYST:DEF MISC`, but not affected by `*RST` or `:SYSTem:PRESet`
State Saved	Not saved in instrument state
Backwards Compatibility Notes	`:SYST:PRES` no longer turns on `:DISPlay:ENABle` as it did in legacy analyzers

3.8.6 Frequency

Opens the **Frequency** menu, which contains controls that allow you to control the Frequency and Channel parameters of the instrument.

Some settings in the **Frequency** menu are the same for all measurements in the current Mode – they do not change as you change measurements. Settings like these are called "Meas Global" and are unaffected by Meas Preset. For example, the Center Freq setting is the same for all measurements - it does not change as you change measurements.

3.8.6.1 Settings

Contains controls that pertain to the X axis parameters of the measurement. These parameters control how data on the vertical (X) axis is displayed and control instrument settings that affect the horizontal axis.

Center Frequency

Sets the frequency that corresponds to the horizontal center of the graticule. While adjusting the Center Frequency, the Span is held constant.

The **Center Frequency** setting is the same for all measurements within a mode, that is, it is Meas Global. Some modes are also able to share a Mode Global center frequency value. If this is the case, then a **Global** tab appears in the **Meas Setup** menu.

The **Center Frequency** function sets (and queries) the Center Frequency for the currently selected input. If your instrument has multiple inputs, and you select another input, the Center Freq changes to the value for that input. SCPI commands are available to directly set the Center Freq for a specific input.

Center Freq is remembered as you go from input to input. Thus you can set a Center Freq of 10 GHz with the RF Input selected, change to BBIQ and set a Center Freq of 20 MHz, then switch to External Mixing and set a Center Freq of 60 GHz, and when you go back to the RF Input the Center Freq will go back to 10 GHz; back to BBIQ and it is 20 MHz; back to External Mixing and it is 60 GHz.

See:

"RF Center Freq" on page 1406

"Ext Mix Center Freq" on page 1407

"I/Q Center Freq" on page 1407

"Center Frequency Presets" on page 1404

"VXT Models with Radio Heads/CIU Frequency Range" on page 1406

Remote Command	`[:SENSe]:FREQuency:CENTer <freq>` `[:SENSe]:FREQuency:CENTer?`

Example	`:FREQ:CENT 50 MHz`
	sets Center Frequency to 50 MHz
	`:FREQ:CENT UP`
	increments the Center Frequency by the value of CF Step
	`:FREQ:CENT?`
	returns the current value of Center Frequency

Notes	This command sets the RF, External Mixing or I/Q Center Frequency depending on the selected input – For RF input it is equivalent to `:FREQ:RF:CENT` – For I/Q input it is equivalent to `:FREQ:IQ:CENT`

	– For External Mixer it is equivalent to `:FREQ:EMIX:CENT` Preset and Max values are dependent on Hardware Options (5xx) If no terminator (for example, MHz) is sent, the terminator Hz is used. If a terminator with unit other than Frequency is used, an invalid suffix error message is generated
Dependencies	Not available in the MSR, LTE-Advanced FDD/TDD and 5G NR modes
Preset	Depends on instrument maximum frequency, mode, measurement, and selected input See "Center Frequency Presets" on page 1404, "RF Center Freq" on page 1406, "Ext Mix Center Freq" on page 1407, "I/Q Center Freq" on page 1407 and "VXT Models with Radio Heads/CIU Frequency Range" on page 1406
State Saved	Saved in instrument state
Min/Max	Depends on instrument maximum frequency, mode, measurement, and selected input See "Center Frequency Presets" on page 1404, "RF Center Freq" on page 1406, "I/Q Center Freq" on page 1407 and "VXT Models with Radio Heads/CIU Frequency Range" on page 1406
Annotation	Center <value> appears in the lower left corner of the display
Status Bits/OPC dependencies	Non-overlapped

Center Frequency Presets

The following table provides the Center Frequency Presets for the Spectrum Analyzer mode, and the Max Freq, for the various frequency options:

Freq Option	CF after Mode Preset	Stop Freq after Mode Preset	Max Freq (can't tune above)
503 (all but CXA)	1.805 GHz	3.6 GHz	3.7 GHz
503 (CXA)	1.505 GHz	3.0 GHz	3.08 GHz
507 (all but CXA)	3.505 GHz	7.0 GHz	7.1 GHz
507 (CXA)	3.755 GHz	7.5 GHz	7.58 GHz
508 (all but MXE)	1.805 GHz	3.6 GHz	8.5 GHz
508 (MXE)	4.205 GHz	8.4 GHz	8.5 GHz
513	6.805 GHz	13.6 GHz	13.8 GHz
526 (except CXA and MXE)	13.255 GHz	26.5 GHz	27.0 GHz*
526 (CXA)	13.255 GHz	26.5 GHz	26.55 GHz
526 (MXE)	1.805 GHz	3.6 GHz	27.0 GHz
532	16.005 GHz	32.0 GHz	32.5 GHz
540	20.005 GHz	40.0 GHz	40.5 GHz
543	21.505 GHz	43.0 GHz	43.0 GHz
544	22.005 GHz	44.0 GHz	45.0 GHz

Freq Option	CF after Mode Preset	Stop Freq after Mode Preset	Max Freq (can't tune above)
550	25.005 GHz	50.0 GHz	52 GHz
F03 (CXA-m)	1.505 GHz	3.0 GHz	3.08 GHz
F07 (CXA-m)	3.755 GHz	7.5 GHz	7.575 GHz
F13 (CXA-m)	6.805 GHz	13.6 GHz	13.8 GHz
F26 (CXA-m)	13.255 GHz	26.5 GHz	26.55 GHz
504 (M9421A, M8920A)	2.145 GHz	3.88GHz	3.88 GHz
506 (M9421A, M8920A)	3.245 GHz	6.08GHz	6.08 GHz
F06 (M9410A/11A)	1.0 GHz	6.08 GHz	6.08 GHz
F06 (M9415A)	1 GHz	1.08 GHz	6.6 GHz
F08 (M9415A)	1 GHz	1.08 GHz	8.6 GHz
F12 (M9415A)	1 GHz	1.08 GHz	12.9 GHz

*For option 526, the Max CF in RTSA is 26.999999995 GHz.

N9041B Center Freq Presets

Input	CF after Mode Preset	Stop Freq after Mode Preset	Max Freq (can't tune above)
Input 1, all models	25.005 GHz	50.0 GHz	52 GHz
Input 2, opt 585	42.505 GHz	85.0 GHz	86 GHz
Input 2, opt 590	45.005 GHz	90.0 GHz	92 GHz
Input 2, opt 5CX	55.005 GHz	110.0 GHz	110 GHz

Input 2, CXA and MXE

Model	CF after Mode Preset	Stop Freq after Mode Preset	Max Freq (can't tune above)
CXA opt C75	0.7505 GHz	1.5 GHz	1.58 GHz
MXE	505 MHz	1 GHz	1.000025 GHz

Tracking Generator Frequency Limits (CXA only)

Tracking Generator Option	Min Freq (clips to this freq when turn TG on and can't tune below while TG on)	If above this Freq, Stop Freq clipped to this Freq when TG turned on	Max Freq (can't tune above) while TG on
T03	9 kHz	3.0 GHz	3.08 GHz
T06	9 kHz	6.0 GHz	6.05 GHz

Tracking Generator Frequency Limits(CXA-m only)

Tracking Generator Option	Min Freq (clips to this freq when turn TG on and can't tune below while TG on)	If above this Freq, Stop Freq clipped to this Freq when TG turned on	Max Freq (can't tune above) while TG on
T03	2 MHz	3.08 GHz	3.08 GHz
T07	2 MHz	7.575 GHz	7.575 GHz
T13	2 MHz	13.8 GHz	13.8 GHz
T26	2 MHz	26.55 GHz	26.55 GHz

VXT Models with Radio Heads/CIU Frequency Range

The following table shows the Center Frequency Presets and Range for VXT modes with Radio Heads/CIU.

Products with Radio Heads/CIU	Preset	Start frequency	Stop frequency
M9421A + CIU	6 GHz	5.9 GHz	12 GHz
M9410A + CIU	6 GHz	5.9 GHz	12 GHz
M9410A + CIU + RRH	25 GHz	24.25 GHz	43.5 GHz

RF Center Freq

Specifies the RF Center Frequency. This command sets the Center Frequency to be used when the RF input is selected, even if the RF input is not the input that is selected at the time the command is sent. Note that the **Center Freq** function in the **Frequency** menu on the front panel always applies to the currently selected input.

Remote Command	`[:SENSe]:FREQuency:RF:CENTer <freq>` `[:SENSe]:FREQuency:RF:CENTer?`
Example	`:FREQ:RF:CENT 30 MHz` `:FREQ:RF:CENT?`
Notes	This command is the same in all modes, but the parameter is Measurement Global, so the value is independent in each mode and common across all the measurements in the mode
Dependencies	If the electronic/soft attenuator is enabled, any attempt to set Center Frequency such that the Stop Frequency would be >3.6 GHz fails and results in an advisory message. If the equivalent SCPI command is sent, this same message is generated as part of a "-221, Settings conflict" warning
Preset	See table above
State Saved	Saved in instrument state
Min	-79.999995 MHz
Max	See table above. Basically instrument maximum frequency - 5 Hz If the knob or step keys are being used, also depends on Span

Ext Mix Center Freq

Specifies the External Mixer Center Frequency. This command sets the Center Frequency to be used when the External Mixer is selected, even if the External Mixer input is not the input which is selected at the time the command is sent. Note that **Center Freq** function in the **Frequency** menu on the front panel always applies to the currently selected input.

Remote Command	`[:SENSe]:FREQuency:EMIXer:CENTer <freq>` `[:SENSe]:FREQuency:EMIXer:CENTer?`
Example	`:FREQ:EMIX:CENT 60 GHz` `:FREQ:EMIX:CENT?`
Notes	This command is the same in all modes, but the parameter is Measurement Global, so the value is independent in each mode and common across all the measurements in the mode
Couplings	When returning to External Mixing after having been switched to one of the other inputs (for example, RF), you will return to the settings that you had when you left External Mixing. So you will return to the band you were in with the Center Frequency that you had. However, Span is not an input-dependent parameter, therefore you will bring the span over from the other input. Therefore, the instrument returns to the span from the previous input, limited as necessary by the current mixer setup
Preset	When a Mode Preset is performed while in External Mixing, the Start frequency of the current Mode is set to the nominal Min Freq of the lowest harmonic range in the Harmonic Table for the current mixer setup. Similarly, the Stop frequency of the current Mode is set to the nominal Max Freq of the highest harmonic range in the Harmonic Table. The Center Freq thus presets to the point arithmetically equidistant from these two frequencies Note that, if the current measurement has a limited Span available to it, and cannot achieve the Span shown in the table (Span=Stop Freq – Start Freq), the instrument uses the maximum Span the measurement allows, and still sets the Center Freq to the midpoint of the Start and Stop Freq values in the Harmonic Table When **Restore Input/Output Defaults** is performed, the mixer presets to the 11970A, whose Start and Stop frequencies are 26.5 and 40 GHz respectively. The center of these two frequencies is 33.25 GHz Therefore, after **Restore Input/Output Defaults**, if you go to External Mixing and do a Mode Preset while in Spectrum Analyzer Mode, the resulting Center Freq is 33.25 GHz
State Saved	Yes
Min	The minimum frequency in the currently selected mixer band + 5 Hz If the knob or step keys are being used, also depends on Span
Max	The maximum frequency in the currently selected mixer band - 5 Hz If the knob or step keys are being used, also depends on Span

I/Q Center Freq

Specifies the I/Q Center Frequency. Sets the Center Frequency to be used when the I/Q input is selected, even if the I/Q input is not the input that is selected at the time the command is sent. Note that the **Center Freq** function in the **Frequency** menu on the front panel always applies to the currently selected input.

Remote Command	`[:SENSe]:FREQuency:IQ:CENTer <freq>` `[:SENSe]:FREQuency:IQ:CENTer?`
Example	`:FREQ:IQ:CENT 30 MHz`
Notes	This command is the same in all modes, but the parameter is Measurement Global, so the value is independent in each mode and common across all the measurements in the mode
Preset	0 Hz
State Saved	Saved in instrument state
Min	-40.049995 MHz
Max	40.049995 MHz

CF Step

Changes the step size for the center frequency and start and stop frequency functions. Once a step size has been selected and the center frequency function is active, the step keys (and the UP|DOWN parameters for Center Frequency from remote commands) change the center frequency by the step-size value. The step size function is useful for finding harmonics and sidebands beyond the current frequency span of the instrument.

Note that the start and stop frequencies also step by the CF Step value.

Remote Command	`[:SENSe]:FREQuency:CENTer:STEP[:INCRement] <freq>`
	`[:SENSe]:FREQuency:CENTer:STEP[:INCRement]?`
	`[:SENSe]:FREQuency:CENTer:STEP:AUTO OFF | ON | 0 | 1`
	`[:SENSe]:FREQuency:CENTer:STEP:AUTO?`

Example	`:FREQ:CENT:STEP 500 MHz`
	`:FREQ:CENT UP`
	increases the current center frequency value by 500 MHz
	`:FREQ:CENT:STEP?`
	`:FREQ:CENT:STEP:AUTO ON`
	`:FREQ:CENT:STEP:AUTO?`

Notes	Preset and Max values are depending on Hardware Options
Dependencies	Not available in the MSR, LTE-A FDD/TDD and 5G NR modes If the electronic/soft attenuator is enabled, any attempt to change the value of the center frequency >3.6 GHz by pressing the Up-arrow key, fails and results in an advisory message. If the equivalent SCPI command is sent, this same message is generated as part of a "-221, Settings conflict" warning
Couplings	When auto-coupled, the center frequency step size is set to 10% of the span
Preset	Auto `ON`

State Saved	Saved in instrument state
Min	– (the maximum frequency of the instrument). That is, 27 GHz max freq instrument has a CF step range of +/- 27 GHz. Note that this is the maximum frequency given the current settings of the instrument, so in External Mixing, for example, it is the maximum frequency of the current mixer band
Max	The maximum frequency of the instrument. That is, 27 GHz max freq instrument has a CF step range of +/- 27 GHz. Note that this is the maximum frequency given the current settings of the instrument, so in External Mixing, for example, it is the maximum frequency of the current mixer band
Status Bits/OPC dependencies	non-overlapped

Freq Offset

Enables you to set a frequency offset value to account for frequency conversions outside of the instrument. This value is added to the display readout of the marker frequency, center frequency, start frequency, stop frequency, and all other absolute frequency settings in the instrument including frequency count. When a frequency offset is entered, the value appears below the center of the graticule. To eliminate an offset, perform a Mode Preset or set the frequency offset to 0 Hz.

See "More Information" on page 1410

Remote Command	`[:SENSe]:FREQuency:OFFSet <freq>` `[:SENSe]:FREQuency:OFFSet?`
Example	`:FREQ:OFFS 10 MHz` `:FREQ:OFFS?`
Notes	Preset and Max values are dependent on Hardware Options
Dependencies	This control appears only in Spectrum Analyzer Mode **Freq Offset** is not available in External Mixing. In this case the Freq Offset control is grayed-out and displays a value of zero. However, the value of CF Offset that was set for the RF Input is retained and restored when the user switches back to the RF Input
Preset	See "Center Frequency Presets" on page 1404
State Saved	Saved in instrument state
Min	-500 GHz
Max	500 GHz
Annotation	If Frequency Offset is not zero, “Freq Offset <value>” appears on the upper line of the annotation, below the graticule, in the center
Status Bits/OPC dependencies	Non-overlapped
Backwards Compatibility SCPI	`:DISPlay:WINDow[1]:TRACe:X[:SCALe]:OFFSet` The `DISPlay` version of the command is in the instrument for compatibility across platforms and is not recommended for new development

More Information

This command does not affect any bandwidths, nor the settings of relative frequency parameters such as delta markers or span. It does not affect the current hardware settings of the instrument, but only the displayed frequency values. Entering an offset does not affect the trace position or display, just the value of the start and stop frequency and the values represented by the trace data. The frequency values of exported trace data, queried trace data, markers, trace data used in calculations such as N dB points, trace math, etc., are all affected by Freq Offset. Changing the offset, even on a trace that is not updating will immediately change all of the above, without taking new data.

NOTE **If a trace is exported with a nonzero Freq Offset, the exported data will contain the trace data with the offset applied. Therefore, if that trace were to be imported back into the instrument, you would want Freq Offset to be 0, or the offset would be applied again to data which is already offset. No such care need be taken when saving a State+Trace file because the data and state are saved together.**

3.8.7 Marker

Accesses a menu that enables you to select, set up and control the markers for the current measurement. If there are no active markers, **Marker** selects marker 1, sets it to Normal and places it at the center of the display. If the selected marker is Off, it is set to Normal and placed it at the center of the screen on the trace determined by the **Marker Trace** rules.

3.8.7.1 Select Marker

Specifies the selected marker. The term “selected marker” is used throughout this document to specify which marker will be affected when you change marker settings, perform a Peak Search, etc.

The **Select Marker** control appears above the menu panel, indicating that it applies to all controls in the Marker menu panels. **Select Marker** is blanked if you select a tab whose controls do *not* depend on the selected marker (for example, Counter).

On any menu tab that displays **Select Marker**, the first control is always **Marker Frequency|Time**.

Notes	The selected marker is remembered even when not in the Marker menu and is used if a Search is done or a Band Function is turned on or for Signal Track or Continuous Peak
Preset	Marker 1
State Saved	The number of the selected marker is saved in instrument state
Annunciation	Appears in the marker results block label for **Normal** and **Delta** markers

3.8.7.2 Settings

The controls on this tab include the Marker active function and a radio button selection for the marker control mode (Normal, Delta, or Off) for the selected marker, as well as additional functions that help you use markers.

Marker Frequency

Sets the marker X-Axis value in the current marker X-Axis Scale unit. It has no effect if the control mode is `OFF`, but is the SCPI equivalent of entering an X value if the control mode is **Normal** (`POSition`) or `DELTa`.

Remote Command	`:CALCulate:SPURious:MARKer[1]|2|…|12:X <freq>` `:CALCulate:SPURious:MARKer[1]|2|…|12:X?`
Example	`:CALC:SPUR:MARK2:X 25 kHz` `:CALC:SPUR:MARK3:X?`
Notes	If no suffix is sent, uses the fundamental units for the current marker X Axis Scale. If a suffix is sent that does not match the current marker X Axis Scale unit, an error "Invalid suffix" is generated The query returns the marker's absolute X Axis value if the control mode is **Normal**, or the offset from the marker's reference marker if the control mode is **Delta**. The query is returned in the fundamental units for the current marker X Axis scale: Hz for **Frequency** and Inverse Time, seconds for Period and Time
Preset	After a preset, all markers are turned `OFF`, so Marker X-Axis Value query returns Not A Number (`NAN`) After Mode Preset, change **Sweep/Measure** to **Single**
State Saved	Saved in instrument state
Min	-9.9E+37
Max	9.9E+37
Annotation	Mkr # <X value> and <Marker value> upper right on graph

Marker X Axis Position (Remote Command Only)

Sets the marker X-Axis Scale position in trace points. This setting has no effect if the control mode is **Off,** but is the SCPI equivalent of entering a value if the control mode is **Normal** or **Delta** - except in trace points rather than X-Axis Scale units. The entered value is immediately translated into the current X-Axis Scale units for setting the value of the marker.

Remote Command	`:CALCulate:SPURious:MARKer[1]|2|…|12:X:POSition <real>` `:CALCulate:SPURious:MARKer[1]|2|…|12:X:POSition?`
Example	`:CALC:SPUR:MARK10:X:POS 300` `:CALC:SPUR:MARK10:X:POS?`

Notes	The query returns the marker's absolute X-Axis value in trace points if the control mode is **Normal**, or the offset from the marker's reference marker in trace points if the control mode is **Delta**. The value is returned as a real number, not an integer, corresponding to the translation from X-Axis Scale units to trace points . When a Marker is turned on, it is placed center of the screen on the trace. Therefore the default value depends on instrument condition. If the marker is `OFF`, the response is Not A Number
Preset	After a preset, all markers are turned `OFF`, so Marker X-Axis Value query returns Not A Number (`NAN`)
State Saved	Saved in instrument state
Min	-9.9E+37
Max	9.9E+37

Marker Y Axis Value (Remote Command only)

Returns the marker Y Axis value in the current marker Y Axis unit.

Remote Command	`:CALCulate:SPURious:MARKer[1]|2|…|12:Y?`
Example	`:CALC:SPUR:MARK11:Y?`
Notes	Returns the marker Y-Axis result, if the control mode is **Normal** or **Delta**. If the marker is `OFF`, the response is Not A Number In the Complex Spectrum measurement, when the marker is on and Marker Trace is set to IQ, it returns I and Q values Case #1 - MarkerTrace SPEC, I or Q: returns a single double value – >:CALC:SPEC:MARK1:Y? – -2.402406506109E+001 Case #2 - MarkerTrace IQ: returns a double array of two values, the first is I, and the second is Q – >:CALC: SPEC:MARK1:Y? – -3.006944493834E-003,+9.9870666467354E-004 The IQ selection is for backward compatibility purposes. It is recommended that the users use the I and/or Q selection instead
Preset	Result dependent on Marker setup and signal source
State Saved	No
Backwards Compatibility SCPI	`:CALCulate:SPURious:MARKer[1]|2|…|12:FUNCtion:RESult?`

Marker Mode

Sets the marker control mode to `POSition` (**Normal**), `DELta`, or `OFF`. All interactions and dependencies detailed under the control description are enforced when the remote command is sent. If the selected marker is OFF, pressing **Marker** sets it to POSition and places it at the center of the screen on the trace determined by the **Marker Trace** rules. At the same time, **Marker X Axis Value** appears on the Active Function area.

The default active function is the active function for the currently selected marker control mode. If the current control mode is OFF, there is no active function and the active function is turned off.

Remote Command	`:CALCulate:SPURious:MARKer[1]|2|…|12:MODE POSition | DELTa | OFF` `:CALCulate:SPURious:MARKer[1]|2|…|12:MODE?`
Example	`:CALC:SPUR:MARK:MODE POS` `:CALC:SPUR:MARK:MODE?`
Preset	OFF
State Saved	Saved in instrument state
Range	POSition|DELTa|OFF
Annotation	Mkr # <X value> and <Marker value> upper right on graph When Marker Trace is Polar in WCDMA mode: Mkr # <Chip Value (RHO & QPSKEVM)/Symbol Value (CDP)>, <X value> and <Y value> upper right on graph

Backwards Compatibility SCPI Commands

Sets or queries the state of a marker. Setting a marker that is OFF to ON (1) puts it in POSition mode and places it at the center of the screen.

Example	`:CALC:SPUR:MARK3:STAT 1` `:CALC:SPUR:MARK3:STAT?`
Preset	OFF
State Saved	Saved in instrument state
Range	OFF|ON
Backwards Compatibility SCPI	`:CALCulate:SPURious:MARKer[1]|2|…|12:STATe OFF | ON | 0 | 1` `:CALCulate:SPURious:MARKer[1]|2|…|12:STATe?`

Delta Marker (Reset Delta)

Pressing this control has exactly the same effect as selecting **Delta** in "Marker Mode" on page 1412. The selected marker becomes a Delta Marker. If the selected marker is already a Delta marker, the reference marker is moved to the current position of the selected marker, thus resetting the Delta to zero.

Marker Settings Diagram

Lets you configure the Marker system using a visual utility.

All Markers Off

Turns off all markers.

Remote Command	`:CALCulate:SPURious:MARKer:AOFF`
Example	`:CALC:SPUR:MARK:AOFF`

Couple Markers

When this function is `ON`, moving any marker causes an equal X-Axis movement of every other marker that is not `OFF`. By "equal X-Axis movement" we mean that we preserve the difference between each marker's X-Axis value (in the fundamental x-axis units of the trace that marker is on) and the X-Axis value of the marker being moved (in the same fundamental X-Axis units).

This may result in markers going off screen.

Remote Command	`:CALCulate:SPURious:MARKer:COUPle[:STATe] ON | OFF | 1 | 0` `:CALCulate:SPURious:MARKer:COUPle[:STATe]?`
Example	`:CALC:SPUR:MARK:COUP ON` `:CALC:SPUR:MARK:COUP?`
Preset	`OFF` Presets on **Mode Preset** and **All Markers Off**
State Saved	Saved in instrument state

3.8.7.3 Peak Search

The controls on this tab allow you to move the marker to selected peaks of the signal, giving you enormous analysis capabilities, particularly when combined with the Delta Marker function.

NOTE Pressing the **Peak Search** hardkey automatically moves you to the **Peak Search** page of the **Marker** menu *and* performs a Peak Search.

Pressing the **Peak Search** tab once you are already *in* the **Marker** menu does *not* perform a Peak Search.

Marker Frequency

This is the fundamental control that you use to move a marker around on the trace. This is the same as "Marker Frequency" on page 1411 on the **Settings** tab.

Peak Search

Moves the selected marker to the trace point that has the maximum y-axis value for that marker's trace.

NOTE: Pressing the **Peak Search** hardkey automatically moves you to the Peak Search page of the Marker menu *and* performs a Peak Search.

Remote Command	`:CALCulate:SPURious:MARKer[1]|2|…|12:MAXimum`

Example	`:CALC:SPUR:MARK2:MAX`
	`:SYST:ERR?`
	can be used to query the errors to determine if a peak is found. The message "No peak found" will be returned after an unsuccessful search

Notes	Sending this command selects the subopcoded marker In W-CDMA Mode, this command does not work when the selected marker is located on the polar trace. In this case, the command is ignored

Next Peak

Moves the selected marker to the peak that is next lower in amplitude than the current marker value.

If the selected marker was `OFF`, then it is turned on as a `POSition` marker and a peak search is performed.

Remote Command	`:CALCulate:SPURious:MARKer[1]|2|…|12:MAXimum:NEXT`
Example	`:CALC:SPUR:MARK2:MAX:NEXT`
Notes	Sending this command selects the subopcoded marker
State Saved	Not part of saved state

Next Pk Right

Moves the selected marker to the nearest peak right of the current marker.

If the selected marker was OFF, then it is turned on as a POSition marker and a peak search is performed.

Remote Command	:CALCulate:SPURious:MARKer[1]|2|…|12:MAXimum:RIGHt
Example	:CALC:SPUR:MARK2:MAX:RIGH
Notes	Sending this command selects the subopcoded marker
State Saved	Not part of saved state

Next Pk Left

Moves the selected marker to the nearest peak left of the current marker.

If the selected marker was OFF, then it is turned on as a POSition marker and a peak search is performed.

Remote Command	:CALCulate:SPURious:MARKer[1]|2|…|12:MAXimum:LEFT
Example	:CALC:SPUR:MARK2:MAX:LEFT
State Saved	Not part of saved state

Minimum Peak

Moves the selected marker to the minimum Y-Axis value on the current trace.

If the selected marker is OFF, it is turned ON before the minimum search is performed.

Remote Command	:CALCulate:SPURious:MARKer[1]|2|…|12:MINimum
Example	:CALC:SPUR:MARK:MIN
Notes	Sending this command selects the subopcoded marker
State Saved	Not part of saved state

Pk-Pk Search

Finds and displays the amplitude and frequency (or time, if in zero span) differences between the highest and lowest y-axis value. It places the selected marker on the minimum value on its selected trace, and places that marker's reference marker on the peak of its selected trace.

This function turns on the reference marker and sets its mode to **Fixed** or **Normal** if it is not already on. (These markers may be on two different traces.)

If the selected marker is OFF, a delta type marker is turned on and the peak-to-peak search is done. If the selected marker is on, but it is not a DELTa marker, then it is changed to delta which turns on the reference marker if needed, and then it performs the peak-to-peak function.

Remote Command	`:CALCulate:SPURious:MARKer[1]|2|…|12:PTPeak`
Example	`:CALC:SPUR:MARK:PTP`
Notes	Turns on the Marker D active function Sending this command selects the subopcoded marker
Dependencies	Pk-Pk Search is not available when **Coupled Markers** is ON
Couplings	The selected marker becomes a delta marker if not already in delta mode
State Saved	Not part of saved state

Marker Delta

Pressing this control has exactly the same effect as selecting **Delta** in "Marker Mode" on page 1412 on the **Settings** tab. The selected marker becomes a Delta Marker. If the selected marker is already a Delta marker, the reference marker is moved to the current position of the selected marker, thus resetting the Delta to zero.

The control is duplicated here to allow you to conveniently perform a peak search, and change the marker's control mode to Delta without having to access two separate menus.

3.8.7.4 Properties

The controls on this tab are used to set certain properties of the selected marker.

Marker Frequency

This is the fundamental control that you use to move a marker around on the trace. This is the same as "Marker Frequency" on page 1411 on the **Settings** tab.

Relative To

Selects the marker to which the selected marker is relative (its reference marker).

Every marker has another marker to which it is relative. This marker is referred to as the "reference marker" for that marker. This attribute is set by the **Marker, Properties, Relative To** control. The marker must be a **Delta** marker to make this attribute relevant. If it is a **Delta** marker, the reference marker determines how the marker is controlled and how its value is displayed. A marker cannot be relative to itself.

Remote Command	`:CALCulate:SPURious:MARKer[1]|2|…|12:REFerence <integer>` `:CALCulate:SPURious:MARKer[1]|2|…|12:REFerence?`
Example	`:CALC:SPUR:MARK3:REF 5` `:CALC:SPUR:MARK:REF?`
Notes	This command causes the marker specified with the subopcode to become selected Range (for SCPI command): 1 to 12. If the range is exceeded the value is clipped A marker cannot be relative to itself, so that choice is not available, and if sent from SCPI generates error -221: “Settings conflict; marker cannot be relative to itself” When queried a single value is returned (the specified marker numbers relative marker)
Couplings	The act of specifying the selected marker’s reference marker makes the selected marker a Delta marker If the reference marker is off it is turned on in **Normal** mode at the delta marker location
Preset	The preset default “Relative To” marker (reference marker) is the next higher numbered marker (current marker +1). For example, if marker 2 is selected, then it’s default reference marker is marker 3. The exception is marker 12, which has a default reference of marker 1 Set to the defaults by using **Restore Mode Defaults**. This is not reset by **Marker Off**, **All Markers Off**, or **Preset**
State Saved	Saved in instrument state. Not affected by Marker Off and hence not affected by Preset or power cycle
Min	1
Max	12
Annunciation	Appears in the marker label of a **Delta** marker

Marker Trace

Selects the trace on which you want your marker placed. A marker is associated with one and only one trace. This trace is used to determine the placement, result, and X-Axis Scale of the marker. All markers have an associated trace; it is from that trace that they determine their attributes and behaviors, and it is to that trace that they go when they become Normal markers.

Specifying a Marker Trace manually or with this command associates the marker with the specified trace. If the marker is not `OFF`, it moves the marker from the trace it was on to the new trace. If the marker is `OFF`, it stays off but is now associated with the specified trace.

The query returns the number of the trace on which the marker is currently placed.

Remote Command	`:CALCulate:SPURious:MARKer[1]|2|…|12:TRACe:ATTached TRACe1 | TRACe2 | TRACe3` `:CALCulate:SPURious:MARKer[1]|2|…|12:TRACe:ATTached?`
Example	`:CALC:SPUR:MARK2:TRAC:ATT TRAC2` `:CALC:SPUR:MARK2:TRAC:ATT?`
Notes	A marker may be placed on a blanked and/or inactive trace, even though the trace is not visible and/or updating.

	An application may register a trace name to be displayed on the control instead of a trace number
Couplings	The state of Marker Trace is not affected by "Auto Couple" on page 1995 Sending the remote command causes the addressed marker to become selected
Preset	`TRACe1`
State Saved	Saved in instrument state
Range	`TRACe1|TRACe2|TRACe3`

Marker Settings Diagram

Lets you configure the Marker system using a visual utility. This is the same as "Marker Settings Diagram" on page 1414 on the **Settings** tab.

3.8.8 Meas Setup

Contains functions for setting up the measurement parameters and also contains functions for setting up parameters global to all measurements in the mode.

3.8.8.1 Settings

Contains frequently-used Meas Setup functions, to which you will want the fastest access.

Avg/Hold Num

Specifies the number of measurement averages used to calculate the measurement result. The average is displayed at the end of each sweep.

Remote Command	`[:SENSe]:SPURious:AVERage:COUNt <integer>` `[:SENSe]:SPURious:AVERage:COUNt?`
Example	`:SPUR:AVER:COUN 2500` `:SPUR:AVER:COUN?`
Preset	10
State Saved	Saved in instrument state
Min/Max	1/10000

Averaging On/Off

Turns Averaging on or off.

NOTE In this measurement, the **Average Type** is preset to the `Log-Pwr Avg (Video)` method. Other averaging methods are not available.

Remote Command	`[:SENSe]:SPURious:AVERage[:STATe] ON | OFF | 1 | 0` `[:SENSe]:SPURious:AVERage[:STATe]?`
Example	`:SPUR:AVER ON` `:SPUR:AVER?`
Preset	`OFF`
State Saved	Saved in instrument state
Range	`ON|OFF`

Average Mode

Enables you to set the Averaging Mode. Options are:

- `EXPonential`: The measurement averaging continues using the specified number of averages to compute each averaged value. The average will be displayed at the end of each sweep
- `REPeat`: The measurement resets the average counter each time the specified number of averages is reached

Remote Command	`[:SENSe]:SPURious:AVERage:TCONtrol EXPonential | REPeat` `[:SENSe]:SPURious:AVERage:TCONtrol?`
Example	`:SPUR:AVER:TCON REP` `:SPUR:AVER:TCON?`
Preset	`EXPonential`
State Saved	Saved in instrument state
Range	`EXPonential|REPeat`

Average Type

Enables you to control the way averaging is done by choosing one of the following averaging scales: Log-Power (Video) or Power (RMS).

There are three different averaging processes in the measurement, and all of them are affected by this setting: Trace Averaging, the Average detector, and VBW filtering.

Control Selection	SCPI	Type
Log-Pwr (Video)	LOG	Simulates the traditional spectrum analyzer type of averaging by averaging the log of the power
Power (RMS)	RMS	True power averaging that is equivalent to taking the RMS value of the voltage. This is the most accurate type of averaging

Remote Command	`[:SENSe]:SPURious:AVERage:TYPE LOG | RMS` `[:SENSe]:SPURious:AVERage:TYPE?`
Example	`:SPUR:AVER:TYPE LOG` `:SPUR:AVER:TYPE?`
Couplings	Sending this command will affect the VBW Average Type
Preset	LOG
State Saved	Yes
Range	Log-Pwr (Video) |Power (RMS)

Meas Type

Selects either EXAMine or FULL measurement type. This parameter is coupled to "Average Mode" on page 1420. Therefore, if the EXAMine measurement type is selected, the measurement sets the Average Mode to exponential. If the FULL measurement type is selected, the measurement sets the Average Mode to repeat. The behavior of each measurement type is described in the table below. When averaging is on, trace averaging is used as each active range is measured. Averaging is not used at any other time.

Type	Single		Continuous	
	No Spurs Found	Spurs Found	No Spurs Found	Spurs Found
EXAMine	All active ranges are measured. On completion the measurement is set to the idle state and the ‘No Spurs’ happening is displayed	All active ranges are measured and the spurs found reported. On completion the measurement is set to the idle state and the trace containing the worst spur restored. The spur control is enabled. A marker is also added which is set to the frequency of the	All active ranges are measured. On completion the SA remains set to last range checked with an active trace and the ‘No Spurs’ happening is displayed	All active ranges are measured and the spurs found reported. On completion the SA is set to the range containing the worst spur found and continually sweeps this range. Note that the trace is

Type	Single		Continuous	
	No Spurs Found	Spurs Found	No Spurs Found	Spurs Found
		worst spur		continually updated but the metrics results aren't updated until restart to keep the initial results as references. Use marker readouts to refer the latest results. The spur control is enabled. A marker is also added which is set to the frequency of the worst spur
FULL	All active ranges are measured. On completion measurement is set to idle state and the 'No Spurs' happening is displayed	All active ranges are measured and spurs found reported. On completion the measurement is set to the idle state, displaying the trace of the last active range	Measurement continually cycles through all active ranges	All active ranges are measured and spurs found reported. On each cycle of the active ranges the spurs found are reset. This ensures any remote queries retrieve the trace data that matches the currently displayed results

Remote Command	`[:SENSe]:SPURious:TYPE EXAMine | FULL` `[:SENSe]:SPURious:TYPE?`
Example	`:SPUR:TYPE FULL` `:SPUR:TYPE?`
Preset	`EXAMine`
State Saved	Saved in instrument state
Range	`EXAMine|FULL`

Spur

Displays any spurs found. Only enabled when the measurement type is set to EXAMine, and turns on upon completion of a measurement. Once the **Spur** control has been enabled, you can view any spur. The measurement sets the instrument to the range in which the currently selected spur was found. The range settings only change if the spur selected is in a range that is different from the current range settings. A marker is used to identify the currently selected spur on the trace.

Remote Command	[:SENSe]:SPURious:SPUR <integer> [:SENSe]:SPURious:SPUR?
Example	:SPUR:SPUR 55 :SPUR:SPUR?
Preset	1
State Saved	No
Min/Max	1/200

Range

Selects the sweep range to show the trace in the display. Marker operation such as peak search is performed in the selected range.

Preset	1
State Saved	No
Min/Max	1/20

Spur Report Mode

Selects the spurious report mode. Options are:

Limit Line Test	LIMTest	Report only spurs above the limit line. Any spurs reported will cause the measurement to fail. See Abs Start Limit for more information
All Spurs	ALL	Report all spurs detected by Peak Threshold and Peak Excursion
Minimum Margin	MMARgin	Report only the spur with the minimum margin from the limit line. For the spur above the limit, its margin is defined as the negative margin. If there are more than one spurs above the limit, only one spur with the largest negative margin is reported

Remote Command	[:SENSe]:SPURious:REPT:MODE ALL | LIMTest | MMARgin [:SENSe]:SPURious:REPT:MODE?

Example	`:SPUR:REPT:MODE LIMT` `:SPUR:REPT:MODE?`
Dependencies	`MMARgin` is available only when option N9060A-7FP is installed
Preset	`ALL`
State Saved	Saved in instrument state
Range	All Spurs|Limit Test|Minimum Margin

Range Settings

This dialog enables you to set range parameters. As you change values, the instrument settings are updated with the new parameter values.

In Spectrum Analyzer Mode, and most other Modes, each Range is defined by its Start Freq and Stop Freq. The index tabs which appear on the left side of the dialog let you change different sets of Range parameters; the Ranges themselves (Start Freq and Stop Freq) are the same in each of these tabs. In some tabs, Center Freq and Span are also shown, but these are dependent on the Start Freq and Stop Freq parameters for each Range.

In MSR Mode, each Range is defined by the parameters under the **Frequency** Index tab. The parameters for each Range are defined using the other index tabs, tied to the **Frequency** tab by the Range number, which appears in the leftmost column of each table.

Each Range has an **Enabled** checkbox, which lets you decide whether to use the Range or not. The checkbox state is the same for all tabs.

Bandwidth

Lets you set RBW and VBW parameters for each range, as well as Filter Type. The **Bandwidth** tab appears in all Modes except MSR.

Frequency Range

Allows you to switch the displayed Frequency Range columns. When `ALL` is selected, Start Frequency, Stop Frequency, Center Frequency, and Span are displayed.

This control appears only in instruments with a 4U size front panel.

Remote Command	`:DISPlay:SPURious:VIEW:RANGe:TABLe:FMODe ALL | SSTop | CSPan` `:DISPlay:SPURious:VIEW:RANGe:TABLe:FMODe?`
Example	`:DISP:SPUR:VIEW:RANG:TABL:FMOD ALL`

	:DISP:SPUR:VIEW:RANG:TABL:FMOD?
Preset	SSTop
State Saved	Saved in instrument state
Range	All|Start/Stop Frequency|Center Frequency/Span

Enabled

Turns on/off each Range. If Range is ON, it will be used as part of the measurement. If it is OFF, it will be excluded. This parameter can send up to 20 values. The location in the list sent corresponds to the range number. When sending the remote command, missing values are not permitted; that is, if you want to change values 2 and 6 you must send all values up to 6. Subsequent values will remain as they were.

The query always returns 20 values.

Remote Command	[:SENSe]:SPURious[:RANGe][:LIST]:STATe ON | OFF | 1 | 0, ON | OFF | 1 | 0, ON | OFF | 1 | 0, ON | OFF | 1 | 0, ON | OFF | 1 | 0, ON | OFF | 1 | 0, ON | OFF | 1 | 0, ON | OFF | 1 | 0, ON | OFF | 1 | 0, ON | OFF | 1 | 0, ON | OFF | 1 | 0, ON | OFF | 1 | 0, ON | OFF | 1 | 0, ON | OFF | 1 | 0, ON | OFF | 1 | 0, ON | OFF | 1 | 0, ON | OFF | 1 | 0, ON | OFF | 1 | 0, ON | OFF | 1 | 0, ON | OFF | 1 | 0 [:SENSe]:SPURious[:RANGe][:LIST]:STATe?
Example	:SPUR:STAT ON :SPUR:STAT?
Preset	SA: ON, ON, ON, ON, ON, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF WCDMA: ON, ON, ON, ON, ON, ON, ON, ON, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF LTETDD, LTEATDD, 5G NR: OFF, OFF, ON, ON, ON, ON, ON, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF LTE, LTEAFDD: ON, ON, ON, ON, ON, ON, ON, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF MSR: ON, ON, ON, ON, ON, ON, ON, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF
State Saved	Yes
Range	ON|OFF

Start Freq

Sets the start frequency of the instrument. This parameter can send up to 20 values. The location where the start frequency occurs in the list sent to the measurement corresponds to the range the value is associated with.

When sending the remote command, missing values are not permitted. If you want to change values 2 and 6 you must send all values up to 6. Subsequent values will remain as they were.

The query always returns 20 values.

Remote Command	`[:SENSe]:SPURious[:RANGe][:LIST]:FREQuency:STARt <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>` `[:SENSe]:SPURious[:RANGe][:LIST]:FREQuency:STARt?`
Example	`:SPUR:FREQ:STAR 9 kHz, 150 kHz, 30 MHz, 1GHz, 1.5 GHz, 1.5 GHz, 1.5 GHz, 1.5 GHz,1.5 GHz,1.5 GHz,1.5 GHz,1.5 GHz,1.5 GHz,1.5 GHz,1.5 GHz,1.5 GHz,1.5 GHz,1.5 GHz,1.5 GHz,1.5 GHz` `:SPUR:FREQ:STAR?`
Preset	SA: +1.92000000E+009, +1.89350000E+009, +2.10000000E+009, +2.17500000E+009, +8.00000000E+008, +1.50000000E+009, +1.50000000E+009, +1.50000000E+009, +1.50000000E+009, +1.50000000E+009, +1.50000000E+009, +1.50000000E+009, +1.50000000E+009, +1.50000000E+009, +1.50000000E+009, +1.50000000E+009, +1.50000000E+009, +1.50000000E+009, +1.50000000E+009, +1.50000000E+009 WCDMA: 9kHz, 150kHz, 30MHz, 1GHz, 2.1GHz, 2.1GHz, 2.1774GHz, 2.18GHz, 1.5GHz, 1.5GHz, 1.5GHz, 1.5GHz, 1.5GHz, 1.5GHz, 1.5GHz, 1.5GHz, 1.5GHz, 1.5GHz, 1.5GHz, 1.5GHz LTETDD, LTEATDD, 5G NR: 9 kHz, 150 kHz, 30 MHz, 1 GHz, 1.90GHz, 2.01 GHz, 2.025 GHz, 1.5 GHz, 1.5 GHz, 1.5 GHz, 1.5 GHz, 1.5 GHz, 1.5 GHz, 1.5 GHz, 1.5 GHz, 1.5 GHz, 1.5 GHz, 1.5 GHz, 1.5 GHz, 1.5 GHz LTE, LTEAFDD: 9 kHz, 150 kHz, 30 MHz, 1 GHz, 1.92GHz, 1.98 GHz, 2.18 GHz, 1.5 GHz, 1.5 GHz, 1.5 GHz, 1.5 GHz, 1.5 GHz, 1.5 GHz, 1.5 GHz, 1.5 GHz, 1.5 GHz, 1.5 GHz, 1.5 GHz, 1.5 GHz, 1.5 GHz WLAN: 9 kHz, 150 kHz, 30 MHz, 1GHz, 1.5 GHz, 1.5 GHz, 1.5 GHz, 1.5 GHz, 1.5 GHz, 1.5 GHz, 1.5 GHz, 1.5 GHz, 1.5 GHz, 1.5 GHz, 1.5 GHz, 1.5 GHz, 1.5 GHz, 1.5 GHz, 1.5 GHz, 1.5 GHz MSR: 9 kHz, 150 kHz, 30 MHz, 1 GHz, 1.92GHz, 1.98 GHz, 2.18 GHz, 1.5 GHz, 1.5 GHz, 1.5 GHz, 1.5 GHz, 1.5 GHz, 1.5 GHz, 1.5 GHz, 1.5 GHz, 1.5 GHz, 1.5 GHz, 1.5 GHz, 1.5 GHz, 1.5 GHz
State Saved	Saved in instrument state
Min/Max	-80 MHz/Hardware Dependent: – Option 503: 3699999990 – Option 508: 8499999990 – Option 513: 13799999990 – Option 526: 26999999990

Stop Freq

Sets the stop frequency of the instrument. This parameter can send up to 20 values.

When sending the remote command, missing values are not permitted. If you want to change values 2 and 6, then you must send all values up to 6. Subsequent values will remain as they were.

The query always returns 20 values.

Remote Command	`[:SENSe]:SPURious[:RANGe][:LIST]:FREQuency:STOP <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>` `[:SENSe]:SPURious[:RANGe][:LIST]:FREQuency:STOP?`
Example	`:SPUR:FREQ:STOP 150kHz, 30MHz, 1GHz, 2.1GHz, 2.1GHz, 2.1774GHz, 2.18GHz, 12.75GHz, 2.5GHz, 2.5GHz, 2.5GHz, 2.5GHz, 2.5GHz, 2.5GHz, 2.5GHz, 2.5GHz, 2.5GHz, 2.5GHz, 2.5GHz, 2.5GHz` `:SPUR:FREQ:STOP?`
Preset	SA: +1.98000000E+009, +1.91960000E+009, +2.10150000E+009, +2.18000000E+009, +1.00000000E+009, +2.50000000E+009, +2.50000000E+009, +2.50000000E+009, +2.50000000E+009, +2.50000000E+009, +2.50000000E+009, +2.50000000E+009, +2.50000000E+009, +2.50000000E+009, +2.50000000E+009, +2.50000000E+009, +2.50000000E+009, +2.50000000E+009, +2.50000000E+009, +2.50000000E+009 WCDMA: 150kHz, 30MHz, 1GHz, 2.1GHz, 2.1GHz, 2.1774GHz, 2.18GHz, 12.75GHz, 2.5GHz, 2.5GHz, 2.5GHz, 2.5GHz, 2.5GHz, 2.5GHz, 2.5GHz, 2.5GHz, 2.5GHz, 2.5GHz, 2.5GHz, 2.5GHz LTETDD, LTEATDD, 5G NR: 150kHz, 30MHz, 1GHz, 1.90GHz, 2.01GHz, 2.025GHz, 12.75GHz, 2.5GHz, 2.5GHz, 2.5GHz, 2.5GHz, 2.5GHz, 2.5GHz, 2.5GHz, 2.5GHz, 2.5GHz, 2.5GHz, 2.5GHz, 2.5GHz, 2.5GHz LTE, LTEAFDD: 150kHz, 30MHz, 1GHz, 1.92GHz, 1.98GHz, 2.1GHz, 12.75GHz, 2.5GHz, 2.5GHz, 2.5GHz, 2.5GHz, 2.5GHz, 2.5GHz, 2.5GHz, 2.5GHz, 2.5GHz, 2.5GHz, 2.5GHz, 2.5GHz, 2.5GHz WLAN: 150kHz, 30 MHz, 1GHz, 12.75GHz, 2.5 GHz, 2.5 GHz, 2.5 GHz , 2.5 GHz, 2.5 GHz, 2.5 GHz, 2.5 GHz, 2.5 GHz, 2.5 GHz, 2.5 GHz, 2.5 GHz, 2.5 GHz, 2.5 GHz, 2.5 GHz, 2.5 GHz, 2.5 GHz MSR: 150kHz, 30MHz, 1GHz, 1.92GHz, 1.98GHz, 2.1GHz, 12.75GHz, 2.5GHz, 2.5GHz, 2.5GHz, 2.5GHz, 2.5GHz, 2.5GHz, 2.5GHz, 2.5GHz, 2.5GHz, 2.5GHz, 2.5GHz, 2.5GHz, 2.5GHz
State Saved	Yes
Min/Max	-79999990/Hardware Dependent: – Option 503: 3.7 GHz – Option 508: 8.5 GHz – Option 513: 13.8 GHz – Option 526: 27.0 GHz

Center Frequency

Sets the center frequency of the instrument. This parameter can send up to 20 values. The location where the center frequency occurs in the list sent to the measurement corresponds to the range the value is associated with.

When sending the remote command, missing values are not permitted. If you want to change values 2 and 6 you must send all values up to 6. Subsequent values will remain as they were.

The query always returns 20 values.

Remote Command	`[:SENSe]:SPURious[:RANGe][:LIST]:FREQuency:CENTer <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>` `[:SENSe]:SPURious[:RANGe][:LIST]:FREQuency:CENTer?`
Example	`:SPUR:FREQ:CENT 9 kHz, 150 kHz, 30 MHz, 1GHz, 1.5 GHz, 1.5 GHz, 1.5 GHz, 1.5 GHz,1.5 GHz,1.5 GHz,1.5 GHz,1.5 GHz,1.5 GHz,1.5 GHz,1.5 GHz,1.5 GHz,1.5 GHz,1.5 GHz,1.5 GHz,1.5 GHz` `:SPUR:FREQ:CENT?`
Preset	(Preset of Start Freq + Preset of Stop Freq)/2
State Saved	No
Min/Max	-79.999995 MHz/ Instrument maximum frequency - 5 Hz

Span

Sets the span of the instrument. This parameter can send up to 20 values. The location where the span occurs in the list sent to the measurement corresponds to the range the value is associated with.

When sending the remote command, missing values are not permitted. If you want to change values 2 and 6, then you must send all values up to 6. Subsequent values will remain as they were.

The query always returns 20 values.

Remote Command	`[:SENSe]:SPURious[:RANGe][:LIST]:FREQuency:SPAN <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>` `[:SENSe]:SPURious[:RANGe][:LIST]:FREQuency:SPAN?`
Example	`:SPUR:FREQ:SPAN 9 kHz, 150 kHz, 30 MHz, 1GHz, 1.5 GHz, 1.5 GHz, 1.5 GHz, 1.5 GHz,1.5 GHz,1.5 GHz,1.5 GHz,1.5 GHz,1.5 GHz,1.5 GHz,1.5 GHz,1.5 GHz,1.5 GHz,1.5 GHz,1.5 GHz` `:SPUR:FREQ:SPAN?`

Preset	(Preset of Stop Freq) - (Preset of Start Freq)
State Saved	No
Min/Max	0Hz/Instrument maximum frequency + 80MHz

Res BW

Sets the resolution bandwidth of the instrument. This parameter can send up to 20 values.

The location of where the resolution bandwidth occurs in the list sent to the measurement corresponds to the range the value is associated with.

When sending the remote command, missing values are not permitted. In other words, if you want to change values 2 and 6, then you must send all values up to 6. Subsequent values will remain as they were.

The query always returns 20 values.

Remote Command	`[:SENSe]:SPURious[:RANGe][:LIST]:BANDwidth[:RESolution] <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>` `[:SENSe]:SPURious[:RANGe][:LIST]:BANDwidth[:RESolution]?` `[:SENSe]:SPURious[:RANGe][:LIST]:BANDwidth[:RESolution]:AUTO OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1`  `[:SENSe]:SPURious[:RANGe][:LIST]:BANDwidth[:RESolution]:AUTO?`

Example	`:SPUR:BAND 1kHz, 10kHz, 100kHz, 1MHz, 1MHz, 1MHz, 1MHz, 3MHz, 3MHz, 3MHz, 3MHz, 3MHz, 3MHz, 3MHz, 3MHz, 3MHz, 3MHz, 3MHz, 3MHz, 3MHz`
	
	`:SPUR:BAND?`
	
	`:SPUR:BWID:AUTO ON, ON, ON, OFF, OFF, OFF, OFF, OFF, ON, ON, ON, ON, OFF, OFF, OFF, OFF, OFF, OFF, ON, ON`
	
	`:SPUR:BWID:AUTO?`

Preset	SA: 1.2MHz, 0.51MHz, 0.1MHz, 0.1MHz, 4MHz, 3MHz, 3MHz, 3MHz, 3MHz, 3MHz, 3MHz, 3MHz, 3MHz, 3MHz, 3MHz, 3MHz, 3MHz, 3MHz, 3MHz, 3MHz WCDMA:1kHz, 10kHz, 100kHz, 1MHz, 1MHz, 1MHz, 1MHz, 1MHz, 3MHz, 3MHz, 3MHz, 3MHz, 3MHz, 3MHz, 3MHz, 3MHz, 3MHz, 3MHz, 3MHz, 3MHz LTETDD, LTEATDD, 5G NR: 1kHz, 10kHz, 100kHz, 1MHz, 1MHz, 1MHz, 1MHz, 3MHz, 3MHz, 3MHz, 3MHz, 3MHz, 3MHz, 3MHz, 3MHz, 3MHz, 3MHz, 3MHz, 3MHz, 3MHz LTE, LTEAFDD: 1kHz, 10kHz, 100kHz, 1MHz, 100kHz, 1MHz, 1MHz, 3MHz, 3MHz, 3MHz, 3MHz, 3MHz, 3MHz, 3MHz, 3MHz, 3MHz, 3MHz, 3MHz, 3MHz, 3MHz WLAN: 1kHz, 10kHz, 100kHz, 1MHz, 3MHz, 3MHz, 3MHz, 3MHz, 3MHz, 3MHz, 3MHz, 3MHz, 3MHz, 3MHz, 3MHz, 3MHz, 3MHz, 3MHz, 3MHz, 3MHz

	MSR: 1kHz, 10kHz, 100kHz, 1MHz, 100kHz, 1MHz, 1MHz, 3MHz, 3MHz, 3MHz, 3MHz, 3MHz, 3MHz, 3MHz, 3MHz, 3MHz, 3MHz, 3MHz, 3MHz, 3MHz SA: OFF, OFF, OFF, OFF, OFF, ON, ON, ON, ON, ON, ON, ON, ON, ON, ON, ON, ON, ON, ON, ON WCDMA: OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, ON, ON, ON, ON, ON, ON, ON, ON, ON, ON, ON, ON LTE, LTEAFDD, LTETDD, LTEATDD, 5G NR: OFF, OFF, OFF, OFF, OFF, OFF, OFF, ON, ON, ON, ON, ON, ON, ON, ON, ON, ON, ON, ON, ON WLAN: OFF, OFF, OFF, OFF, ON, ON, ON, ON, ON, ON, ON, ON, ON, ON, ON, ON, ON, ON, ON, ON MSR: OFF, OFF, OFF, OFF, OFF, OFF, OFF, ON, ON, ON, ON, ON, ON, ON, ON, ON, ON, ON, ON, ON
State Saved	Saved in instrument state Saved in instrument state
Min	1 Hz
Max	If Option FS1 or FS2 is installed: 10 MHz Otherwise: 8 MHz
Backwards Compatibility SCPI	`[:SENSe]:SPURious[:RANGe][:LIST]:BWIDth[:RESolution]` `[:SENSe]:SPURious[:RANGe][:LIST]:BWIDth[:RESolution]:AUTO`

Meas BW

Allows you to specify a multiplier of Res BW for the measurement integration bandwidth.

Meas BW is multiplier integer number. It shows a ratio between Integration BW and Resolution BW of the measurement result:

Integ BW = Meas BW * Resolution BW

Integration BW is desired resolution bandwidth and Resolution BW is actual bandwidth for sweep. Measurement sweeps with Resolution BW and Meas BW compensates sweep resolution bandwidth to Integration BW.

When sending the remote command, missing values are not permitted; that is, if you want to change values 2 and 6, you must send all values up to 6. Subsequent values will remain as they were. The query always returns 20 values.

Remote Command	`[:SENSe]:SPURious[:RANGe][:LIST]:BANDwidth:IMULti <integer>, …` `[:SENSe]:SPURious[:RANGe][:LIST]:BANDwidth:IMULti?`
Example	`:SPUR:BAND:IMUL 1,1,1,1,1,1` `:SPUR:BAND:IMUL?`
Notes	Comma separated list of values
Preset	`1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1`
State Saved	Yes

Max	1000
Min/Max	1
Backwards Compatibility SCPI	[:SENSe]:SPURious[:RANGe][:LIST]:BWIDth:IMULti

Video BW

Sets the Video BW mode of the instrument. This can be Auto, where the instrument determines the optimum setting, or Manual, where you determine the setting. This parameter can send up to 20 values. The location in the list sent corresponds to the range the value is associated with. When sending the remote command, missing values are not permitted; that is, if you want to change values 2 and 6, then you must send all values up to 6. Subsequent values will remain as they were.

The query always returns 20 values.

Remote Command	[:SENSe]:SPURious[:RANGe][:LIST]:BANDwidth:VIDeo <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq> [:SENSe]:SPURious[:RANGe][:LIST]:BANDwidth:VIDeo? [:SENSe]:SPURious[:RANGe][:LIST]:BANDwidth:VIDeo:AUTO OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1 [:SENSe]:SPURious[:RANGe][:LIST]:BANDwidth:VIDeo:AUTO?
Example	:SPUR:BAND:VID 1kHz, 10kHz, 100kHz, 1MHz, 1MHz, 1MHz, 1MHz, 3MHz, 3MHz, 3MHz, 3MHz, 3MHz, 3MHz, 3MHz, 3MHz, 3MHz, 3MHz, 3MHz, 3MHz, 3MHz :SPUR:BAND:VID? :SPUR:BAND:VID:AUTO ON, ON, OFF, OFF, OFF, ON, ON, ON, OFF, OFF, OFF, OFF, OFF, OFF, OFF, ON, ON, ON, ON, ON :SPUR:BAND:VID:AUTO?
Preset	SA, WCDMA, WLAN: Automatically calculated LTE, LTEAFDD, MSR: 4.7kHz, 47kHz, 470kHz, 5MHz, 470kHz, 5MHz, 5MHz, 300kHz, 300kHz, 300kHz, 300kHz, 300kHz, 300kHz, 300kHz, 300kHz, 300kHz, 300kHz, 300kHz, 300kHz, 300kHz LTETDD, LTEATDD 4.7kHz, 47kHz, 470kHz, 5MHz, 5MHz, 5MHz, 5MHz, 300kHz, 300kHz, 300kHz, 300kHz, 300kHz, 300kHz, 300kHz, 300kHz, 300kHz, 300kHz, 300kHz, 300kHz, 300kHz 5G NR 100 Hz, 1 kHz, 10 kHz, 100 kHz, 100 kHz, 100 kHz, 100 kHz, 300 kHz, 300 kHz, 300 kHz, 300 kHz, 300 kHz, 300 kHz, 300 kHz, 300 kHz, 300 kHz, 300 kHz, 300 kHz, 300 kHz, 300 kHz ON,ON,ON,ON,ON,ON,ON,ON,ON,ON,ON,ON,ON,ON,ON,ON,ON,ON,ON,ON

	unless noted below LTE, LTEAFDD, LTETDD, LTEATDD, MSR: `OFF, OFF, OFF, OFF, OFF, OFF, OFF, ON, ON, ON, ON, ON, ON, ON, ON, ON, ON, ON, ON, ON`
State Saved	Saved in instrument state Saved in instrument state
Min/Max	1 Hz/50 MHz
Backwards Compatibility SCPI	`[:SENSe]:SPURious[:RANGe][:LIST]:BWIDth:VIDeo` `[:SENSe]:SPURious[:RANGe][:LIST]:BWIDth:VIDeo:AUTO`

Filter Type

In addition to the Gaussian filter shape, there are certain special filter types, such as Flat Top, that are desirable under certain conditions. The **Filter Type** menu gives you control over these parameters.

Remote Command	`[:SENSe]:SPURious[:RANGe][:LIST]:BANDwidth:SHAPe GAUSsian | FLATtop, GAUSsian | FLATtop, GAUSsian | FLATtop, GAUSsian | FLATtop, GAUSsian | FLATtop, GAUSsian | FLATtop, GAUSsian | FLATtop, GAUSsian | FLATtop, GAUSsian | FLATtop, GAUSsian | FLATtop, GAUSsian | FLATtop, GAUSsian | FLATtop, GAUSsian | FLATtop, GAUSsian | FLATtop, GAUSsian | FLATtop, GAUSsian | FLATtop, GAUSsian | FLATtop, GAUSsian | FLATtop, GAUSsian | FLATtop, GAUSsian | FLATtop` `[:SENSe]:SPURious[:RANGe][:LIST]:BANDwidth:SHAPe?`
Example	`:SPUR:BAND:SHAP GAUS, GAUS, GAUS, GAUS, GAUS, GAUS, FLAT, FLAT, FLAT, FLAT, FLAT, GAUS, GAUS, GAUS, GAUS, GAUS, FLAT, FLAT, GAUS, GAUS` `:SPUR:BAND:SHAP?`
Preset	`GAUS, GAUS, GAUS, GAUS, GAUS, GAUS, GAUS, GAUS, GAUS, GAUS, GAUS, GAUS, GAUS, GAUS, GAUS, GAUS, GAUS, GAUS, GAUS, GAUS`
State Saved	Saved in instrument state
Range	Gaussian (Normal)|Flattop
Backwards Compatibility SCPI	`[:SENSe]:SPURious[:RANGe][:LIST]:BWIDth:SHAPe`

Enabled

Same as the **Enabled** checkbox under the **Bandwidth** index tab. See "Enabled" on page 1425

Frequency Type

Selects the frequency type as either ABSolute or OFFSet:

ABSolute	The frequency range is determined by Abs Start Freq and Abs Stop Freq. Absolute and offset frequencies are not coupled
OFFSet	The frequency range is determined based on Offset Start Freq and Offset Stop Freq. Abs Start Freq and Abs Stop Freq are coupled with the offset parameters and show the actual frequency ranges. The following coupling equations are used to calculate Abs Start Freq and Abs Stop Freq

When Offset Side is Negative:

[Abs Start Freq] = [OB Start Freq] – [Offset Stop Freq]

[Abs Stop Freq] = [OB Start Freq] – [Offset Start Freq]

When Offset Side is Positive:

[Abs Start Freq] = [OB Stop Freq] + [Offset Start Freq]

[Abs Stop Freq] = [OB Stop Freq] + [Offset Stop Freq]

When changing OB Start/Stop Freq, Abs Start/Stop Freq is changed and Offset Start/Stop Freq remains unchanged.

When changing Offset Start/Stop Freq, Abs Start/Stop Freq is changed and OB Start/Stop Freq remains unchanged.

Remote Command	[:SENSe]:SPURious[:RANGe][:LIST]:FREQuency:TYPE ABSolute | OFFSet, ABSolute | OFFSet, ABSolute | OFFSet, ABSolute | OFFSet, ABSolute | OFFSet, ABSolute | OFFSet, ABSolute | OFFSet, ABSolute | OFFSet, ABSolute | OFFSet, ABSolute | OFFSet, ABSolute | OFFSet, ABSolute | OFFSet, ABSolute | OFFSet, ABSolute | OFFSet, ABSolute | OFFSet, ABSolute | OFFSet, ABSolute | OFFSet, ABSolute | OFFSet, ABSolute | OFFSet, ABSolute | OFFSet [:SENSe]:SPURious[:RANGe][:LIST]:FREQuency:TYPE?
Example	:SPUR:FREQ:TYPE OFFS, OFFS, ABS, ABS, ABS :SPUR:FREQ:TYPE?
Couplings	Freq Type automatically changes to OFFSet when you change a value of Offset Start Freq, Offset Stop Freq or Offset Side, and automatically changes to ABSolute when you change a value of Abs Start Freq or Abs Stop Freq
Preset	ABSolute, ABSolute, ABSolute, ABSolute, ABSolute, ABSolute, ABSolute, ABSolute, ABSolute, ABSolute, ABSolute, ABSolute, ABSolute, ABSolute, ABSolute, ABSolute, ABSolute, ABSolute, ABSolute, ABSolute
State Saved	Saved in instrument state
Range	ABSolute|OFFSet

Abs Start Freq

Sets the start frequency of the instrument. This parameter can send up to 20 values. The location where the start frequency occurs in the list sent to the measurement corresponds to the range the value is associated with.

This parameter is coupled with either Offset Start Freq or Offset Stop Freq. The coupling equations are shown in "Enabled" on page 1432.

When sending the remote command, missing values are not permitted; that is, if you want to change values 2 and 6 you must send all values up to 6. Subsequent values will remain as they were.

The query always returns 20 values.

Remote Command	`[:SENSe]:SPURious[:RANGe][:LIST]:FREQuency:STARt <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>` `[:SENSe]:SPURious[:RANGe][:LIST]:FREQuency:STARt?`
Example	`:SPUR:FREQ:STAR 9 kHz, 150 kHz, 30 MHz, 1GHz, 1.5 GHz, 1.5 GHz, 1.5 GHz, 1.5 GHz,1.5 GHz,1.5 GHz,1.5 GHz,1.5 GHz,1.5 GHz,1.5 GHz,1.5 GHz,1.5 GHz,1.5 GHz,1.5 GHz,1.5 GHz,1.5 GHz` `:SPUR:FREQ:STAR?`
Preset	9 kHz, 150 kHz, 30 MHz, 1 GHz, 1.92GHz, 1.98 GHz, 2.18 GHz, 1.5 GHz, 1.5 GHz, 1.5 GHz, 1.5 GHz, 1.5 GHz, 1.5 GHz, 1.5 GHz, 1.5 GHz, 1.5 GHz, 1.5 GHz, 1.5 GHz, 1.5 GHz, 1.5 GHz
State Saved	Saved in instrument state
Min/Max	-80 MHz/Hardware Dependent – Option 503: 3699999990 – Option 508: 8499999990 – Option 513: 13799999990 – Option 526: 26999999990

Abs Stop Freq

Sets the stop frequency of the instrument. This parameter can send up to 20 values. The location in the list sent corresponds to the range the value is associated with.

This parameter is coupled with either "Offset Start Freq" on page 1435 or "Offset Stop Freq" on page 1436. The coupling equations are shown in "Enabled" on page 1432.

The location of where the stop frequency occurs in the list sent to the measurement corresponds to the range the value is associated with.

When sending the remote command, missing values are not permitted; that is, if you want to change values 2 and 6 you must send all values up to 6. Subsequent values will remain as they were.

The query always returns 20 values.

Remote Command	`[:SENSe]:SPURious[:RANGe][:LIST]:FREQuency:STOP <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>` `[:SENSe]:SPURious[:RANGe][:LIST]:FREQuency:STOP?`
Example	`:SPUR:FREQ:STOP 150kHz, 30MHz, 1GHz, 2.1GHz, 2.1GHz, 2.1774GHz, 2.18GHz, 12.75GHz, 2.5GHz, 2.5GHz, 2.5GHz, 2.5GHz, 2.5GHz, 2.5GHz, 2.5GHz, 2.5GHz, 2.5GHz, 2.5GHz, 2.5GHz, 2.5GHz` `:SPUR:FREQ:STOP?`
Preset	150kHz, 30MHz, 1GHz, 1.92GHz, 1.98GHz, 2.1GHz, 12.75GHz, 2.5GHz, 2.5GHz, 2.5GHz, 2.5GHz, 2.5GHz, 2.5GHz, 2.5GHz, 2.5GHz, 2.5GHz, 2.5GHz, 2.5GHz, 2.5GHz, 2.5GHz
State Saved	Yes
Min/Max	-79999990/Hardware Dependent: – Option 503: 3.7 GHz – Option 508: 8.5 GHz – Option 513: 13.8 GHz – Option 526: 27.0 GHz

Offset Start Freq

Sets the range frequency as offset from one of the operating band edges. This parameter can send up to 20 values. The location where the start frequency occurs in the list sent to the measurement corresponds to the range the value is associated with. When sending the remote command, missing values are not permitted; that is, if you want to change values 2 and 6 you must send all values up to 6. Subsequent values will remain as they were.

The query always returns 20 values.

This parameter is coupled with either "Abs Start Freq" on page 1434 or "Abs Stop Freq" on page 1434 using the coupling equations shown in "Enabled" on page 1432.

This value is clipped to keep Abs Start/Stop Freq within the available frequency range. This clipping applies even when OB Start Freq, OB Stop Freq or Offset Side is changed.

Remote Command	`[:SENSe]:SPURious[:RANGe][:LIST]:OFFSet:FREQuency:STARt <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>` `[:SENSe]:SPURious[:RANGe][:LIST]:OFFSet:FREQuency:STARt?`

Example	`:SPUR:OFFS:FREQ:STAR 9 kHz, 150 kHz, 30 MHz, 1GHz, 1.5 GHz, 1.5 GHz, 1.5 GHz, 1.5 GHz,1.5 GHz,1.5 GHz, 1.5 GHz, 1.5 GHz, 1.5 GHz,1.5 GHz,1.5 GHz,1.5 GHz,1.5 GHz,1.5 GHz,1.5 GHz,1.5 GHz` `:SPUR:OFFS:FREQ:STAR?`
Preset	10 MHz, 20 MHz, 30 MHz, 30 MHz, 30 MHz, 30 MHz, 30 MHz, 30 MHz, 30 MHz, 30 MHz, 30 MHz, 30 MHz, 30 MHz, 30 MHz, 30 MHz, 30 MHz, 30 MHz, 30 MHz, 30 MHz, 30 MHz
State Saved	Saved in instrument state
Min/Max	-80 MHz/SA Max Freq - 10Hz (Hardware Dependent)

Offset Stop Freq

Sets the range frequency as offset from one of operating band edges. This parameter can send up to 20 values. The location in the list sent corresponds to the range the value is associated with.

The location of where the stop frequency occurs in the list sent to the measurement corresponds to the range the value is associated with.

When sending the remote command, missing values are not permitted. If you want to change values 2 and 6, then you must send all values up to 6. Subsequent values will remain as they were. The query always returns 20 values.

This parameter is coupled with either "Abs Start Freq" on page 1434 or "Abs Stop Freq" on page 1434 using the coupling equations shown in "Enabled" on page 1432.

This value is clipped to keep Abs Start/Stop Freq inside the available frequency range. This clipping applies even when OB Start Freq, OB Stop Freq or Offset Side is changed.

Remote Command	`[:SENSe]:SPURious[:RANGe][:LIST]:OFFSet:FREQuency:STOP <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>` `[:SENSe]:SPURious[:RANGe][:LIST]:OFFSet:FREQuency:STOP?`
Example	`:SPUR:OFFS:FREQ:STOP 150kHz, 30MHz, 1GHz, 2.1GHz, 2.1GHz, 2.1774GHz, 2.18GHz, 12.75GHz, 2.5GHz, 2.5GHz, 2.5GHz, 2.5GHz, 2.5GHz, 2.5GHz, 2.5GHz, 2.5GHz, 2.5GHz, 2.5GHz, 2.5GHz, 2.5GHz` `:SPUR:OFFS:FREQ:STOP?`
Preset	20 MHz,30 MHz, 30 MHz, 30 MHz, 30 MHz, 30 MHz, 30 MHz, 30 MHz, 30 MHz, 30 MHz, 30 MHz, 30 MHz, 30 MHz, 30 MHz, 30 MHz, 30 MHz, 30 MHz, 30 MHz, 30 MHz, 30 MHz
State Saved	Yes
Min/Max	-79999990/SA Max Frequency (Hardware Dependent)

Offset Side

Sets the offset side to either Negative or Positive. This parameter indicates which side of the operation band the specified range is on. It also determines which coupling equations defined in Frequency Type section are used to couple the absolute frequencies and the offset frequencies. This setting is effective only when "Frequency Type" on page 1433 is `OFFset`.

Remote Command	`[:SENSe]:SPURious[:RANGe][:LIST]:OFFSet:SIDE NEGative | POSitive, NEGative | POSitive, NEGative | POSitive, NEGative | POSitive, NEGative | POSitive, NEGative | POSitive, NEGative | POSitive, NEGative | POSitive, NEGative | POSitive, NEGative | POSitive, NEGative | POSitive, NEGative | POSitive, NEGative | POSitive, NEGative | POSitive, NEGative | POSitive, NEGative | POSitive, NEGative | POSitive, NEGative | POSitive, NEGative | POSitive, NEGative | POSitive` `[:SENSe]:SPURious[:RANGe][:LIST]:OFFSet:SIDE?`
Example	`:SPUR:OFFS:SIDE NEG, NEG, POS, POS` `:SPUR:OFFS:SIDE?`
Preset	`NEG, NEG, POS, POS, POS, POS, POS, POS, POS, POS, POS, POS, POS, POS, POS, POS, POS, POS, POS, POS`
State Saved	Saved in instrument state
Range	Negative (From Op. Band Start Edge)|Positive (From Op. Band Stop Edge)

Filter/Atten

Lets you set Attenuation and IF Gain values for each Range. This tab appears in all Modes except MSR.

Frequency Range

Same as Frequency Range under the **Bandwidth** index tab. See "Frequency Range" on page 1424.

Enabled

Same as Enabled under the **Bandwidth** index tab. See "Enabled" on page 1425.

Start Freq

Same as the Start Freq column under the **Bandwidth** index tab. See "Start Freq" on page 1426.

Stop Freq

Same as the Stop Freq column under the **Bandwidth** index tab. See "Stop Freq" on page 1427.

Center Frequency

Same as the Center column under the **Bandwidth** index tab. See "Center Frequency" on page 1428.

Span

Same as the Span column under the **Bandwidth** index tab. See "Span" on page 1428.

Attenuation

Defines attenuation value for each range:

ON	The Attenuation value under AMPTD Y Scale is used
OFF	This value is used as mechanical attenuation value without electric attenuation

Remote Command	`[:SENSe]:SPURious[:RANGe][:LIST]:ATTenuation <rel_ampl>, <rel_ampl>, <rel_ampl>, <rel_ampl>, <rel_ampl>, <rel_ampl>, <rel_ampl>, <rel_ampl>, <rel_ampl>, <rel_ampl>, <rel_ampl>, <rel_ampl>, <rel_ampl>, <rel_ampl>, <rel_ampl>, <rel_ampl>, <rel_ampl>, <rel_ampl>, <rel_ampl>, <rel_ampl>` `[:SENSe]:SPURious[:RANGe][:LIST]:ATTenuation?` `[:SENSe]:SPURious[:RANGe][:LIST]:ATTenuation:AUTO OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1`   `[:SENSe]:SPURious[:RANGe][:LIST]:ATTenuation:AUTO?`

Example	`:SPUR:ATT 10dB, 10dB, 10dB, 10dB, 10dB, 10dB, 10dB, 10dB, 10dB, 10dB, 10dB, 10dB, 10dB, 10dB, 10dB, 10dB, 10dB, 10dB, 10dB, 10dB`
	 `:SPUR:ATT?`
	 `:SPUR:ATT:AUTO 0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0`
	 `:SPUR:ATT:AUTO?`

Couplings	“---“ is displayed as value when Auto state is ON, to indicate attenuation value under AMPTD Y Scale is being used
Preset	10dB, 10dB, 10dB, 10dB, 10dB, 10dB, 10dB, 10dB, 10dB, 10dB, 10dB, 10dB, 10dB, 10dB, 10dB,

	10dB, 10dB, 10dB, 10dB, 10dB `ON,ON,ON,ON,ON,ON,ON,ON,ON,ON,ON,ON,ON,ON,ON,ON,ON,ON,ON,ON`
State Saved	Saved in instrument state
Range	Auto|Man
Min/Max	0 dB/70 dB

IF Gain

Sets **IF Gain** to: Auto, On (the extra 10 dB) or Off. These settings affect sensitivity and IF overloads. A switched IF amplifier with approximately 10 dB of gain is available. This amplifier takes full advantage of the RF dynamic range of the instrument. When it can be turned on without an overload, the dynamic range is always better with the amplifier on than off.

Dependencies	The IF Gain controls (FFT IF Gain and Swept IF Gain) have no effect when the U7227A USB Preamplifier is connected. This is not annotated or reflected on any control; there are no controls grayed out nor any SCPI locked out. The instrument simply behaves as though both FFT IF Gain and Swept IF Gain are set to Low regardless of the setting on the controls

IF Gain Auto

Activates the rules for auto IF Gain.

Remote Command	`[:SENSe]:SPURious:IF:GAIN:AUTO[:STATe] OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1` `[:SENSe]:SPURious:IF:GAIN:AUTO[:STATe]?`
Example	`:SPUR:IF:GAIN:AUTO ON,ON` `:SPUR:IF:GAIN:AUTO?`
Couplings	When the sweep type is Swept, 'Auto' sets IF Gain to High Gain under any of the following conditions: the input attenuator is set to 0 dB, the preamp is turned on, or the Max Mixer Level is –20 dBm or lower. For other settings using the swept sweep type, auto sets IF Gain to Low Gain
Preset	`OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF`
State Saved	Saved in instrument state

IF Gain State

Selects the range of IF Gain.

Remote Command	`[:SENSe]:SPURious:IF:GAIN[:STATe] OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON |`

	0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1 [:SENSe]:SPURious:IF:GAIN[:STATe]?
Example	:SPUR:IF:GAIN ON,ON :SPUR:IF:GAIN?
Preset	OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF
State Saved	Saved in instrument state
Range	Low|High

Enabled

Same as the **Enabled** checkbox under the **Bandwidth** index tab. See "Enabled" on page 1425.

Res BW

Same as the **Enabled** checkbox under the **Bandwidth** index tab. See "Res BW" on page 1429.

Meas BW

Same as the Meas BW column under the **Bandwidth** index tab. See "Meas BW" on page 1430.

Video BW

Sets the Video BW mode of the instrument. This can be Auto, where the instrument determines the optimum setting, or Manual, where you determine the setting. This parameter can send up to 20 values. The location in the list sent corresponds to the range the value is associated with. When sending the remote command, missing values are not permitted; that is, if you want to change values 2 and 6, then you must send all values up to 6. Subsequent values will remain as they were.

The query always returns 20 values.

Remote Command	[:SENSe]:SPURious[:RANGe][:LIST]:BANDwidth:VIDeo <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq>, <freq> [:SENSe]:SPURious[:RANGe][:LIST]:BANDwidth:VIDeo?

	`[:SENSe]:SPURious[:RANGe][:LIST]:BANDwidth:VIDeo:AUTO OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1` `[:SENSe]:SPURious[:RANGe][:LIST]:BANDwidth:VIDeo:AUTO?`

Example	`:SPUR:BAND:VID 1kHz, 10kHz, 100kHz, 1MHz, 1MHz, 1MHz, 1MHz, 3MHz, 3MHz, 3MHz, 3MHz, 3MHz, 3MHz, 3MHz, 3MHz, 3MHz, 3MHz, 3MHz, 3MHz, 3MHz`
	`:SPUR:BAND:VID?`
	`:SPUR:BAND:VID:AUTO ON, ON, OFF, OFF, OFF, ON, ON, ON, OFF, OFF, OFF, OFF, OFF, OFF, OFF, ON, ON, ON, ON, ON`
	`:SPUR:BAND:VID:AUTO?`

Preset	SA, WCDMA, WLAN: Automatically calculated
	LTE, LTEAFDD, MSR: 4.7kHz, 47kHz, 470kHz, 5MHz, 470kHz, 5MHz, 5MHz, 300kHz, 300kHz, 300kHz, 300kHz, 300kHz, 300kHz, 300kHz, 300kHz, 300kHz, 300kHz, 300kHz, 300kHz, 300kHz
	LTETDD, LTEATDD
	4.7kHz, 47kHz, 470kHz, 5MHz, 5MHz, 5MHz, 5MHz, 300kHz, 300kHz, 300kHz, 300kHz, 300kHz, 300kHz, 300kHz, 300kHz, 300kHz, 300kHz, 300kHz, 300kHz, 300kHz
	5G NR
	100 Hz, 1 kHz, 10 kHz, 100 kHz, 100 kHz, 100 kHz, 100 kHz, 300 kHz, 300 kHz, 300 kHz, 300 kHz, 300 kHz, 300 kHz, 300 kHz, 300 kHz, 300 kHz, 300 kHz, 300 kHz, 300 kHz, 300 kHz
	`ON,ON,ON,ON,ON,ON,ON,ON,ON,ON,ON,ON,ON,ON,ON,ON,ON,ON,ON,ON`
	unless noted below
	LTE, LTEAFDD, LTETDD, LTEATDD, MSR:
	`OFF, OFF, OFF, OFF, OFF, OFF, OFF, ON, ON, ON, ON, ON, ON, ON, ON, ON, ON, ON, ON, ON`

State Saved	Saved in instrument state Saved in instrument state
Min/Max	1 Hz/50 MHz
Backwards Compatibility SCPI	`[:SENSe]:SPURious[:RANGe][:LIST]:BWIDth:VIDeo` `[:SENSe]:SPURious[:RANGe][:LIST]:BWIDth:VIDeo:AUTO`

Filter Type

Same as the Filter Type column under the **Bandwidth** index tab. See "Filter Type" on page 1432.

Attenuation

Same as the Attenuation column under the **Atten** index tab. See "Attenuation" on page 1438.

IF Gain

Same as the IF Gain column under the **Atten** index tab. See "IF Gain" on page 1439.

Detector/Sweep

Lets you set Sweep, IF Gain, and Detector parameters for each Range.

Frequency Range

Same as **Frequency Range** under the **Bandwidth** index tab. See "Frequency Range" on page 1424. This control does not appear in MSR mode.

Enabled

Same as the **Enabled** checkbox under the **Bandwidth** index tab. See "Enabled" on page 1425.

Start Freq

Same as the Start Freq column under the **Bandwidth** index tab. See "Start Freq" on page 1426. This column does not appear in MSR mode.

Stop Freq

Same as the Stop Freq column under the **Bandwidth** index tab. See "Stop Freq" on page 1427. This column does not appear in MSR mode.

Center Frequency

Same as the Center column under the **Bandwidth** index tab. See "Center Frequency" on page 1428. This column does not appear in MSR mode.

Span

Same as the Span column under the **Bandwidth** index tab. See "Span" on page 1428. This column does not appear in MSR mode.

Sweep Time

Sets the **Sweep Time** mode of the instrument. This can be **Auto**, where the instrument determines the optimum setting, or **Manual**, where you determine the setting.

This parameter can send up to 20 values. The location in the list sent corresponds to the range of the associated value. When sending the remote command, missing values are not permitted. If you want to change values 2 and 6, then you must send all values up to 6. Subsequent values will remain as they were.

The query always returns 20 values.

Remote Command	`[:SENSe]:SPURious[:RANGe][:LIST]:SWEep:TIME <time>, <time>, <time>, <time>, <time>, <time>, <time>, <time>, <time>, <time>, <time>, <time>, <time>, <time>, <time>, <time>, <time>, <time>, <time>, <time>` `[:SENSe]:SPURious[:RANGe][:LIST]:SWEep:TIME?` `[:SENSe]:SPURious[:RANGe][:LIST]:SWEep:TIME:AUTO OFF | ON | 0 | 1,OFF | ON | 0 | 1,OFF | ON | 0 | 1,OFF | ON | 0 | 1,OFF | ON | 0 | 1,OFF | ON | 0 | 1,OFF | ON | 0 | 1,OFF | ON | 0 | 1,OFF | ON | 0 | 1,OFF | ON | 0 | 1,OFF | ON | 0 | 1,OFF | ON | 0 | 1,OFF | ON | 0 | 1,OFF | ON | 0 | 1,OFF | ON | 0 | 1,OFF | ON | 0 | 1,OFF | ON | 0 | 1,OFF | ON | 0 | 1,OFF | ON | 0 | 1,OFF | ON | 0 | 1` `[:SENSe]:SPURious[:RANGe][:LIST]:SWEep:TIME:AUTO?`

Example	`:SPUR:SWE:TIME 10,10,10,10,10,10,10,10,10,10,10,10,10,10,10,10,10,10,10,10`
	`:SPUR:SWE:TIME?`
	`:SPUR:SWE:TIME:AUTO ON,ON,ON,ON,ON,ON,ON,ON,ON,ON,ON,ON,ON,ON,ON,ON,ON,ON,ON,ON`
	`:SPUR:SWE:TIME:AUTO?`

Preset	Automatically calculated `ON,ON,ON,ON,ON,ON,ON,ON,ON,ON,ON,ON,ON,ON,ON,ON,ON,ON,ON,ON`
State Saved	Saved in instrument state Saved in instrument state
Range	`OFF|ON`
Min/Max	1.0E-3/2.0E+3

Points

Sets the number of points per sweep for the measurement. This parameter can send up to 20 values. The location in the list sent corresponds to the range of the associated value. When sending the remote command, missing values are not permitted. If you want to change values 2 and 6, then you must send all values up to 6. Subsequent values will remain as they were. The query always returns 20 values.

The Points mode can be manual, where you determine the setting or auto, where the instrument determines the number of trace points to ensure the sweep points resolution equals RBW/2. This is calculated using the following algorithm:

Points = (Stop Freq – Start Freq) / (ResBW / 2)

with the computed values being clipped to a minimum of 601 and a maximum of 20001.

Remote Command	`[:SENSe]:SPURious[:RANGe][:LIST]:SWEep:POINts <integer>` `[:SENSe]:SPURious[:RANGe][:LIST]:SWEep:POINts?` `[:SENSe]:SPURious[:RANGe][:LIST]:SWEep:POINts:AUTO OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1` `[:SENSe]:SPURious[:RANGe][:LIST]:SWEep:POINts:AUTO?`

Example	`:SPUR:SWE:POIN 1001,1001,1001`
	`:SPUR:SWE:POIN?`
	`:SPUR:SWE:POIN:AUTO ON,ON,ON`
	`:SPUR:SWE:POIN:AUTO?`

Preset	SA, 5G NR: +601, +601, +601, +601, +601, +601, +601, +601, +601, +601, +601, +601, +601, +601, +601, +601, +601, +601, +601, +601
	WCDMA: 601, 2985, 9700, 1100, 601, 601, 601, 10570, 601, 601, 601, 601, 601, 601, 601, 601, 601, 601, 601, 601
	LTE, LTETDD, LTEAFDD, LTEATDD, WLAN, MSR: Automatically calculated
	`OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF`
	unless noted below
	LTE, LTETDD, LTEAFDD, LTEATDD, MSR:
	`ON,ON,ON,ON,ON,ON,ON,ON,ON,ON,ON,ON,ON,ON,ON,ON,ON,ON,ON,ON`

State Saved	Saved in instrument state Saved in instrument state
Range	`OFF|ON`
Min/Max	101/20001

Detector 1

Sets the detector to be used by the trace for spur detection and limit line testing.

Remote Command	[:SENSe]:SPURious[:RANGe][:LIST]:DETector[1][:FUNCtion] AVERage | NEGative | NORMal | POSitive | SAMPle | RMS, AVERage | NEGative | NORMal | POSitive | SAMPle | RMS, AVERage | NEGative | NORMal | POSitive | SAMPle | RMS, AVERage | NEGative | NORMal | POSitive | SAMPle | RMS, AVERage | NEGative | NORMal | POSitive | SAMPle | RMS, AVERage | NEGative | NORMal | POSitive | SAMPle | RMS, AVERage | NEGative | NORMal | POSitive | SAMPle | RMS, AVERage | NEGative | NORMal | POSitive | SAMPle | RMS, AVERage | NEGative | NORMal | POSitive | SAMPle | RMS, AVERage | NEGative | NORMal | POSitive | SAMPle | RMS, AVERage | NEGative | NORMal | POSitive | SAMPle | RMS, AVERage | NEGative | NORMal | POSitive | SAMPle | RMS, AVERage | NEGative | NORMal | POSitive | SAMPle | RMS, AVERage | NEGative | NORMal | POSitive | SAMPle | RMS, AVERage | NEGative | NORMal | POSitive | SAMPle | RMS, AVERage | NEGative | NORMal | POSitive | SAMPle | RMS, AVERage | NEGative | NORMal | POSitive | SAMPle | RMS, AVERage | NEGative | NORMal | POSitive | SAMPle | RMS, AVERage | NEGative | NORMal | POSitive | SAMPle | RMS, AVERage | NEGative | NORMal | POSitive | SAMPle | RMS [:SENSe]:SPURious[:RANGe][:LIST]:DETector[1][:FUNCtion]?
Example	:SPUR:DET NORM, NORM, NORM, NORM, NORM, NORM, NORM, NORM, NORM, NORM, NORM, NORM, NORM, NORM, NORM, NORM, NORM, NORM, NORM, NORM :SPUR:DET?
Notes	For backwards compatibility, NORMal is available as a command parameter. However, this is treated the same as RMS internally, so the query never returns NORMal
Preset	POS, POS, POS, POS, POS, POS, POS, POS, POS, POS, POS, POS, POS, POS, POS, POS, POS, POS, POS, POS
State Saved	Saved in instrument state
Range	Normal|Average|Peak|Sample|Negative Peak

Detector 2

Sets the detector to be used by the trace for display purposes only.

Remote Command	[:SENSe]:SPURious[:RANGe][:LIST]:DETector2[:FUNCtion] OFF | AVERage | NEGative | NORMal | POSitive | SAMPle | RMS, OFF | AVERage | NEGative | NORMal | POSitive | SAMPle | RMS, OFF | AVERage | NEGative | NORMal | POSitive | SAMPle | RMS, OFF | AVERage | NEGative | NORMal | POSitive | SAMPle | RMS, OFF | AVERage | NEGative | NORMal | POSitive | SAMPle | RMS, OFF | AVERage | NEGative | NORMal | POSitive | SAMPle | RMS, OFF | AVERage | NEGative | NORMal | POSitive | SAMPle | RMS, OFF | AVERage | NEGative | NORMal | POSitive | SAMPle | RMS, OFF | AVERage | NEGative | NORMal | POSitive | SAMPle | RMS, OFF | AVERage | NEGative | NORMal | POSitive | SAMPle | RMS, OFF | AVERage | NEGative | NORMal | POSitive | SAMPle | RMS, OFF | AVERage | NEGative | NORMal | POSitive | SAMPle | RMS, OFF | AVERage | NEGative | NORMal |

	POSitive | SAMPle | RMS, OFF | AVERage | NEGative | NORMal | POSitive | SAMPle | RMS, OFF | AVERage | NEGative | NORMal | POSitive | SAMPle | RMS, OFF | AVERage | NEGative | NORMal | POSitive | SAMPle | RMS, OFF | AVERage | NEGative | NORMal | POSitive | SAMPle | RMS, OFF | AVERage | NEGative | NORMal | POSitive | SAMPle | RMS [:SENSe]:SPURious[:RANGe][:LIST]:DETector2[:FUNCtion]?
Example	:SPUR:DET2 AVER, AVER, AVER, AVER, AVER, AVER, AVER, AVER, AVER, AVER, AVER, AVER, AVER, AVER, AVER, AVER, AVER, AVER, AVER, AVER :SPUR:DET2?
Notes	For backward compatibility, "NORMal" is available as a SCPI command parameter. However, this is treated same as "RMS" internally, so the query never returns "NORMal" as its results.
Preset	OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF
State Saved	Saved in instrument state
Range	Off| Normal|Average|Peak|Sample|Negative Peak

Limits

Lets you set Start and Stop Limits and Threshold values for each Range.

Frequency Range

Same as **Frequency Range** under the **Bandwidth** index tab. See "Frequency Range" on page 1424.

Enabled

Same as the **Enabled** checkbox under the **Bandwidth** index tab. See "Enabled" on page 1425.

Start Freq

Same as the Start Freq column under the **Bandwidth** index tab. See "Start Freq" on page 1426. This column does not appear in MSR.

Stop Freq

Same as the Stop Freq column under the **Bandwidth** index tab. See "Stop Freq" on page 1427. This column does not appear in MSR.

Center Frequency

Same as the Center column under the **Bandwidth** index tab. See"Center Frequency" on page 1428. This column does not appear in MSR mode.

Span

Same as the Span column under the **Bandwidth** index tab. See "Span" on page 1428. This column does not appear in MSR mode.

Abs Start Limit

Determines the limit above which spurs will report a failing. If Abs Stop Limit Mode is set to **Auto**, this is coupled to **Abs Stop Limit** to make a flat limit line. If set to **Man**, Abs Start Limit and Abs Stop Limit can take different values to make a sloped limit line.

If the Limit Line Test parameter is off, then any spurs that are found to be above the current 'Peak Excursion' are added to the results table. From these spurs, the amplitude is checked using the abs limit start and abs limit stop parameters, then the limit is calculated. An 'F' is appended to the amplitude value of the spur if the measured amplitude is above the limit. If the Limit Line Test is on, only the spurs whose amplitudes exceed the limit are reported.

This parameter can send up to 20 values. The location in the list sent corresponds to the range of the associated value. When sending the remote command, missing values are not permitted. If you want to change values 2 and 6, then you must send all values up to 6. Subsequent values will remain as they were.

The query always returns 20 values.

Remote Command	`:CALCulate:SPURious[:RANGe][:LIST]:LIMit:ABSolute[:UPPer]:DATA[:STARt] <ampl>, <ampl>, <ampl>, <ampl>, <ampl>, <ampl>, <ampl>, <ampl>, <ampl>, <ampl>, <ampl>, <ampl>, <ampl>, <ampl>, <ampl>, <ampl>, <ampl>, <ampl>, <ampl>, <ampl>` `:CALCulate:SPURious[:RANGe][:LIST]:LIMit:ABSolute[:UPPer]:DATA[:STARt]?`
Example	`:CALC:SPUR:LIM:ABS:DATA 0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0` `:CALC:SPUR:LIM:ABS:DATA?`
Preset	SA: -5.00000000E+001, -5.00000000E+001, -5.00000000E+001, -5.00000000E+001, -5.00000000E+001, -5.00000000E+001, -5.00000000E+001, -5.00000000E+001, -5.00000000E+001, -5.00000000E+001, -5.00000000E+001, -5.00000000E+001, -5.00000000E+001, -5.00000000E+001, -5.00000000E+001, -5.00000000E+001, -5.00000000E+001, -5.00000000E+001, -5.00000000E+001, -5.00000000E+001 WCDMA: -36dBm, -36dBm, -36dBm, -30dBm, -25dBm, -15dBm, -25dBm, -30dBm, -50dBm, -50dBm, -50dBm, -50dBm, -50dBm, -50dBm, -50dBm, -50dBm, -50dBm, -50dBm, -50dBm, -50dBm

	LTE, LTEAFDD, MSR: -36dBm, -36dBm, -36dBm, -30dBm, -96dBm, -30dBm, -30dBm, -50dBm, -50dBm, -50dBm, -50dBm, -50dBm, -50dBm, -50dBm, -50dBm, -50dBm, -50dBm, -50dBm, -50dBm, -50dBm LTETDD, LTEATDD, 5G NR: -36dBm, -36dBm, -36dBm, -30dBm, -30dBm, -30dBm, -30dBm, -50dBm, -50dBm, -50dBm, -50dBm, -50dBm, -50dBm, -50dBm, -50dBm, -50dBm, -50dBm, -50dBm, -50dBm, -50dBm WLAN: -36dBm, -36dBm, -36dBm, -30dBm, -50dBm, -50dBm, -50dBm, -50dBm, -50dBm, -50dBm, -50dBm, -50dBm, -50dBm, -50dBm, -50dBm, -50dBm, -50dBm, -50dBm, -50dBm, -50dBm
State Saved	Saved in instrument state
Min/Max	-200.0 dBm/50.0 dBm

Abs Stop Limit

Determines the limit above which spurs will report a failing. If Abs Stop Limit Mode is set to **Auto**, this is coupled to **Abs Start Limit** to make a flat limit line. If set to **Man**, Abs Start Limit and Abs Stop Limit can take different values to make a sloped limit line.

Abs Stop Limit Mode, when set to Couple, couples Abs Start Limit and Abs Stop Limit to make a flat limit line. If set to Man, Abs Start and Abs Stop can take different values to make a sloped limit line.

This parameter can send up to 20 values. The location in the list sent corresponds to the range of the associated value. When sending the remote command, missing values are not permitted; that is, if you want to change values 2 and 6, then you must send all values up to 6. Subsequent values will remain as they were. The query for this parameter always returns 20 values.

Remote Command	`:CALCulate:SPURious[:RANGe][:LIST]:LIMit:ABSolute[:UPPer]:DATA:STOP <ampl>, <ampl>, <ampl>, <ampl>, <ampl>, <ampl>, <ampl>, <ampl>, <ampl>, <ampl>, <ampl>, <ampl>, <ampl>, <ampl>, <ampl>, <ampl>, <ampl>, <ampl>, <ampl>, <ampl>` `:CALCulate:SPURious[:RANGe][:LIST]:LIMit:ABSolute[:UPPer]:DATA:STOP?` `:CALCulate:SPURious[:RANGe][:LIST]:LIMit:ABSolute[:UPPer]:DATA:STOP:AUTO OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1, OFF | ON | 0 | 1` `:CALCulate:SPURious[:RANGe][:LIST]:LIMit:ABSolute[:UPPer]:DATA:STOP:AUTO?`

Example	`:CALC:SPUR:LIM:ABS:DATA:STOP -25, -25, -25, -25, -25, -25, -25, -25, -25, -25, -25, -25, -25, -25, -25, -25, -25, -25, -25, -25`
	`:CALC:SPUR:LIM:ABS:DATA:STOP?`
	`:CALC:SPUR:LIM:ABS:DATA:STOP:AUTO ON, ON, ON, ON, ON, ON, ON, ON, ON, ON, ON,`

	ON, ON, ON, ON, ON, ON, ON, ON, ON :CALC:SPUR:LIM:ABS:DATA:STOP:AUTO?
Preset	SA: -5.00000000E+001, -5.00000000E+001, -5.00000000E+001, -5.00000000E+001, -5.00000000E+001, -5.00000000E+001, -5.00000000E+001, -5.00000000E+001, -5.00000000E+001, -5.00000000E+001, -5.00000000E+001, -5.00000000E+001, -5.00000000E+001, -5.00000000E+001, -5.00000000E+001, -5.00000000E+001, -5.00000000E+001, -5.00000000E+001, -5.00000000E+001, -5.00000000E+001 WCDMA: -36dBm, -36dBm, -36dBm, -30dBm, -25dBm, -15dBm, -25dBm, -30dBm, -50dBm, -50dBm, -50dBm, -50dBm, -50dBm, -50dBm, -50dBm, -50dBm, -50dBm, -50dBm, -50dBm, -50dBm LTETDD, LTEATDD, 5G NR: -36dBm, -36dBm, -36dBm, -30dBm, -30dBm, -30dBm, -30dBm, -50dBm, -50dBm, -50dBm, -50dBm, -50dBm, -50dBm, -50dBm, -50dBm, -50dBm, -50dBm, -50dBm, -50dBm, -50dBm LTE, LTEAFDD, MSR: -36dBm, -36dBm, -36dBm, -30dBm, -96dBm, -30dBm, -30dBm, -50dBm, -50dBm, -50dBm, -50dBm, -50dBm, -50dBm, -50dBm, -50dBm, -50dBm, -50dBm, -50dBm, -50dBm, -50dBm WLAN: -36dBm, -36dBm, -36dBm, -30dBm, -50dBm, -50dBm, -50dBm, -50dBm, -50dBm, -50dBm, -50dBm, -50dBm, -50dBm, -50dBm, -50dBm, -50dBm, -50dBm, -50dBm, -50dBm, -50dBm ON,ON,ON,ON,ON,ON,ON,ON,ON,ON,ON,ON,ON,ON,ON,ON,ON,ON,ON,ON
State Saved	Saved in instrument state Saved in instrument state
Min/Max	-200.0 dBm/50.0 dBm

Peak Excursion

Sets the minimum amplitude variation of signals that can be identified as peaks. If a value of 6 dB is selected, peaks that rise and fall more than 6 dB above the peak threshold value are identified.

This parameter can send up to 20 values. The location in the list sent corresponds to the range of the associated value. When sending the remote command, missing values are not permitted. If you want to change values 2 and 6 you must send all values up to 6. Subsequent values will remain as they were.

The query for this parameter always returns 20 values.

Remote Command	[:SENSe]:SPURious[:RANGe][:LIST]:PEAK:EXCursion <rel_ampl>, <rel_ampl>, <rel_ampl>, <rel_ampl>, <rel_ampl>, <rel_ampl>, <rel_ampl>, <rel_ampl>, <rel_ampl>, <rel_ampl>, <rel_ampl>, <rel_ampl>, <rel_ampl>, <rel_ampl>, <rel_ampl>, <rel_ampl>, <rel_ampl>, <rel_ampl>, <rel_ampl>, <rel_ampl> [:SENSe]:SPURious[:RANGe][:LIST]:PEAK:EXCursion?
Example	:SPUR:PEAK:EXC 20,20, 20, 20, 20, 20, 20, 20, 20, 20, 20, 20, 20, 20, 20, 20, 20, 20, 20, 20 :SPUR:PEAK:EXC?

Preset	+6.00000000E+000, +6.00000000E+000, +6.00000000E+000, +6.00000000E+000, +6.00000000E+000, +6.00000000E+000, +6.00000000E+000, +6.00000000E+000, +6.00000000E+000, +6.00000000E+000, +6.00000000E+000, +6.00000000E+000, +6.00000000E+000, +6.00000000E+000, +6.00000000E+000, +6.00000000E+000, +6.00000000E+000, +6.00000000E+000, +6.00000000E+000, +6.00000000E+000
State Saved	Saved in instrument state
Min/Max	0.0 dB/100.0 dB

Pk Threshold

Sets the minimum amplitude of signals that can be identified as peaks. For example, if a value of -90 dBm is selected, only peaks that rise and fall more than the peak excursion value which are above –90 dBm are identified.

This parameter can send up to 20 values. The location in the list sent corresponds to the range of the associated value. When sending the remote command, missing values are not permitted. If you want to change values 2 and 6, then you must send all values up to 6. Subsequent values will remain as they were.

The query always returns 20 values.

Remote Command	`[:SENSe]:SPURious[:RANGe][:LIST]:PEAK:THReshold <real>, <real>, <real>, <real>, <real>, <real>, <real>, <real>, <real>, <real>, <real>, <real>, <real>, <real>, <real>, <real>, <real>, <real>, <real>, <real>` `[:SENSe]:SPURious[:RANGe][:LIST]:PEAK:THReshold?`
Example	`:SPUR:PEAK:THR 0,0,0` `:SPUR:PEAK:THR?`
Preset	-9.00000000E+001, -9.00000000E+001, -9.00000000E+001, -9.00000000E+001, -9.00000000E+001, -9.00000000E+001, -9.00000000E+001, -9.00000000E+001, -9.00000000E+001, -9.00000000E+001, -9.00000000E+001, -9.00000000E+001, -9.00000000E+001, -9.00000000E+001, -9.00000000E+001, -9.00000000E+001, -9.00000000E+001, -9.00000000E+001, -9.00000000E+001, -9.00000000E+001
State Saved	Saved in instrument state
Min/Max	-200/0

Meas Setup Summary Table

Lets you view and access many of the parameters in the Meas Setup menus on one screen.

Auto Couple

Immediately puts all **Auto/Man** functions into **Auto**. **Auto Couple** is confined to the current measurement only. It does not affect other measurements in the Mode.

In the **Auto** state, **Auto/Man** functions are said to be “coupled”, meaning their values change as you make changes to other values in the measurement. This helps ensure accurate measurements and optimum dynamic range. **Auto Couple** is an immediate action function, and when it is executed, all the **Auto/Man** controls for the current measurement are set to **Auto**, and all measurement settings coupled to the **Auto/Man** parameters are automatically set to their optimal values.

For further details of measurement-specific settings (if any), see "Measurement-Specific Details" on page 1452 below.

Remote Command	`:COUPle ALL`
Example	`:COUP ALL`
Backwards Compatibility SCPI	`:COUPLE ALL | NONE`
Backwards Compatibility Notes	`:COUP:NONE` puts all Auto/Man parameters in manual mode, decoupling all the coupled instrument parameters. It is retained for backwards compatibility and is *not* recommended for making measurements or new designs

All **Auto/Man** parameter couplings in the measurement are set to **Auto**. This includes couplings that may be unavailable or grayed-out due to the current state. For example, in the Swept SA measurement, there is no **Auto/Man** coupling for **RBW** while in Zero Span. Nonetheless, if **Auto Couple** were executed while in Zero Span, it would set **RBW** to Auto "behind the scenes" so that, on exit from Zero Span, it would be in **Auto**.

Any **Auto/Man** selection specific (local) to the other measurements in the current Mode are not affected by **Auto Couple**. Any functions that are *not* coupled with other instrument parameters, such as ranging or leveling variables, such as **AutoRange** or **AutoScale**, are not affected.

Executing **Auto Couple** generates the informational message, "All Auto/Man functions have been set to Auto".

Each parameter, upon being set to **Auto**, selects and sets the appropriate auto-coupled value based on that parameter’s coupling rules. The Dependency Resolver orchestrates the couplings for parameters that depend on one or more other parameters. The coupling and dependency rules for each parameter are defined in the section describing that parameter.

Executing **Auto Couple** *does not* affect markers, marker functions, trace or display attributes, or any other instrument setting other than those specifically mentioned above.

Measurement-Specific Details

TOI (SA Mode only)

Parameters affected by **Auto Couple** are:

- Center Frequency Step
- Resolution Bandwidth
- Span/RBW Ratio
- Sweep Time
- Video BANDwidth VBW/RBW ratio
- Upper and Lower Tone (set to Sense)
- Zero span measurement Resolution Bandwidth
- Zero span measurement Dwell Time

Harmonics (SA Mode only)

Parameters affected by **Auto Couple** are:

- Resolution Bandwidth
- Fundamental Frequency
- Dwell Time
- Range Table Resolution Bandwidths
- Range Table Dwell Times

Meas Preset

Restores all measurement parameters to their default values.

Remote Command	`:CONFigure:SPURious`
Example	`:CONF:SPUR`

Fast Spurious Meas (Remote Command only)

This command is the backward compatibility command for the Fast Spurious Measurement. Since this command is another representation of Spurious Report Mode, it is coupled with that command.

- When set to ON, only spurs above the limit line are reported. This is the same as Spurious Report Mode LIMTest.
- When set to OFF, all detected spurs are reported. This is the same as Spurious Report Mode ALL.

Remote Command	[:SENSe]:SPURious:FSMeas ON | OFF | 1 | 0 [:SENSe]:SPURious:FSMeas?
Example	:SPUR:FSM ON :SPUR:FSM?
Couplings	If :SPUR:REPT:MODE is ALL, this parameter is OFF If :SPUR:REPT:MODE is LIMTest, this parameter is ON
Preset	OFF
State Saved	Saved in instrument state

3.8.8.2 Meas Standard

Contains controls that allow you to preset the PowerSuite measurements to conform to various communications standards.

Radio Standard Presets

Lets you specify the Radio Standard to be used. Spectrum Analyzer Mode supports many Radio Standards. You can select the desired Radio Standard using the **Radio Std Presets** dialog, which is a cascading list of standards. When you have the selected the desired Standard, press **OK** and the measurement settings will change to reflect that standard.

Remote Command	[:SENSe]:RADio:STANdard[:SELect] NONE | JSTD | IS95a | IS97D | IS98D | GSM | W3GPP | C2000MC1 | C20001X | NADC | PDC | BLUEtooth | TETRa | WL802DOT11A | WL802DOT11B | WL802DOT11G | HIPERLAN2 | DVBTLSN | DVBTGPN | DVBTIPN | FCC15 | SDMBSE | UWBINDOOR | LTEB1M4 | LTEB3M | LTEB5M | LTEB10M | LTEB15M | LTEB20M | WL11N20M | WL11N40M | WL11AC20M | WL11AC40M | WL11AC80M | WL11AC160M | WL11AX20M | WL11AX40M | WL11AX80M | WL11AX160M | WL11BE20M | WL11BE40M | WL11BE80M | WL11BE160M | WL11BE320M | WL11AD2G | WL11AY2G16 | WL11AY4G32 | WL11AY6G48 | WL11AY8G64 | NR5GFR1B100M [:SENSe]:RADio:STANdard[:SELect]?

Example	`:RAD:STAN NONE` `:RAD:STAN?`
Dependencies	Some selections appear only when support license is valid
Couplings	By changing the radio standard, the measurement parameters will be automatically set to an appropriate default value
State Saved	Saved in instrument state

The **Radio** column in the table lets you specify the device to be used. It is a global setting that affects the Device selection, between Mobile (MS) and Base Station (BTS) settings, for all relevant PowerSuite measurements. The Device SCPI command has the same effect as a selection in the **Radio** column:

Remote Command	`[:SENSe]:RADio:STANdard:DEVice BTS | MS` `[:SENSe]:RADio:STANdard:DEVice?`
Example	`:RAD:STAN:DEV MS` `:RAD:STAN:DEV?`
Preset	`BTS`
State Saved	Saved in instrument state
Range	`BTS|MS`

Chart for Standard and Available Measurements

Note that not every measurement in Spectrum Analyzer Mode is available for every standard. The chart below describes which measurements are available for each Radio Standard.

For TOI or Harmonics measurements, *no* Radio Standards are available.

	Swept SA	CHP	OBW	ACP	CCDF	Burst Power	Spurious Emission	SEM	List Sweep
None	X	X	X	X	X	X	X	X	(X)
3GPP 5G NR	(X)	X	X	X	X			X	(X)
3GPP LTE	(X)	X	X	X	X			X	(X)
3GPP W-CDMA	(X)	X	X	X	X	X		X	(X)
GSM/EDGE	(X)				X	X			(X)
cdma2000 1x	(X)	X	X	X	X	X			(X)
IS-95A	(X)	X	X	X	X	X			(X)
J-STD-008	(X)	X	X	X	X	X			(X)
IS-97D/98D	(X)	X	X	X	X				(X)
NADC	(X)	X	X	X	X	X			(X)
PDC	(X)	X	X	X	X	X			(X)

	Swept SA	CHP	OBW	ACP	CCDF	Burst Power	Spurious Emission	SEM	List Sweep
Bluetooth	(X)				X	X			(X)
W-LAN 802.11a	(X)							X	(X)
W-LAN 802.11b	(X)							X	(X)
W-LAN 802.11g	(X)							X	(X)
W-LAN 802.11n	(X)	X	X		X			X	(X)
W-LAN 802.11ac	(X)	X	X		X			X	(X)
W-LAN 802.11ax	(X)	X	X		X			X	(X)
W-LAN 802.11be	(X)	X	X		X			X	(X)
W-LAN 802.11ad	(X)	X	X		X			X	(X)
W-LAN 802.11ay	(X)	X	X		X			X	(X)
W-LAN HiperLAN/2	(X)							X	(X)
TETRA	(X)	X		X					(X)
DVB-T L/SECAM/NICAM	(X)	X			X				(X)
FCC Part 15 Subpart F	(X)	X			X				(X)
DVBT-T G/PAL/NICAM	(X)	X			X				(X)
DVB-T I/PAL/NICAM	(X)						X		(X)
S-DMB System E	(X)	X	X	X					(X)
UWB Indoor	(X)						X		(X)

General Radio Standards

The table below lists the settings and provides an example for each general Radio Standard.

None	Command Example	:RAD:STAN NONE
	IBW	2 MHz
	Span	3 MHz
	RBW	Auto rules
	VBW	Auto rules
TETRA	Command Example	:RAD:STAN TETR
	IBW	18 kHz
	Span	27 kHz
	RBW	1.2 kHz
	VBW	Auto rules
	RRC Filter	On
	RRC Filter Alpha	0.35
FCC Part15 Subpart F	Command Example	:RAD:STAN FCC15

Video Radio Standards

The table below lists the settings and provides an example for each video Radio Standard.

DVB-T L/SECAM/NICAM	Command Example	:RAD:STAN DVBTLSN
	IBW	7.61 MHz
	Span	24 MHz
	RBW	3.9 kHz
	VBW	Auto rules
	Sweep Points	8001
DVB-T G/PAL/NICAM	Command Example	:RAD:STAN DVBTGPN
	IBW	7.61 MHz
	Span	24 MHz
	RBW	3.9 kHz
	VBW	Auto rules
	Sweep Points	8001
DVB-T I/PAL/NICAM	Command Example	:RAD:STAN DVBTIPN
	IBW	7.61 MHz
	Span	24 MHz
	RBW	3.9 kHz
	VBW	Auto rules
	Sweep Points	8001

S-DMB System E	Command Example	:RAD:STAN SDMBSE
	IBW	25 MHz
	Span	37.5 MHz
	RBW	360 kHz
	VBW	Auto rules
	RRC Filter	Off
	RRC Filter Alpha	0.22

Cellular Radio Standards

The table below lists the CHP settings and provides an example for each cellular Radio Standard.

GSM/EDGE	Command Example	:RAD:STAN GSM
3GPP 5G NR	Command Example	:RAD:STAN NR5GFR1B100M
	IBW	100 MHz
	Span	150 MHz
	RBW	Auto rules
	VBW	Auto rules
3GPP W-CDMA	Command Example	:RAD:STAN W3GPP
	IBW	5 MHz
	Span	7.5 MHz
	RBW	240 kHz
	VBW	Auto rules
	RRC Filter	Off
	RRC Filter Alpha	0.22
3GPP LTE 1.4 MHz	Command Example	:RAD:STAN LTEB1M4
	IBW	1.4 MHz
	Span	2.1 MHz
	RBW	Auto rules
	VBW	Auto rules
3GPP LTE 3 MHz	Command Example	:RAD:STAN LTEB3M
	IBW	3 MHz
	Span	4.5 MHz
	RBW	Auto rules
	VBW	Auto rules

3GPP LTE 5 MHz	Command Example	:RAD:STAN LTEB5M
	IBW	5 MHz
	Span	7.5 MHz
	RBW	Auto rules
	VBW	Auto rules
3GPP LTE 10 MHz	Command Example	:RAD:STAN LTEB10M
	IBW	10 MHz
	Span	15 MHz
	RBW	Auto rules
	VBW	Auto rules
3GPP LTE 15 MHz	Command Example	:RAD:STAN LTEB15M
	IBW	15 MHz
	Span	22.5 MHz
	RBW	Auto rules
	VBW	Auto rules
3GPP LTE 20 MHz	Command Example	:RAD:STAN LTEB20M
	IBW	20 MHz
	Span	30 MHz
	RBW	Auto rules
	VBW	Auto rules
cdma2000	Command Example	:RAD:STAN C20001X :RAD:STAN C2000MC1 :RAD:STAN? (Query always returns C20001X)
	IBW	1.23 MHz
	Span	1.845 MHz
	RBW	24 kHz
	VBW	Auto rules
IS-95A	Command Example	:RAD:STAN IS95
	IBW	1.23 MHz
	Span	1.845 MHz
	RBW	24 kHz
	VBW	Auto rules

J-STD-008	Command Example	:RAD:STAN JSTD
	IBW	1.23 MHz
	Span	1.845 MHz
	RBW	24 kHz
	VBW	Auto rules
NADC	Command Example	:RAD:STAN NADC
	IBW	32.8 kHz
	Span	49.2 kHz
	RBW	1.2 kHz
	VBW	Auto rules
PDC	Command Example	:RAD:STAN PDC
	IBW	21 kHz
	Span	31.5 kHz
	RBW	6.2 kHz
	VBW	Auto rules
IS-97D/98D	Command Example	:RAD:STAN IS97D :RAD:STAN IS98D :RAD:STAN IS95C :RAD:STAN? Query always returns `IS97D`
	IBW	1.23 MHz
	Span	1.845 MHz
	RBW	24kHz
	VBW	Auto rules

Band Class (IS-97D/98D only)

The following function is only available when you have selected the standard: IS-97D/98D. It lets you select the band class.

Remote Command	`[:SENSe]:RADio:STANdard:BAND:CLASs BC0 | BC1` `[:SENSe]:RADio:STANdard:BAND:CLASs?`
Example	`:RAD:STAN:BAND:CLAS BC0` `:RAD:STAN:BAND:CLAS?`
Preset	`BC0`
State Saved	Saved in instrument state
Range	0 (800 MHz Band)|1 (1900 MHz Band)

Wireless Radio Standards

The table below lists the CHP settings and provides an example for each wireless Radio Standard.

WLAN 802.11a	Command Example	:RAD:STAN WL802DOT11A
	IBW	20 MHz
	Span	30 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11g	Command Example	:RAD:STAN WL802DOT11G
	IBW	20 MHz
	Span	30 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11b	Command Example	:RAD:STAN WL802DOT11B
	IBW	25 MHz
	Span	37.5 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11n 20 MHz	Command Example	:RAD:STAN WL11N20M
	IBW	20 MHz
	Span	30 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11n 40 MHz	Command Example	:RAD:STAN WL11N40M
	IBW	40 MHz
	Span	60 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11ac 20 MHz	Command Example	:RAD:STAN WL11AC20M
	IBW	20 MHz
	Span	30 MHz
	RBW	100 kHz
	VBW	Auto rules

WLAN 802.11ac 40 MHz	Command Example	:RAD:STAN WL11AC40M
	IBW	40 MHz
	Span	60 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11ac 80 MHz	Command Example	:RAD:STAN WL11AC80M
	IBW	80 MHz
	Span	120 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11ac 160 MHz	Command Example	:RAD:STAN WL11AC160M
	IBW	160 MHz
	Span	240 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11ax 20 MHz	Command Example	:RAD:STAN WL11AX20M
	IBW	20 MHz
	Span	30 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11ax 40 MHz	Command Example	:RAD:STAN WL11AX40M
	IBW	40 MHz
	Span	60 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11ax 80 MHz	Command Example	:RAD:STAN WL11AX80M
	IBW	80 MHz
	Span	120 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11ax 160 MHz	Command Example	:RAD:STAN WL11AX160M
	IBW	160 MHz
	Span	240 MHz
	RBW	100 kHz
	VBW	Auto rules

WLAN 802.11be 20 MHz	Command Example	:RAD:STAN WL11BE20M
	IBW	20 MHz
	Span	30 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11be 40 MHz	Command Example	:RAD:STAN WL11BE40M
	IBW	40 MHz
	Span	60 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11be 80 MHz	Command Example	:RAD:STAN WL11BE80M
	IBW	80 MHz
	Span	120 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11be 160 MHz	Command Example	:RAD:STAN WL11BE160M
	IBW	160 MHz
	Span	240 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11be 320 MHz	Command Example	:RAD:STAN WL11BE320M
	IBW	320 MHz
	Span	480 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11ad 2 GHz	Command Example	:RAD:STAN WL11AD2G
	IBW	2.16 GHz
	Span	3.24 GHz
	RBW	1 MHz
	VBW	Auto rules
WLAN 802.11ay 2.16 GHz	Command Example	:RAD:STAN WL11AY2G16
	IBW	2.16 GHz
	Span	3.24 GHz
	RBW	1 MHz
	VBW	Auto rules

WLAN 802.11ay 4.32 GHz	Command Example	:RAD:STAN WL11AY4G32
	IBW	4.32 GHz
	Span	6.48 GHz
	RBW	1 MHz
	VBW	Auto rules
WLAN 802.11ay 6.48 GHz	Command Example	:RAD:STAN WL11AY6G48
	IBW	6.48 GHz
	Span	9.72 GHz
	RBW	1 MHz
	VBW	Auto rules
WLAN 802.11ay 8.64 GHz	Command Example	:RAD:STAN WL11AY8G64
	IBW	8.64 GHz
	Span	12.96 GHz
	RBW	1 MHz
	VBW	Auto rules
3GPP 5G NR 5G NR FR1 100MHz	Command Example	:RAD:STAN NR5GFR1B100M
	IBW	100 MHz
	Span	150 MHz
	RBW	Auto rules
	VBW	Auto rules

WLAN HiperLAN/2	Command Example	`:RAD:STAN HIPERLAN2`	
	UWB Indoor	Command Example RAD:STAN UWBINDOOR	
	Bluetooth	Command Example RAD:STAN BLUE	

Packet Type (Bluetooth only)

The command below sets the packet type for the Bluetooth measurement

Remote Command	`[:SENSe]:RADio:STANdard:PACKet DH1 | DH3 | DH5` `[:SENSe]:RADio:STANdard:PACKet?`
Example	`:RAD:STAN:PACK DH1` `:RAD:STAN:PACK?`
Notes	The packet length is:
	`DH1` 366 µs

	DH3	1622 µs
	DH5	2870 µs
Preset	DH1	
State Saved	Saved in instrument state	
Range	DH1 | DH3 | DH5	

Radio Standard Presets Hierarchy

General	None	
	TETRA	BTS
		MS
	FCC Part 15 Subpart F	
	APCO-25	
	DMR	
	dPMR	
Video	DVB-T	L/SECAM/NICAM
		G/PAL/NICAM
		I/PAL/NICAM
	S-DMB System E	

Cellular	3GPP 5G NR	BTS	FR1 100 MHz
		MS	FR1 100 MHz
	3GPP LTE	BTS	1.4 MHz (6 RB)
			3 MHz (15 RB)
			5 MHz (25 RB)
			10 MHz (50 RB)
			15 MHz (75 RB)
			20 MHz (100 RB)
		MS	1.4 MHz (6 RB)
			3 MHz (15 RB)
			5 MHz (25 RB)
			10 MHz (50 RB)
			15 MHz (75 RB)
			20 MHz (100 RB)
	3GPP W-CDMA	BTS	
		MS	
	GSM/EDGE	BTS	
		MS	
	cdma2000 1x	BTS	
		MS	
	IS-95A	BTS	
		MS	
	J-STD-008	BTS	
		MS	
	IS-97D/98D	BTS	Band Class 0
			Band Class 1
		MS	Band Class 0
			Band Class 1
	NADC	BTS	
		MS	
	PDC	BTS	
		MS	

Wireless	W-LAN	802.11a	
		802.11b	
		802.11g	
		802.11n	20 MHz
			40 MHz
		802.11ac	20 MHz
			40 MHz
			80 MHz
			160 MHz
		802.11ax	20 MHz
			40 MHz
			80 MHz
			160 MHz
		802.11be	20 MHz
			40 MHz
			80 MHz
			160 MHz
			320 MHz
		802.11ad	
		802.11ay	2.16 GHz
			4.32 GHz
			6.48 GHz
			8.64 GHz
		HiperLAN/2	
	Bluetooth	DH1	
		DH3	
		DH5	
	UWB Indoor		

Each Radio Standard has the preset parameter set for the measurement.

When a standard is selected, the default value of the measurement parameters are overwritten by those preset values.

When the standard is NONE, or the standard does not specify the firm RBW requirement, then the table displays “auto”, and the following definition is used to compute the proper RBW setting:

1. Compute the guard-band = [Offset Freq A] - 0.5*([Chan Integ BW] + [Ref BW])

2. Divide by 4.5. Call the result GuardbandGoalRBW

3. Compute the greater of the Reference and Offset A integration bandwidths. Divide that result by 100 and call it the ChannelWidthGoalRBW
4. Find the smallest integration bandwidth of any of the offsets; divide it by two and call the result IntegBWGoalRBW
5. Compute AutoRBWGoal = min(IntegBWGoal, max(GuardbandGoalRBW, ChannelWidthGoalRBW))
6. Compute the RBW to be selected to be the largest available RBW that is smaller than AutoRBWGoal

Measurements that are unavailable for a particular Radio Standard are grayed-out. Radio Standards that are unavailable for the current active measurement are also grayed-out.

However, remote operations, such as `:CONF` allow the measurement to be active even if it is not a supported format. In this case, the measurement configuration should be set to `NONE`.

Enable Non-Std Meas

Lets you specify whether all measurements and radio standards are enabled or not.

By default, **Enable Non-Std Measurements** is set to `NO`, so you can select only valid combinations of preset available standards and measurements. Combinations of measurement and standard that would have no valid preset value are grayed-out.

When **Enable Non-Std Measurements** is set to `YES`, all measurements and standard selections are enabled, so you can select any combination.

NOTE: **If you select an unavailable measurement or unavailable radio standard using the Enable Non-Std Meas control, the measurement results may not conform to the selected standard.**

Remote Command	`[:SENSe]:RADio:STANdard:EAMeas YES | NO` `[:SENSe]:RADio:STANdard:EAMeas?`
Example	`:RAD:STAN:EAM YES` `:RAD:STAN:EAM?`
Preset	`NO`
State Saved	Saved in instrument state
Range	`YES|NO`

3.8.8.3 Advanced

Contains controls for setting advanced functions of the instrument.

This tab does not appear in VXT, M9393A, or M9391A.

Noise Floor Extension

Allows you to turn on/configure the **Noise Floor Extension** (NFE) function. Some Modes (such as Spectrum Analyzer Mode), support two states of NFE, Full and Adaptive. The ON state (in Modes which do not support Adaptive NFE) matches the FULL state (in Modes which DO support Adaptive NFE).

In ON or FULL NFE, the expected noise power of the instrument (derived from a factory calibration) is subtracted from the trace data. This will usually reduce the apparent noise level by about 10 dB in low band, and 8 dB in high band (>~3.6 GHz).

In Adaptive NFE, there is not the same dramatic visual impact on the noise floor as there is in Full NFE. Adaptive NFE controls the amount of correction that is applied based on other instrument settings like RBW, averaging and sweep time. Adaptive NFE controls the degree of potential improvement in the noise floor to give more improvement for those instrument settings that can make good use of the potential improvement, such as settings that provide more averaging. The result is that when not much averaging is being performed, the signal displays more like the NFE-off case; and when lots of averaging is being performed, the signal displays more like the full-NFE case.

Adaptive NFE (in Modes which support it) is recommended for general-purpose use. For fully ATE (automatic test equipment) applications, where the distraction of a person using the instrument is not a risk, Full NFE is recommended.

NFE works with any RBW, VBW, detector, any setting of Average Type, any amount of trace averaging, and any signal type. It is ineffective when the trace is not smoothed (smoothing processes include narrow VBWs, trace averaging, and long sweep times with the detector set to Average or Peak). It works best with extreme amounts of smoothing, and with the average detector, with the Average Type set to Power.

In those cases where the cancellation is ineffective, it nonetheless has no undesirable side-effects. There is no significant speed impact to having **Noise Floor Extension** on.

The best accuracy is achieved when substantial smoothing occurs in each point before trace averaging. Thus, when using the average detector, results are better with long sweep times and fewer trace averages. When using the sample detector, the VBW filter should be set narrow with less trace averaging, instead of a wide VBW filter with more trace averaging.

NOTE **Noise Floor Extension has no effect unless the RF Input is selected, therefore it does nothing when External Mixing is selected.**

In Modes that support Adaptive NFE, the default state of NFE is Adaptive. In Modes that do not support Adaptive NFE, the default state of NFE is OFF. Prior to the introduction of Adaptive NFE (firmware version A.18.00), the default state of NFE was OFF for all Modes.

With the introduction of Adaptive NFE, the menu control is changed from On|Off to Full|Adaptive|Off. For SCPI Backwards Compatibility, the existing SCPI command to turn NFE on and off was retained, and a new command was added to set the state to turn Adaptive On and Off

`[:SENSe]:CORRection:NOISe:FLOor ON|OFF|1|0` is retained, default changed to On for modes which support Adaptive NFE

`[:SENSe]:CORRection:NOISe:FLOor:ADAPtive ON|OFF|1|0` is added (for certain Modes), default=On

FULL = `:CORRection:NOISe:FLOor ON` plus `:CORRection:NOISe:FLOor:ADAPtive ON`

Remote Command	`[:SENSe]:CORRection:NOISe:FLOor ON | OFF | 1 | 0` `[:SENSe]:CORRection:NOISe:FLOor?`
Example	`:CORR:NOIS:FLO ON`
Dependencies	This control only appears in instruments with the NFE or NF2 license installed. In all others, the control does not appear, however the SCPI command will be accepted without error (but will have no effect)
Couplings	If NFE is enabled in any Mode manually, a prompt is displayed reminding you to perform the Characterize Noise Floor operation if it is needed If NFE is enabled via SCPI and a Characterize Noise Floor operation is needed, an error will be entered in the system error queue
Preset	Unaffected by Mode Preset. Turned `ON` at startup and by Restore Mode Defaults in Modes which support Adaptive. Turned `OFF` at startup and by Restore Mode Defaults in Modes that do not support Adaptive
State Saved	No

Remote Command	`[:SENSe]:CORRection:NOISe:FLOor:ADAPtive ON | OFF | 1 | 0` `[:SENSe]:CORRection:NOISe:FLOor:ADAPtive?`

Example	First turn NFE on, this is Full mode
	`:CORR:NOIS:FLO ON`
	Then set it to Adaptive
	`:CORR:NOIS:FLO:ADAP ON`

Dependencies	Only available in Modes which support Adaptive NFE Only appears in instruments with the NFE or NF2 license installed. In all others, the control does not appear, however the SCPI command is accepted without error, but has no effect

Couplings	Sending `:CORR:NOIS:FLO ON` turns NFE Adaptive `OFF` for backwards compatibility, so to turn Adaptive on, you must issue the commands in the proper order, as shown in the example above
Preset	Not affected by Mode Preset, but set to `ON` at startup and by Restore Mode Defaults
State Saved	No

More Information

The instrument is characterized in the factory (or during a field calibration) with a model of the noise, referred to the input mixer, versus frequency in each band and path combination. Bands are 0 (low band) and 1 through 4 (high band) in a 26.5 GHz instrument, for example. Paths include normal paths, preamp paths, the electronic attenuator, etc.

In most band/path combinations, the noise can be well characterized based on just two parameters and the instrument frequency response before compensation for frequency-dependent losses.

After the noise density at the input mixer is estimated, the effects of the input attenuator, RBW, detector, etc. are computed to get the estimated input-port-referred noise level.

In the simplest case, the measured power (signal plus analyzer noise) in each display point (bucket) is compensated by subtracting the estimated noise power, leaving just the signal power. This is the operation when the detector is Average and the Average Type is set to Power.

In other cases, operation is often not quite as good but still highly effective. With peak detection, the noise floor is estimated based on the RBW and the duration of the bucket using the same equations used in the noise marker function. The voltage of the noise is subtracted from the voltage of the observed signal-plus-noise measurement to compute the estimated signal voltage. The peak detector is one example of processing that varies with detector to give good estimates of the signal level without the analyzer noise.

For best operation, the average detector and the power scale are recommended, as already stated. Peak detection for pulsed-RF can still give excellent effectiveness. FFT analysis does not work well, and does not do NFE well, with pulsed-RF signals, so this combination is not recommended. Negative peak detection is not very useful, either. Sample detection works well, but is never better than the average detector because it doesn't smooth as well. The Normal detector is a combination of peak and negative peak behaviors, and works about as well as these.

For best operation, extreme smoothing is desirable, as already stated. Using narrow VBWs works well, but using very long bucket durations and the average detector works best. Reducing the number of trace points will make the buckets longer.

For best operation, the power scale (Average Type = Power) is optimum. When making CW measurements in the presence of noise without NFE, averaging on the decibel scale has the advantage of reducing the effect of noise. When using NFE, the NFE does an even better job than using the log scale ever could. Using NFE with the log scale is not synergistic, though; NFE with the power scale works a little better than NFE with log averaging type.

The results from NFE with internal preamp can often be lower than the theoretical noise in a signal source at room temperature, a noise density of -174 dBm/Hz. This is expected and useful behavior, because NFE is designed to report the amount of input signal that is in excess of the thermal noise, not the amount that includes the thermal noise. This can be a useful behavior because thermal noise often interferes with what you want to measure, instead of being part of what you want to measure. Note that NFE is not adequately accurate to always be able to read below kTB.

Adaptive NFE provides an alternative to fully-on and -off NFE. Fully-on NFE can, notably in cases with little or no averaging of the spectrum, result in a display that is distractingly unfamiliar in the variability in response to low level signals. Fully-off NFE fails to achieve the potential improvement in dynamic range and associated accuracy of measurement of low level signals. Adaptive NFE controls the degree of potential improvement in the noise floor to give more improvement for those instrument settings that can make good use of the potential improvement—those settings with high degrees of variance reduction through some variant of averaging. When the potential improvement is small, the display acts like the NFE-off case, and when it is high, it acts like the fully-on case, and in-between, application is a compromise between attractiveness and effectiveness.

On instruments with the NF2 license installed, the calibrated Noise Floor used by Noise Floor Extensions should be refreshed periodically. Keysight recommends that the **Characterize Noise Floor** operation be performed after the first 500 hours of operation, and once every calendar year. The control to perform this is located in the **System, Alignments, Advanced** menu. If you have not done this yourself at the recommended interval, then when you turn on Noise Floor Extensions, the instrument will prompt you to do so with a dialog that says:

"This action will take several minutes to perform. Please disconnect all cables from the RF input and press Enter to proceed. Press ESC to cancel, or Postpone to postpone for a week"

If you Cancel, you will be prompted again the next time you turn NFE on. If you postpone, you will be prompted again after a week passes and you then turn NFE on.

3.8.8.4 Global

The controls in this menu apply to all Modes in the instrument.

Some controls (for example, "Global Center Freq" on page 2013) allow you to switch certain Meas Global parameters to a Mode Global state. These switches apply to all

Modes that support global settings. For example, no matter what Mode you are in when you set **Global Center Freq** to ON, it applies to all Modes that support Global settings.

Other controls (for example, **Extend Low Band**) are actually set in this menu, but apply to all Modes.

Global Center Freq

The software maintains a Mode Global value called **Global Center Freq**.

When **Global Center Freq** is switched ON, the current Mode's center frequency is copied into the **Global Center Frequency**, and from then on all Modes that support global settings use the **Global Center Frequency**, so you can switch between any of these Modes and the **Center Frequency** remains unchanged.

Adjusting the **Center Frequency** of any Mode that supports Global Settings, while **Global Center Freq** is ON, modifies the **Global Center Freq**.

When **Global Center Freq** is switched OFF, the **Center Frequency** of the current Mode is unchanged, but now the **Center Frequency** of each Mode is once again independent.

When **Mode Preset** is pressed while **Global Center Freq** is ON, the **Global Center Freq** is preset to the preset **Center Frequency** of the current Mode.

This function resets to OFF when "Restore Defaults" on page 2016 is pressed, or when **System**, **Restore Defaults**, **All Modes** is pressed.

Remote Command	`:INSTrument:COUPle:FREQuency:CENTer ALL | NONE` `:INSTrument:COUPle:FREQuency:CENTer?`
Example	`:INST:COUP:FREQ:CENT ALL` `:INST:COUP:FREQ:CENT?`
Preset	Set to OFF on **Global** Settings, **Restore Defaults** and **System, Restore Defaults, All Modes**
Range	ALL|NONE

Preset	OFF
Backwards Compatibility SCPI	`:GLOBal:FREQuency:CENTer[:STATe] 1 | 0 | ON | OFF` `:GLOBal:FREQuency:CENTer[:STATe]?`

Global EMC Std

When this control is switched ON, the current Mode's EMC Std is copied into the **Global EMC Std**, and from then on all Modes that support global settings use the **Global EMC Std**, so you can switch between any of these Modes and the EMC Std remains unchanged.

Adjusting the EMC Std of any Mode that supports Global settings, while **Global EMC Std** is ON modifies the **Global EMC Std**.

When **Global EMC Std** is switched OFF, the EMC Std of the current Mode remains unchanged, but now the EMC Std of each Mode is once again independent. When **Mode Preset** is pressed while **Global EMC Std** is ON, **Global EMC Std** is preset to the preset EMC Std of the current Mode.

This function resets to OFF when "Restore Defaults" on page 2016 is pressed, or when **System, Restore Defaults, All Modes** is pressed.

Remote Command	`:INSTrument:COUPle:EMC:STANdard ALL | NONE` `:INSTrument:COUPle:EMC:STANdard?`
Example	`:INST:COUP:EMC:STAN ALL` `:INST:COUP:EMC:STAN?`
Dependencies	Only available if Option EMC is installed
Preset	Set to OFF on **Global** Settings, **Restore Defaults** and **System, Restore Defaults, All Modes**
Range	ALL | NONE

Global Limit Lines (Freq and Amptd)

When this control is set to ALL, the current Mode's Limit Line is copied into the **Global Limit Lines**, and from there to all Modes that support Global settings and use **Global Limit Lines**, so you can switch between any of these Modes and the Limit Lines remain unchanged.

Adjusting the Limit Lines of any Mode that supports **Global** Settings, while **Global Limit Lines** is ALL, modifies the **Global Limit Lines**.

When **Global Limit Lines** is set to NONE, the Limit Lines of the current Mode are unchanged, but now the Limit Lines of each Mode are once again independent. When **Mode Preset** is pressed while **Global Limit Lines** is ALL, **Global Limit Lines** is preset to the preset Limit Lines of the current Mode.

This function is reset to NONE when "Restore Defaults" on page 2016 is pressed, or when **System**, **Restore Defaults**, **All Modes** is pressed.

Remote Command	`:INSTrument:COUPle:LLINe ALL | NONE` `:INSTrument:COUPle:LLINe?`
Example	`:INST:COUP:LLIN ALL | NONE` `:INST:COUP:LLIN?`
Preset	Set to OFF on **Global** Settings, **Restore Defaults** and **System, Restore Defaults, All Modes**
Range	ALL | NONE

Extend Low Band

The software maintains a Mode Global value called **Extend Low Band**.

Under the current sweep configuration crossing over two bands, when **Extend Low Band** is turned `ON`, the instrument checks whether one band can cover the whole sweep frequency range or not. If it can, then the instrument locks the band; otherwise, it does nothing (the band crossover occurs).

This function does *not* work when **Band Lock** under **System** > **Service** > **Lock Functions** is not -1 (no Band Lock). In that case, **Band Lock** takes priority over **Extend Low Band**.

This function resets to `OFF` when "Restore Defaults" on page 2016 is pressed, or when **System**, **Restore Defaults**, **All Modes** is pressed.

Remote Command	`:INSTrument:COUPle:FREQuency:BAND:EXTend 0 | 1 | ON | OFF` `:INSTrument:COUPle:FREQuency:BAND:EXTend?`
Example	`:INST:COUP:FREQ:BAND:EXT 1` `:INST:COUP:FREQ:BAND:EXT?`
Preset	Set to `OFF` by **Global** Settings > **Restore Defaults** and **System** > **Restore Defaults** > **All Modes**
Range	`ON|OFF`

Restore Defaults

Resets all functions in the **Global** settings menu to `OFF`. Pressing **System**, **Restore Defaults**, **All Modes** has the same effect.

Remote Command	`:INSTrument:COUPle:DEFault`
Example	`:INST:COUP:DEF`
Backwards Compatibility SCPI	`:GLOBal:DEFault`

3.8.9 Sweep

Accesses controls that enable you to configure and control the acquisition of data and the X-axis parameters of the instrument. These controls might include Sweep Time, Continuous/Single, Pause/Resume, X Scale and number of Points.

3.8.9.1 Sweep/Control

Accesses controls that let you operate the sweep and control functions of the instrument, such as **Sweep Time** and **Continuous/Single**.

Sweep/Measure

Lets you toggle between **Continuous** and **Single** sweep or measurement operation. The single/continuous state is Meas Global, so the setting affects all measurements.

The front-panel key **Single/Cont** performs exactly the same function

See "More Information" on page 1476

Remote Command	`:INITiate:CONTinuous OFF | ON | 0 | 1` `:INITiate:CONTinuous?`

Example	Put instrument into **Single** measurement operation:
	`:INIT:CONT 0`
	`:INIT:CONT OFF`
	Put instrument into **Continuous** measurement operation:
	`:INIT:CONT 1`
	`:INIT:CONT ON`

Preset	`ON` Note that `:SYST:PRES` sets `:INIT:CONT` to `ON`, but `*RST` sets `:INIT:CONT` to `OFF`
State Saved	Saved in instrument state
Annunciation	The **Single/Continuous** icon in the Meas Bar changes depending on the setting: – A line with an arrow is **Single** – A loop with an arrow is **Continuous**
Backwards Compatibility Notes	X-Series A-models had **Single** and **Cont** hardkeys in place of the **SweepSingleCont** softkey. In the X-Series A-models, if in single measurement, the **Cont** hardkey (and `INIT:CONT ON`) switched to continuous measurement, but never restarted a measurement and never reset a sweep X-Series B-models have a **Cont/Single** toggle control instead of **Single** and **Cont** hardkeys, but it is still true that, if in single measurement, the **Cont/Single** toggle control never restarts a measurement and never resets a sweep

More Information

Continuous Mode	The instrument takes repetitive sweeps, averages, measurements, etc., when in continuous mode. If in average or Max/Min Hold, and the average/hold count reaches the **Average/Hold Num**, the count stops incrementing, but the instrument keeps sweeping

	See the **Trace** key description under **Trace Average** for the averaging formula used both before and after the **Average/Hold Num** is reached. The trigger condition must be met prior to each sweep The type of trace processing for multiple sweeps is set under the **Trace** key, with choices of **Trace Average**, **Max Hold**, or **Min Hold**
Single Mode	The instrument takes a single sweep when in **Single** mode, or if in average or Max/Min Hold, or if there is a **Waterfall** window displayed, it takes multiple sweeps until the average/hold count reaches the **Average/Hold Num**, then the count stops incrementing, and the instrument stops sweeping See the **Trace** key description under **Trace Average** for the averaging formula used. The trigger condition must be met prior to the sweep The type of trace processing for multiple sweeps is set under the **Trace** key, with choices of **Trace Average**, **Max Hold**, or **Min Hold**

If the instrument is in **Single** measurement mode, pressing the **Cont/Single** toggle control does not zero the count and does not cause the sweep to be reset; the only action is to put the instrument into Continuous measurement operation.

If the instrument is already in **Continuous** sweep:

- `:INIT:CONT 1` has no effect
- `:INIT:CONT 0` places the instrument in Single Sweep but has no effect on the current sequence until k = N, at which point the current sequence will stop and the instrument will go to the idle state

See "Restart" on page 2018 for details of `:INIT:IMMediate`.

If the instrument is already in **Single** sweep, `:INIT:CONT OFF` has no effect.

If the instrument is already in **Single** sweep, then pressing **Cont/Single** in the middle of a sweep does not restart the sweep or sequence. Similarly, pressing **Cont/Single** does not restart the sweep or sequence if the sweep is not in the idle state (for example, if you are taking a very slow sweep, or the instrument is waiting for a trigger). Even though pressing **Cont/Single** in the middle of a sweep does not restart the sweep, sending `:INIT:IMM` *does* reset it.

If the instrument is in **Single** sweep, and *not* Averaging/Holding, and you want to take one more sweep, press **Restart**.

If the instrument is in **Single** sweep, *and* Averaging/Holding, and you want to take one more sweep without resetting the Average trace or count, go to **Meas Setup** and increment the average count by 1 by pressing the **Step-Up** key while **Average/Hold Num** is the active function. You can also do this by sending `:CALC:AVER:TCON UP`.

Restart

Restarts the current sweep, or measurement, or set of averaged/held sweeps or measurements. If you are Paused, pressing **Restart** performs a Resume.

The front-panel key **Restart** performs exactly the same function.

The **Restart** function is accessed in several ways:

- Pressing the **Restart** key
- Sending `:INIT:IMM`
- Sending `:INIT:REST`

See "More Information" on page 1478

Remote Command	`:INITiate[:IMMediate]` `:INITiate:RESTart`
Example	`:INIT:IMM` `:INIT:REST`
Notes	`:INIT:REST` and `:INIT:IMM` perform exactly the same function
Couplings	Resets average/hold count k. For the first sweep overwrites all active (update = on) traces with new current data. For application modes, it resets other parameters as required by the measurement
Status Bits/OPC dependencies	This is an Overlapped command The `STATus:OPERation` register bits 0 through 8 are cleared , *except* bit 6 (Waiting for Periodic Sync). Initiating a measurement and Waiting for Periodic Sync could be asynchronous The `STATus:QUEStionable` register bit 9 (`INTegrity` sum) is cleared The `SWEEPING` bit is set The `MEASURING` bit is set
Backwards Compatibility Notes	For Spectrum Analysis Mode in ESA and PSA, the **Restart** hardkey and the `:INIT:REST` command restarted trace averages (displayed average count reset to 1) for a trace in **Clear Write**, but did not restart **Max Hold** and **Min Hold** In X-Series, the **Restart** hardkey and the `:INIT:REST` command restart not only **Trace Average**, but **MaxHold** and **MinHold** traces as well

More Information

The **Restart** function first aborts the current sweep or measurement as quickly as possible. It then resets the sweep and trigger systems, sets up the measurement and initiates a new data measurement sequence with a new data acquisition (sweep) taken once the trigger condition is met.

If the instrument is in the process of aligning when a **Restart** is executed, the alignment finishes before the restart function is performed.

Even when set for **Single** operation, multiple sweeps may be taken when **Restart** is pressed (for example, when averaging/holding is on). Thus, when we say that **Restart** "restarts a measurement", depending on the current settings, we may mean that it:

- Restarts the current sweep
- Restarts the current measurement
- Restarts the current set of sweeps if any trace is in Trace Average, Max Hold or Min Hold
- Restarts the current set of measurements if Averaging, or Max Hold, or Min Hold is on for the measurement

If there is no Average or Max/Min Hold function (no trace in Trace Average or Hold, or **Average/Hold Num** set to 1), and no **Waterfall** window is being displayed, a single sweep is equivalent to a single measurement. A single sweep is taken after the trigger condition is met; and the instrument stops sweeping once that sweep has completed. However, with **Average/Hold Num** >1, and at least one trace set to Trace Average, Max Hold, or Min Hold, or a **Waterfall** window being displayed, multiple sweeps/data acquisitions are taken for a single measurement. The trigger condition must be met prior to each sweep. The sweep is stopped when the average count k equals the number N set for **Average/Hold Num**.

Once the full set of sweeps has been taken, the instrument goes to the idle state. To take one more sweep without resetting the average count, increment the average count by 1, by pressing the **Step-Up** key while **Average/Hold Number** is the active function, or by sending the remote command `:CALC:AVER:TCON UP`.

Trace Update

The numeric results are not blanked at any time during the restart cycle.

For slow sweeps (see **Trace Update** section in **Trace/Detector**), the traces are updated real-time during the sweep. There may be a special circumstance in application mode measurements where an exception is made and the traces and/or results need to be blanked before displaying the new results.

To summarize, the following list shows what happens to the trace data on various events:

Event	Trace Effect
Clear/Write pressed (even if already in Clear/Write)	Set to mintracevalue
Max Hold pressed (even if already in Max Hold)	Set to mintracevalue

Event	Trace Effect
Min Hold pressed (even if already in Min Hold)	Set to maxtracevalue
Trace Average pressed (even if already in Trace Average)	Trace data unaffected but start new sweep/avg/hold
Restart pressed	Trace data unaffected but start new sweep/avg/hold
Parameter requiring restart changed (e.g., RBW)	Trace data unaffected but start new sweep/avg/hold

Sweep and Trigger Reset

Resetting the sweep system resets the average/hold count k to 0. It also resets the set point counter to 0. Resetting the trigger system resets the internal auto trig timer to the value set by the **Auto Trig** control.

Averaging

The weighting factor used for averaging is k. This k is also the average/hold count for how many valid sweeps (data acquisitions) have been done. This k is used for comparisons with N, as those comparisons always needs to be based on valid completed sweeps.

The displayed average/hold, K, shows the count for the sweep (data acquisition) in progress. K = k + 1, with a limit of N. The displayed value K changes from its previous value to 1 as soon as the trigger condition for the first data acquisition (sweep) is met.

Pause/Resume

Pauses a measurement after the current data acquisition is complete.

When paused, the label on the control changes to **Resume**. Pressing **Resume** un-pauses the measurement. When paused, pressing **Restart** performs a Resume.

Remote Command	`:INITiate:PAUSe` `:INITiate:RESume`
Example	`:INIT:PAUS` `:INIT:RES`
Dependencies	Not displayed in Modes that do not support pausing
Annotation	Only on control

Abort (Remote Command Only)

Stops the current measurement. Aborts the current measurement as quickly as possible, resets the sweep and trigger systems, and puts the measurement into an "idle" state. If the instrument is in the process of aligning when `:ABORt` is sent, the alignment finishes *before* the abort function is performed, so `:ABORt` does not abort an alignment.

If the instrument is set for **Continuous** measurement, it sets up the measurement and initiates a new data measurement sequence with a new data acquisition (sweep) taken once the trigger condition is met.

If the instrument is set for **Single** measurement, it remains in the "idle" state until an `:INIT:IMM` command is received.

Remote Command	`:ABORt`
Example	`:ABOR`
Notes	If :`INIT:CONT` is `ON`, then a new continuous measurement will start immediately, with sweep (data acquisition) occurring once the trigger condition has been met If :`INIT:CONT` is `OFF`, then `:INIT:IMM` is used to start a single measurement, with sweep (data acquisition) occurring once the trigger condition has been met
Dependencies	For continuous measurement, `:ABORt` is equivalent to the **Restart** key Not all measurements support this command
Status Bits/OPC dependencies	The `STATus:OPERation` register bits 0 through 8 are cleared , *except* bit 6 (Waiting for Periodic Sync). Initiating a measurement and Waiting for Periodic Sync could be asynchronous The `STATus:QUEStionable` register bit 9 (`INTegrity` sum) is cleared Since all the bits that feed into OPC are cleared by `:ABORt`, the Abort command will cause the `*OPC` query to return true

3.8.9.2 Sweep Config

Accesses controls that enable you to configure the Sweep and Control functions of the instrument, such as Sweep Rules.

Sweep Type

Sets the Sweep Type of the spurious measurement to either Auto or Swept.

When in Auto, the selections of swept type of ranges are governed by the Best Speed Sweep Type Rule, and FFT analysis might be chosen for some ranges if it speeds up the measurement.

Remote Command	`[:SENSe]:SPURious[:RANGe]:ALL:SWEep:TYPE:AUTO OFF | ON | 0 | 1`

	[:SENSe]:SPURious[:RANGe]:ALL:SWEep:TYPE:AUTO?
Example	:SPUR:ALL:SWE:TYPE:AUTO 1 :SPUR:ALL:SWE:TYPE:AUTO?
Dependencies	This parameter is available only when option N9060A-7FP is installed
Preset	ON
State Saved	Saved in instrument state
Range	Auto|Swept
Annotation	When in Auto and the instrument is in FFT analysis, an indicator, "FFT" is displayed at the right bottom of range spectrum trace window

Sweep Time Rules

Switches the instrument between NORMal and ACCuracy sweep states.

Setting **Auto Sweep Time** to **Accy** (ACCuracy) results in slower sweep times, usually about three times as long, but yields better amplitude accuracy for CW signals. The instrument amplitude accuracy specifications only apply when **Auto Sweep Time** is set to **Accy**.

Additional amplitude errors which occur when **Auto Sweep Time** is set to **Norm** are usually well under 0.1 dB, though this is not guaranteed. Because of the faster sweep times and still low errors, **Norm** is the preferred setting of **Auto Sweep Time**. **Auto Sweep Time** is set to **Norm** on a **Preset**. This means that in the Preset state, instrument amplitude accuracy specifications do not apply.

Remote Command	[:SENSe]:SPURious:SWEep:TIME:AUTO:RULes NORMal | ACCuracy [:SENSe]:SPURious:SWEep:TIME:AUTO:RULes?
Example	:SPUR:SWE:TIME:AUTO:RUL ACC :SPUR:SWE:TIME:AUTO:RUL?
Notes	This command is implemented as [:SENSe]:SPURious[:RANGe][:LIST]:SWEep:TIME:AUTO:RULes to avoid illegal SCPI node definition, so this command should be used as [:SENSe]:SPURious:SWEep:TIME:AUTO:RULes
Dependencies	This control does not appear in Spectrum Analyzer Mode in VXT This control is not available in E7760
Preset	NORMal
State Saved	Saved in instrument state
Range	NORMal|ACCuracy

IF Dithering

Lets you turn **IF Dithering** on and off. IF Dithering is a technique used in unpreselected instruments (such as Keysight's modular instruments) to enhance the rejection of images and internally-generated spurious signals.

Remote Command	`[:SENSe]:SWEep:IF:DITHer OFF | ON | 0 | 1` `[:SENSe]:SWEep:IF:DITHer?`
Dependencies	This control only appears in Spectrum Analyzer Mode in VXT models
Preset	`OFF`
State Saved	Saved in instrument state

Image Protection

Lets you turn IF Protection on and off. IF Protection is a technique used in unpreselected instruments (such as Keysight's modular instruments) to detect and suppress images and spurs that may be present in non-preselected hardware.

IF Protection takes two sweeps and by correlating the data between them, provides a single, correct power-versus-frequency trace.

Remote Command	`[:SENSe]:SWEep:IMAGeprot OFF | ON | 0 | 1` `[:SENSe]:SWEep:IMAGeprot?`
Dependencies	Only appears in Spectrum Analyzer Mode in VXT model M9421A
Preset	`ON`
State Saved	Saved in instrument state

3.8.10 Trace

Lets you control the acquisition, display, storage, detection and manipulation of trace data for the available traces.

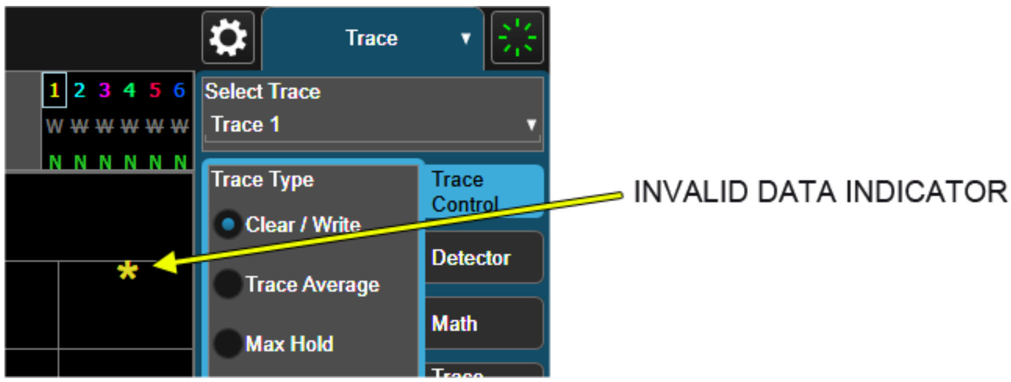
The "Trace Control" on page 1904 tab of this menu contains radio-button selections for the trace type (**Clear/Write, Trace Average, Max Hold, Min Hold**) and **View/Blank** setting for the selected trace.

A trace is a series of data points, each having an x and a y value. The x value is frequency (or time, in zero span) and the y value is amplitude. Each data point is referred to as a *trace point*. In any given trace, trace point 0 is the first point, and trace point (*sweep_points – 1*) is the last. For example, in a 1001 point trace, the first point is 0 and the last is 1000. Another term sometimes used to describe traces is *bucket*. A bucket is the frequency span of a trace point, equal to the point spacing.

For swept analysis, the y value in each bucket is measured while the instrument is sweeping across the bucket. The selected detector determines how it is measured.

When in **Single** Mode, Measurements and their Views save the trace data from the last acquisition. This is true on multiple screens. The marker and trace data will be present whenever the measurement is brought back into focus. The measurement switches for these measurements do not clear the traces, so the data will be present until the next acquisition is completed.

Invalid Data Indicator



The Invalid Data Indicator is displayed whenever the data on the display does not match the settings of the instrument. The most common example of this is when instrument settings have changed in the time since the data in the traces on the display was taken. This means that the screen annotation cannot be guaranteed to match the trace data. For example, if you change **Center Frequency**, the Invalid Data Indicator will display until the trace has been retaken.

If any Trace is in View mode (displaying but not updating) and instrument settings are changed, the Invalid Data Indicator will display as long as that trace remains in View. Traces that are blanked do not turn on the Invalid Data Indicator.

Not all instrument settings require display of the invalid data indicator when they change; only changes that require a new acquisition will cause it to display. For example, changing the Y-Axis scale of the instrument does not cause the invalid data indicator to display, unless the attenuation changes.

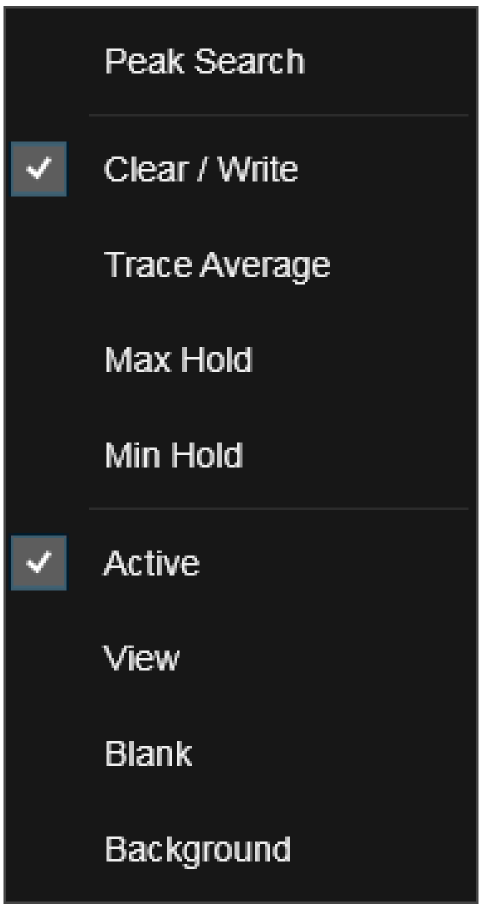
The Invalid Data Indicator is also turned on:

- When the counter is turned on, until the completion of the first count
- When a trace is imported from mass storage and the trace's parameters do not match the current instrument settings
- When a trace is sent to the instrument from a remote interface (since there is no way to know if its settings match)

NOTE The Invalid Data Indicator has an associated status bit that can be checked at any time to determine whether the indicator is on.

Trace right-click menu

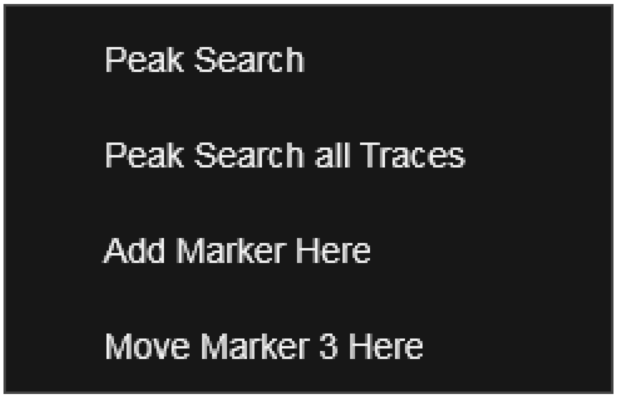
If you right-click on a trace (or touch and hold a trace and wait for the circle to close) you will see the Trace Right-Click Menu:



If you now tap or click on one of the items in this menu, the instrument will perform the corresponding function. **Peak Search** finds the highest peak on the selected Trace. **Clear/Write**, **Trace Average**, **Max Hold** and **Min Hold** set the "Trace Type" on page 1905. **Active**, **View**, **Blank**, and **Background** set the "View/Blank" on page 1721 type.

Waterfall Window

If you right-click on the trace (or touch and hold the trace and wait for the circle to close) in the **Waterfall** window (for example, in the Spectrogram View) you will see the Waterfall Trace Right-Click Menu:



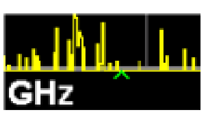
In this menu, **Peak Search** works as above. **Peak Search all Traces** finds the highest peak in the Waterfall window. **Add Marker Here** takes the lowest numbered Marker that is currently Off and turns it On as a **Normal** marker in the Waterfall window at the point where you right-clicked (or touched-and-held). **Move Marker n Here** moves the currently selected Marker to the point in the Waterfall window where you right-clicked (or touched-and-held).

Trace Update Indicator

Trace updates can take one of two forms:

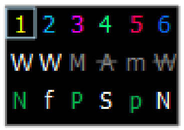
1. The trace is updated in a single operation that affects all of the points in the trace at once. This happens, for example, in the case of very fast (< 200 ms) sweeps, single-chunk FFT's, and the initial math operation after a math function is set for a trace
2. The trace is updated in a series of discrete steps, with measurement data being gathered between each step. This will be the case for slow sweeps, multi-chunk FFTs, gated sweeps, etc.

In the first case, no update indicator is required. In the second case, however, a visual indicator exists on the trace where the new data is being written. The indicator is a green caret (^) , which moves across the bottom of the graticule showing the current trace point.



Trace Annunciator Panel

This panel appears on the right hand side of the Meas Bar. Here is an explanation of the fields in this panel, as shown below:



Top Line

On the top line, each trace number is shown, in the trace color. A box is drawn around the currently selected trace.

Middle Line

Below each trace number, is a letter signifying the trace type for that trace number, where

`W`	Clear/Write
`A`	Trace Average
`M`	Max Hold
`m`	Min Hold

If the letter is white, it means the trace is being updated (**Update** = `ON`); if the letter is dimmed , it means the trace is not being updated (**Update** = `OFF`). A strikethrough indicates that the trace is blanked (**Display** = `OFF`). Note that it is possible for a trace to be updating *and* blanked, which is useful if the trace is a trace math component.

Bottom Line

The third line shows the detector type for each trace, or, if trace math is on for that trace, it shows “f” (for “math function”). It is not always possible to have a unique detector for each trace, but the instrument hardware provides the maximum flexibility of detector selection in order to maintain the highest accuracy. The letters used for this readout are

`N`	Normal
`A`	Average
`P`	peak
`p`	negative peak
`S`	Sample
`Q`	Quasi Peak
`E`	EMI Average
`R`	RMS Average
`f`	math function

If the letter is green, the detector is in Auto. If white, the detector has been manually selected.

In the example above, the panel is indicating the following:

- Trace 1: Visible, being updated, in Clear/Write, with Normal detector auto selected
- Trace 2: Visible, being updated, in Clear/Write, being written to with a math function
- Trace 3: Visible, not updating, data was taken in Max Hold, with the peak detector auto selected
- Trace 4: Blanked, not updating, data was taken with Averaging turned on, Sample detector manually selected
- Trace 5: Visible, not updating, data was taken in Min Hold with Negative Peak detector auto selected
- Trace 6: Blanked, not updating, in Clear/Write, with Normal detector manually selected

Trace Annotation

When **Trace Annotation** (see **Display**) is `ON`, each non-blanked trace is labeled on the trace with the detector used to take it, unless a Trace Math function is on for that trace, in which case it is labeled with the "Math Function" on page 1724.

The detector labels are:

`NORM`	Normal
`PEAK`	Peak
`SAMP`	Sample
`NPEAK`	Negative Peak
`RMS`	Average detector with Power Average (RMS)
`LG AVG`	Average detector with Log-Pwr Average
`VAVG`	Average detector with Voltage Average
`QPEAK`	Quasi Peak
`EMI AVG`	EMI Average
`RMS AVG`	RMS Average

The trace math labels are:

`PDIF`	Power Difference
`PSUM`	Power Sum

`LOFF`	Log Offset
`LDIF`	Log Difference

3.8.10.1 Select Trace

Specifies the *selected trace*, which is the trace that will be affected when you change trace settings.

Select Trace appears above the menu panel, indicating that it applies to *all* controls in the menu panel. **Select Trace** is blanked if you select a tab whose controls do *not* depend on the selected trace (for example, **Trace Function**).

Notes	The selected trace is remembered even when not in the **Trace** menu
Dependencies	For the Swept SA measurement: – In Image Suppress mode, when you select a trace it becomes the active trace, and the formerly active trace goes into View – When you turn on Image Suppress, Update turns off for all traces except the selected trace For the ACP measurement, when **Meas Method** is `RBW`, `FAST` or `FPOWer`, **Select Trace** is disabled
Preset	Trace 1
State Saved	Yes

3.8.10.2 Trace Control

The controls on this tab allow you to set the "Trace Type" on page 1905 and its update mode.

There are four Trace Types:

- **Clear/Write**
- **Trace Average**
- **Max Hold**
- **Min Hold**

Each type handles data in a different way.

Each trace also has two values that determine whether it is being written or not, and whether it is being displayed or not. These values, **Update** and **Display,** are described fully in the "View/Blank" on page 1721 control description. Essentially, when **Update** is `ON`, a trace is updating, and when **Update** is `OFF` it is not. When

Display is ON, it is visible and when **Display** is OFF it is not. These terms are used throughout the descriptions in this section.

Trace Type

There are four trace Types:

Option	Parameter	SCPI Example	Details
Clear/Write	WRITe	:TRAC2:TYPE WRIT	See: "Clear/Write" on page 1493
Trace Average	AVERage	:TRAC2:TYPE AVER	See: "Trace Average" on page 1493
Maximum Hold	MAXHold	:TRAC3:TYPE MAXH	See: "Max Hold" on page 1494
Minimum Hold	MINHold	:TRAC5:TYPE MINH	See: "Min Hold" on page 1494

Full descriptions of each type are provided below. You may select one of these types for each trace. Re-selecting the current **Trace Type** initiates the same action that selecting it the first time did, even though it is already selected. For example, selecting **Clear/Write** while **Clear/Write** is already selected will nonetheless clear the trace and begin rewriting it.

Besides the **Trace Type**, the "View/Blank" on page 1721 state must be set to **Active** (**Update**: ON, **Display**: ON) for a trace to be updating and visible. Selecting any **Trace Type** automatically makes the trace **Active**.

See also: "Trace Mode Backwards Compatibility Commands" on page 1491

<table>
<tr><td>Remote Command</td><td>For Swept SA Measurement (in SA Mode):
:TRACe[1]|2|…|6:TYPE WRITe | AVERage | MAXHold | MINHold
:TRACe[1]|2|…|6:TYPE?
For all other measurements:
:TRACe[1]|2|3:<meas>:TYPE WRITe | AVERage | MAXHold | MINHold
:TRACe[1]|2|3:<meas>:TYPE?
where <meas> is the identifier for the current measurement</td></tr>
<tr><td>Example</td><td>:TRAC:TYPE WRIT
:TRAC:TYPE?</td></tr>
<tr><td>Couplings</td><td>Selecting a Trace Type (by pressing any of the Trace Type selections or sending :TRAC:TYPE) sets the Trace to Active (Update: ON, Display: OFF), even if the same trace type was already selected
When Detector setting is “Auto” ([:SENSe]:<meas>:DETector:AUTO?), Detector ([:SENSe]:<meas>:DETector[:FUNCtion]?) switches aligning with the switch of this parameter: “NORMal” with WRITe (Clear Write), “AVERage” with AVERage, “POSitive (peak)” with MAXHold, and “NEGative (peak)” with MINHold</td></tr>
<tr><td>Preset</td><td>Swept SA and Monitor Spectrum: WRITe
All other measurements: AVERage
Following Preset, all traces are cleared (all trace points set to mintracevalue)</td></tr>
</table>

State Saved	The type of each trace is saved in instrument state
Annunciation	The type for each trace is indicated in the Trace annunciator panel on the Measurement Bar

Trace Mode Backwards Compatibility Commands

In earlier instruments, the “Trace Modes” were: Clear/Write, Max Hold, Min Hold, View and Blank. Averaging was global to all traces and was controlled under the **BW/Avg** menu.

In X-Series, trace averaging can be done on a per-trace basis. The Trace Modes (now called Trace Types) are Clear/Write, Trace Average, Max Hold and Min Hold. View and Blank are set separately under "View/Blank" on page 1721.

While this provides more flexibility, it also gives rise to potential backwards compatibility problems. To mitigate these, the old Trace Mode command has been retained and a new Trace Type command has been added. The `:TRACe:MODE` command is retained for backwards compatibility, and the `:TRACe:TYPE`, `:TRACe:UPDate` and `:TRACe:DISPlay` commands introduced for ongoing use. The old Trace Modes are selected using `:TRAC:MODE`, whose parameters are mapped into calls to `:TRACe:TYPE`, `:TRACe:UPDate` and `:TRACe:DISPlay`, and the old global Averaging command `[:SENSe]:AVERage[:STATe]` is provided for backwards compatibility. See the individual command descriptions for details.

When **Average/Hold** in the **Meas Setup**, **Legacy Compatibility** menu is `ON`, the following is true for traces in Max Hold and Min Hold:

- They ignore the **Average/Hold** number; **Single** for Max Hold causes one sweep only, so switching to **Single** stops after the current sweep, and switching to **Cont** starts again without clearing the accumulated result
- Max Hold is not cleared on a **Restart**, **Single** or `:INIT:IMM`, but changing a measurement parameter, like frequency or bandwidth etc., still restarts the Max Hold

Preset	`WRITe`
State Saved	The trace mode is an alias only
Backwards Compatibility SCPI	`:TRACe[1]|2|…|6:MODE WRITe | MAXHold | MINHold | VIEW | BLANk` `:TRACe[1]|2|…|6:MODE?`
Backwards Compatibility Notes	The legacy `:TRACe:MODE` command is retained for backwards compatibility. In conjunction with the legacy `:AVErage` command, it works as follows: – `:AVErage ON|OFF` sets/clears a variable that we will call average for the sake of this discussion. This variable is maintained by the instrument solely for backwards compatibility. See the `[:SENSe]:AVERage[:STATe]` command description below – `:TRACe:MODE WRITe` sets `:TRACe:TYPE WRITe` (Clear/Write) unless average is true, in which case it sets it to `:TRACe:TYPE AVErage`. It also sets `:TRACe:UPDate ON`,

	:TRACe:DISPlay ON, for the selected trace – :TRACe:MODE MAXHold sets :TRACe:TYPE MAXHold (Max Hold). It also sets :TRACe:UPDate ON, :TRACe:DISPlay ON, for the selected trace – :TRACe:MODE MINHold sets :TRACe:TYPE MINHold (Min Hold). It also sets :TRACe:UPDate ON, :TRACe:DISPlay ON, for the selected trace – :TRACe:MODE VIEW sets :TRACe:UPDate OFF, :TRACe:DISPlay ON, for the selected trace – :TRACe:MODE BLANK sets :TRACe:UPDate OFF, :TRACe:DISPlay OFF, for the selected trace The query returns the same value as :TRACe:TYPE?, meaning that if you set :TRACe:MODE:VIEW or :TRACe:MODE:BLANK, the query response will not be what you sent :TRACe[n]:MODE was formerly used to set the type or "writing mode" of the trace. At that time, View and Blank were writing modes. The new :TRACe:TYPE command should be used in the future, but :TRACe:MODE is retained to provide backwards compatibility In X-Series, unlike earlier instruments, Max Hold and Min Hold now obey the Average Number and counts up to a terminal value as Average always has As the **Average/Hold Number** now affects **Min Hold** and **Max Hold**, the operations that restart Averaging (for example, the **Restart** key) now also restart **Min Hold** and **Max Hold** As a result of these changes, legacy code that restarts averaging while retaining a running Max Hold will need to be rewritten, because the Max Hold will now restart when the Average does Also, previous to X-Series: – Pressing **Max Hold** while already in **Max Hold** (or doing so remotely) had no effect. Now it will clear the trace and restart the sweep and the Max Hold sequence – Changing the vertical scale (Log/Lin or dB/div) of the display restarted **Max Hold** and **Min Hold**. This is no longer the case
Preset	OFF
State Saved	The state of Average is saved in Instrument State for ghosting purposes
Backwards Compatibility SCPI	[:SENSe]:AVERage[:STATe] ON | OFF | 1 | 0 [:SENSe]:AVERage[:STATe]?
Backwards Compatibility Notes	Previous to X-Series, Averaging (also sometimes known as trace averaging) was global to all traces, that is, it was either on or off for all active traces. The legacy command [:SENSe]:AVERage [:STATe] ON|OFF|1|0 was used to turn Averaging on or off In X-Series, Averaging is turned on or off on a per-trace basis, so it can be on for one trace and off for another For backwards compatibility, the old global Average State variable is retained solely as a legacy variable, turned on and off and queried by the legacy command [:SENSe]:AVERage[:STATe] OFF|ON|0|1. When Average is turned on, any trace in Clear/Write will get put into Average. While Average is on, any trace put into Clear/Write by the old :TRAC:MODE command will instead get put into Average. When Average is turned off, any trace in Average will get put into Clear/Write

Trace Type Details

Clear/Write

Each trace update replaces the old data in the trace with new data.

Pressing **Clear/Write** for the selected trace, or sending `:TRAC:TYPE WRIT` for the specified trace, sets the trace type to **Clear/Write** and clears the trace, even if you are already in **Clear/Write**. Then a new sweep is initiated. Trigger conditions must be met before the sweep actually starts, and if in **Single** the sweep won't start until **Restart** is pressed.

Pressing **Clear/Write** stops the current sweep and initiates a new one, so **Trace Average, Max Hold** and **Min Hold** data may be interrupted in mid-sweep when **Clear/Write** is pressed, and therefore may not accurately reflect the displayed count. Therefore, when **Clear/Write** is pressed for one trace, **Trace Average, Max Hold** and **Min Hold** must restart for all traces.

When in **Clear/Write**, if a measurement-related instrument setting is changed (that is, one which requires new data to be taken, like **Center Frequency** or **Attenuation**), a new sweep is initiated but the trace is not cleared.

Trace Average

The instrument maintains and displays an average trace, which represents the cumulative average on a point-by-point basis of the new trace data and previous averaged trace data.

Pressing **Trace Average** (for the selected trace), or sending `:TRAC:TYPE AVER` (for the specified trace), sets the trace type to **Trace Average**, clears the trace, initiates a new sweep, and restarts the Average sequence.

Details of the count limiting behavior and the averaging calculations may be found under **Avg|Hold Number** and **Average Type** under **Meas Setup.**

When in **Trace Average**, if a measurement-related instrument setting is changed (that is, one which requires new data to be taken, like Center Frequency or Attenuation), the average restarts and a new sweep is initiated but the trace is not cleared.

Restarting the average means:

- The average/hold count k is set to 1, so that the next time the average trace is displayed it simply represents one trace of new data
- A new sweep is initiated

– Once the new sweep starts, the trace is overwritten with current trace data as the first trace of the new average

Remember that restarting averaging also restarts **Max Hold** and **Min Hold**, as there is only one count for Trace Average and Hold.

Max Hold

The instrument maintains and displays a max hold trace, which represents the maximum data value on a point-by-point basis of the new trace data and previous trace data. Details of the count limiting behavior may be found under **Avg|Hold Number** under **Meas Setup.**

Pressing **Max Hold** for the selected trace, or sending `:TRAC:TYPE MAXH` for the specified trace, sets the Trace Type to **Max Hold,** clears the trace , initiates a new sweep, and restarts the hold sequence, even if you are already in **Max Hold**.

When in **Max Hold**, if a measurement-related instrument setting is changed(that is, one which requires new data to be taken, like **Center Frequency** or **Attenuation**), the **Max Hold** sequence restarts and a new sweep is initiated but the trace is not cleared.

Restarting the **Max Hold** sequence means:

– The average/hold count k is set to 1, so that the next time the max hold trace is displayed it simply represents one trace of new data

– A new sweep is initiated.

Remember that restarting **Max Hold** also restarts averaging and **Min Hold**, as there is only one count for Trace Average and Hold.

Min Hold

The instrument maintains and displays a min hold trace, which represents the minimum data value on a point-point basis of the new trace data and previous trace data. Details of the count limiting behavior may be found under **Avg|Hold Number** under the **Meas Setup** functions.

Pressing **Min Hold** for the selected trace, or sending `:TRAC:TYPE MINH` for the specified trace, sets the Trace Type to **Min Hold,** clears the trace, initiates a new sweep, and restarts the hold sequence, even if you are already in **Min Hold**.

When in **Min Hold**, if a measurement-related instrument setting is changed(that is, one which requires new data to be taken, like **Center Frequency** or **Attenuation**), the **Min Hold** sequence restarts and a new sweep is initiated but the trace is not cleared.

Restarting the **Min Hold** sequence means:

– The average/hold count k is set to 1, so that the next time the min hold trace is displayed it simply represents one trace of new data

– A new sweep is initiated

Remember that restarting **Min Hold** also restarts **Max Hold** and averaging, because there is only one count for Trace Average and Hold.

Clear and Write | Restart Averaging | Restart Max/Min Hold

Starts the trace writing, as though the "Trace Type" on page 1905 had just been selected. The effect is exactly the same as reselecting the current **Trace Type** again – the control is provided because it may not be obvious that reselecting the same selection from a radio button menu will take any action.

This control displays different labels, depending on the selected Trace Type:

– **Clear/Write**: Clear and Write

– **Trace Average**: Restart Averaging

– **Max Hold**: Restart Max Hold

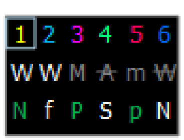
– **Min Hold**: Restart Min Hold

View/Blank

Lets you set the state of the two trace variables: **Update** and **Display**. The choices available in this dropdown menu are:

Active	Update and Display both ON
View	Update OFF; Display ON
Blank	Update OFF; Display OFF
Background	Update ON, Display OFF Allows a trace to be blanked *and* continue to update "in the background", which was not possible in the past

In the Swept SA measurement, a trace with **Display**OFF is indicated by a strikethrough of the type letter in the trace annotation panel in the Measurement Bar. A trace with **Update**OFF is indicated by dimming the type letter in the trace annotation panel in the Measurement Bar. In the example below, Traces 3, 4, 5 and 6 have **Update**OFF, and Traces 4 and 6 have **Display**OFF.



See: "More Information" on page 1497

Notes	For the commands to control the two variables, Update and Display, see "Trace Update State On/Off" on page 1496 and "Trace Display State On/Off" on page 1496 below
Dependencies	When Signal ID is on, this key is grayed-out
Couplings	Selecting a Trace Type for a trace (pressing the key or sending the equivalent command) puts the trace in **Active** (Update ON and Display ON), even if that trace type was already selected Selecting a detector for a trace (pressing the key or sending `[:SENS]:DET:TRAC`) puts the trace in **Active** (**Update**ON and **Display**ON), even if that detector was already selected Selecting a "Math Function" on page 1724 other than OFF for a trace (pressing the key or sending the equivalent command) puts the trace in **Active** (**Update**ON and **Display**ON), even if that Math Mode was already selected Loading a trace from a file puts that trace in **View** regardless of the state it was in when it was saved; as does being the target of a **Copy** or a participant in an **Exchange**

Trace Update State On/Off

Remote Command	For Swept SA Measurement (in SA Mode):
	`:TRACe[1]|2|…|6:UPDate[:STATe] ON | OFF | 1 | 0`
	`:TRACe[1]|2|…|6:UPDate[:STATe]?`
	For all other measurements:
	`:TRACe[1]|2|3:<meas>:UPDate[:STATe] ON | OFF | 1 | 0`
	`:TRACe[1]|2|3:<meas>:UPDate[:STATe]?`
	where <meas> is the identifier for the current measurement

Example	Make trace 2 inactive (stop updating): `:TRAC2:UPD 0`
Couplings	Whenever you set **Update** to ON for any trace, the **Display** is set to ON for that trace

Preset	For Swept SA Measurement (in SA Mode):
	`1|0|0|0|0|0`
	ON for Trace 1; OFF for 2–6
	For all other measurements:
	`1|0|0`
	ON for Trace 1; OFF for 2 &3

State Saved	Saved in instrument state

Trace Display State On/Off

Remote Command	For Swept SA Measurement (in SA Mode):
	`:TRACe[1]|2|…|6:DISPlay[:STATe] ON | OFF | 1 | 0`
	`:TRACe[1]|2|…|6:DISPlay[:STATe]?`
	For all other measurements:

	`:TRACe[1]|2|3:<meas>:DISPlay[:STATe] ON | OFF | 1 | 0`
	`:TRACe[1]|2|3:<meas>:DISPlay[:STATe]?`
	where <meas> is the identifier for the current measurement

Example	Make trace 1 visible:
	`:TRAC2:DISP 1`
	Blank trace 3:
	`:TRAC3:DISP 3`

Couplings	Whenever you set **Update** to `ON` for any trace, the **Display** is set to `ON` for that trace

Preset	For Swept SA Measurement (in SA Mode):
	`1|0|0|0|0|0`
	`ON` for Trace 1; `OFF` for 2–6
	For all other measurements:
	`1|0|0`
	`ON` for Trace 1; `OFF` for 2 &3

State Saved	Saved in instrument state

More Information

When a trace becomes inactive, any update from the `:SENSe` system (detectors) immediately stops, without waiting for the end of the sweep. The trace data remains unchanged, but stops updating. If the trace is blanked, this still does not affect the data in the trace. Traces that are blanked (**Display**=`OFF`) do not display nor appear on printouts, but their data stays intact, they may be queried, and markers may be placed on them

In most cases, inactive traces are static and unchanging; however, there are cases when an inactive trace will update, specifically:

- if data is written to that trace from remote
- if trace data is loaded from mass storage
- if the trace is the target of a **Copy** or participant in an **Exchange**
- if the trace is cleared using **Clear Trace**

Inactive traces that are also being displayed (traces in **View**) are displayed at half intensity. Traces in **View** display across the entire X-Axis of the instrument. Their horizontal placement does not change, even if X-Axis settings subsequently are changed, although Y-Axis settings do affect the vertical placement of data.

When a trace becomes active (**Update**=`ON`), the trace is cleared, the average count is reset, and a new sweep is initiated.

Note that putting a trace into **Display**=`OFF` and/or **Update**=`OFF` does *not* restart the sweep and does *not* restart Averaging or Hold functions for any traces.

3.8.10.3 Math

Lets you turn on and configure Trace Math functions.

Math Function

Trace Math functions perform mathematical operations between traces and, in some cases, user-specified offsets. When in a Trace Math function, the indicated function is performed during the sweep with the math function used in place of a detector. The trace operands for the math function are set using the "Operand 1 / Operand 2" on page 1730 controls.

– See "How trace math is processed" on page 1502

Remote Command	For option details, see "Trace Math Options" on page 1500
	For Swept SA Measurement (in SA Mode):
	`:CALCulate:MATH <trace_num>, PDIFference | PSUM | LOFFset | LDIFference | OFF, <trace_num>, <trace_num>, <real>,<real>`
	`:CALCulate:MATH? <trace_num>`
	where `<trace_num>` is any one of:
	`TRACE1|…|TRACE6`
	For all other measurements:
	`:CALCulate:<meas>:MATH <trace_num>, PDIFference | PSUM | LOFFset | LDIFference | OFF, <trace_num>, <trace_num>, <real>,<real>`
	`:CALCulate[:<meas>]:MATH? <trace_num>`
	where:
	`<meas>` is the identifier for the current measurement, and
	`<trace_num>` is any one of:
	`TRACe1|TRACe2|TRACe3`
	Note that the format of the `TRACe<n>` parameter differs from that for the Swept SA Measurement

Example	`:CALC:MATH TRACE3,PDIF,TRACE1,TRACE2,0,0`
	Sets Trace 3 to Power Diff trace math function, and sets the First Trace operand (for Trace 3) to Trace 1 and the Second Trace operand (for Trace 3) to Trace 2
	`:CALC:MATH TRACE3,PSUM,TRACE1,TRACE2,0,0`
	Sets Trace 3 to Power Sum trace math function and sets the First Trace operand (for Trace 3) to Trace 1 and the Second Trace operand (for Trace 3) to Trace 2
	`:CALC:MATH TRACE3,LOFF,TRACE1,TRACE2,-6.00,0`

	Sets Trace 3 to Log Offset trace math function, sets the First Trace operand (for Trace 3) to Trace 1, leaves the Second Trace operand (for Trace 3) unchanged (it is irrelevant for this function) and sets the Log Offset (for Trace 3) to -6 dB
	`:CALC:MATH TRACE3,LDIF,TRACE1,TRACE2,0,-6.00`
	Sets Trace 3 to Log Diff trace math function, sets the First Trace operand (for Trace 3) to Trace 1, sets the Second Trace operand (for Trace 3) to Trace 2, and sets the Log Difference reference (for Trace 3) to -6 dBm
	`:CALC:MATH TRACE1,OFF,TRACE2,TRACE3,0,0`
	Turns off trace math for trace 1

Notes	The Trace Math Function command has 6 main set of parameters:
	- Set 1 defines the “result trace”:
	`TRACE1|…|TRACE6`
	-Set 2 defines the “function”:
	`PDIFference|PSUM|LOFFset|LDIFference|OFF`
	- Set 3 is a “trace operand” (1):
	`TRACE1|…|TRACE6`
	- Set 4 is a “trace operand” (2):
	`TRACE1|…|TRACE6`
	- Set 5 defines the “Log Offset” (in dB)
	- Set 6 defines the “Log Difference Reference” (in dBm)
	Note that the trace math mode is an enumeration; that is, when a math function is set for a trace, it turns off any math function that is on for that trace, then sets the new math function
	The parameters sent in the command are reflected in the values in the control menu. There is no default for any parameter; all 6 parameters must be sent to satisfy the parser. Failure to specify a parameter will result in a missing parameter message
	The query returns the math mode, the operand traces, the offset and the reference for the specified trace, all separated by commas

Dependencies	Trace Math is not available if **Normalize** is on Trace Math is not available if Signal ID is on None of the trace operands can be the destination trace. If any of the three trace math commands is sent with a destination trace number matching one of the operands, a warning is generated and the function does not turn on
Couplings	When a math function is changed for a trace, that trace is set to Display = ON; and Update = ON

Preset	For Swept SA Measurement (in SA Mode):
	`OFF,TRACE5,TRACE6,0,0 | OFF,TRACE6,TRACE1,0,0 | OFF,TRACE1,TRACE2,0,0 | OFF,TRACE2,TRACE3,0,0 | OFF,TRACE3,TRACE4,0,0 | OFF,TRACE4,TRACE5,0,0`
	For all other measurements:
	`OFF,TRACE2,TRACE3,0,0 | OFF,TRACE3,TRACE1,0,0 | OFF,TRACE1,TRACE2,0,0`

State Saved	The trace math function for each trace is saved in instrument state
Annunciation	An “f” is shown on the trace annunciation panel in the Measurement Bar when a math function is on;

	and the function is annotated on the trace if Trace Annotation is on
Status Bits/OPC dependencies	*OPC can be used to detect the completion of a sweep, which will also correspond to the completion of the math operation, since all math takes place during the sweep

Trace Math Options

IMPORTANT

To generate a trace math result, *you must take a sweep*. The trace math engine, described below, operates in concert with the sweep engine in the instrument. Until a sweep has been taken, even if the constituent traces are not in Update mode, no result is generated.

Note that certain events can affect the trace in ways that affects all points at once. This can happen in any number of ways, including:

- A trace clear taking place
- A trace being loaded from the file system
- Trace data being sent in from the remote interface
- A copy or exchange of trace data

You should try to avoid these occurrences during a sweep, as they will tend to invalidate the math result being accumulated.

The Trace Math functions are:

Power Diff (Op1 - Op2)

Calculates a power difference between the `First Trace` operand and the `Second Trace` operand and puts the result in the destination trace.

During the sweep, the following formula is executed for each point in the trace operands, and the corresponding point is generated for the destination trace:

```
DestinationTrace = 10 log(10(1/10)(FirstTrace) – 10(1/10)(SecondTrace))
```

The values of the trace points are assumed to be in a decibel scale, as they are internally stored.

If a point in `FirstTrace` is equal to `maxtracevalue`, the resultant point is also `maxtracevalue`.

Otherwise, if the result of the subtraction is less than or equal to 0, the resultant point is `mintracevalue`.

Power Sum (Op1 + Op2)

Calculates a power sum between the `First Trace` operand and the `Second Trace` operand and puts the result in the destination trace.

During the sweep, the following formula is executed for each point in the trace operands, and the corresponding point is generated for the destination trace.

```
DestinationTrace = 10 log(10(1/10)(FirstTrace) + 10(1/10)(SecondTrace))
```

The values of the trace points are assumed to be in a decibel scale, as they are internally stored.

If a point in either trace operand is equal to `maxtracevalue`, the resultant point is also `maxtracevalue`.

Log Offset (Op1 + Offset)

Calculates a log offset from the `First Trace` operand and puts the result in the destination trace. This is like the B-DL function in some older instruments. The offset is entered on the `Offset` control, which only appears when this math function is in force for the selected trace. Each destination trace has its own offset.

During the sweep, the following formula is executed for each point in the trace operand, and the corresponding point is generated for the destination trace.

```
DestinationTrace = FirstTrace + Offset
```

The values of the trace points are assumed to be in dBm (as they are internally stored) and the offset is in dB.

If a point in the trace operand is equal to `maxtracevalue`, the resultant point is also `maxtracevalue`.

If a point in the trace operand is equal to `mintracevalue`, the resultant point is also `mintracevalue`.

Example: If offset is 25 dB, then our destination trace will be higher than the operand trace by 25 dB.

Note that the `Second Trace` operand is not used for this function.

Log Diff (Op1 - Op2 + Ref)

Offsets the difference between the `First Trace` operand and the `Second Trace` operand by a reference and puts the result in the destination trace. This is like the A-B+DL function in some older instruments. The Reference is entered on the **Reference** control, which only appears when this math function is in force for the selected trace. Each destination trace has its own reference.

Offsets the difference between the `First Trace` operand and the `Second Trace` operand by a reference and puts the result in the destination trace. This is like the A-

B+DL function in some older instruments. The Reference is entered on the **Reference** control, which only appears when this math function is in force for the selected trace. Each destination trace has its own reference.

During the sweep, the following formula is executed for each point in the trace operands, and the corresponding point is generated for the destination trace.

```
DestinationTrace = (FirstTrace - SecondTrace) + Reference
```

The values of the operand trace points are assumed to be in decibel units (as they are internally stored) and the reference is in dBm so the result is in dBm.

Example: If the first operand trace 1 is at 5 dBm, the second operand trace 2 is at –5 dBm, and the reference is –25 dBm, then the destination trace will be –15 dBm.

Example: If the first operand trace1 is at 60 dBuV, the second operand trace 2 is at 50 dBuV, and the reference is 35 dBuV, then the destination trace will be 45 dBuV.

If a point in `FirstTrace` is equal to `maxtracevalue`, the resultant point is also `maxtracevalue`.

If a point in `FirstTrace` is equal to `mintracevalue`, the resultant point is also `mintracevalue`.

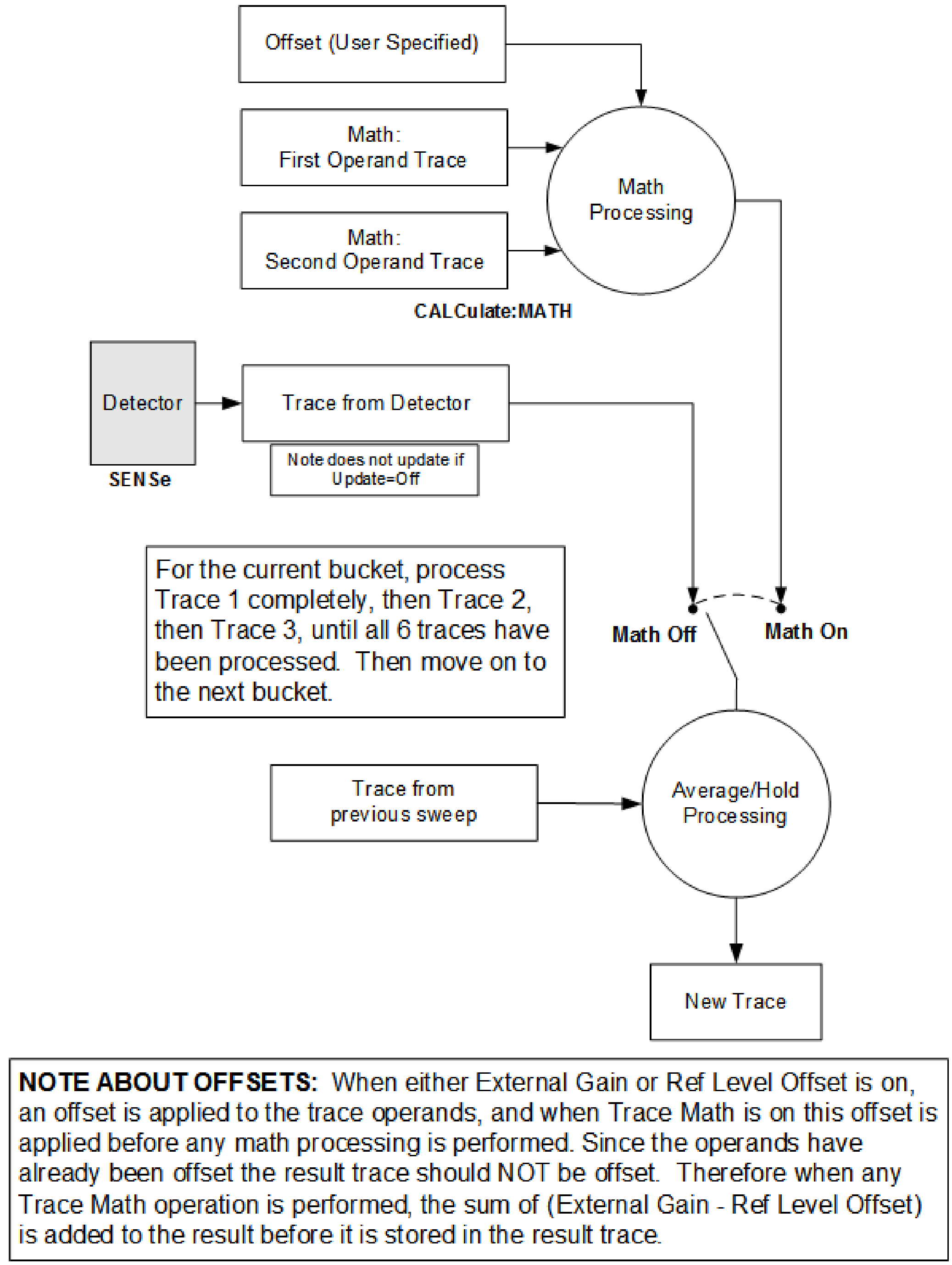
If neither of the above is true for a given point, then:

- If that point in `SecondTrace` is equal to `maxtracevalue`, the resultant point is `mintracevalue`.
- If that point in `SecondTrace` is equal to `mintracevalue`, the resultant point is `maxtracevalue`.

How trace math is processed

Whenever a trace math function is turned on, or the parameters and/or operands of an existing trace math function are changed, the destination trace is cleared. After the trace is cleared, all x-axis values in the trace, and the domain of the trace, are set to match the X-Axis settings of the first trace operand. When this is complete, a new sweep is initiated.

The process of acquiring data, processing it using the math and Average/Hold functions, and presenting it as trace data, consists of several functional blocks, as shown below:



For each active trace, the current trace point is processed for `Trace 1`, then `Trace 2`, then `Trace 3`, etc. Trace data is taken from either the detector for that trace, or

from the mathematical result of up to two other traces and an offset, depending on whether trace math is on or not. The resultant data is then fed to the Average/Hold processing block, where (if the trace type is **Average**, **Max Hold**, or **Min Hold**) it is processed with previous trace data. The new trace data resulting from this process is then available for display, storage or remote output.

When the processing is complete for `Trace 1`, `Trace 2` is processed, and so on until all six traces have been processed. This allows a downstream trace to use as one of its math components a fully processed upstream trace. In other words, if math is `ON` for `Trace 4`, and its operand traces are `Trace 2` and `Trace 3`, then all detector, math, average and hold processing for Traces 2 and 3 is completed before the math is performed for `Trace 4`. When the current trace point is completed for all traces, the instrument moves on to the next trace point.

This allows very flexible and powerful math functions to be configured. For example, `Trace 1` can be an average trace, which can be fed with an offset to `Trace 2`, which can also be in **Max Hold**, allowing you to obtain the **Max Hold** of an Average trace.

Note that none of this processing is performed on inactive traces.

Note also that for any active trace with math `ON`, the Operand traces should have *lower* numbers than the trace (for example, using `Trace 4` as an operand for `Trace 1` will cause the data coming from `Trace 4` to be delayed by one sweep).

Operand 1 / Operand 2

These two controls select the first and second trace operands to be used for the trace math functions for the destination trace. The operands are common to all math functions for a given trace. The most recently sent `:CALCulate:MATH` command for a given trace sets the operands for that trace. Those settings are displayed on the trace operand controls for that trace.

Example	The following examples are for the Swept SA measurement
	Set Trace 3 to Power Diff trace math function. Set the First Trace operand (for Trace 3) to Trace 1 and the Second Trace operand (for Trace 3) to Trace 2:
	`:CALC:MATH TRACE3,PDIF,TRACE1,TRACE2,0,0`
	Set Trace 3 to Log Offset trace math function. Set the First Trace operand (for Trace 3) to Trace 1, leave the Second Trace operand (for Trace 3) unchanged (it is irrelevant for this function) and set the Log Offset (for Trace 3) to -6 dB:
	`:CALC:MATH TRACE3,LOFF,TRACE1,TRACE2,-6.00,0`

Notes	See "Math Function" on page 1724 for how to specify Operands 1 and 2 using `:CALCulate:MATH`
Dependencies	The destination trace cannot be an operand. The destination trace number is grayed-out on the dropdown
Preset	Operand 1: Trace number minus 2 (wraps at 1). For example, for Trace 1, Operand 1 presets to Trace

	5; for Trace 6, it presets to Trace 4 Operand 2: Trace number minus 1 (wraps at 1). For example, for Trace 1, Operand 2 presets to Trace 6; for Trace 6, it presets to Trace 5
State Saved	Operands 1 and 2 for each trace are stored in instrument state

Offset

Used by the Log Offset math function.

Example	The following example is for the Swept SA measurement Set Trace 3 to Log Offset trace math function, set the First Trace operand (for Trace 3) to Trace 1, leave the Second Trace operand (for Trace 3) unchanged (it is irrelevant for this function) and set the Log Offset (for Trace 3) to -6 dB: `:CALC:MATH TRACE3,LOFF,TRACE1,TRACE2,-6.00,0`
State Saved	The Log Offset value for each trace is saved in Instrument State
Min	–100 dB
Max	100 dB

Reference

Used by the Log Diff math function.

Example	The following example is for the Swept SA measurement Set Trace 3 to Log Diff trace math function, set the First Trace operand (for Trace 3) to Trace 1, set the Second Trace operand (for Trace 3) to Trace 2, and set the Log Difference reference (for Trace 3) to -6 dBm: `:CALC:MATH TRACE3,LDIF,TRACE1,TRACE2,0,-6.00`
State Saved	The Log Difference reference value for each trace is saved in instrument state
Min/Max	Same as reference level

3.8.10.4 Trace Function

Contains controls to:

– Copy and Exchange traces

– Preset or Clear all traces

From Trace

Selects the trace to be copied to or exchanged with the "To Trace" on page 1732 when a "Copy" on page 1732 or "Exchange" on page 1733 is performed

Preset	1

To Trace

Selects the trace to be copied from or exchanged with the "From Trace" on page 1732 when a "Copy" on page 1732 or "Exchange" on page 1733 is performed

Preset	2

Copy

Executes a Trace Copy based on the "From Trace" on page 1732 and "To Trace" on page 1732 parameters. The copy operation is from the **From Trace** to the **To Trace**. The action is performed once.

The X-Axis settings and domain of a trace are also copied.

Remote Command	For Swept SA Measurement (in SA Mode):
	`:TRACe:COPY TRACE1 | … | TRACE6, TRACE1 | … | TRACE6`
	For all other measurements:
	`:TRACe:<meas>:COPY TRACe1 | TRACe2 | TRACe3, TRACe1 | TRACe2 | TRACe3`
	where `<meas>` is the identifier for the current measurement
	Note that the format of the `TRACe<n>` parameter differs from that for the Swept SA Measurement

Example	Copy Trace 1 to Trace 3 and put Trace 3 in Update=Off, Display=On `:TRAC:COPY TRACE1,TRACE3`
Notes	The command is of the form: `:TRACe:COPY <source_trace>,<dest_trace>`
Dependencies	When Signal ID is on, this key is grayed-out
Couplings	The destination trace is put in **View** (Update = Off, Display = On) after the copy

Preset	For Swept SA Measurement (in SA Mode):
	`TRACE1, TRACE2`
	For all other measurements:
	`TRACe1, TRACe2`

Exchange

Executes a Trace Exchange based on the "From Trace" on page 1732 and "To Trace" on page 1732 parameters. The **From Trace** and **To Trace** values are exchanged with each other. The action is performed once.

The X-Axis settings and domain of a trace are also copied when it is exchanged with another trace.

Remote Command	For Swept SA Measurement (in SA Mode):
	`:TRACe:EXCHange TRACE1 | … | TRACE6, TRACE1 | … | TRACE6`
	For all other measurements:
	`:TRACe:<meas>:EXCHange TRACe1 | TRACe2 | TRACe3, TRACe1 | TRACe2 | TRACe3`
	where `<meas>` is the identifier for the current measurement
	Note that the format of the `:TRACe<n>` parameter differs from that for the Swept SA Measurement

Example	Exchange Trace 1 and Trace 2 and put both traces in Update=`OFF`, Display=`ON`: `:TRAC:EXCH TRACE1,TRACE2`
Notes	The command is of the form: `:TRACe:EXCHange <trace_1>,<trace_2>`
Couplings	Both traces are put in **View** (Update=Off, Display=On) after the exchange

Preset All Traces

Turns on Trace 1 and blanks all other traces. This is useful when you have many traces on and you want to return to having only Trace 1 on the display. Does not affect the trace type, detector or any other aspect of the trace system.

Remote Command	`:TRACe[:<meas>]:PRESet:ALL`
Example	`:TRAC:PRES:ALL`
Dependencies	When Signal ID is on, this key is grayed-out

Clear All Traces

Clears all traces. Does not affect the state of any function or variable in the instrument. Loads `mintracevalue` into all of the points for all traces, except traces in **Min Hold**, in which case it loads `maxtracevalue`, even if **Update** = `OFF`.

Remote Command	`:TRACe[:<meas>]:CLEar:ALL`
Example	`:TRAC:CLE:ALL`
Dependencies	When Signal ID is on, this key is grayed-out

3.8.10.5 Advanced

Contains controls for setting advanced trace functions of the instrument.

Measure Trace

Specifies which trace's scalar results are displayed in the Metrics window and retrieved by sending a `:READ` or `:FETCh` command:

- Trace 1
- Trace 2
- Trace 3

Remote Command	`:CALCulate:SPURious:MTRace TRACe1 | TRACe2 | TRACe3` `:CALCulate:SPURious:MTRace?`
Example	`:CALC:SPUR:MTR TRACe1` `:CALC:SPUR:MTR?`
Preset	`TRACe1`
State Saved	No
Range	Trace 1 | Trace 2 | Trace 3

3.9 SEM Measurement

The Spectrum Emission Mask measurement analyzes spurious signal levels in up to six pairs of offset frequencies and relates them to the carrier power.

SEM Measurement Commands

The following commands and queries can be used to configure the measurement, then retrieve measurement results:

The general functionality of "CONFigure" on page 2732, "INITiate" on page 2733, "FETCh" on page 2733, "MEASure" on page 2735, and "READ" on page 2734 are described in the section **SCPI Operation and Results Query** in the topic **Programming the Instrument**.

Note that, in general, `:CONF:<measurement>` resets the specified measurement settings to their defaults. X-Series permits the addition of the `NDEFault` node to the command, which prevents a measurement preset after a measurement switch.

```
:CONFigure:SEMask
:CONFigure:SEMask:NDEFault
:INITiate:SEMask
:FETCh:SEMask[n]?
:MEASure:SEMask[n]?
:READ:SEMask[n]?
```

Remote Command Results Overview

The following table provides an overview of the results returned by the `:FETCh`, `:MEASure`, and `:READ` queries listed above, according to the index value `n`. For Mode-specific details, click on the appropriate link for each `n` value.

Offsets that are turned off (inactive) return -999.0 or `NAN` when their results are queried via SCPI. The value of `NAN` is 9.91E+37.

n	Results
1	Result summary (Offsets A - F) Note that n = 1 returns results of 6 offsets (Offset A to F) See "Results for n = 1" on page 1511
2	Displayed frequency domain spectrum trace data for Trace 1 See "Results for n = 2-4" on page 1512
3	Displayed frequency domain absolute limit trace data See "Results for n = 2-4" on page 1512
4	Displayed frequency domain relative limit trace data

n	Results
	See "Results for n = 2-4" on page 1512
5	Offset abs power, Offset abs PSD, Offset abs peak power depending on "Measurement Type" on page 1681 (Offset A- L) See "Results for n = 5" on page 1512
6	Offset rel power, Offset rel PSD, Offset rel peak power depending on "Measurement Type" on page 1681 (Offset A- L) See "Results for n = 6" on page 1513
7, 8	Offset pass/fail (Offset A- L) See "Results for n = 7-11" on page 1514
9	Offset peak power freq (Offset A- L) See "Results for n = 7-11" on page 1514
10	Offset abs peak power (Offset A- L) See "Results for n = 7-11" on page 1514
11	Offset rel peak power (Offset A- L) See "Results for n = 7-11" on page 1514
12	Peak power of the signal in the ref channel when "Measurement Type" on page 1681 is Spectrum Peak Reference See "Results for n = 12" on page 1516
13	Ref channel summary Available only in LTEAFDD, LTEATDD, MSR and 5GNR Modes
14	Offset result summary (Offset A- L) See "Results for n = 14" on page 1516
15	Offset limit margins (Offset A- L) See "Results for n = 15" on page 1517
16	Carrier powers Available only in LTEAFDD, LTEATDD, MSR, 5GNR, and WLAN Modes
17	Displayed frequency domain combined limit trace data Available only in LTEAFDD, LTEATDD, MSR and 5GNR Modes
18	Displayed frequency domain spectrum trace data for Trace 2 See "Results for n = 18-20" on page 1518
19	Displayed frequency domain spectrum trace data for Trace 3 See "Results for n = 18-20" on page 1518
20	Displayed frequency domain absolute 2 limit trace data See "Results for n = 18-20" on page 1518
21	Result Summary (Offset A – L, Outer and Inner) Available only in LTEAFDD, LTEATDD, and 5GNR Modes
22	Offset pass/fail (Offset A- L) Available only in LTEAFDD, LTEATDD, and 5GNR Modes

3.9.1 Results for n = 1

For WLAN Mode, these results apply to all standards *except* 802.11ac/ax (80+80MHz).

Returns 82 comma-separated scalar results, in the following order:

k is an index for each offset: k = 0 for offset A; k = 1 for offset B; k = 2 for offset C, etc. The number of offsets is 6 (A-F).

#	Item	Unit, if any
1	Reserved for future use, returns -999.0	
2	Power(*1) at the center frequency (reference) area	When "Measurement Type" on page 1681 is PSD Ref: dBm/Hz Others: dBm
3~4	Reserved for future use, returns -999.0	
5	Peak frequency in the center frequency (reference) area	Hz
6~10	Reserved for future use, returns -999.0	
11 10k + 11, k = 0	Relative integrated power on the negative offset A Returns -999.0 when "Measurement Type" on page 1681 is Spectrum Peak Ref	When "Measurement Type" on page 1681 is PSD Ref: dB When Total Power Ref: dBc
12 10k + 12, k = 0	Absolute integrated power on the negative offset A Returns -999.0 when "Measurement Type" on page 1681 is Spectrum Peak Ref	When "Measurement Type" on page 1681 is PSD Ref: dBm/Hz When Total Power Ref: dBm
13 10k + 13, k = 0	Relative peak power on the negative offset A	When "Measurement Type" on page 1681 is Total Power Ref: dBc Others: dB
14 10k + 14, k = 0	Absolute peak power on the negative offset A	When "Measurement Type" on page 1681 is PSD Ref: dBm/Hz Others: dBm
15 10k + 15, k = 0	Peak power offset frequency from the center or carrier edge frequency in the negative offset A Depends on the setting of "Offset Freq Define" on page 1623	Hz
16 10k + 16, k = 0	Relative integrated power on the positive offset A Returns -999.0 when "Measurement Type" on page 1681 is Spectrum Peak Ref	When "Measurement Type" on page 1681 is PSD Ref: dB Others: dBc
17 10k + 17, k = 0	Absolute integrated power on the positive offset A Returns -999.0 when "Measurement Type" on page 1681 is Spectrum Peak Ref	When "Measurement Type" on page 1681 is PSD Ref: dBm/Hz Others: dBm
18 10k + 18, k = 0	Relative peak power on the positive offset A	When "Measurement Type" on page 1681 is Total Power Ref: dBc Others: dB

#	Item	Unit, if any
19 10k + 19, k = 0	Absolute peak power on the positive offset A	When "Measurement Type" on page 1681 is PSD Ref: dBm/Hz Others: dBm
20 10k + 20, k = 0	Peak power offset frequency from the center or carrier edge frequency in the positive offset A Depends on the setting of "Offset Freq Define" on page 1623	Hz
---		
70 10k + 20, k = 5	Peak power offset frequency from the center or carrier edge frequency in the positive offset F Depends on the setting of "Offset Freq Define" on page 1623	Hz
71 2k + 71, k = 0	Minimum margin from limit line on the negative offset A	dB
72 2k + 72, k = 0	Minimum margin from limit line on the positive offset A	dB
---		
82 2k + 72, k = 5	Minimum margin from limit line on the positive offset F	dB

*1: Absolute power when "Measurement Type" on page 1681 is Total Power Ref or PSD Ref; Peak power when "Measurement Type" on page 1681 is Spectrum Peak Ref

3.9.2 Results for n = 2-4

n	Data
2	Returns the displayed frequency domain spectrum trace data for Trace 1 separated by commas
3	Returns the displayed frequency domain absolute limit trace data separated by commas
4	Returns the displayed frequency domain relative limit trace data separated by commas

3.9.3 Results for n = 5

Returns comma-separated scalar values of the absolute integrated power when "Measurement Type" on page 1681 is Total Power Ref or PSD Ref and the absolute peak power when "Measurement Type" on page 1681 is Spectrum Peak Ref of the segment frequencies

The length of the result depends on the number of available offset (See "Number of Offsets" on page 1518)

k is an index for each offset: k = 0 for offset A; k = 1 for offset B; k = 2 for offset C, etc. The number of offsets is 12 (A-L).

#	Item
1	Depends on "Measurement Type" on page 1681: – Total power reference (dBm) – Power spectral density reference (dBm/Hz) – Spectrum peak power reference (dBm)
2	Reserved for future use, returns -999.0
3 2k + 3, k = 0	Power(*1) at negative offset A
4 2k + 4, k = 0	Power(*1) at positive offset A
---	
26 2k + 4, k = 11	Power(*1) at positive offset L

*1: Absolute integrated power when "Measurement Type" on page 1681 is Total Power Ref or PSD Ref; Absolute peak power when "Measurement Type" on page 1681 is Spectrum Peak Ref

3.9.4 Results for n = 6

When "Measurement Type" on page 1681 is Total Power Ref or PSD Ref, returns comma-separated scalar values (in dBc or dBc/Hz) of the integrated power relative to the carrier at the segment frequencies

When "Measurement Type" on page 1681 is Spectrum Peak Ref, returns comma-separated scalar values (in dB) of the peak power relative to the carrier at the segment frequencies

The length of the result depends on the number of available offset (See "Number of Offsets" on page 1518)

For MSR, 5G NR, LTEAFDD, and LTEATDD Modes, returns outer offset results when "Non-Contiguous Meas Region" on page 1603 is set to **Outer** or **Outer & Inner** (5GNR, LTEAFDD, LTEATDD only), and returns inner offset results when it is set to **Inner**

The results are in the following order:

k is an index for each offset: k = 0 for offset A; k = 1 for offset B; k = 2 for offset C, etc. The number of offsets is 12 (A-L).

#	Item
1	Reserved for future use, returns -999.0
2	Reserved for future use, returns -999.0
3 2k + 3, k = 0	Power(*1) at negative offset A
4 2k + 4, k = 0	Power(*1) at positive offset A
---	
26 2k + 4, k = 11	Power(*1) at positive offset L

*1: Relative integrated power when "Measurement Type" on page 1681 is Total Power Ref or PSD Ref; Relative peak power when "Measurement Type" on page 1681 is Spectrum Peak Ref

3.9.5 Results for n = 7-11

n	Data
7, 8	Returns comma-separated pass/fail test results (0 = passed, or 1 = failed) determined by testing the minimum margin point from the limit line that is determined each offset's Limits setting. The length of the result depends on the number of available offset (See "Number of Offsets" on page 1518) For MSR, 5G NR, LTEAFDD, and LTEATDD Modes, returns outer offset results when "Non-Contiguous Meas Region" on page 1603 is set to **Outer** or **Outer & Inner** (5GNR, LTEAFDD, LTEATDD only), and returns inner offset results when it is set to **Inner** The results are in the following order:
	# | Item
	1 | Reserved for future use, returns -999.0
	2 | Reserved for future use, returns -999.0
	3, 2k + 3, k = 0 | At negative offset A
	4, 2k + 4, k = 0 | At positive offset A

	26, 2k + 4, k = 11 | At positive offset L
9	Returns comma-separated scalar values of frequency (in Hz) that have peak power from center or carrier edge frequency in each offset, depending on the setting of "Offset Freq Define" on page 1623. The length of the result depends on the number of available offset (See "Number of Offsets" on page 1518)

n	Data
	For MSR, 5G NR, LTEAFDD, and LTEATDD Modes, returns outer offset results when "Non-Contiguous Meas Region" on page 1603 is set to **Outer** or **Outer & Inner** (5GNR, LTEAFDD, LTEATDD only), and returns inner offset results when it is set to **Inner** The results are in the following order:

#	Item
1	Reserved for future use, returns -999.0
2	Reserved for future use, returns -999.0
3 2k + 3, k = 0	Negative offset A
4 2k + 4, k = 0	Positive offset A
---	---
26 2k + 4, k = 11	Positive offset L

n	Data
10	Returns comma-separated scalar values (in dBm) of the absolute peak power of the segment frequencies. The length of the result depends on the number of available offset (See "Number of Offsets" on page 1518) For MSR, 5G NR, LTEAFDD, and LTEATDD Modes, returns outer offset results when "Non-Contiguous Meas Region" on page 1603 is set to **Outer** or **Outer & Inner** (5GNR, LTEAFDD, LTEATDD only), and returns inner offset results when it is set to **Inner** The results are in the following order:

#	Item
1	Reserved for future use, returns -999.0
2	Reserved for future use, returns -999.0
3 2k + 3, k = 0	At negative offset A
4 2k + 4, k = 0	At positive offset A
---	
26 2k + 4, k = 11	At positive offset L

n	Data
11	Returns comma-separated scalar values in dBc (dB if **MeasType** = PSD) of the peak power relative to the carrier at the segment frequencies. The length of the result depends on the number of available offset (See "Number of Offsets" on page 1518) For MSR, 5G NR, LTEAFDD, and LTEATDD Modes, returns outer offset results when "Non-Contiguous Meas Region" on page 1603 is set to **Outer** or **Outer & Inner** (5GNR, LTEAFDD, LTEATDD only), and returns inner offset results when it is set to **Inner** The results are in the following order:

n	Data	
	#	**Item**
	1	Reserved for future use, returns -999.0
	2	Reserved for future use, returns -999.0
	3 2k + 3, k = 0	At negative offset A
	4 2k + 4, k = 0	At positive offset A
	---	
	26 2k + 4, k = 11	At positive offset L

3.9.6 Results for n = 12

When "Measurement Type" on page 1681 is Spectrum Peak reference, returns the peak power of the signal in the ref channel

Otherwise, the value returned is -999.0

3.9.7 Results for n = 14

Returns comma-separated scalar results

For MSR, 5G NR, LTEAFDD, and LTEATDD Modes, returns outer offset results when "Non-Contiguous Meas Region" on page 1603 is set to **Outer** or **Outer & Inner** (5GNR, LTEAFDD, LTEATDD only), and returns inner offset results when it is set to **Inner**

The results are in the following order:

k is an index for each offset: k = 0 for offset A; k = 1 for offset B; k = 2 for offset C, etc. The number of offsets is 12 (A-L)

#	Item	Unit
1 10k + 1, k = 0	Relative integrated power on the negative offset A Returns NaN when "Measurement Type" on page 1681 is Spectrum Peak Ref	When "Measurement Type" on page 1681 is Total Power Ref: dBc When PSD: dB
2 10k + 2, k = 0	Absolute integrated power on the negative offset A Returns NaN when "Measurement Type" on page 1681 is Spectrum Peak Ref	When "Measurement Type" on page 1681 is Total Power Ref: dBm When PSD: dBm/Hz
3 10k + 3, k	Relative peak power on the negative offset A	When "Measurement Type" on page 1681 is Total Power Ref PSD: dBc

#	Item	Unit
= 0		Others: dB
4 10k + 4, k = 0	Absolute peak power on the negative offset A	When "Measurement Type" on page 1681 is PSD Ref: dBm/Hz Others: dBm
5 10k + 5, k = 0	Peak power offset frequency from the center or carrier edge frequency in the negative offset A Depends on the setting of "Offset Freq Define" on page 1623	Hz
6 10k + 6, k = 0	Relative integrated power on the positive offset A Returns NaN when "Measurement Type" on page 1681 is Spectrum Peak Ref	When "Measurement Type" on page 1681 is Total Power Ref: dBc When PSD: dB
7 10k + 7, k = 0	Absolute integrated power on the positive offset A Returns NaN when "Measurement Type" on page 1681 is Spectrum Peak Ref	When "Measurement Type" on page 1681 is Total Power Ref: dBm When PSD: dBm/Hz
8 10k + 8, k = 0	Relative peak power on the positive offset A	When "Measurement Type" on page 1681 is Total Power Ref: dBc Others: dB
9 10k + 9, k = 0	Absolute peak power on the positive offset A	When "Measurement Type" on page 1681 is PSD Ref: dBm/Hz Others: dBm
10 10k + 10, k = 0	Peak power offset frequency from the center or carrier edge frequency in the positive offset A Depends on the setting of "Offset Freq Define" on page 1623	Hz
---		
120 10k + 10, k = 11	Peak power offset frequency from the center or carrier edge frequency in the positive offset L Depends on the setting of "Offset Freq Define" on page 1623	Hz

If the result is not available, NaN (9.91E+37) is returned

3.9.8 Results for n = 15

Results available only when "Measurement Type" on page 1681 is Total Power Reference.

Returns comma-separated scalar results

For MSR, 5G NR, LTEAFDD, and LTEATDD Modes, returns outer offset results when "Non-Contiguous Meas Region" on page 1603 is set to **Outer** or **Outer & Inner** (5GNR, LTEAFDD, LTEATDD only), and returns inner offset results when it is set to **Inner**

The results are in the following order:

k is an index for each offset: k = 0 for offset A; k = 1 for offset B; k = 2 for offset C, etc. The number of offsets is 12 (A–L).

#	Item	Unit
1 2k + 1, k = 0	Minimum margin from limit line on the negative offset A	dB
2 2k + 2, k = 0	Minimum margin from limit line on the positive offset A	dB
3 2k + 1, k = 1	Minimum margin from limit line on the negative offset B	dB
4 2k + 2, k = 1	Minimum margin from limit line on the positive offset B	dB
---		
24 2k + 2, k = 11	Minimum margin from limit line on the positive offset L	dB

3.9.9 Results for n = 18-20

n	Return Value
18	Returns the displayed frequency domain spectrum trace data for Trace 2 separated by commas
19	Returns the displayed frequency domain spectrum trace data for Trace 3 separated by commas
20	Returns the displayed frequency domain absolute 2 limit trace data, separated by commas

3.9.10 Number of Offsets

The number of available offsets varies depending on the mode and option as below.

Mode	Number of available offsets
MSR LTEAFDD, LTEATDD, 5G NR	12 (Offset A to L)
WLAN	14 (Offset A to N)
Other Modes with option: N9060A-7FP, N9060B-2FP, N9060C-2FP, N9060EM1D, N9060EM1E, or N90EMPSMB	12 (Offset A to L)
Other Modes without option N9060A-7FP, N9060B-2FP, N9060C-2FP, N9060EM1D, N9060EM1E, or N90EMPSMB	6 (Offset A to F)

3.9.11 Views

All Modes provide three predefined views. In MSR, LTE-Advanced FDD/TDD and 5G NR Modes, there is also a fourth predefined view. The views are listed in the table below.

In the following table:

- The Enumerated ID is used with :DISP:SEM:VIEW
- The Numeric ID is used with :DISP:SEM:VIEW:NSEL

View Name	Enumerated ID	Numeric ID	Details
"Abs Pwr Freq" on page 1520	APFReq	1	Displays the absolute power levels in dBm and the corresponding frequencies in the text window
"Rel Pwr Freq" on page 1520	RPFReq	2	Displays the relative power levels in dBc and the corresponding frequencies in the text window
"Integrated Power" on page 1520	IPOWer	3	Displays the absolute and relative power levels integrated throughout the bandwidths between the start and stop frequencies in the text window

View Selection by Name

Remote Command	:DISPlay:SEMask:VIEW[:SELect] APFReq | RPFReq | IPOWer | CINFormation :DISPlay:SEMask:VIEW[:SELect]?
Example	:DISP:SEM:VIEW IPOW :DISP:SEM:VIEW?
Dependencies	In SA Mode, when **Radio Standard** is set to WLAN, IPOWer is not available CINFormation is available only in MSR, LTE-Advanced FDD/TDD and 5G NR Modes
Preset	APFReq unless noted below RPFReq WLAN
State Saved	Saved in instrument state
Range	Abs Pwr Freq| Rel Pwr Freq|Integrated Power|Carrier Info

Views Selection by Number

Remote Command	:DISPlay:SEMask:VIEW:NSELect <integer> :DISPlay:SEMask:VIEW:NSELect?
Example	:DISP:SEM:VIEW:NSEL 2 :DISP:SEM:VIEW:NSEL?
Dependencies	In SA Mode, when **Radio Standard** is set to WLAN, Option 3 is not available Option 4 is available only in MSR, LTE-Advanced FDD/TDD and 5G NR Modes

Preset	1 unless noted below: 2 WLAN	
State Saved	Saved in instrument state	
Min/Max	MSR, LTEAFDD, LTEATDD, 5G NR Modes	1/4
	All other Modes	1/3

3.9.11.1 Abs Pwr Freq

Displays the absolute power levels in dBm and the corresponding frequencies in the text window.

Windows: "Graph" on page 1521, "Table" on page 1526

Example	`:DISP:SEM:VIEW APFR`

3.9.11.2 Rel Pwr Freq

Displays the relative power levels in dBc and the corresponding frequencies in the text window.

Windows: "Graph" on page 1521, "Table" on page 1526

Example	`:DISP:SEM:VIEW RPFR`

3.9.11.3 Integrated Power

Displays the absolute and relative power levels integrated throughout the bandwidths between the start and stop frequencies in the text window.

Windows: "Graph" on page 1521, "Table" on page 1526

Example	`:DISP:SEM:VIEW IPOW`

3.9.12 Windows

There are four available window types:

- In all Modes, the "Graph" on page 1521 and "Table" on page 1526 windows are available
- When **Gate View** is on, the "Gate" on page 1536 window is available

This section describes the windows.

3.9.12.1 Graph

Used to display the spectrum being measured by the SEM measurement.

This window appears in several Views, as follows:

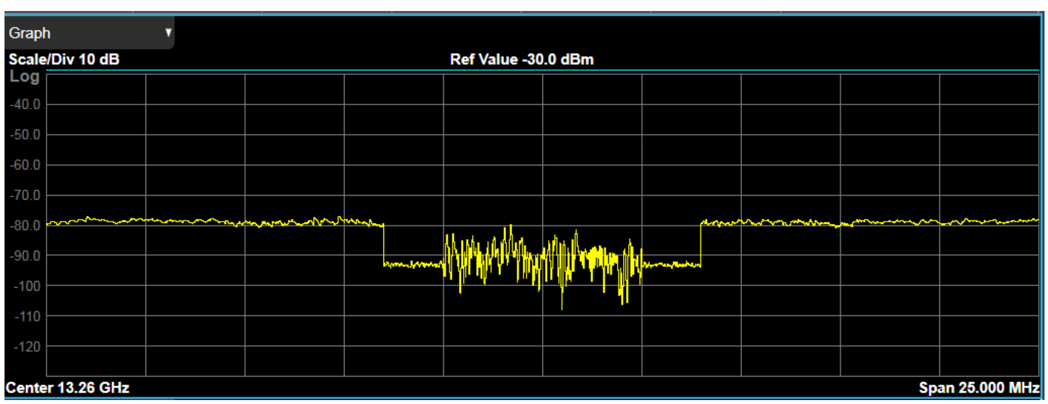
View	Size	Position
Abs Pwr Freq	Three fifth, full width	Top
Rel Pwr Freq	Three fifth, full width	Top
Integrated Power	Three fifth, full width	Top
Gate View	One third, full width	Middle

The Graph differs depending on which View you are in. The views differ depending on the setting of the measurement type ("Measurement Type" on page 1681) under the **Meas Setup** menu

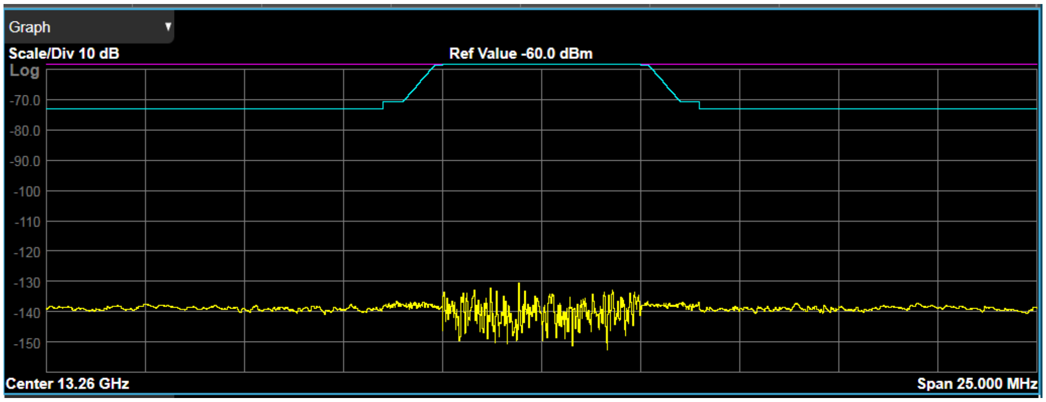
Graph Window in Abs Pwr Freq View

Corresponding Trace	yellow - Combined trace from carrier and each offset

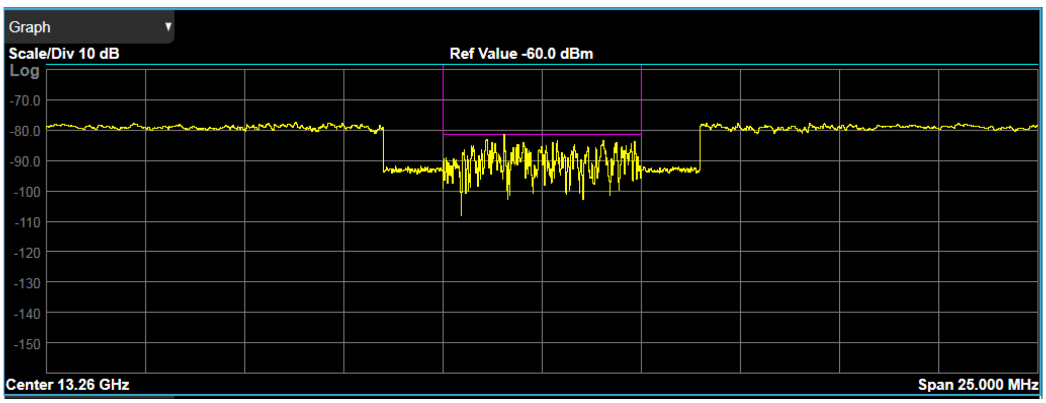
Abs Peak Pwr & Freq (Total Pwr Ref)



Abs Peak Pwr & Freq (PSD Ref)



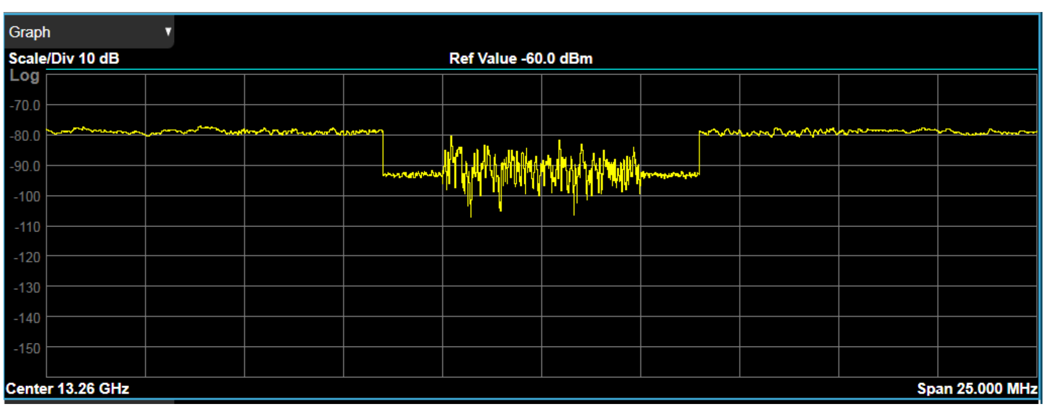
Abs Peak Pwr & Freq (Spectrum Pk Ref)



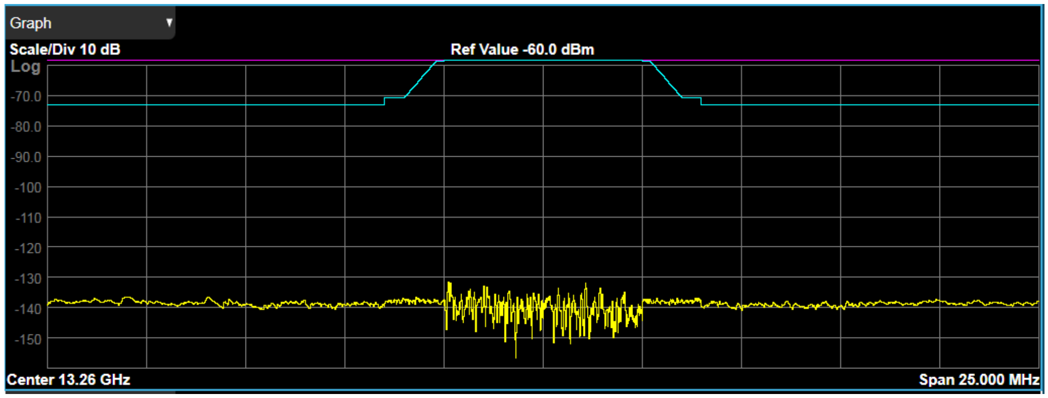
Graph Window in Rel Pwr Freq View

Corresponding Trace	yellow - Combined trace from carrier and each offset

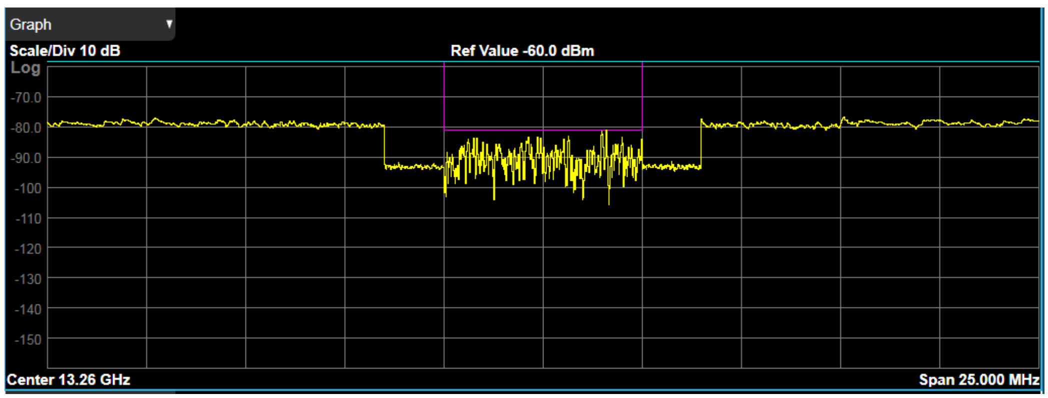
Rel Peak Pwr & Freq (Total Pwr Ref)



Rel Peak Pwr & Freq (PSD Ref)



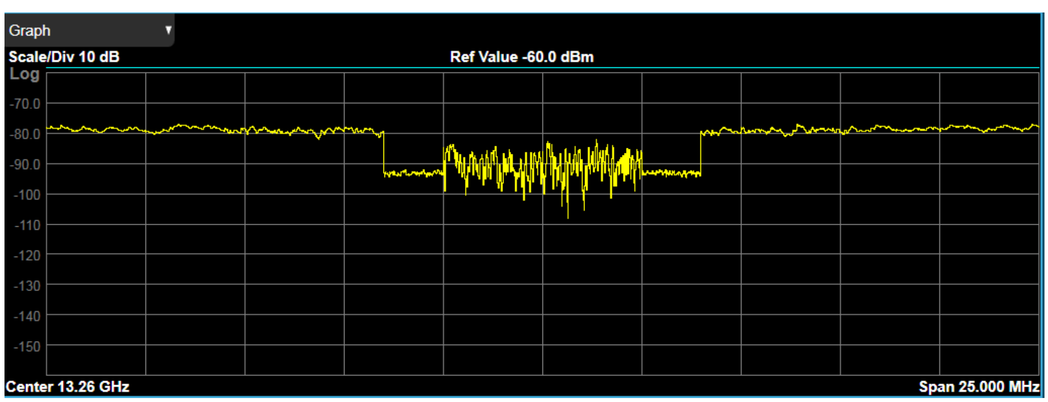
Rel Peak Pwr & Freq (Spectrum Pk Ref)



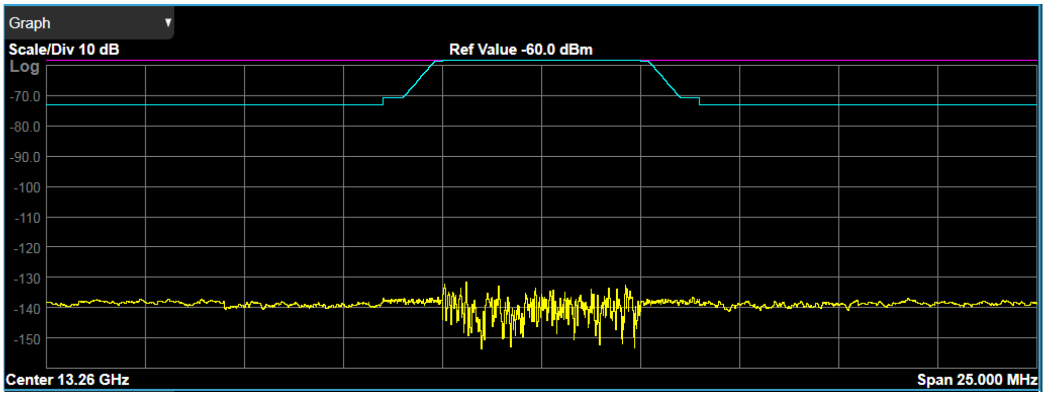
Graph Window in Integrated Power View

Corresponding Trace	yellow - Combined trace from carrier and each offset

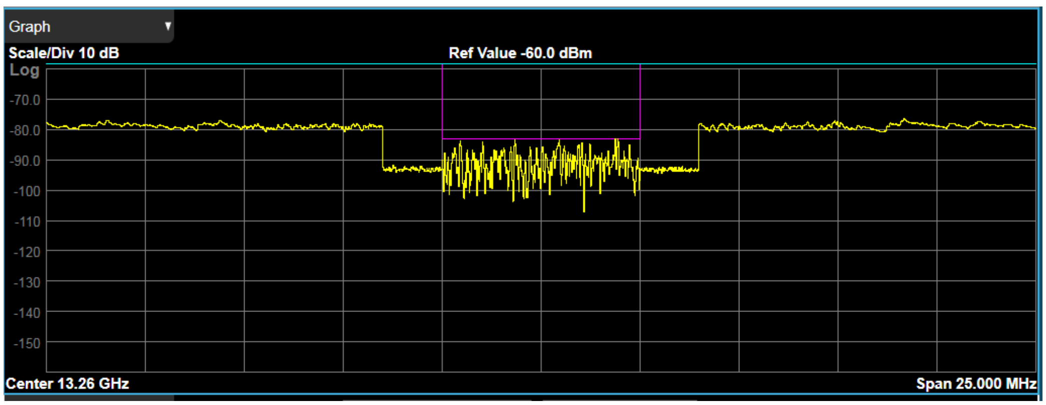
Integrated Power (Total Pwr Ref)



Integrated Power (PSD Ref)



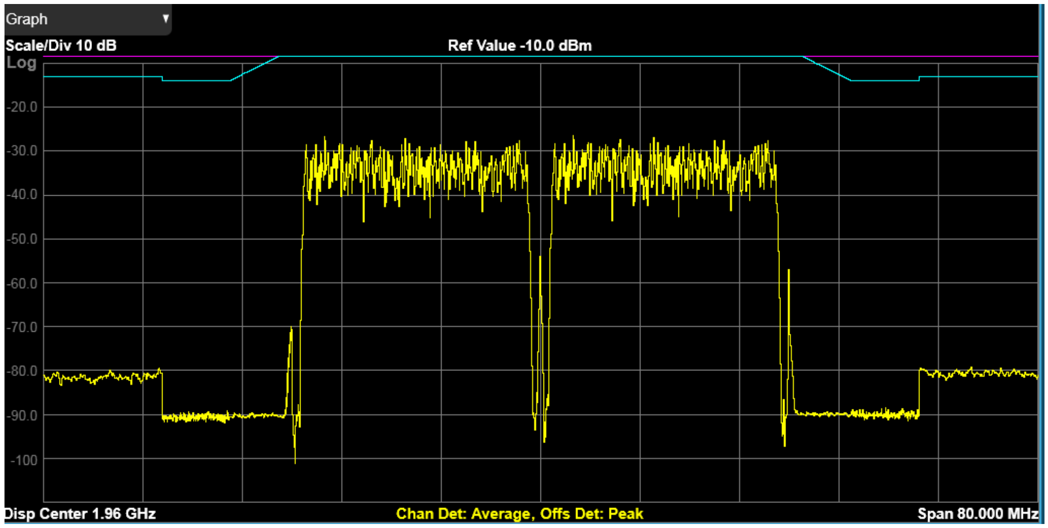
Integrated Power (Spectrum Pk Ref)



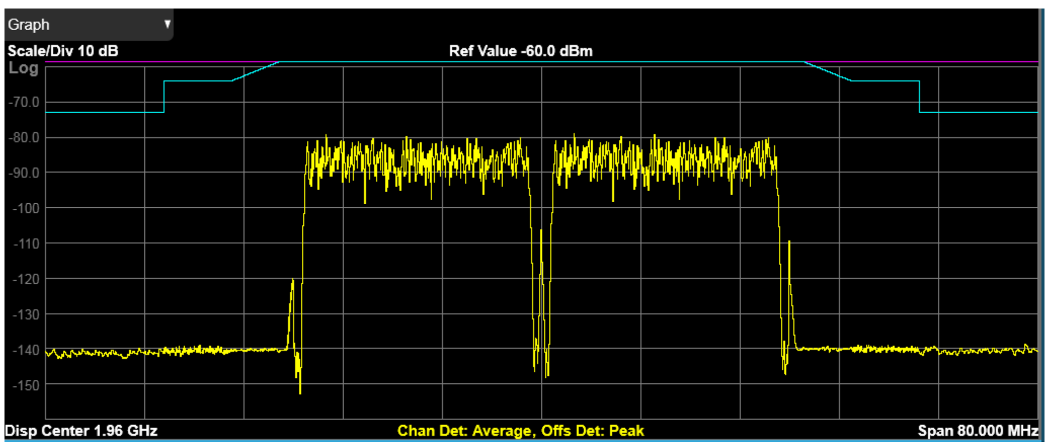
Graph Window in Carrier Info View

Sets the display to the carrier info view. The views differ depending on the setting of "Measurement Type" on page 1681.

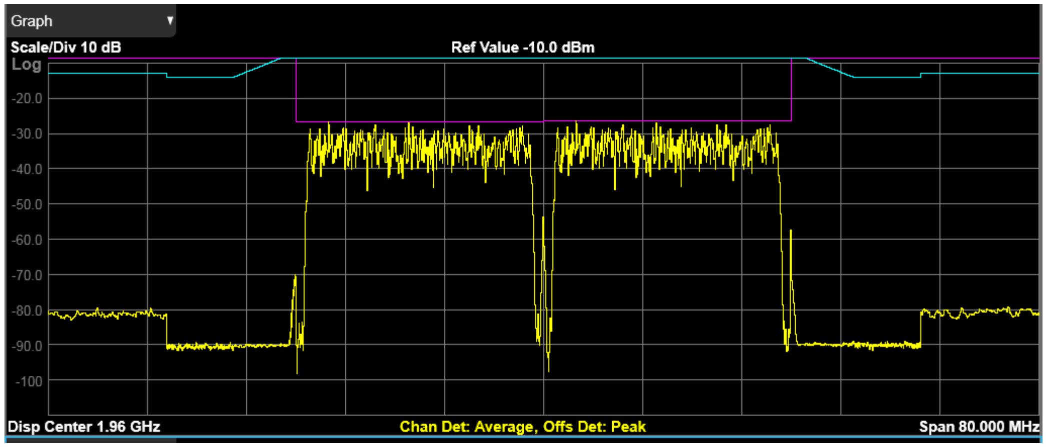
Spectrum trace (Total Pwr Ref)



Spectrum trace (PSD Ref)



Spectrum trace (Spectrum Pk Ref)



3.9.12.2 Table

Displays textual results for the measurement. The Table differs depending on which View you are in.

The views differ depending on the setting of "Measurement Type" on page 1681.

View	Size	Position
Abs Pwr Freq	Two fifth, full width	Bottom
Rel Pwr Freq	Two fifth, full width	Bottom
Integrated Power	Two fifth, full width	Bottom
Gate View	One third, full width	Bottom

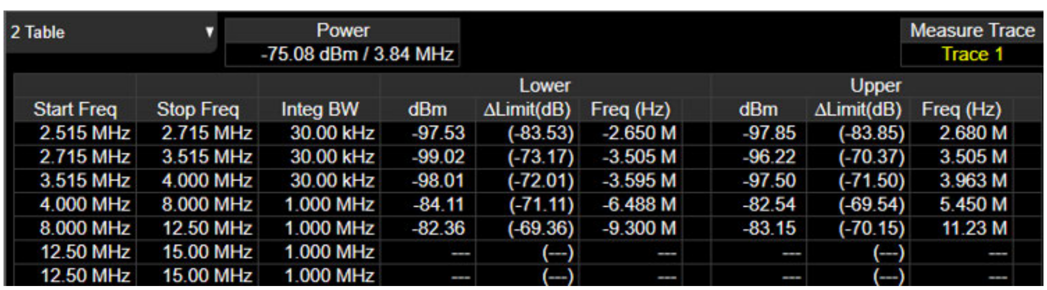
Table Window in Abs Pwr Freq View

Name (Measurement Type)	Unit, if any	Corresponding Results
Power		n = 1 2nd element Absolute power at the reference area
Reference		In multi-carrier applications, this column displays which carrier is reference carrier
PSD Ref (PSD Ref)		n = 5 1st element Power spectral density reference at the reference area
Spectrum Peak ref (Spectrum Pk Ref)		n = 5 1st element Spectrum peak power reference at the reference area

Name (Measurement Type)	Unit, if any	Corresponding Results
Measure Trace		See "Measure Trace" on page 1734
Start Freq	Hz	Start frequency for offset
Stop Freq	Hz	Stop frequency for offset
Integ BW	Hz	Measurement bandwidth for offset
Lower Peak (Total Power Ref, Spectrum Pk Ref)	dBm	Absolute peak power on minimum margin point of the negative offset
Lower (PSD Ref)	dBm/Hz	Absolute power spectrum density of the negative offset
Lower Δlim	dB	Minimum margin from limit line which is decided by Fail Mask setting on the negative offset
Lower Freq	Hz	Frequency on minimum margin point of the negative offset
Upper Peak (Total Power Ref, Spectrum Pk Ref)	dBm	Absolute peak power on minimum margin point of the positive offset
Upper (PSD Ref)	dBm/Hz	Absolute power spectrum density of the positive offset
Upper Δlim	dB	Minimum margin from limit line which is decided by Fail Mask setting on the positive offset
Upper Freq	Hz	Frequency on minimum margin point of the positive offset

When Measurement Type is Total Power Ref

Modes other than MSR, LTE-Advanced FDD/TDD and 5G NR


2 Table
Power: -75.08 dBm / 3.84 MHz
Measure Trace: Trace 1

			Lower			Upper		
Start Freq	Stop Freq	Integ BW	dBm	ΔLimit(dB)	Freq (Hz)	dBm	ΔLimit(dB)	Freq (Hz)
2.515 MHz	2.715 MHz	30.00 kHz	-97.53	(-83.53)	-2.650 M	-97.85	(-83.85)	2.680 M
2.715 MHz	3.515 MHz	30.00 kHz	-99.02	(-73.17)	-3.505 M	-96.22	(-70.37)	3.505 M
3.515 MHz	4.000 MHz	30.00 kHz	-98.01	(-72.01)	-3.595 M	-97.50	(-71.50)	3.963 M
4.000 MHz	8.000 MHz	1.000 MHz	-84.11	(-71.11)	-6.488 M	-82.54	(-69.54)	5.450 M
8.000 MHz	12.50 MHz	1.000 MHz	-82.36	(-69.36)	-9.300 M	-83.15	(-70.15)	11.23 M
12.50 MHz	15.00 MHz	1.000 MHz	---	(---)	---	---	(---)	---
12.50 MHz	15.00 MHz	1.000 MHz	---	(---)	---	---	(---)	---

MSR, LTE-Advanced FDD/TDD and 5G NR

2 Table	Reference	Power	Measure Trace
	Sub-block Left	-60.63 dBm / 99.97 MHz	Trace 1
	Sub-block Right	-60.63 dBm / 99.97 MHz	

			Lower			Upper		
Start Freq	Stop Freq	Integ BW	dBm	ΔLimit(dB)	Freq (Hz)	dBm	ΔLimit(dB)	Freq (Hz)
50.00 kHz	5.050 MHz	102.0 kHz	-89.50	(-77.23)	-4.884 M	-89.58	(-77.08)	5.050 M
5.050 MHz	10.05 MHz	100.0 kHz	-87.86	(-75.36)	-6.725 M	-87.98	(-75.48)	7.675 M
10.50 MHz	40.00 MHz	1.000 MHz	-20.42	(-5.42)	-14.80 M	-78.24	(-63.24)	35.65 M
40.00 MHz	100.0 MHz	1.000 MHz	-77.73	(-62.73)	-57.55 M	-77.94	(-62.94)	59.95 M
100.0 MHz	500.0 MHz	1.000 MHz	---	(---)	---	---	(---)	---
100.0 MHz	500.0 MHz	1.000 MHz	---	(---)	---	---	(---)	---
100.0 MHz	500.0 MHz	1.000 MHz	---	(---)	---	---	(---)	---

When Measurement Type is PSD Ref:

Modes other than MSR, LTE-Advanced FDD/TDD and 5G NR

2 Table	Power	PSD Ref	Measure Trace
	-75.55 dBm / 3.84 MHz	-141.39 dBm/Hz	Trace 1

			Lower			Upper		
Start Freq	Stop Freq	Integ BW	dBm/Hz	ΔLimit(dB)	Freq (Hz)	dBm/Hz	ΔLimit(dB)	Freq (Hz)
2.515 MHz	2.715 MHz	30.00 kHz	-145.39	(-84.46)	-2.553 M	-144.42	(-82.94)	2.658 M
2.715 MHz	3.515 MHz	30.00 kHz	-144.96	(-73.59)	-3.515 M	-144.86	(-72.24)	3.513 M
3.515 MHz	4.000 MHz	30.00 kHz	-144.92	(-70.74)	-3.843 M	-145.04	(-71.79)	3.558 M
4.000 MHz	8.000 MHz	1.000 MHz	-146.73	(-71.41)	-5.950 M	-146.24	(-70.80)	7.525 M
8.000 MHz	12.50 MHz	1.000 MHz	-145.26	(-69.37)	-11.89 M	-145.49	(-69.12)	8.388 M
12.50 MHz	15.00 MHz	1.000 MHz	---	(---)	---	---	(---)	---
12.50 MHz	15.00 MHz	1.000 MHz	---	(---)	---	---	(---)	---

MSR, LTE-Advanced FDD/TDD and 5G NR

2 Table	Reference	Power	PSD Ref	Measure Trace
	Sub-block Left	-60.39 dBm / 99.97 MHz	-140.39 dBm/Hz	Trace 1
	Sub-block Right	-60.39 dBm / 99.97 MHz	-140.39 dBm/Hz	

			Lower			Upper		
Start Freq	Stop Freq	Integ BW	dBm/Hz	ΔLimit(dB)	Freq (Hz)	dBm/Hz	ΔLimit(dB)	Freq (Hz)
50.00 kHz	5.050 MHz	102.0 kHz	-139.82	(-77.24)	-5.050 M	-139.86	(-77.14)	5.050 M
5.050 MHz	10.05 MHz	100.0 kHz	-139.53	(-75.14)	-6.375 M	-139.45	(-75.05)	8.900 M
10.50 MHz	40.00 MHz	1.000 MHz	-94.24	(-5.41)	-14.80 M	-139.59	(-62.92)	34.00 M
40.00 MHz	100.0 MHz	1.000 MHz	-139.81	(-62.31)	-69.55 M	-139.88	(-62.73)	54.70 M
100.0 MHz	500.0 MHz	1.000 MHz	---	(---)	---	---	(---)	---
100.0 MHz	500.0 MHz	1.000 MHz	---	(---)	---	---	(---)	---

When Measurement Type is Spectrum Pk Ref:

Modes other than MSR, LTE-Advanced FDD/TDD and 5G NR

2 Table	Power	Spectrum Peak Ref	Measure Trace
	-74.79 dBm / 3.84 MHz	-82.60 dBm	Trace 1

			Lower			Upper		
Start Freq	Stop Freq	Integ BW	dBm	ΔLimit(dB)	Freq (Hz)	dBm	ΔLimit(dB)	Freq (Hz)
2.515 MHz	2.715 MHz	30.00 kHz	-99.47	(-85.47)	-2.545 M	-98.13	(-84.13)	2.538 M
2.715 MHz	3.515 MHz	30.00 kHz	-98.92	(-73.18)	-3.498 M	-97.29	(-71.55)	3.498 M
3.515 MHz	4.000 MHz	30.00 kHz	-98.39	(-72.39)	-3.835 M	-97.40	(-71.40)	3.723 M
4.000 MHz	8.000 MHz	1.000 MHz	-84.06	(-71.06)	-5.250 M	-83.22	(-70.22)	6.663 M
8.000 MHz	12.50 MHz	1.000 MHz	-82.52	(-69.52)	-9.313 M	-82.16	(-69.16)	12.26 M
12.50 MHz	15.00 MHz	1.000 MHz	---	(---)	---	---	(---)	---
12.50 MHz	15.00 MHz	1.000 MHz	---	(---)	---	---	(---)	---

MSR, LTE-Advanced FDD/TDD and 5G NR

2 Table	Reference	Power	Spectrum Peak Ref	Measure Trace
	Sub-block Left	-60.60 dBm / 99.97 MHz	-74.10 dBm	Trace 1
	Sub-block Right	-60.60 dBm / 99.97 MHz	-74.10 dBm	

			Lower			Upper		
Start Freq	Stop Freq	Integ BW	dBm	ΔLimit(dB)	Freq (Hz)	dBm	ΔLimit(dB)	Freq (Hz)
50.00 kHz	5.050 MHz	102.0 kHz	-89.75	(-77.34)	-4.986 M	-89.69	(-77.19)	5.050 M
5.050 MHz	10.05 MHz	100.0 kHz	-87.79	(-75.29)	-8.875 M	-87.91	(-75.41)	8.975 M
10.50 MHz	40.00 MHz	1.000 MHz	-20.42	(-5.42)	-14.80 M	-77.91	(-62.91)	31.00 M
40.00 MHz	100.0 MHz	1.000 MHz	-77.44	(-62.44)	-47.80 M	-78.05	(-63.05)	41.35 M
100.0 MHz	500.0 MHz	1.000 MHz	---	(---)	---	---	(---)	---
100.0 MHz	500.0 MHz	1.000 MHz	---	(---)	---	---	(---)	---
100.0 MHz	500.0 MHz	1.000 MHz	---	(---)	---	---	(---)	---

Table Window in Rel Pwr Freq View

Name (Measurement Type)	Unit, if any	Corresponding Results
Power		n = 1 2nd element Absolute power at the reference area
Reference		In multi-carrier applications, this column displays which carrier is reference carrier
PSD Ref		n=5 1st element Power spectral density reference at the reference area
Spectrum Peak Ref		n = 5 1st element Spectrum peak power reference at the reference area
Measure Trace		See "Measure Trace" on page 1734
Start Freq	Hz	Start frequency for offset
Stop Freq	Hz	Stop frequency for offset
Integ BW	Hz	Measurement bandwidth for offset
Lower Peak (Total Pwr Ref, Spectrum Pk Ref)	dBc (Total Pwr Ref) dB (Spectrum Pk Ref)	Relative peak power on minimum margin point of the negative offset

Name (Measurement Type)	Unit, if any	Corresponding Results
Lower (PSD Ref)	dB	Relative power spectrum density of the negative offset
Lower ΔLim	dB	Minimum margin from limit line which is decided by Fail Mask setting on the negative offset
Lower Freq	Hz	Frequency on minimum margin point of the negative offset
Upper Peak (Total Pwr Ref, Spectrum Pk Ref)	dBc (Total Pwr Ref) dB (Spectrum Pk Ref)	Relative peak power on minimum margin point of the positive offset
Upper (PSD Ref)	dB	Relative power spectrum density of the positive offset
Upper ΔLim	dB	Minimum margin from limit line which is decided by Fail Mask setting on the positive offset
Upper Freq	Hz	Frequency on minimum margin point of the positive offset

When Measurement Type is Total Power Ref:

Modes other than MSR, LTE-Advanced FDD/TDD and 5G NR

2 Table

Power	Measure Trace
-75.54 dBm / 3.84 MHz	Trace 1

			Lower			Upper		
Start Freq	Stop Freq	Integ BW	dBc	ΔLimit(dB)	Freq (Hz)	dBc	ΔLimit(dB)	Freq (Hz)
2.515 MHz	2.715 MHz	30.00 kHz	-23.32	(-84.86)	-2.515 M	-22.02	(-83.56)	2.703 M
2.715 MHz	3.515 MHz	30.00 kHz	-21.35	(-71.38)	-3.483 M	-21.76	(-71.57)	3.498 M
3.515 MHz	4.000 MHz	30.00 kHz	-21.68	(-71.22)	-3.633 M	-22.23	(-71.77)	3.790 M
4.000 MHz	8.000 MHz	1.000 MHz	-8.29	(-70.83)	-6.488 M	-5.96	(-68.50)	5.900 M
8.000 MHz	12.50 MHz	1.000 MHz	-6.02	(-68.56)	-8.100 M	-6.17	(-68.71)	8.775 M
12.50 MHz	15.00 MHz	1.000 MHz	---	(---)	---	---	(---)	---
12.50 MHz	15.00 MHz	1.000 MHz	---	(---)	---	---	(---)	---

MSR, LTE-Advanced FDD/TDD and 5G NR

2 Table

Reference	Power	Measure Trace
Sub-block Left	-60.67 dBm / 99.97 MHz	Trace 1
Sub-block Right	-60.67 dBm / 99.97 MHz	

			Lower			Upper		
Start Freq	Stop Freq	Integ BW	dBc	ΔLimit(dB)	Freq (Hz)	dBc	ΔLimit(dB)	Freq (Hz)
50.00 kHz	5.050 MHz	102.0 kHz	-28.81	(-76.98)	-5.050 M	-28.69	(-76.99)	4.961 M
5.050 MHz	10.05 MHz	100.0 kHz	-27.13	(-75.30)	-9.275 M	-27.07	(-75.25)	6.200 M
10.50 MHz	40.00 MHz	1.000 MHz	40.24	(-5.43)	-14.80 M	-17.50	(-63.17)	16.30 M
40.00 MHz	100.0 MHz	1.000 MHz	-17.42	(-63.09)	-71.65 M	-17.24	(-62.91)	81.10 M
100.0 MHz	500.0 MHz	1.000 MHz	---	(---)	---	---	(---)	---
100.0 MHz	500.0 MHz	1.000 MHz	---	(---)	---	---	(---)	---

When Measurement Type is PSD Ref:

Modes other than MSR, LTE-Advanced FDD/TDD and 5G NR

2 Table	Power	PSD Ref	Measure Trace
	-75.32 dBm / 3.84 MHz	-141.16 dBm/Hz	Trace 1

			Lower			Upper		
Start Freq	Stop Freq	Integ BW	dB	ΔLimit(dB)	Freq (Hz)	dB	ΔLimit(dB)	Freq (Hz)
2.515 MHz	2.715 MHz	30.00 kHz	-3.38	(-82.66)	-2.553 M	-4.49	(-85.02)	2.680 M
2.715 MHz	3.515 MHz	30.00 kHz	-3.71	(-73.61)	-3.490 M	-3.79	(-73.81)	3.515 M
3.515 MHz	4.000 MHz	30.00 kHz	-3.79	(-71.26)	-3.588 M	-3.48	(-70.88)	3.865 M
4.000 MHz	8.000 MHz	1.000 MHz	-5.66	(-69.72)	-4.300 M	-5.37	(-71.05)	8.000 M
8.000 MHz	12.50 MHz	1.000 MHz	-4.17	(-69.03)	-11.44 M	-4.36	(-68.82)	12.50 M
12.50 MHz	15.00 MHz	1.000 MHz	---	(---)	---	---	(---)	---
12.50 MHz	15.00 MHz	1.000 MHz	---	(---)	---	---	(---)	---

MSR, LTE-Advanced FDD/TDD and 5G NR

2 Table	Reference	Power	PSD Ref	Measure Trace
	Sub-block Left	-60.58 dBm / 99.97 MHz	-140.58 dBm/Hz	Trace 1
	Sub-block Right	-60.58 dBm / 99.97 MHz	-140.58 dBm/Hz	

			Lower			Upper		
Start Freq	Stop Freq	Integ BW	dB	ΔLimit(dB)	Freq (Hz)	dB	ΔLimit(dB)	Freq (Hz)
50.00 kHz	5.050 MHz	102.0 kHz	0.72	(-77.17)	-5.050 M	0.72	(-77.34)	4.859 M
5.050 MHz	10.05 MHz	100.0 kHz	1.02	(-75.25)	-6.025 M	1.00	(-75.39)	6.450 M
10.50 MHz	40.00 MHz	1.000 MHz	46.32	(-5.39)	-14.80 M	0.90	(-62.81)	26.50 M
40.00 MHz	100.0 MHz	1.000 MHz	0.70	(-62.71)	-72.55 M	0.60	(-63.26)	67.00 M
100.0 MHz	500.0 MHz	1.000 MHz	---	(---)	---	---	(---)	---
100.0 MHz	500.0 MHz	1.000 MHz	---	(---)	---	---	(---)	---

When Measurement Type is Spectrum Pk Ref:

Modes other than MSR, LTE-Advanced FDD/TDD and 5G NR

2 Table	Power	Spectrum Peak Ref	Measure Trace
	-75.00 dBm / 3.84 MHz	-82.77 dBm	Trace 1

			Lower			Upper		
Start Freq	Stop Freq	Integ BW	dB	ΔLimit(dB)	Freq (Hz)	dB	ΔLimit(dB)	Freq (Hz)
2.515 MHz	2.715 MHz	30.00 kHz	-14.59	(-83.37)	-2.530 M	-15.11	(-83.88)	2.575 M
2.715 MHz	3.515 MHz	30.00 kHz	-15.41	(-72.22)	-3.513 M	-14.67	(-71.45)	3.515 M
3.515 MHz	4.000 MHz	30.00 kHz	-14.73	(-71.51)	-3.528 M	-12.62	(-69.39)	3.700 M
4.000 MHz	8.000 MHz	1.000 MHz	0.62	(-69.16)	-6.450 M	-0.56	(-70.33)	7.813 M
8.000 MHz	12.50 MHz	1.000 MHz	-0.34	(-70.12)	-11.18 M	0.72	(-69.05)	11.44 M
12.50 MHz	15.00 MHz	1.000 MHz	---	(---)	---	---	(---)	---

MSR, LTE-Advanced FDD/TDD and 5G NR

2 Table

Reference	Power	Spectrum Peak Ref	Measure Trace
Sub-block Left	-60.58 dBm / 99.97 MHz	-74.09 dBm	Trace 1
Sub-block Right	-60.58 dBm / 99.97 MHz	-74.09 dBm	

			Lower			Upper		
Start Freq	Stop Freq	Integ BW	dB	ΔLimit(dB)	Freq (Hz)	dB	ΔLimit(dB)	Freq (Hz)
50.00 kHz	5.050 MHz	102.0 kHz	-15.34	(-77.14)	-4.897 M	-15.66	(-77.27)	5.037 M
5.050 MHz	10.05 MHz	100.0 kHz	-13.91	(-75.50)	-5.475 M	-13.91	(-75.50)	7.775 M
10.50 MHz	40.00 MHz	1.000 MHz	53.62	(-5.47)	-14.80 M	-3.87	(-62.96)	18.85 M
40.00 MHz	100.0 MHz	1.000 MHz	-3.51	(-62.60)	-99.25 M	-3.65	(-62.74)	96.70 M
100.0 MHz	500.0 MHz	1.000 MHz	---	(---)	---	---	(---)	---
100.0 MHz	500.0 MHz	1.000 MHz	---	(---)	---	---	(---)	---

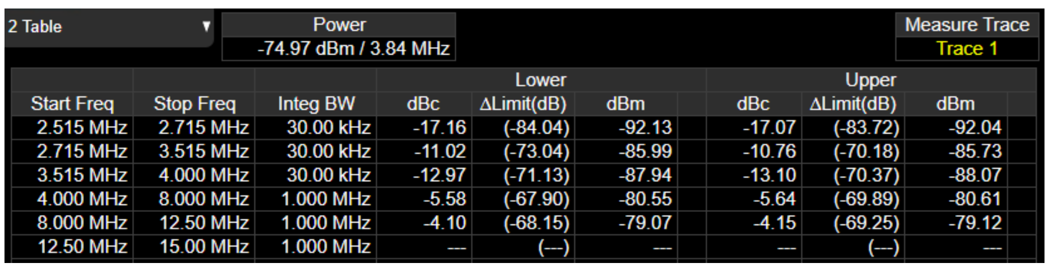
Table Window in Integrated Power View

Name (Measurement Type)	Unit, if any	Corresponding Results
Power		n = 1 2nd element Absolute power at the reference area
Reference		In multi-carrier applications, this column displays which carrier is reference carrier
PSD Ref		n = 5 1st element Power spectral density reference at the reference area
Spectrum Peak Ref		n = 5 1st element Peak power at the reference area
Measure Trace		See "Measure Trace" on page 1734
Start Freq	Hz	Start frequency for offset
Stop Freq	Hz	Stop frequency for offset
Integ BW	Hz	Measurement bandwidth for offset
Lower Integ (Total Power Ref)	dBc	Relative integrated power on the negative offset
Lower (PSD Ref)	dB	Relative power spectrum density of the negative offset
Lower Peak (Spectrum Pk Ref)	dB	Relative peak power on minimum margin point of the negative offset
Lower ΔLim	dB	Minimum margin from limit line which is decided by Fail Mask setting on the negative offset
Lower Integ (Total Power Ref)	dBm	Absolute integrated power on the negative offset
Lower (PSD Ref)	dBm/Hz	Absolute power spectrum density of the negative offset
Lower Peak (Spectrum Pk Ref)	dBm	Absolute peak power on minimum margin point of the negative offset
Upper Integ (Total Power Ref)	dBc	Relative integrated power on the positive offset

Name (Measurement Type)	Unit, if any	Corresponding Results
Upper (PSD Ref)	dB	Relative power spectrum density of the positive offset
Upper Peak (Spectrum Pk Ref)	dB	Relative peak power on minimum margin point of the positive offset
Upper ΔLim	dB	Minimum margin from limit line which is decided by Fail Mask setting on the positive offset
Upper Integ (Total Power Ref	dBm	Absolute integrated power on the positive offset
Upper (PSD Ref)	dBm/Hz	Absolute power spectrum density of the positive offset
Upper Peak (Spectrum Pk Ref)	dBm	Absolute peak power on minimum margin point of the positive offset

When Measurement Type is Total Power Ref:

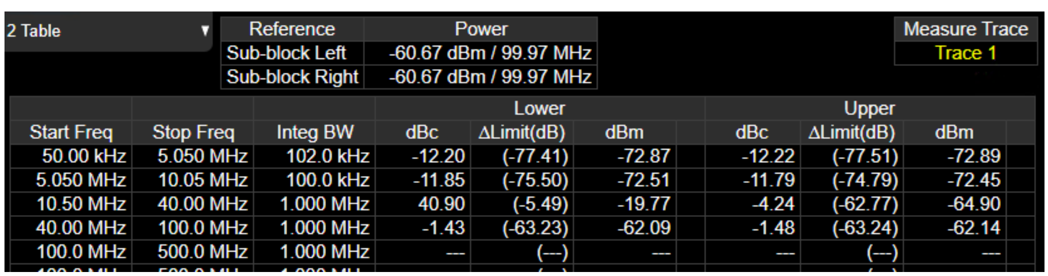
Modes other than MSR, LTE-Advanced FDD/TDD and 5G NR


2 Table

Power	Measure Trace
-74.97 dBm / 3.84 MHz	Trace 1

			Lower			Upper		
Start Freq	Stop Freq	Integ BW	dBc	ΔLimit(dB)	dBm	dBc	ΔLimit(dB)	dBm
2.515 MHz	2.715 MHz	30.00 kHz	-17.16	(-84.04)	-92.13	-17.07	(-83.72)	-92.04
2.715 MHz	3.515 MHz	30.00 kHz	-11.02	(-73.04)	-85.99	-10.76	(-70.18)	-85.73
3.515 MHz	4.000 MHz	30.00 kHz	-12.97	(-71.13)	-87.94	-13.10	(-70.37)	-88.07
4.000 MHz	8.000 MHz	1.000 MHz	-5.58	(-67.90)	-80.55	-5.64	(-69.89)	-80.61
8.000 MHz	12.50 MHz	1.000 MHz	-4.10	(-68.15)	-79.07	-4.15	(-69.25)	-79.12
12.50 MHz	15.00 MHz	1.000 MHz	---	(---)	---	---	(---)	---

MSR, LTE-Advanced FDD/TDD and 5G NR


2 Table

Reference	Power	Measure Trace
Sub-block Left	-60.67 dBm / 99.97 MHz	Trace 1
Sub-block Right	-60.67 dBm / 99.97 MHz	

			Lower			Upper		
Start Freq	Stop Freq	Integ BW	dBc	ΔLimit(dB)	dBm	dBc	ΔLimit(dB)	dBm
50.00 kHz	5.050 MHz	102.0 kHz	-12.20	(-77.41)	-72.87	-12.22	(-77.51)	-72.89
5.050 MHz	10.05 MHz	100.0 kHz	-11.85	(-75.50)	-72.51	-11.79	(-74.79)	-72.45
10.50 MHz	40.00 MHz	1.000 MHz	40.90	(-5.49)	-19.77	-4.24	(-62.77)	-64.90
40.00 MHz	100.0 MHz	1.000 MHz	-1.43	(-63.23)	-62.09	-1.48	(-63.24)	-62.14
100.0 MHz	500.0 MHz	1.000 MHz	---	(---)	---	---	(---)	---

When Measurement Type is PSD Ref:

Modes other than MSR, LTE-Advanced FDD/TDD and 5G NR

2 Table	Power	PSD Ref	Measure Trace
	-75.62 dBm / 3.84 MHz	-141.47 dBm/Hz	Trace 1

			Lower			Upper		
Start Freq	Stop Freq	Integ BW	dB	ΔLimit(dB)	dBm/Hz	dB	ΔLimit(dB)	dBm/Hz
2.515 MHz	2.715 MHz	30.00 kHz	-3.69	(-82.69)	-145.16	-3.85	(-83.76)	-145.32
2.715 MHz	3.515 MHz	30.00 kHz	-3.46	(-73.42)	-144.92	-3.53	(-71.41)	-145.00
3.515 MHz	4.000 MHz	30.00 kHz	-3.62	(-71.73)	-145.09	-3.32	(-70.57)	-144.79
4.000 MHz	8.000 MHz	1.000 MHz	-5.13	(-69.13)	-146.59	-5.20	(-69.79)	-146.66
8.000 MHz	12.50 MHz	1.000 MHz	-4.73	(-70.43)	-146.19	-4.20	(-69.28)	-145.67
12.50 MHz	15.00 MHz	1.000 MHz	---	(---)	---	---	(---)	---

MSR, LTE-Advanced FDD/TDD and 5G NR

2 Table	Reference	Power	PSD Ref	Measure Trace
	Sub-block Left	-60.69 dBm / 99.97 MHz	-140.69 dBm/Hz	Trace 1
	Sub-block Right	-60.69 dBm / 99.97 MHz	-140.69 dBm/Hz	

			Lower			Upper		
Start Freq	Stop Freq	Integ BW	dB	ΔLimit(dB)	dBm/Hz	dB	ΔLimit(dB)	dBm/Hz
50.00 kHz	5.050 MHz	102.0 kHz	0.86	(-76.90)	-139.83	0.89	(-77.15)	-139.80
5.050 MHz	10.05 MHz	100.0 kHz	1.08	(-75.27)	-139.61	1.07	(-75.63)	-139.62
10.50 MHz	40.00 MHz	1.000 MHz	46.46	(-5.39)	-94.23	0.92	(-63.00)	-139.77
40.00 MHz	100.0 MHz	1.000 MHz	0.80	(-63.20)	-139.89	0.77	(-62.95)	-139.92
100.0 MHz	500.0 MHz	1.000 MHz	---	(---)	---	---	(---)	---

When Measurement Type is Spectrum Pk Ref:

Modes other than MSR, LTE-Advanced FDD/TDD and 5G NR

2 Table	Power	Spectrum Peak Ref	Measure Trace
	-75.44 dBm / 3.84 MHz	-84.03 dBm	Trace 1

			Lower			Upper		
Start Freq	Stop Freq	Integ BW	dB	ΔLimit(dB)	dBm	dB	ΔLimit(dB)	dBm
2.515 MHz	2.715 MHz	30.00 kHz	-12.79	(-82.82)	-96.82	-13.07	(-83.10)	-97.10
2.715 MHz	3.515 MHz	30.00 kHz	-14.32	(-72.50)	-98.35	-15.22	(-73.62)	-99.25
3.515 MHz	4.000 MHz	30.00 kHz	-12.82	(-70.85)	-96.85	-12.95	(-70.98)	-96.98
4.000 MHz	8.000 MHz	1.000 MHz	0.61	(-70.42)	-83.42	0.58	(-70.45)	-83.45
8.000 MHz	12.50 MHz	1.000 MHz	2.05	(-68.98)	-81.98	-0.18	(-71.21)	-84.21
12.50 MHz	15.00 MHz	1.000 MHz	---	(---)	---	---	(---)	---
12.50 MHz	15.00 MHz	1.000 MHz	---	(---)	---	---	(---)	---

MSR, LTE-Advanced FDD/TDD and 5G NR

2 Table	Reference	Power	Spectrum Peak Ref	Measure Trace
	Sub-block Left	-60.52 dBm / 99.97 MHz	-73.53 dBm	Trace 1
	Sub-block Right	-60.52 dBm / 99.97 MHz	-73.53 dBm	

			Lower			Upper		
Start Freq	Stop Freq	Integ BW	dB	ΔLimit(dB)	dBm	dB	ΔLimit(dB)	dBm
50.00 kHz	5.050 MHz	102.0 kHz	-16.13	(-77.17)	-89.67	-15.70	(-76.91)	-89.23
5.050 MHz	10.05 MHz	100.0 kHz	-14.00	(-75.03)	-87.53	-14.14	(-75.17)	-87.67
10.50 MHz	40.00 MHz	1.000 MHz	53.13	(-5.40)	-20.40	-4.35	(-62.88)	-77.88
40.00 MHz	100.0 MHz	1.000 MHz	-4.44	(-62.97)	-77.97	-4.43	(-62.96)	-77.96
100.0 MHz	500.0 MHz	1.000 MHz	---	(---)	---	---	(---)	---
100.0 MHz	500.0 MHz	1.000 MHz	---	(---)	---	---	(---)	---

Table Window in Carrier Info View

Only available in MSR, LTE-Advanced FDD/TDD and 5G NR Modes. Carrier center frequency can be displayed in either offset or absolute frequency depending on Carrier Freq.

LTE-Advanced FDD/TDD has a different carrier info table from that in MSR in this view, which displays with measured component carrier powers and its power spectral density in the order of component carrier index in one of the view windows.

Name	Unit, if any	Corresponding Results
Total Carrier Power		The total power of all the carriers with carrier measure state set to yes. The power is calculated by integrating across the bandwidth declared by the Carrier Integ Bw parameter for each carrier and then totaling the sums. The total integration bandwidth is shown as part of the result. This will be the total of the Carrier Integ Bw of the carriers used in calculating the total carrier power. If the RRC Filter is on, then the integration bandwidth used is (1 + alpha)/T where T = 1/(Carrier Integ Bw) multiplied by the number of carriers with carrier measure state set to yes
RF-BW		Displays the total bandwidth from the lowest carrier to uppermost carrier
Carrier Power	dBm	The power in all the currently defined carriers with measure state is on. The power is calculated by integrating across the bandwidth declared by the Carrier Integ Bw parameter. The integration bandwidth is shown as part of the result. This is the value of the Carrier Integ Bw for the carrier unless the RRC Filter is on, then the integration bandwidth used is the displayed value, which is (1 + alpha)/T where T = 1/(Carrier Integ Bw)
Integration Bandwidth	Hz	Shows carrier transmission bandwidth
Filter		Displays whether RRC filter is used or not
Offset Frequency	Hz	Shows the offset frequency from the carrier reference frequency in multi-carrier measurements. The carrier frequency display type determines whether the relative frequency or absolute frequency will be displayed
Sub-block		Displays which sub-block the carrier belongs to in the intra-band non-contiguous aggregation mode. The column will be displayed when **Carrier Allocation** is Non-contiguous
Measure		Indicates whether the carrier power is present or not

MSR

2 Carrier Info

Total Car Pwr	-66.71 dBm / 22.575 MHz
Total PSD	---
RF-BW	5.000 MHz

	Ref Carrier Power
Carrier #1: Left	-73.70 dBm / 4.515 MHz
Carrier #---: Right	--- dBm / ---

	Carrier Power	Integ BW	Filter	Offset Freq	Measure	Parameter Set
1	-73.70 dBm	4.515 MHz	OFF	0.0000 Hz	On	
2	-73.70 dBm	4.515 MHz	OFF	0.0000 Hz	On	
3	-73.70 dBm	4.515 MHz	OFF	0.0000 Hz	On	
4	-73.70 dBm	4.515 MHz	OFF	0.0000 Hz	On	
5	-73.70 dBm	4.515 MHz	OFF	0.0000 Hz	On	

LTE-Advanced FDD/TDD and 5G NR

2 Carrier Info

Total Car Pwr	-49.83 dBm / 1.199280 GHz
Total PSD	---
RF-BW	99.970 MHz

Reference	Ref Power
Sub-block Left	-60.62 dBm / 99.97 MHz
Sub-block Right	-60.62 dBm / 99.97 MHz

	Carrier Power	Integ BW	Filter	Offset Freq	Sub-block	Measure
CC0	-60.62 dBm	100.000 MHz	OFF	0.0 Hz	1	On
CC1	-60.62 dBm	100.000 MHz	OFF	0.0 Hz	1	On
CC2	-60.62 dBm	100.000 MHz	OFF	0.0 Hz	1	On
CC3	-60.62 dBm	100.000 MHz	OFF	0.0 Hz	1	On
CC4	-60.62 dBm	100.000 MHz	OFF	0.0 Hz	1	On
CC5	-60.62 dBm	100.000 MHz	OFF	0.0 Hz	1	On

3.9.12.3 Gate

Allows you to see your Gating signal at the same time as the measured data. See the description under "Gate View On/Off" on page 2665 in **Trigger**, **Gate Settings**.

Views in which the **Gate** window appears:

View	Size	Position
Gate View	One third, full width	Top

3.9.13 Amplitude

Activates the **Amplitude** menu and selects **Reference Level** or **Reference Value** as the active function, depending on the measurement.

Some features in this menu apply to multiple measurements. Some other features apply only to specific measurements and their controls are blanked or grayed-out in measurements that do not support the feature.

3.9.13.1 Y Scale

Contains controls that pertain to the Y axis parameters of the measurement. These parameters control how data on the vertical (Y) axis is displayed and control instrument settings that affect the vertical axis.

Ref Value

Sets the value for the absolute power reference. The reference line is at the top, center, or bottom of the graticule, depending on the value of "Ref Position" on page 1544.

Remote Command	`:DISPlay:SEMask:WINDow[1]:TRACe:Y[:SCALe]:RLEVel <real>` `:DISPlay:SEMask:WINDow[1]:TRACe:Y[:SCALe]:RLEVel?`
Example	`:DISP:SEM:WIND:TRAC:Y:RLEV 100` `:DISP:SEM:WIND:TRAC:Y:RLEV?`
Couplings	When "Auto Scaling" on page 1544 is ON (default), this value is automatically determined by the measurement result. If you set a value manually, **Auto Scaling** changes to OFF Attenuation is not coupled to **Ref Value**
Preset	0.00 dBm
State Saved	Saved in instrument state
Min/Max	-250.00 dBm / 250.00 dBm
Annotation	Ref <value> top left of graph
Backwards Compatibility SCPI	`:DISPlay:SEMask:VIEW[1]:WINDow[1]:TRACe:Y[:SCALe]:RLEVel`

Scale/Div

For measurements that support a logarithmic Y-Axis, **Scale/Div** sets the height of one division of the graticule in the current Y-Axis unit.

Scale/Div also determines the displayed amplitude range in the log plot graph. Since there are usually 10 vertical graticule division on the display, the total amplitude range of the graph is typically 10x this amount. For example, if **Scale/Div** is 10 dB, then the total range of the graph is 100 dB.

Remote Command	`:DISPlay:SEMask:WINDow[1]:TRACe:Y[:SCALe]:PDIVision <rel_ampl>` `:DISPlay:SEMask:WINDow[1]:TRACe:Y[:SCALe]:PDIVision?`
Example	`:DISP:SEM:WIND:TRAC:Y:PDIV 15dB` `:DISP:SEM:WIND:TRAC:Y:PDIV?`

Couplings	When "Auto Scaling" on page 1544 is ON, this value is automatically determined by the measurement result. If you set a value manually, "Auto Scaling" on page 1544 automatically changes to OFF
Preset	10.00 dB / Div
State Saved	Saved in instrument state
Min	0.10 dB
Max	20 dB
Annotation	<value> dB/ left upper of graph
Backwards Compatibility SCPI	`:DISPlay:SEMask:VIEW[1]:WINDow[1]:TRACe:Y[:SCALe]:PDIVision`

Scale Range

Sets the Y-Axis scale range.

Remote Command	Replace `<meas>` with the identifier for the current measurement
	`:DISPlay:<meas>:WINDow[1]:TRACe:Y[:SCALe]:RANGe <rel_ampl>`
	`:DISPlay:<meas>:WINDow[1]:TRACe:Y[:SCALe]:RANGe?`

Example	`:DISP:CHP:WIND:TRAC:Y:RANG 100` `:DISP:CHP:WIND:TRAC:Y:RANG?`
Couplings	Coupled to **Scale/Div** as follows **Scale Range** = **Scale/Div** * 10 (number of divisions) When you change this value, **Auto Scaling** automatically changes to OFF
Preset	100 dB
State Saved	Saved in instrument state
Min	1
Max	200

Y Axis Unit

Displays a dropdown menu that enables you to change the vertical (Y) axis amplitude unit. This setting affects how the data is read over the remote interface. When using the remote interface, only numerical values are returned, so you must know what the Y Axis Unit is to interpret the results. This is described in more detail in "Amplitude Data Query and Y Axis Unit" on page 1541 below.

For measurements that support both Log and Lin scales, the instrument retains the entered Y Axis Unit separately for both Log and Lin amplitude Display Scales. For example, if Display Scale has been set to Log, and you set Y Axis Unit to dBm, pressing **Display Scale (Log)** sets the Y Axis Unit to dBm. If Display Scale has been set to Lin and you set Y Axis Unit to V, pressing **Display Scale (Lin)** sets the Y Axis Unit to V. Pressing **Display Scale (Log)** again sets the Y Axis Unit back to dBm.

If an Amplitude Correction is being applied that has an associated Transducer Unit, all selections but **Xducer Unit** are grayed-out. For more information, see "Transducer Unit" on page 1542 below.

Remote Command	`:UNIT:POWer DBM | DBMV | DBMA | V | W | A | DBUV | DBUA | DBPW | DBUVM | DBUAM | DBPT | DBG` `:UNIT:POWer?`

Example	`:UNIT:POW dBmV`
	`:UNIT:POW?`
	See also "Remote Interface Examples" on page 1540 below

Notes	The Y axis unit has either logarithmic or linear characteristics. The set of units that is logarithmic consists of dBm, dBmV, dBmA, dBmV, dBmA, dBmV/m, dBmA/m, dBpT, and dBG. The set of units that are linear consists of V, W, and A. The chosen unit will determine how the reference level and all the amplitude-related outputs like trace data, marker data, etc., read out
Dependencies	Appears only in Spectrum Analyzer Mode If an amplitude correction with a Transducer Unit other than None is applied and enabled: – The Transducer Unit selection is forced, and is the only Y Axis Unit available. The specific Transducer Unit is shown in square brackets in the dropdown, and all other Y Axis Unit choices are grayed-out – If you turn off that correction or set Apply Corrections to NO, the Y Axis Unit that existed before the Transducer Unit was applied is restored When Normalize is ON (in the **Trace**, **Normalize** menu), Y Axis Unit is grayed-out, and forced to dBm
Couplings	The instrument retains the entered Y Axis Unit separately for both Log and Lin amplitude Display Scales
Preset	dBm for log scale, V for linear. The true ‘preset’ value is dBm, since at preset the Y Display Scale is set to logarithmic
State Saved	Saved in instrument state
Annotation	The Y Axis Unit is shown after Ref Level value at the top of the graticule

Unit	Example	Notes
dBm	`:UNIT:POW DBM`	Y Axis Unit is set to dBm
dBmV	`:UNIT:POW DBMV`	Y Axis Unit is set to dBmV
dBmA	`:UNIT:POW DBMA`	Y Axis Unit is set to dBmA
W	`:UNIT:POW W`	Y Axis Unit is set to W
V	`:UNIT:POW V`	Y Axis Unit is set to V
A	`:UNIT:POW A`	Y Axis Unit is set to A
dBmV	`:UNIT:POW`	Y Axis Unit is set to dBmV

Unit	Example	Notes
	DBUV	
dBmA	:UNIT:POW DBUA	Y Axis Unit is dBmA. The unit dBuA can also appear as a Transducer Unit
dBpW	:UNIT:POW DBPW	Y Axis Unit is set to dBpW

Remote Interface Examples

Command examples and details appear in the table below. Note that each of the commands below sets the amplitude unit only for the *selected* amplitude scale (Log or Lin), the other scale is unaffected.

Unit	Example	Notes
dBm	:UNIT:POW DBM	dB relative to one milliwatt
dBmV	:UNIT:POW DBMV	dB relative to one millivolt
dBmA	:UNIT:POW DBMA	dB relative to one milliamp
W	:UNIT:POW W	Watts
V	:UNIT:POW V	Volts
A	:UNIT:POW A	Amperes
dBmV	:UNIT:POW DBUV	dB relative to one microvolt
dBmA	:UNIT:POW DBUA	dB relative to one microamp The unit dBuA can also appear as a "Transducer Unit" on page 1542 When querying the Y-Axis unit, you can query the Transducer Unit to distinguish between regular dBuA and the dBuA transducer unit. If :CORR:CSET:ANT? returns NOC (for No Conversion), you are using a normal Y Axis dBuA. If it returns UA, you are using a Transducer Unit dBuA
dBpW	:UNIT:POW DBPW	dB relative to one picowatt
dBmV/m (Transducer Unit)	:UNIT:POW DBUVM	Sets the amplitude unit for the selected amplitude scale (log/lin) to dBmV/meter. This selection is only available if a Correction is turned on, and the Transducer Unit for that Correction is not None See "Transducer Unit" on page 1542
dBmA/m (Transducer Unit)	:UNIT:POW DBUAM	Sets the amplitude unit for the selected amplitude scale (log/lin) to dBmA/meter. This selection is only available if a Correction is turned on, and the Transducer Unit for that Correction is not None See "Transducer Unit" on page 1542
dBpT (Transducer Unit)	:UNIT:POW DBPT	Sets the amplitude unit for the selected amplitude scale (log/lin) to dBpT (dB relative to one picotesla). This selection is only available if a Correction is turned on, and the Transducer Unit for that Correction is not None

Unit	Example	Notes
		See "Transducer Unit" on page 1542
dBG (Transducer Unit)	`:UNIT:POW DBG`	Sets the amplitude unit for the selected amplitude scale (log/lin) to dBG (dB relative to one Gauss). This selection is only available if a Correction is turned on, and the Transducer Unit for that Correction is not None See "Transducer Unit" on page 1542
dBmA (Transducer Unit)	`:UNIT:POW DBUA`	Sets the amplitude unit for the selected amplitude scale (log/lin) to dBmA. This selection is only available as a Transducer Unit if a Correction is turned on, and the Transducer Unit for that Correction is not None See "Transducer Unit" on page 1542 The unit dBuA can also appear as a normal Y Axis Unit (see above) dBuA as a Transducer Unit is used when using current probes, because current probes are often supplied with conversion tables that provide the transducer factors. When dBuA is used as a Transducer Unit, the normal conversion from power to amps for dBuA (based on the instrument input impedance) is not done, but instead the conversion is based solely on the Correction that contains the transducer factors. This is what distinguishes dBuA as a normal unit from dBuA as a transducer unit When querying the Y-Axis unit, you can query the Transducer Unit to distinguish between regular dBuA and the dBuA Transducer Unit. If `:CORR:CSET:ANT?` returns `NOC` (for No Conversion), you are using a normal Y-Axis dBuA. If it returns `UA`, you are using a Transducer Unit dBuA

Amplitude Data Query and Y Axis Unit

The settings of Y-Axis Unit and Display Scale affect how the data is returned over the remote interface in response to a query. When using the remote interface, no unit is returned, so you must know what the Y-Axis unit is to interpret the results:

Example 1

Set the following:

- Display Scale (Log)
- Y Axis Unit, dBm
- Scale/Div, 1 dB
- Ref Level, 10 dBm

This sets the top line to 10 dBm with each vertical division representing 1 dB. Thus, if a point on trace 1 is on the fifth graticule line from the top, it represents 5 dBm and will read out remotely as 5.

Example 2

Set the following:

– Display Scale (Lin)

– Y Axis Unit, Volts

– Ref Level, 100 mV (10 mV/div)

This sets the top line to 100 mV and the bottom line to 0 V, so each vertical division represents 10 mV. Thus, if a point on trace 1 is on the fifth graticule line from the top, it represents 50 mV and will read out remotely as 50.

NOTE **The units of current (A, dBmA, dBuA) are calculated based on 50 Ω input impedance.**

Transducer Unit

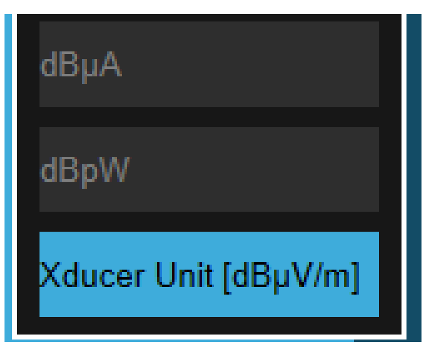
Transducer Units (formerly called Antenna Units) are units of field strength rather than amplitude, and are used when correcting the response of device such as antennas whose amplitude characteristics are measured in units of field strength. All five of the Transducer Units (dBmA/m, dBmV/m, dBG, dBpT, dBmA) are treated by the instrument exactly as though they were dBmV, when uncorrected. You must load an appropriate correction factor using Input/Output, Corrections for accurate and meaningful results.

If a remote command is sent to the instrument that uses one of the Transducer Units as a terminator, the instrument treats it as though DBUV had been sent as the terminator.

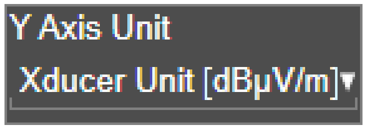
When a Correction is turned on that uses a Transducer Unit, the Y Axis Unit changes to that Transducer Unit. All of the selections in the **Y-Axis Unit** dropdown are then grayed-out, except the Transducer Unit selection. The unit being used is shown on this selection in square brackets, and appears on the control in square brackets preceded by **Xducer Unit**.

Example:

If the Transducer Unit in the Correction is dBmV/m, then the selection in the dropdown looks like this:



And on the control it looks like this:



NOTE If a Transducer Unit is set, it is displayed as **Xducer Unit** in the **Y Axis Unit** dropdown. However, you can only *change* the Transducer Unit via the **Edit Correction** dialog in the **Input/Output**, **Corrections** menu. In that dialog, tap **Settings** then **Transducer Unit**. You can also turn off Transducer Unit from the same menu, by selecting **None**.

If a Transducer Unit is set, it is displayed as **Xducer Unit** in the **Y Axis Unit** dropdown. However, you can only *change* the Transducer Unit via the **Edit Correction** dialog in the **Input/Output**, **Corrections** menu. In that dialog, tap **Settings** then **Transducer Unit**. You can also turn off Transducer Unit from the same menu, by selecting **None**.

The Transducer Units are:

Units	Example
dBmV/m	`:UNIT:POW DBUVM`
dBmA/m	`:UNIT:POW DBUAM`
dBpT	`:UNIT:POW DBPT`
dBG	`:UNIT:POW DBG`
dBmA	`:UNIT:POW DBUA`
None	n/a

Ref Level Offset

Adds an offset value to the displayed reference level. The reference level is the absolute amplitude represented by the top graticule line on the display.

The on/off switch turns **Ref Level Offset** on or off. Setting a value for **Ref Level Offset** turns it ON.

For more on using offsets, see "Reference Level Offset" on page 208.

Remote Command	`:DISPlay:WINDow[1]:TRACe:Y[:SCALe]:RLEVel:OFFSet <rel_ampl>`
	`:DISPlay:WINDow[1]:TRACe:Y[:SCALe]:RLEVel:OFFSet?`
	`:DISPlay:WINDow[1]:TRACe:Y[:SCALe]:RLEVel:OFFSet:STATe OFF | ON | 0 | 1`
	`:DISPlay:WINDow[1]:TRACe:Y[:SCALe]:RLEVel:OFFSet:STATe?`

Example	Set the Ref Level Offset to 12.7 dB. The only valid suffix is dB. If no suffix is sent, dB will be assumed:

	:DISP:WIND:TRAC:Y:RLEV:OFFS 12.7 :DISP:WIND:TRAC:Y:RLEV:OFFS? :DISP:WIND:TRAC:Y:RLEV:OFFS:STAT ON Turns the Ref Level Offset On
Dependencies	This control appears only in Spectrum Analyzer Mode
Preset	0 dBm OFF
State Saved	Saved in instrument state
Min	The range for **Ref Lvl Offset** is variable. It is limited to values that keep the reference level within the range of -327.6 dB to 327.6 dB
Max	327.6 dB
Annotation	The offset is displayed as “Ref Offset <value>” to the right of the reference level annotation if nonzero. When the offset is zero, no annotation is shown

Ref Position

Positions the reference level at the top, center, or bottom of the Y Scale display. Changing the reference position does not change "Ref Value" on page 1537.

Remote Command	:DISPlay:SEMask:WINDow[1]:TRACe:Y[:SCALe]:RPOSition TOP | CENTer | BOTTom :DISPlay:SEMask:WINDow[1]:TRACe:Y[:SCALe]:RPOSition?
Example	:DISP:SEM:WIND:TRAC:Y:RPOS CENT :DISP:SEM:WIND:TRAC:Y:RPOS?
Preset	TOP
State Saved	Saved in instrument state
Range	TOP|CENTer|BOTTom
Annotation	The greater than (>) and less than (<) symbols are displayed on both sides of the graph to indicate the Reference Position
Backwards Compatibility SCPI	:DISPlay:SEMask:VIEW[1]:WINDow[1]:TRACe:Y[:SCALe]:RPOSition

Auto Scaling

Toggles **Auto Scaling** On or Off.

Remote Command	:DISPlay:SEMask:WINDow[1]:TRACe:Y[:SCALe]:COUPle 0 | 1 | OFF | ON :DISPlay:SEMask:WINDow[1]:TRACe:Y[:SCALe]:COUPle?
Example	:DISP:SEM:WIND:TRAC:Y:COUP OFF

	`:DISP:SEM:WIND:TRAC:Y:COUP?`
Couplings	When **Auto Scaling** is `ON`, and the **Restart** front-panel key is pressed, this function automatically sets the scale per division to 10 dB and determines the reference values based on the measurement results When you set the value of either **Scale/Div**, **Ref Value**, or **Scale Range** manually, **Auto Scaling** automatically changes to `OFF`
Preset	1
State Saved	Saved in instrument state
Range	`OFF|ON`
Backwards Compatibility SCPI	`:DISPlay:SEMask:VIEW[1]:WINDow[1]:TRACe:Y[:SCALe]:COUPle`

3.9.13.2 Attenuation

Controls the attenuator functions and interactions between the attenuation system components.

There are two attenuator configurations in the X-Series. One is a Dual-Attenuator configuration consisting of a mechanical attenuator and an optional electronic attenuator. The other configuration uses a single attenuator with combined mechanical and electronic sections that controls all the attenuation functions. Different models in the X-Series come with different configurations.

- See "Dual-Attenuator Configurations" on page 1545
- See "Single-Attenuator Configuration" on page 1546

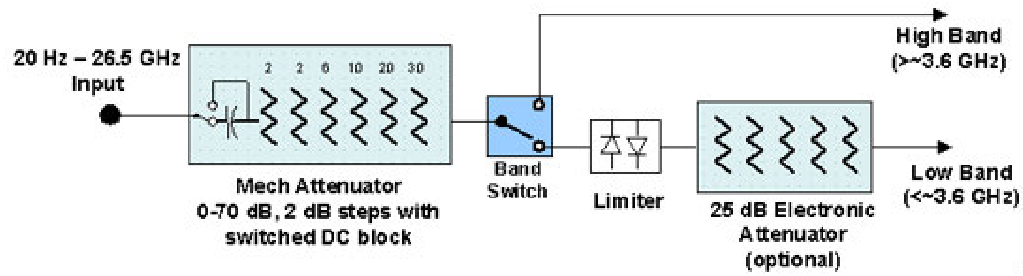
Most attenuation settings are the same for all measurements – they do not change as you change measurements. Settings like these are called “Meas Global” and are unaffected by **Meas Preset**.

Only available when the hardware set includes an input attenuator, which is typically only the case for Keysight’s benchtop instruments. For example, this tab does *not* appear in VXT models M9421A/10A/11A, nor in UXM. In UXM, all **Attenuation** and **Range** settings are disabled, as the expected input power level is handled by the Call Processing App that drives the DUT power control.

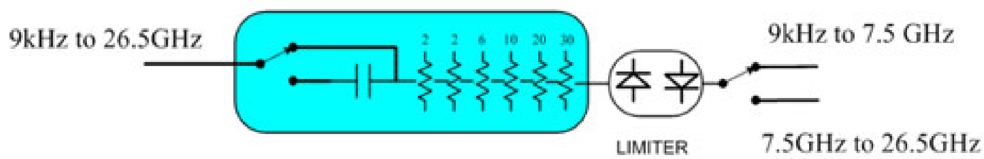
Dependencies	In measurements that support the I/Q inputs, unavailable when I/Q is the selected input. Replaced by the **Range** tab in that case

Dual-Attenuator Configurations

Configuration 1: Mechanical attenuator + optional electronic attenuator

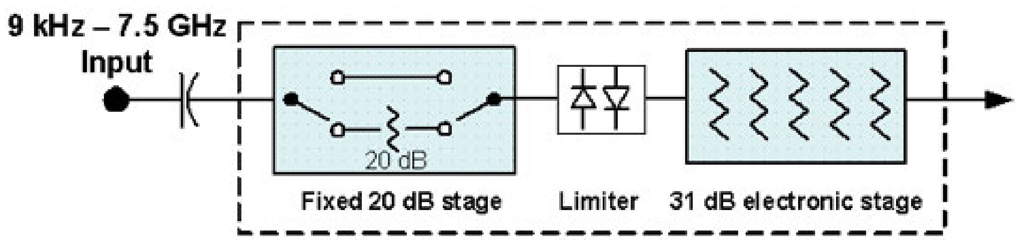


Configuration 2: Mechanical attenuator, no optional electronic attenuator

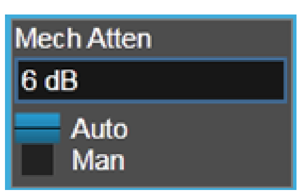


Note that Configuration 2 is not strictly speaking a dual-section attenuator, since there is no electronic section available. However, it behaves exactly like Configuration 1 without the Electronic Attenuator Option EA3, therefore for the sake of this document it is grouped into the “Dual-Attenuator” configuration.

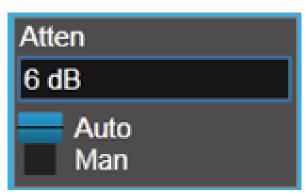
Single-Attenuator Configuration



You can tell which attenuator configuration you have by pressing the Attenuation tab, which (in most Modes) opens the Attenuation menu. If the first control in the Attenuation menu says **Mech Atten** you have the Dual-Attenuator configuration. If the first control says **Atten** you have the Single-Attenuator configuration.



Dual Attenuator



Single Attenuator

(Note that depending on the measurement, there may be no Auto/Man functionality on the Mech Atten control.)

In the Single-Attenuator configuration, you control the attenuation with a single control, as the fixed stage has only two states. In the Dual-Attenuator configuration, both stages have significant range, so you are given separate control of the mechanical and electronic attenuator stages.

When you have the Dual-Attenuator configuration, you may still have only a Single-Attenuator, because unless Option EA3 (the Electronic Attenuator option) is available, and you purchase it, you will have only the mechanical attenuator.

Full Range Atten

This control and **Attenuator Summary** only appear in N9041B, when the RF input is selected, the RF Input Port is set to RF Input 2, and the Full Range Attenuator is installed. The Full Range Attenuator adds a second input attenuator in front of RF Input 2, which enhances the protection and optimizes the performance of the extra internal mixers used by RF Input 2.

Remote Command	`[:SENSe]:POWer[:RF]:FRATten <rel_ampl>` `[:SENSe]:POWer[:RF]:FRATten?`
Example	`:POW:FRAT 14` `:POW:FRAT?`
Notes	When you enter an amplitude value that falls between valid values, the value will be incremented to the next smallest valid value
Dependencies	Only appears if input RF is selected, RF Input Port 2 is selected, and the Full Range Attenuator exists
Couplings	This value is never changed by any coupling, but other couplings use this value. See **Reference Level** and "Mech Atten" on page 1935 command descriptions
Preset	20 dB
State Saved	Saved in instrument state
Min	0 dB
Max	Only valid values are 0, 6, 14, 20 dB
Annotation	When the **Input** is **RF**, and the **Input Port** is **RF Input 2**, and the Full Range Attenuator is installed: On the Meas Bar, the field “Atten” displays as follows: – If the sweep is entirely < 50 GHz, the value shown after “Atten:” is equal to Mech Atten + Elec Atten + Full Range Atten – If the sweep is entirely > 50 GHz, the value shown after “Atten:” is equal to Full Range Atten – If the sweep straddles 50 GHz, the value shown after “Atten:” is preceded by the symbol “>=” and is equal to Full Range Atten

In the **Amplitude**, "Y Scale" on page 1929 menu, and the Atten **Meas Bar** dropdown menu panel, a summary is displayed as follows:

"Total Atten below 50 GHz" followed by the value of Full Range Atten + Mech Atten + Elec Atten

"Total Atten above 50 GHz" followed by the value of Full Range Atten

For example, if Mech Atten = 6 dB, Elec Atten = 4 dB, and Full Range Atten = 20 dB, the summary below is shown:

- Attenuator summary:
- Total Atten below 50 GHz: 30 dB
- Total Atten above 50 GHz: 20 dB

Mech Atten

Labeled **Mech Atten** in Dual-Attenuator models and **Atten** in Single-Attenuator models. In the Dual-Attenuator configuration, this control only affects the mechanical attenuator.

Lets you modify the attenuation applied to the RF input signal path. This value is normally auto-coupled to the Ref Level, the Internal Preamp Gain, any External Gain that is entered, and the Max Mixer Level, as described in the table below.

See "Attenuator Configurations and Auto/Man" on page 1550

Remote Command	`[:SENSe]:POWer[:RF]:ATTenuation <rel_ampl>`
	`[:SENSe]:POWer[:RF]:ATTenuation?`
	`[:SENSe]:POWer[:RF]:ATTenuation:AUTO OFF | ON | 0 | 1`
	`[:SENSe]:POWer[:RF]:ATTenuation:AUTO?`

Example	`:POW:ATT 20`
	Dual-Attenuator configuration: sets the mechanical attenuator to 20 dB
	Single-Attenuator mode: sets the main attenuation to 20 dB (see below for definition of "main" attenuation)
	In either case, if the attenuator was in Auto, it is set to Manual
	`:POW:ATT:AUTO ON`
	Turn Auto Mech Atten ON

Dependencies	Some measurements do not support Auto setting of "Mech Atten" on page 1548. In these measurements, the **Auto/Man** selection is not available, and the Auto/Man toggle function is not available In Dual-Attenuator configurations, when the electronic attenuator is enabled, the mechanical attenuator has no auto setting, and the Auto/Man toggle function is not available. The state of Auto/Man is remembered and restored when the electronic attenuator is once again disabled. This is described in more detail in "Elec Atten" on page 1937 See "Attenuator Configurations and Auto/Man" on page 1550 for more information on the Auto/Man

	functionality `:POW:ATT:AUTO` is only available in measurements that support Mech Atten Auto, such as Swept SA
Couplings	If the RF Input Port is the RF Input: – If the USB Preamp is connected to USB, use 0 dB for Mech Atten – Otherwise compute the auto-selected value of Mech Atten based on **Reference Level**, Int Preamp, External Gain, Ref Level Offset, Max Mixer Level, µW Path Control and IF Gain settings. Limit this value to be no less than 6 dB (total attenuation below 6 dB can never be chosen by Auto) – In the N9041B, if the RF Input Port is RF Input 2, use the formula above and subtract the Full Range Atten value from the result to determine the Mech Atten. Limit the value so that it is never lower than 0 dB and so that total attenuation, including Full Range Atten, is never less than 6 dB (total attenuation, including Full Range Atten below 6 dB, can never be chosen by Auto) In External Mixing and BBIQ, where the Attenuator is not in the signal path, the Attenuator setting changes as described above when "Mech Atten" on page 1548 is in Auto, but no changes are made to the actual attenuator hardware setting until the input is changed back to the RF Input For CXA-m with option FSA (Fine-Step Attenuator or 2 dB steps), the FSA-like behavior is only available when the frequency setting is <= 7.5 GHz. So, when the frequency is changed from below 7.5 GHz to above 7.5 GHz, the attenuation setting will be changed to a multiple of 10 dB which will be no smaller than the previous setting. For example, 4 dB attenuation will be changed to 10 dB
Preset	The preset for Mech Attenuation is "Auto" The Auto value of attenuation is 10 dB `ON`
State Saved	Saved in instrument state
Min	0 dB The attenuation set by this control cannot be decreased below 6 dB with the knob or step keys. Values below 6 dB must be directly entered from the keypad or via SCPI. This protects against setting a dangerously small attenuation value, which can put the instrument at risk of damage to input circuitry. If the current mechanical attenuation is below 6 dB, it can be increased with the knob and step keys, but not decreased
Max	CXA Option 503 or 507: 50 dB EXA: 60 dB All other models: 70 dB Note that in the Single-Attenuator configuration, the total of ATT and EATT cannot exceed 50 dB. So, if the EATT is set to 24 dB first, the main attenuation cannot be greater than 26 dB and will be reduced accordingly; if the main attenuator is set to 40 dB first, EATT cannot be greater than 10 dB
Annotation	The current value for Total Atten is displayed in the Measurement Bar at the top of the display. A value appears for Electronic Attenuation only if the Electronic Attenuator is enabled. The annotation appears as Atten: <total> dB (e<elec>) The e letter is in amber in Single-Attenuator configurations For example:

Dual-Attenuator configuration:

Atten: 24 dB (e14)

Indicating the total attenuation is at 24 dB and the electronic attenuation is at 14 dB

Single-Attenuator configuration:

A: 24 dB (e14)

Indicating the total attenuation is at 24 dB and the “soft” attenuation is at 14 dB (see below for definition of “soft” attenuation)

When in Manual, a # sign appears in front of Atten in the annotation

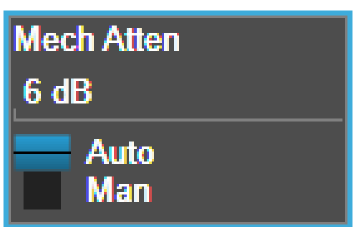
Attenuator Configurations and Auto/Man

As described under "Y Scale" on page 1929, there are two distinct attenuator configurations available in the X-Series, the single attenuator and Dual-Attenuator configurations. In Dual-Attenuator configurations, we have the mechanical attenuation and the electronic attenuation, and the current total attenuation is the sum of the electronic + mechanical attenuation. In Single-Attenuator configurations, we refer to the attenuation set using "Mech Atten" on page 1548 (or `:POW:ATT`) as the “main” attenuation; and the attenuation that is set by `:POW:EATT` as the “soft” attenuation (`:POW:EATT` is honored even in the Single-Attenuator configuration, for compatibility purposes). Then the current total attenuation is the sum of the main + soft attenuation.

See "Elec Atten" on page 1937 for more about “soft” attenuation.

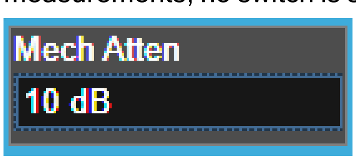
NOTE

In some measurements, the **Mech Atten** control has an Auto/Man function. In these measurements, an Auto/Man switch is shown on the **Mech Atten** control:



Note that in configurations that include an Electronic Attenuator, this switch is only shown when the Electronic Attenuator is disabled.

In other measurements, **Mech Atten** has no Auto/Man function. In these measurements, no switch is shown on the **Mech Atten** control:



Mech Atten also appears with no switch, as above, in configurations that include an Electronic Attenuator but when the Electronic Attenuator is enabled.

Elec Atten

Controls the Electronic Attenuator in Dual-Attenuator configurations. Does not appear in Single-Attenuator configurations, because the control of both the mechanical and electronic stages of the Single-Attenuator is integrated into the single **Atten** control.

This control includes an **Enable/Disable** toggle switch; it is only possible to enter a value for the Electronic Attenuator when this switch is in the **Enable** position.

For more details about the Electronic Attenuator, see "More Information" on page 1552

Remote Command	`[:SENSe]:POWer[:RF]:EATTenuation <rel_ampl>`
	`[:SENSe]:POWer[:RF]:EATTenuation?`
	`[:SENSe]:POWer[:RF]:EATTenuation:STATe OFF | ON | 0 | 1`
	`[:SENSe]:POWer[:RF]:EATTenuation:STATe?`

Example	`:POW:EATT 10`
	`:POW:EATT?`
	`:POW:EATT:STAT ON`
	`:POW:EATT:STAT?`

Notes	Electronic Attenuation's specification is defined only when Mechanical Attenuation is 6 dB
Dependencies	Only appears in Dual-Attenuator models with an Electronic Attenuator installed and licensed. Does not appear in models with the Single-Attenuator configuration, because in the Single-Attenuator configuration there is no "electronic attenuator"; there is only a single integrated attenuator (which has both a mechanical and electronic stage). However, in the Single-Attenuator configuration, EATT SCPI commands are accepted for compatibility with other X-series instruments, and set a "soft" attenuation. The "soft" attenuation is treated as an addition to the "main" attenuation value set by the **Attenuation** control or `:POW:ATT`, and affects the total attenuation displayed on the **Attenuation** control and the Meas Bar The electronic attenuator, and the "soft" attenuation function provided in Single-Attenuator configurations, are unavailable above the low band (0-3.6 GHz, 0-3.4 GHz, 0-3 GHz, depending on the model). If the low band range is from 0-3.6 GHz, and Stop Frequency of the instrument is > 3.6 GHz, then the **Enabled/Disabled** section of the **Elec Atten** control will be `OFF` and grayed-out If "Internal Preamp" on page 1959 is `ON` (that is, set to Low Band or Full), the electronic attenuator (and the "soft" attenuation function provided in Single-Attenuator configurations) is unavailable. In this case the **Enabled/Disabled** section of the **Elec Atten** control will be `OFF` and grayed-out If either of the above is true, and the SCPI command is sent, an error indicating that the electronic attenuator is unavailable is returned If both the above are true, pressing the control generates error message -221, in other words, the frequency range lockout takes precedence If the electronic/soft Attenuator is enabled, then the **Stop Freq** of the instrument is limited to 3.6 GHz and **Internal Preamp** is unavailable

	If "LNA" on page 1960 is ON, the electronic attenuator (and the "soft" attenuation function provided in Single-Attenuator configurations) is unavailable. In this case the **Enabled/Disabled** section of the **Elec Atten** control will be OFF and grayed-out. This coupling works in the following modes/measurements: – Channel Power, Occupied BW, ACP, SEM, Spurious Emissions, Power Stat CCDF measurements in all Modes – Transmit On|Off Power measurement in 5GNR Mode – Power vs. Time and Transmit Power measurement in GSM/EDGE Mode – Burst Power measurement in Spectrum Analyzer Mode The SCPI-only "soft" electronic attenuation for the single-attenuator configuration is not available in all measurements; in particular, it is not available in the Swept SA measurement
Couplings	Enabling and disabling the Electronic Attenuator affects the setting of the Mechanical Attenuator (in Dual-Attenuator configurations). This is described in more detail below and in "Mechanical Attenuator Transition Rules" on page 1552
Preset	0 dB OFF (Disabled) for Swept SA measurement ON (Enabled) for all other measurements that support the electronic attenuator
State Saved	Saved in instrument state
Min	0 dB
Max	Dual-Attenuator configuration: 24 dB Single-Attenuator configuration: the total of ATT and EATT cannot exceed 50 dB. So, if the EATT is set to 24 dB first, the main attenuation cannot be greater than 26 dB and will be reduced accordingly; if the main attenuator is set to 40 dB first, EATT cannot be greater than 10 dB
Annotation	See Annotation under the **Mech Atten** control description

More Information

The electronic attenuator offers finer steps than the mechanical attenuator, has no acoustical noise, is faster, and is less subject to wear. These advantages primarily aid in remote operation and are negligible for front panel use. See "Using the Electronic Attenuator: Pros and Cons" on page 1553 for a detailed discussion of the pros and cons of using the electronic attenuator.

For the Single-Attenuator configuration, for SCPI backwards compatibility, the "soft" attenuation feature replaces the Dual-Attenuator configuration's electronic attenuator. All the same couplings and limitations apply. See "Attenuator Configurations and Auto/Man" on page 1937

Mechanical Attenuator Transition Rules

When the Electronic Attenuator is enabled, the Mechanical Attenuator transitions to a state that has no Auto function. Below are the rules for transitioning the Mechanical Attenuator. Note that the information below *only* applies to the Dual-

Attenuator configurations, and *only* when the Electronic Attenuator is installed:

When the Electronic Attenuation is enabled from a disabled state:

- The Mechanical Attenuator is initialized to 10 dB (this is its optimal performance setting). You can then set it as desired with SCPI, numeric keypad, step keys, or knob, and it behaves as it normally would in manual mode
- The Auto/Man state of (Mech) Atten is saved
- The Auto/Man toggle on the (Mech) Atten control disappears, and the auto rules are disabled
- The Electronic Attenuator is set to 10 dB less than the previous value of the Mechanical Attenuator, within the limitation that it must stay within the range of 0 to 24 dB of attenuation

Examples in the Dual-Attenuator configuration:

- Mech Atten at 20 dB. Elec Atten enabled, Mech Atten set to 10 dB, and Elec Atten set to 10 dB. New total attenuation equals the value before Elec Atten enabled
- Mech Atten at 0 dB. Elec Atten enabled, Mech Atten set to 10 dB, and Elec Atten set to 0 dB. New total attenuation does not equal the value before Elec Atten enabled
- Mech Atten at 40 dB. Elec Atten enabled, Mech Atten set to 10 dB, and Elec Atten set to 24 dB. New total attenuation does not equal the value before Elec Atten enabled

When the Electronic Attenuation is disabled from an enabled state:

- The Elec Atten control is grayed out
- The Auto/Man state of (Mech) Atten is restored
- If now in Auto, (Mech) Atten recouples
- If now in Man, (Mech) Atten is set to the value of total attenuation that existed before the Elec Atten was disabled. The resulting value is rounded up to the smallest value possible given the (Mech) Atten Step setting - (That is, 57 dB changes to 58 dB when (Mech) Atten Step is 2 dB)

Using the Electronic Attenuator: Pros and Cons

The electronic attenuator offers finer steps than the mechanical attenuator, has no acoustical noise, is faster, and is less subject to wear.

The “finer steps” advantage of the electronic attenuator is beneficial in optimizing the alignment of the instrument dynamic range to the signal power in the front panel as well as remote use. Thus, you can achieve improved relative signal measurement accuracy. Compared to a mechanical attenuator with 2 dB steps, the 1 dB resolution of the electronic attenuator only gives better resolution when the odd-decibel steps are used. Those odd-decibel steps are less accurately calibrated than the even-decibel steps, so one tradeoff for this superior relative accuracy is reduced absolute amplitude accuracy.

Another disadvantage of the electronic attenuator is that the spectrum analyzer loses its “Auto” setting, making operation less convenient.

Also, the relationship between the dynamic range specifications (TOI, SHI, compression, and noise) and instrument performance are less well-known with the electrical attenuator. With the mechanical attenuator, TOI, SHI, and compression threshold levels increase dB-for-dB with increasing attenuation, and the noise floor does as well. With the electronic attenuator, there is an excess attenuation of about 1 to 3 dB between 0 and 3.6 GHz, making the effective TOI, SHI, and so forth, less well known. Excess attenuation is the actual attenuation relative to stated attenuation. Excess attenuation is accounted for in the instrument calibration.

Adjust Atten for Min Clipping

Sets the combination of mechanical and electronic attenuation and gain based on the current measured signal level so that clipping will be at a minimum.

This is an immediate action function, that is, it executes once, when the control is pressed.

The algorithms that are used for the adjustment are documented under "Pre-Adjust for Min Clipping" on page 1942.

Remote Command	`[:SENSe]:POWer[:RF]:RANGe:OPTimize IMMediate`
Example	`:POW:RANG:OPT IMM`
Notes	Executing **Adjust Atten for Min Clipping** initiates the measurement
Dependencies	Does not appear in the Swept SA, RTSA, Monitor Spectrum and Complex Spectrum measurements Appears in the Waveform measurement in 5G NR Mode only

Adjust Atten

Allows you to select;

– Electric attenuator only

– Combination of Electric attenuator and Mechanical attenuator when [:SENSe]:POWer[:RF]:RANGe:OPTimize IMMediate is executed.

Remote Command	[:SENSe]:POWer[:RF]:RANGe:OPTimize:TYPE EONLy | COMBined [:SENSe]:POWer[:RF]:RANGe:OPTimize:TYPE?
Example	:POW:RANG:OPT:TYPE EONL :POW:RANG:OPT:TYPE?
Dependencies	Does not appear in the Swept SA, RTSA, Monitor Spectrum and Complex Spectrum measurements Appears in the Waveform measurement in 5G NR Mode only
Preset	COMBined
State Saved	Saved in instrument state

Pre-Adjust for Min Clipping

If this function is ON, it applies the adjustment described under "Adjust Atten for Min Clipping" on page 1941 each time a measurement restarts. Therefore, in Continuous measurement mode, it only executes before the first measurement.

In Dual-Attenuator models, you can set **Elec+Mech Atten**, in which case both attenuators participate in the autoranging, or **Elec Atten Only**, in which case the mechanical attenuator does not participate in the autoranging. This latter case results in less wear on the mechanical attenuator and is usually faster.

See "Adjustment Algorithm" on page 1556

Selection	SCPI	Note
Off	OFF	This is the default setting
On	ON	Available in Single-Attenuator instruments. For compatibility with models that do not have an input attenuator, the ON parameter is supported and mapped to COMBined
Elec Atten Only	ELECtrical	Selects only the electric attenuator to participate in auto ranging. This offers less wear on the mechanical attenuator and is usually faster
Elec+Mech Atten	COMBined	In Dual-Attenuator models, this selects both attenuators to participate in the autoranging

Remote Command	[:SENSe]:POWer[:RF]:RANGe:OPTimize:ATTenuation OFF | ON | ELECtrical | COMBined [:SENSe]:POWer[:RF]:RANGe:OPTimize:ATTenuation?
Example	:POW:RANG:OPT:ATT OFF :POW:RANG:OPT:ATT?
Notes	The parameter option ELECtrical sets this function to ON in Single-Attenuator models The parameter option COMBined is mapped to ELECtrical in Single-Attenuator models. If you send COMBined, it sets the function to ON and returns ELEC to a query

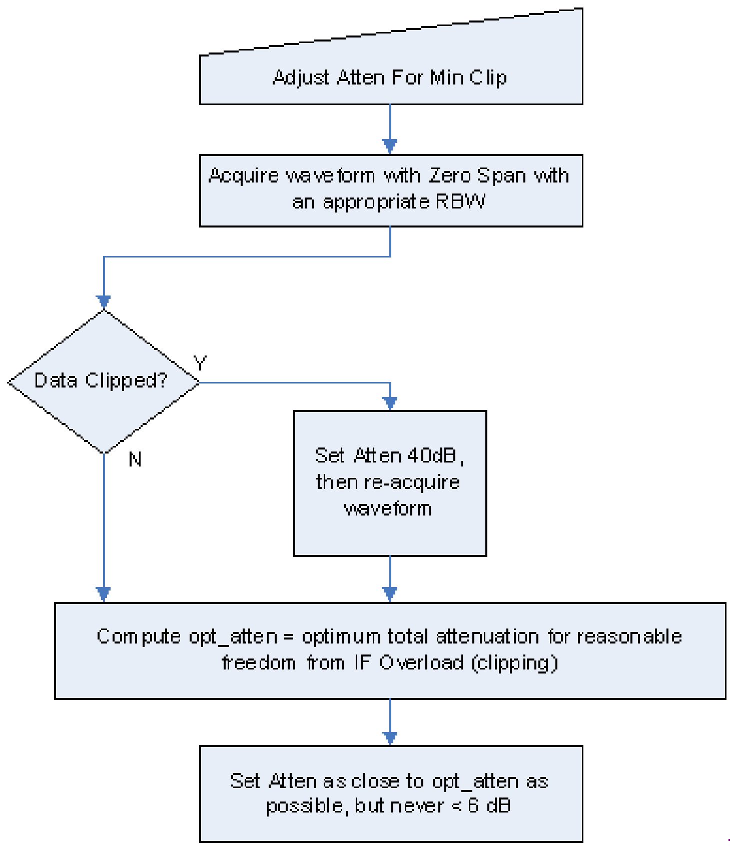
	For SCPI compatibility with models that do not have an input attenuator, the ON parameter is honored and mapped to COMBined
Dependencies	Only appears in Dual-Attenuator models with an Electronic Attenuator installed In instruments with Dual-Attenuator model, when "Elec Atten" on page 1937 is OFF or grayed-out, "Pre-Adjust for Min Clipping" on page 1555 is grayed-out Does not appear in the Swept SA, RTSA, Monitor Spectrum and Complex Spectrum measurements For the Waveform measurement, available only in 5G NR Mode
Preset	OFF when Elec Atten is Disabled at preset, otherwise ELEC
State Saved	Saved in instrument state
Range	Dual-Attenuator models: Off | Elec Atten Only | Mech + Elec Atten Single-Attenuator models: Off | On

Notes	ON aliases to "Elec Atten Only" (:POW:RANG:OPT:ATT ELEC) OFF aliases to "Off" (:POW:RANG:OPT:ATT OFF) :POW:RANG:AUTO? returns true if :POW:RANG:OPT:ATT is not OFF
Backwards Compatibility SCPI	[:SENSe]:POWer[:RF]:RANGe:AUTO ON | OFF | 1 | 0 [:SENSe]:POWer[:RF]:RANGe:AUTO?

Adjustment Algorithm

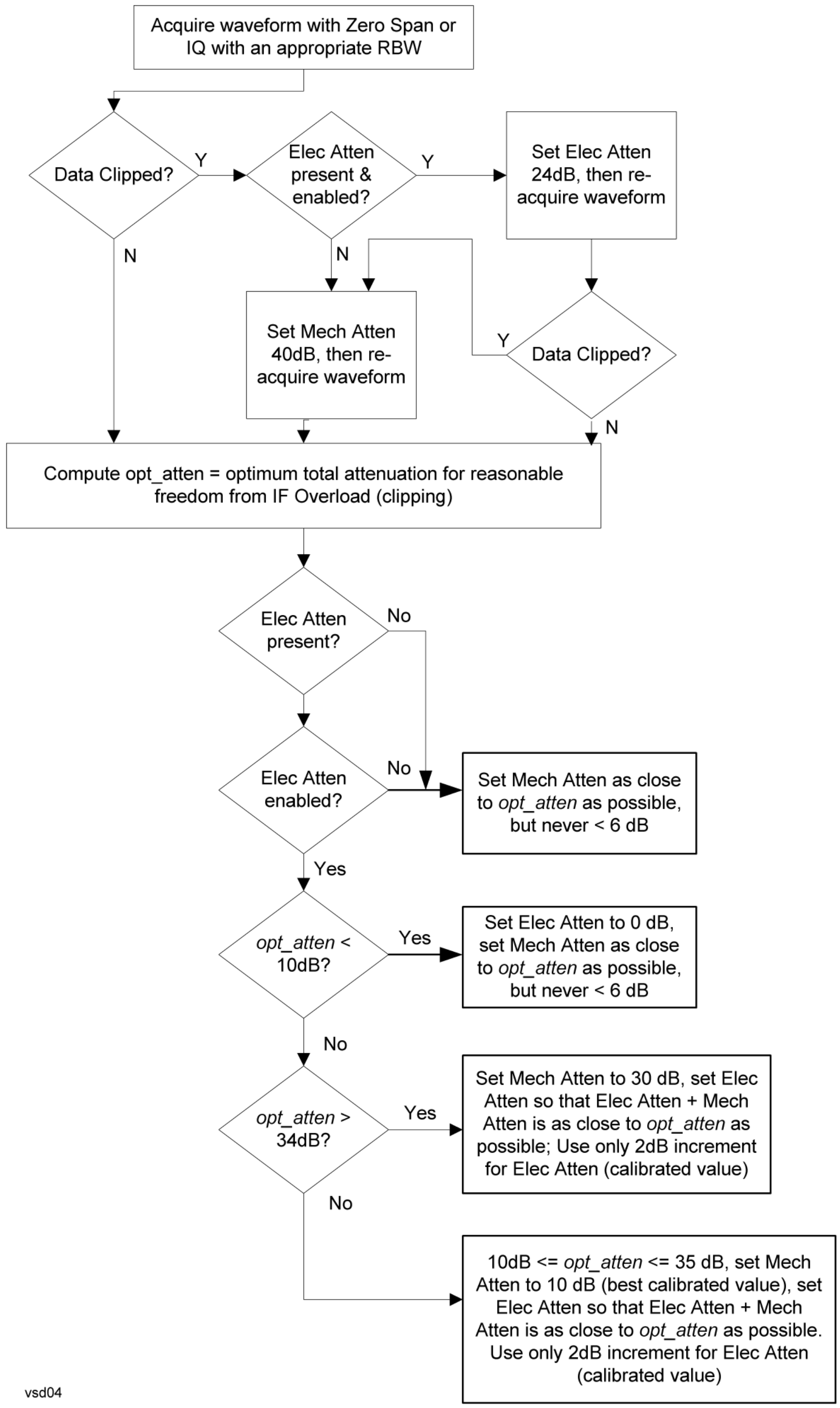
The algorithms for the adjustment are documented below:

Single-Attenuator Models



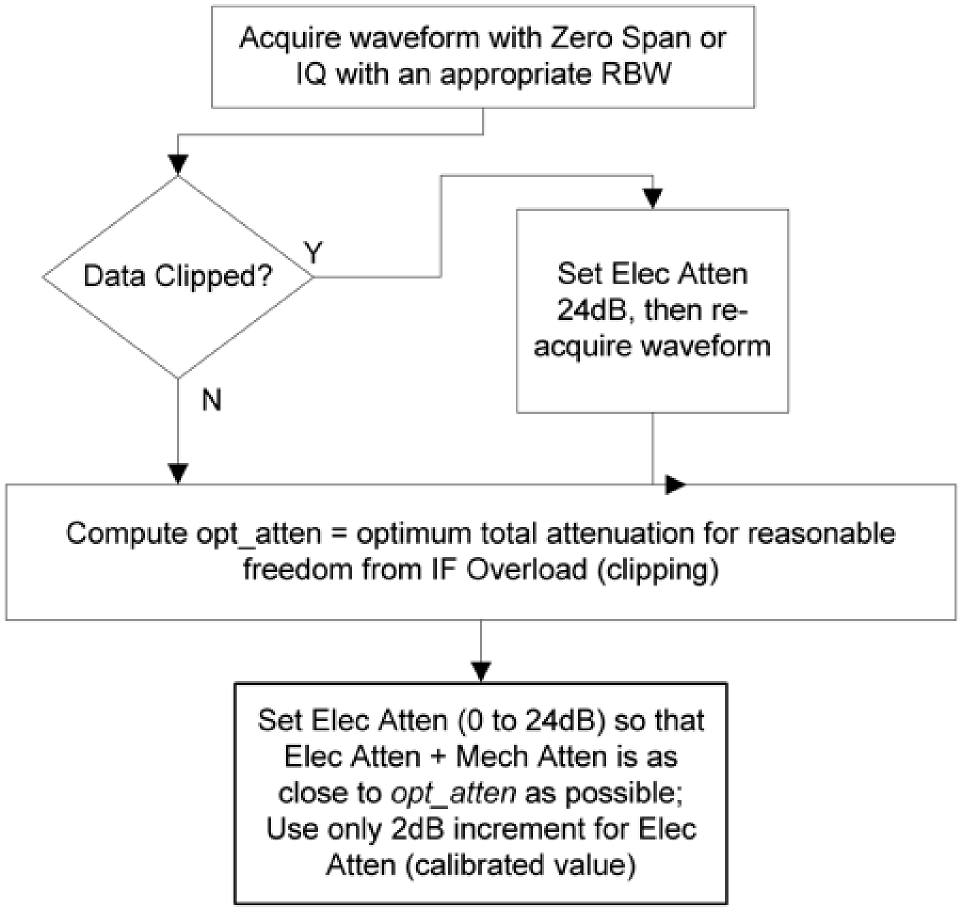
Dual-Attenuator models

"Adjust Atten for Min Clipping" on page 1941 or "Pre-Adjust for Min Clipping" on page 1555 selection is Mech + Elec Atten:


Acquire waveform with Zero Span or IQ with an appropriate RBW
Data Clipped?
Y
N
Elec Atten present & enabled?
Y
N
Set Elec Atten 24dB, then re-acquire waveform
Data Clipped?
Y
N
Set Mech Atten 40dB, then re-acquire waveform
Compute opt_atten = optimum total attenuation for reasonable freedom from IF Overload (clipping)
Elec Atten present?
No
Elec Atten enabled?
No
Yes
Set Mech Atten as close to opt_atten as possible, but never < 6 dB
opt_atten < 10dB?
Yes
No
Set Elec Atten to 0 dB, set Mech Atten as close to opt_atten as possible, but never < 6 dB
opt_atten > 34dB?
Yes
No
Set Mech Atten to 30 dB, set Elec Atten so that Elec Atten + Mech Atten is as close to opt_atten as possible; Use only 2dB increment for Elec Atten (calibrated value)
10dB <= opt_atten <= 35 dB, set Mech Atten to 10 dB (best calibrated value), set Elec Atten so that Elec Atten + Mech Atten is as close to opt_atten as possible. Use only 2dB increment for Elec Atten (calibrated value)
vsd04

"Pre-Adjust for Min Clipping" on page 1555 selection is Elec Only.

Note that the **Mech Atten** value is not adjusted, and the value previously set is used. Therefore, there is a case that IF Overload is still observed depending on the input signal level and the Mech Atten setting.



Mech Atten Step

Controls the step size used when making adjustments to the input attenuation.

Labeled **Mech Atten Step** in Dual-Attenuator models and **Atten Step** in Single-Attenuator models. In the Dual-Attenuator configuration, only affects the step size of the mechanical attenuator.

Remote Command	`[:SENSe]:POWer[:RF]:ATTenuation:STEP[:INCRement] 10 dB | 2 dB`

	`[:SENSe]:POWer[:RF]:ATTenuation:STEP[:INCRement]?`
Example	`:POW:ATT:STEP 2` `:POW:ATT:STEP?`
Notes	Has a toggle control on the front panel, but takes a specific value (in dB) when used remotely. The only valid values are 2 and 10
Dependencies	Blanked in EXA, CXA and CXA-m if option FSA (2 dB steps) is not present. If blanked, attempts to set it via SCPI yield an error
Couplings	When the attenuation step size changes, the current mechanical attenuation value is adjusted (if necessary) to be quantized to the new step size. That is, if step is set to 10 dB, mech atten is increased if necessary so it is a multiple of 10 dB
Preset	EXA, CXA and CXA-m: 10 dB (2 dB with option FSA) All other models: 2 dB
State Saved	Saved in instrument state

Max Mixer Level

Allows you to set the maximum level to be applied to the mixer for a signal at the top of the screen. By setting this value up or down you can allow more or less signal through the system.

The major impact of changes to **Max Mixer Level** is seen in changes to the value to which **Reference Level** is limited. Max Ref Level depends on Max Mixer Level and Attenuation, and therefore a higher Max Mixer Level may let you set Ref Level higher. However, changing this value can impact your TOI, compression, or dynamic range. The preset value of this function is best for most measurements.

See also "Max Mixer Lvl Rules" on page 1948.

Remote Command	`[:SENSe]:POWer[:RF]:MIXer:RANGe[:UPPer] <real>` `[:SENSe]:POWer[:RF]:MIXer:RANGe[:UPPer]?`
Example	`:POW:MIX:RANG -15 dBm` `:POW:MIX:RANG?`
Dependencies	Only appears in Swept SA and RTSA measurements
Preset	-10 dBm
State Saved	Saved in instrument state
Min	-50 dBm
Max	0 dBm

Max Mixer Lvl Rules

Allows you to optimize the Max Mixer Level setting for certain kinds of measurements.

NORMal	The historical, and thus backwards compatible, setting range (–50 to 0 dBm) and default setting (–10 dBm). The instrument has been designed so that, at the default setting, any signal below the Reference Level is extremely unlikely to create ADC overloads. At this mixer level the scale fidelity will be within specifications, thus compression with be negligible
TOI	Allows a range of settings of the "Max Mixer Level" on page 1947, –50 to –10 dBm, that can be optimum for measurements limited by the instrument third-order dynamic range. The default setting, –25 dBm, is commonly appropriate but RBW affects this. A good setting for Max Mixer Level would be higher than the optimum mixer level by half of the attenuator step size
COMPression	Allows a range of settings of the Max Mixer Level, –10 to +10 dBm or more, that can be optimum for measurements limited by the tradeoffs between instrument accuracy due to compression, and dynamic range due to the noise floor. The default setting, –3 dBm, is commonly appropriate, representing mixer drive levels that cause 1 dB or less compression at most carrier frequencies Typical measurements that would be optimized by this setting are the measurement of low sideband levels, including nulls, in angle-modulated signals (FM and PM). Also pulsed-RF measurements, including finding nulls to estimate pulse width, which are often best done with significant overdrive (compression) of the front end

Setting Name (readback)	Setting Name (verbose)	Max Mixer Level Preset Value, dBm	Max Mixer Level minimum value, dBm	Max Mixer Level maximum value, dBm
NORMal	Normal – balance TOI, noise, and compression	–10	–50	0
TOI	TOI-limited dynamic range	–25	–50	–10
COMPression	Compression-limited dynamic range	–3	–10	+30

Remote Command	`[:SENSe]:POWer[:RF]:MIXer:RULEs NORMal | TOI | COMPression` `[:SENSe]:POWer[:RF]:MIXer:RULEs?`
Example	`:POW:MIX:RULE:COMP`
Dependencies	Only appears in the Swept SA and RTSA measurements
Preset	`NORM`

3.9.13.3 Range (Non-attenuator models)

Only available for Keysight's modular signal analyzers and certain other Keysight products, such as VXT

State Saved	No

Range

Represents the amplitude of the largest sinusoidal signal that could be present within the IF without being clipped by the ADC. For signals with high peak-to-average ratios, the range may need to exceed the rms signal power by a significant amount to avoid clipping.

This is a measurement global setting.

Remote Command	`[:SENSe]:POWer[:RF]:RANGe <real>` `[:SENSe]:POWer[:RF]:RANGe?`
Example	`:POW:RANG 10 dBm` `:POW:RANG?`
Notes	The MIN and MAX values are affected by the External Gain parameters, and by the **Center Frequency** The hardware compensates for frequency response and alters the Range setting
Preset	0 dBm
State Saved	Yes
Min	-100
Max	100
Annotation	Meas Bar

Adjust Range for Min Clipping

Sets the combination of attenuation and gain based on the current measured signal level so that clipping will be at a minimum.

This is an "immediate action" function, that is, it executes once, when the key is pressed.

This key does not appear in measurements that do not support this functionality.

Remote Command	`[:SENSe]:POWer[:RF]:RANGe:OPTimize IMMediate`
Notes	Executing Adjust Range for Min Clipping initiates the measurement
Dependencies	Does not appear in the Swept SA and Monitor Spectrum measurements

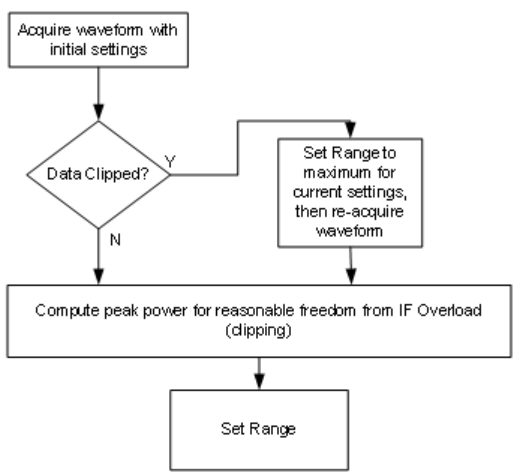
Pre-Adjust for Min Clipping

If this function is ON, it applies the adjustment described under Adjust Range For Min Clipping each time a measurement restarts. Therefore, in Continuous measurement mode, it only executes before the first measurement.

Remote Command	`[:SENSe]:POWer[:RF]:RANGe:OPTimize:ATTenuation OFF | ON | ELECtrical | COMBined` `[:SENSe]:POWer[:RF]:RANGe:OPTimize:ATTenuation?`
Notes	Because there is no attenuator control available in these models, the control displays only ON and OFF choices. However, for SCPI compatibility with other platforms, all three parameters (ELECtrical, COMBined, and ON) are honored and all are mapped to ELECtrical, so if any of these three parameters is sent, a subsequent query will return ELEC
Dependencies	Does not appear in the Swept SA and Monitor Spectrum measurements
Preset	OFF for Swept SA measurement; ON for all other measurements that support **Pre-Adjust for Min Clipping**
State Saved	Saved in instrument state

Adjustment Algorithm

The algorithm for the adjustment is documented below:



Peak-to-Average Ratio

Used with "Range (Non-attenuator models)" on page 1953 to optimize the level control in the instrument. The value is the ratio, in dB, of the peak power to the average power of the signal to be measured. A ratio of 0 should be used for sinusoidal signals; for 802.11g OFDM signals use 9 dB.

All Modes show the current value of Peak-to-Average ratio on the control. However, some Modes do not permit changing the value. In these situations, the control is grayed-out.

Remote Command	`[:SENSe]:POWer[:RF]:RANGe:PARatio <real>` `[:SENSe]:POWer[:RF]:RANGe:PARatio?`
Example	`:POW:RANG:PAR 12 dB`
Notes	In some Modes, this parameter is read-only; meaning the value will appear on the control and query via SCPI, but is not changeable. In such applications the control is grayed-out. Attempting to change the value via SCPI will be ignored but no error message will be generated
Dependencies	Does not appear in Spectrum Analyzer Mode
Preset	10 dB VXT Models M9410A/11A: 0 dB
State Saved	Saved in instrument state
Min	0 dB
Max	20 dB VXT Models M9410A/11A: 50 dB

Mixer Lvl Offset

This is an advanced setting to adjust target Range at the input mixer, which in turn affects the signal level in the instrument's IF. This setting can be used when additional optimization is needed after setting "Peak-to-Average Ratio" on page 1955. Positive values of offset optimize noise performance over distortion, negative values optimize distortion performance over noise.

Remote Command	`[:SENSe]:POWer[:RF]:RANGe:MIXer:OFFSet <real>` `[:SENSe]:POWer[:RF]:RANGe:MIXer:OFFSet?`
Example	`:POW:RANG:MIX:OFFS -5 dB`
Preset	0 dB
State Saved	Saved in instrument state
Min	-35 dB VXT Models M9410A/11A: -34 dB
Max	30 dB

3.9.13.4 Signal Path

Contains controls that pertain to the routing of the signal through the frontend of the instrument.

In general, only appears in instruments whose hardware supports this signal routing. For example, this tab does not appear in many of the modular instrument products, including VXT Model M9421A, or UXM.

This tab *does* appear in VXT Models M9410A/11A, because "Software Preselection" on page 1971 is under this tab, and VXT Models M9410A/11A implement a version of Software Preselection.

Presel Center

Adjusts the centering of the preselector filter to optimize the amplitude accuracy at the frequency of the selected marker. If the selected marker is not on when **Presel Center** is pressed, the instrument turns on the selected marker, performs a peak search, and then performs centering on the marker's center frequency. If the selected marker is already on and between the start and stop frequencies of the instrument, the instrument performs the preselector calibration on that marker's frequency. If the selected marker is already on, but outside the frequency range between **Start Freq** and **Stop Freq**, the instrument first performs a peak search, and then performs centering on the marker's center frequency.

The value displayed on "Preselector Adjust" on page 1958 changes to reflect the new preselector tuning.

Certain considerations should be observed to ensure proper operation, as detailed in "Proper Preselector Operation" on page 1566.

Remote Command	`[:SENSe]:POWer[:RF]:PCENter`
Example	`:POW:PCEN`
Notes	The rules outlined above under the control description apply for the remote command as well as the key. The result of the command depends on marker position, etc. Any message generated by the control press is also generated in response to the remote command
Dependencies	Does not appear in CXA-m, nor in VXT Models M9410A/11A Grayed-out if the microwave preselector is off – If the selected marker's frequency is below Band 1, an advisory message is generated "Preselector not used in this frequency range" and no action is taken – Grayed-out if entirely in Band 0, that is, if **Stop Freq** is below about 3.6 GHz Grayed-out if entirely above 50 GHz, that is, if **Start Freq** is above 50 GHz – Blanked in models that do not include a preselector, such as Option 503. If the remote command is sent in these instruments, accepted without error, and the query always returns 0 – Grayed-out in the Spectrogram View
Couplings	The active marker position determines where the centering will be attempted If the instrument is in a measurement such as averaging when centering is initiated, the act of centering the preselector restarts averaging, but the first average trace will not be taken until the centering is completed

	The offset applied to do the centering appears in "Preselector Adjust" on page 1958
Status Bits/OPC dependencies	When centering the preselector, `*OPC` does not return true until the process is complete and a subsequent measurement has completed, nor are results returned in response to `:READ` or `:MEASure` queries The `Measuring` bit remains set (true) while this command is operating, and does not go false until the subsequent sweep/measurement has completed

Proper Preselector Operation

Certain considerations should be observed to ensure proper operation:

1. If the selected marker is **Off**, the instrument turns on a marker, performs a peak search, and adjusts the preselector using the selected marker's frequency. It uses the "highest peak" peak search method unqualified by threshold or excursion, so that there is no chance of a 'no peak found' error. It continues with that peak, even if it is the peak of just noise. Therefore, for this operation to work properly, there should be a signal on-screen in a preselected range for the peak search to find
2. If the selected marker is already **On**, the instrument attempts the centering at that marker's frequency. There is no preselector for signals below about 3.6 GHz, so if the marker is on a signal below 3.6 GHz, no centering is attempted, and an advisory message is generated
3. In some models, the preselector can be bypassed. If it is bypassed, no centering is attempted in that range and a message is generated

Preselector Adjust

Lets you manually adjust the preselector filter frequency to optimize its response to the signal of interest. Only available when "Presel Center" on page 1956 is available.

For general purpose signal analysis, using **Presel Center** is recommended. Centering the filter minimizes the impact of long-term preselector drift. **Preselector Adjust** can be used instead to manually optimize the preselector. One application of manual optimization would be to peak the preselector response, which both optimizes the signal-to-noise ratio and minimizes amplitude variations due to small (short-term) preselector drifting.

When **Presel Center** is performed, the offset applied to do the centering becomes the new value of **Preselector Adjust**.

Remote Command	`[:SENSe]:POWer[:RF]:PADJust <freq>` `[:SENSe]:POWer[:RF]:PADJust?`
Example	`:POW:PADJ 100KHz` `:POW:PADJ?`

Notes	The value on the control is displayed to 0.1 MHz resolution
Dependencies	– Does not appear in CXA-m – Does not appear in VXT Models M9410A/11A – Grayed-out if microwave preselector is off – Grayed-out if entirely in Band 0, that is, if Stop Freq is lower than about 3.6 GHz – Grayed-out if entirely above 50 GHz, that is, if Start Freq is higher than 50 GHz – Blank in models that do not include a preselector, such as Option 503. If the command is sent in these instruments, it is accepted without error, and the query always returns 0 – Grayed-out in the Spectrogram View
Preset	0 MHz
State Saved	The **Preselector Adjust** value set by "Presel Center" on page 1956, or by manually adjusting **Preselector Adjust** Not saved in instrument state, and does not survive a Preset or power cycle
Min	-500 MHz
Max	500 MHz
Backwards Compatibility SCPI	`[:SENSe]:POWer[:RF]:MW:PADJust` `[:SENSe]:POWer[:RF]:MMW:PADJust`

Notes	The command has no effect, and the query always returns `MWAVe`
Backwards Compatibility SCPI	`[:SENSe]:POWer[:RF]:PADJust:PRESelector MWAVe | MMWave | EXTernal` `[:SENSe]:POWer[:RF]:PADJust:PRESelector?`

Internal Preamp

Accesses a menu of controls for the internal preamps. Turning on the preamp gives a better noise figure, but a poorer inter-modulation distortion (TOI) to noise floor dynamic range. You can optimize this setting for your measurement.

The instrument takes the preamp gain into account as it sweeps. If you sweep outside of the range of the preamp, the instrument will also account for that. The displayed result always reflects the correct gain.

For some measurements, when the preamp is on and any part of the displayed frequency range is below the lowest frequency for which the preamp has specifications, a warning condition message appears in the status line. For example, for a preamp with a 9 kHz lowest specified frequency: "Preamp: Accy unspec'd below 9 kHz".

Selection	Example	Note
Off	`:POW:GAIN OFF`	
Low Band	`:POW:GAIN ON` `:POW:GAIN:BAND LOW`	Sets the internal preamp to use only the low band. The frequency range of the installed (optional) low-band preamp is displayed in square brackets on the Low Band selection in the dropdown
Full Range	`:POW:GAIN ON` `:POW:GAIN:BAND FULL`	Sets the internal preamp to use its full range. The low band (0-3.6 GHz, 0-3.4 GHz, 0-3 GHz, depending on the model) is supplied by the low band preamp and the frequencies above low band are supplied by the high band preamp The frequency range of the installed (optional) low-band preamp is displayed in square brackets on the Full Range selection in the dropdown. If the high band option is not installed the Full Range selection does not appear

NOTE The maximum **Center Frequency** for Low Band, displayed in square brackets, can change based on the selected IFBW for measurements that support IFBW (for example, Waveform measurement across all Modes that support it). In certain models (such as N9042B & N9032B), IFBW values <= 40 MHz have a maximum Low Band frequency of 3.6 GHz, while 40 MHz < IFBW <= 1 GHz have a maximum of 3.3 GHz, and 1 GHz < IFBW <= 1.5 GHz have a maximum of 3.5 GHz. IFBW values > 1.5 GHz do not support a **Center Frequency** that can reach the Low Band maximum frequency. In these cases, **N/A** is displayed in the square brackets for Low Band.

Remote Command	`[:SENSe]:POWer[:RF]:GAIN:BAND LOW | FULL`
	`[:SENSe]:POWer[:RF]:GAIN:BAND?`
	`[:SENSe]:POWer[:RF]:GAIN[:STATe] OFF | ON | 0 | 1`
	`[:SENSe]:POWer[:RF]:GAIN[:STATe]?`

Example	`:POW:GAIN:BAND LOW`
	`:POW:GAIN:BAND?`
	`:POW:GAIN OFF`
	`:POW:GAIN?`

Dependencies	Not available on all hardware platforms. If the preamp is not present or is unlicensed, this control is not shown Does not appear in VXT Models M9410A/11A/15A/16A If `:POW:GAIN:BAND FULL` is sent when a low band preamp is available, the preamp band parameter is set to `LOW` instead of `FULL`, and an "Option not installed" message is generated Not available when the electronic/soft attenuator is enabled
Preset	`LOW`

	OFF
State Saved	Saved in instrument state
Annotation	When the USB Preamp is not connected to USB, the Preamp annotation in the Meas Bar says "Off" if the preamp is off and displays the frequency range of the low band or full range preamp depending on the setting. For example, if the Preamp is set to Low Band and the Low Band is 3.6 GHz the annotation says "3.6 GHz". If it is a 13.6 GHz preamp and it is set to Full Range the annotation says "13.6 GHz" When the USB Preamp is connected to USB, the Preamp annotation says "Preamp: USB" if the internal preamp is off or "Preamp: USB, Int" if the internal preamp is on (only for measurements that support the USB preamp)

LNA

Lets you turn the Low Noise Amplifier (**LNA**) on or off.

LNA is an additional preamplifier that provides superior DANL and frequency range compared to "Internal Preamp" on page 1959. LNA provides lower system noise figure, especially at frequencies above 100 MHz, and can be operated up to the full range of 50 GHz instruments.

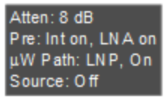
For best possible sensitivity, **LNA** can be turned on *together* with "Internal Preamp" on page 1959, although if you operate both preamps together, note that the TOI (distortion) specifications are impacted. The sensitivity improvement of this combination is substantial when operating in high band (frequencies above 3.6 GHz).

For more details about annotation, see "More Information" on page 1569

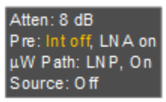
Remote Command	`[:SENSe]:POWer[:RF]:GAIN:LNA[:STATe] OFF | ON | 0 | 1` `[:SENSe]:POWer[:RF]:GAIN:LNA[:STATe]?`
Example	`:POW:GAIN:LNA ON`
Dependencies	Requires Option LNA, except for VXT models M9415A/16A Does not appear in VXT models M9421A/10A/11A May not appear in some measurements **LNA** is not available when the electronic/soft attenuator is enabled
Preset	OFF
State Saved	Saved in State

More Information

When **LNA** is installed, the preamp annotation changes to show the state of both **LNA** and **Internal Preamp**. Below is an example:



Note that when operating entirely in the low band (below about 3.6 GHz), if **LNA** is on, **Internal Preamp** is switched off (even if you have its switch set to ON). This is because the noise performance is actually degraded in low band if both preamps are on. In this case, the annotation reflects the actual state of the two preamps, but the **Internal Preamp** annotation displays in amber, to warn you that the actual state of **Internal Preamp** does not match its switch control display:



µW Path Control

Options for this control include **µW Preselector Bypass** (Option MPB), **Low Noise Path** (Option LNP) and **Full Bypass Enable** in the High Band path circuits.

When the µW Preselector is bypassed, flatness is improved, but will be subject to spurs from out of band interfering signals. When **Low Noise Path Enable** is selected, the instrument automatically bypasses certain circuitry in the high frequency bands that can contribute to noise, when it is appropriate based on other instrument settings.

For most applications, the preset state is **Standard Path**, which provides the best remote-control throughput, minimizes acoustic noise from switching and minimizes the risk of wear in the hardware switches, particularly in remote test scenarios where both low band and high band setups will follow in rapid succession. In this path, the bypass of the low band/high band switch and microwave preamp is never activated, which can cause some noise degradation but preserves the life of the bypass switch.

For applications that utilize the wideband IF paths, the preset state is **µW Preselector Bypas**s, if option MPB is present. This is because, when using a wideband IF such as the 140 MHz IF, the µW Preselector's bandwidth can be narrower than the available IF bandwidth, causing degraded amplitude flatness and phase linearity, so it is desirable to bypass the preselector in the default case.

You may choose **Low Noise Path Enable** for a lower noise floor, especially in the 21-26.5 GHz region, though without improving many measures of dynamic range, and without giving the best possible noise floor. The preamp, if purchased and used, gives better noise floor than does **Low Noise Path Enable**, but the preamp's compression threshold and third-order intercept are much poorer than that of **Low Noise Path Enable**.

A fourth choice is **Full Bypass Enable**, which combines **µW Preselector Bypass** and **Low Noise Path Enable**. Because this can bypass most of the circuitry between the input and the first mixer, care should be taken when using this setting to avoid damaging the mixer. **Full Bypass Enable** is only available if both options LNP and MPB are present, as well as option FBP.

Path	Example	Note
Standard Path	`:POW:MW:PATH STD`	Normal setting for most measurements. µW Preselector in circuit, Low Noise Path disabled
Low Noise Path Enable	`:POW:MW:PATH LNP`	See "Low Noise Path Enable" on page 1574
µW Preselector Bypass	`:POW:MW:PATH MPB`	See "µW Preselector Bypass" on page 1576
Full Bypass Enable	`:POW:MW:PATH FULL`	See "Full Bypass Enable" on page 1577

Remote Command	`[:SENSe]:POWer[:RF]:MW:PATH STD | LNPath | MPBypass | FULL` `[:SENSe]:POWer[:RF]:MW:PATH?`

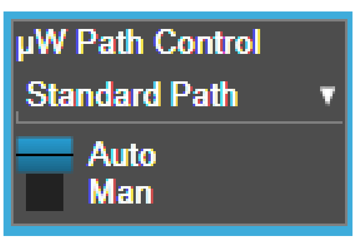
Example	`:POW:MW:PATH LNP`
	Enables the Low Noise path
	`:POW:MW:PATH?`

Notes	If "Presel Center" on page 1956 is performed, the instrument will momentarily switch to the Standard Path, regardless of the setting of **µW Path Control** The DC Block will always be switched in when the low noise path is switched in, to protect succeeding circuitry from DC. Note that this does not mean “when the low noise path is enabled” but when, based on the Low Noise Path rules, the path is actually switched in. This can happen when the selection is **Low Noise Path Enable** or **Full Bypass Enable**. In the case where the DC Block is switched in the instrument is now AC coupled. However, if you selected DC coupling, the UI would still behave as though it were DC coupled, including all annunciation, warnings, status bits, and responses to SCPI queries. This is because, based on other settings, the instrument could switch out the low noise path at any time and hence go back to being DC coupled Alignment switching ignores the settings in this menu, and restores them when finished
Dependencies	Does not appear in CXA-m, VXT Models M9410A/11A, nor in BBIQ and External Mixing – The **Low Noise Path Enable** selection does not appear unless Option LNP is present and licensed – The **µW Preselector Bypass** selection does not appear unless Option MPB is present and licensed – The **Full Bypass Enable** selection does not appear unless options LNP and MPB are both present as well as option FBP In any of these cases, if the required options are not present and the SCPI command is sent, error -241, "Hardware missing; Option not installed" is generated **Low Noise Path Enable** and **Full Bypass Enable** are grayed-out if the current measurement does not support them **Low Noise Path Enable** and **Full Bypass Enable** are not supported in Avionics and MMR Modes (non-modulation measurements). In any of these cases (that is, the feature is not supported in either measurement or Mode), if the SCPI command is sent, the following error is generated: -221, “Setting Conflict; Feature not supported for this measurement”

<table>
<tr><td>Preset</td><td><table><tr><th>Mode</th><th>Value</th></tr><tr><td>IQ Analyzer
Pulse
Avionics</td><td>MPB option present and licensed: <code>MPB</code>
MPB option not present and licensed: <code>STD</code></td></tr><tr><td>All other Modes</td><td><code>STD</code></td></tr></table></td></tr>
<tr><td>State Saved</td><td>Save in instrument state</td></tr>
<tr><td>Range</td><td>Standard Path | Low Noise Path Enable | µW Presel Bypass | Full Bypass Enable</td></tr>
<tr><td>Annotation</td><td>In the Meas Bar, if the Standard path is chosen:
µW Path: Standard
If Low Noise Path is enabled but the LNP switch is not thrown:
µW Path: LNP,Off
If the Low Noise Path is enabled and the LNP switch is thrown:
µW Path: LNP,On
If the preselector is bypassed:
µW Path: Bypass
If Full Bypass Enable is selected but the LNP switch is not thrown:
µW Path: FByp,Off
If Full Bypass Enable is selected and the LNP switch is thrown:
µW Path: FByp,On</td></tr>
</table>

µW Path Control Auto

In VMA, WLAN, 5G NR, CQM Modes, an **Auto/Man** switch is added to **µW Path Control**:



This allows the function to automatically switch based on certain Auto Rules as shown below:

VMA Mode

Measurement	When µW Path Control is in Auto
Digital Demod	Use Standard Path unless tuned frequency > 3.6 GHz and IFBW > 15 MHz, in which case choose Preselector Bypass
Monitor Spectrum	Always Presel Bypass

Measurement	When µW Path Control is in Auto
IQ Waveform	Use Standard Path unless tuned frequency > 3.6 GHz and IFBW > 15 MHz, in which case choose Preselector Bypass
Custom OFDM	Use Standard Path unless tuned frequency > 3.6 GHz and IFBW > 15 MHz, in which case choose Preselector Bypass
Channel Power	Always Presel Bypass
Occupied BW	Always Presel Bypass
CCDF	Use Standard Path unless tuned frequency > 3.6 GHz and IFBW > 15 MHz, in which case choose Preselector Bypass
ACP	Always Presel Bypass
SEM	Always Presel Bypass
Spurious Emissions	Always Standard Path

WLAN Mode

Measurement	When µW Path Control is in Auto
Modulation Analysis	Always Presel Bypass
Spectral Flatness	Always Presel Bypasss
Power vs Time	Always Presel Bypass
Monitor Spectrum	Always Presel Bypass
IQ Waveform	Always Presel Bypass
Channel Power	Always Presel Bypass
Occupied BW	Always Presel Bypass
CCDF	Always Presel Bypass
SEM	For 11be 320M, when 'Enabled Wideband IF for FFT' is OFF or 'Sweep Type Rule' is Best Dynamic Range, auto µW path is standard For other cases, auto µW path is presel bypass if presel bypass is enabled, auto µW path is standard if presel bypass is not enabled
Spurious Emissions	Always Standard Path

5G NR Mode

Measurement	When µW Path Control is in Auto
Modulation Analysis	Use Standard Path unless tuned frequency > 3.6 GHz and IFBW > 15 MHz, in which case choose Full Bypass if conditions warrant(FBP Option is available and "Allow Full Bypass in Auto" is On), otherwise choose Preselector Bypass
Monitor Spectrum	Always Standard Path
IQ Waveform	Use Standard Path unless tuned frequency > 3.6 GHz and IFBW > 15 MHz, in which case choose Full Bypass if conditions warrant(FBP Option is available

Measurement	When µW Path Control is in Auto
	and “Allow Full Bypass in Auto” is On), otherwise choose Preselector Bypass
Channel Power	Always Standard Path
Occupied BW	Always Standard Path
CCDF	Use Standard Path unless tuned frequency > 3.6 GHz and IFBW > 15 MHz, in which case choose Preselector Bypass
ACP	Always Standard Path
SEM	Always Standard Path
Spurious Emissions	Always Standard Path
Transmit On|Off Power	Use Standard Path unless tuned frequency > 3.6 GHz and Info BW > 15 MHz, in which case choose Preselector Bypass

Channel Quality Mode

Measurement	When µW Path Control is in Auto
Group Delay	Use Standard Path unless tuned frequency > 3.6 GHz and IFBW > 15 MHz, in which case choose Full Bypass if conditions warrant(FBP Option is available and “Allow Full Bypass in Auto” is On), otherwise choose Preselector Bypass
Monitor Spectrum	Always Standard Path
IQ Waveform	Use Standard Path unless tuned frequency > 3.6 GHz and IFBW > 15 MHz, in which case choose Preselector Bypass
CCDF	Use Standard Path unless tuned frequency > 3.6 GHz and IFBW > 15 MHz, in which case choose Preselector Bypass

Remote Command	`[:SENSe]:POWer[:RF]:MW:PATH:AUTO ON | OFF | 1 | 0` `[:SENSe]:POWer[:RF]:MW:PATH:AUTO?`
Example	`:POW:MW:PATH:AUTO ON` `:POW:MW:PATH:AUTO?`
Dependencies	Only appears in VMA, WLAN, 5G NR and CQM Modes
Couplings	See the tables above
Preset	`ON`
Range	`ON|OFF`

Low Noise Path Enable

Low Noise Path Enable provides a lower noise floor under some circumstances, particularly when operating in the 21–26.5 GHz region. With the Low Noise Path enabled, the low band/high band switch and microwave preamp are bypassed whenever *all* the following are true:

- The instrument is not in the Low Band, meaning:
- the start frequency is above 3.5 GHz and
- the stop frequency is above 3.6 GHz
- The internal preamp is not installed, or if installed, is set to **Off** or **Low Band**

Note that this means that, when any part of a sweep is done in Low Band, the Low Noise Path is not used, whether or not the **Low Noise Path Enable** is selected in the user interface. Also, if the preamp is turned on, the Low Noise Path is not used, whether or not the **Low Noise Path Enable** is selected in the user interface. The only time the Low Noise Path is used is when **Low Noise Path Enable** is selected, the sweep is completely in High Band (> 3.6 GHz) and no preamp is in use.

For measurements that use IQ acquisition, the low noise path is used when **Center Frequency** is in High Band (> 3.6 GHz) and no preamp is in use. In other words, the rules above are modified to use only the center frequency to qualify which path to switch in. This is not the case for FFTs in the Swept SA measurement; they use the same rules as swept measurements.

Note that the Low Noise Path, while giving improved DANL, has the disadvantage of decreased TOI performance and decreased gain compression performance relative to the standard path.

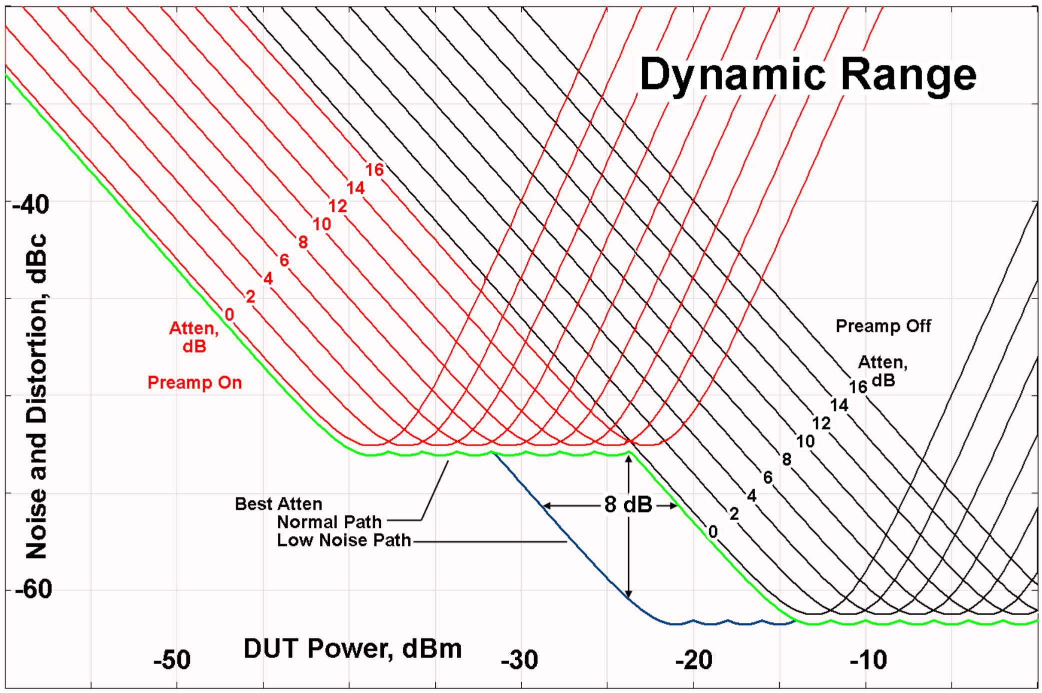
Note also that the bypass switch is a mechanical switch and has finite life, so if the **Low Noise Path Enable** is selected, it is possible to cause frequent cycling of this switch by frequently changing instrument settings such that the above conditions hold true only some of the time. A user making tests of this nature should consider opting for the **Standard Path**, which will never throw the bypass switch, at the expense of some degraded noise performance.

The low noise path is useful for situations where the signal level is so low that the instrument performance is dominated by noise even with 0 dB attenuation, but still high enough that the preamp option would have excessive third-order intermodulation or compression. The preamp, if purchased and used, gives better noise floor than does the “Low Noise Path.” However, its compression threshold and third-order intercept are much poorer than that of the non-preamp path.

There are some applications, typically for signals around –30 dBm, for which the third-order dynamic range of the standard path is good enough, but the noise floor is not low enough even with 0 dB input attenuation. When the third-order dynamic range of the preamp path is too little and the noise floor of the standard path is too high, the Low Noise Path can provide the best dynamic range

The graph below illustrates the concept. It shows, in red, the performance of an instrument at different attenuation settings, both with the preamp on and off, in a measurement that is affected by both instrument noise and instrument TOI. The green shows the best available dynamic range, offset by 0.5 dB for clarity. The blue

shows how the best available dynamic range improves for moderate signal levels with the low noise path switched in. In this illustration, the preamp improves the noise floor by 15 dB while degrading the third-order intercept by 30 dB, and the low noise path reduces loss by 8 dB. The attenuator step size is 2 dB.



There are other times where selecting the low noise path improves performance, too. Compression-limited measurements such as finding the nulls in a pulsed-RF spectrum can profit from the low noise path in a way similar to the TOI-limited measurement illustrated. Accuracy can be improved when the low noise path allows the optimum attenuation to increase from a small amount like 0, 2 or 4 dB to a larger amount, giving better return loss at the instrument input. Harmonic measurements, such as second and third harmonic levels, are much improved using the low noise path because of the superiority of that path for harmonic (though not intermodulation) distortion performance.

µW Preselector Bypass

Toggles the preselector bypass switch for band 1 and higher. When the microwave presel is on, the signal path is preselected. When the microwave preselector is off, the signal path is not preselected. The preselected path is the normal path for the instrument.

The preselector is a tunable bandpass filter which prevents signals away from the frequency of interest from combining in the mixer to generate in-band spurious

signals (images). The consequences of using a preselector filter are its limited bandwidth, the amplitude and phase ripple in its passband, and any amplitude and phase instability due to center frequency drift.

Option MPB or pre-selector bypass provides an unpreselected input mixer path for certain X-Series signal analyzers with frequency ranges above 3.6 GHz. This signal path allows a wider bandwidth and less amplitude variability, which is an advantage when doing modulation analysis and broadband signal analysis. The disadvantage is that, without the preselector, image signals will be displayed. Another disadvantage of bypassing the preselector is increased LO emission levels at the front panel input port.

Image responses are separated from the real signal by twice the 1st IF. For IF Paths of 10 MHz and 25 MHz, the 1st IF is 322.5 MHz, so the image response and the real signal will be separated by 645 MHz. The 1st IF will be different for other IF Path settings. When viewing a real signal and its corresponding image response in internal mixing, the image response will be to the left of the real signal.

Also, the image response and the real signal typically have the same amplitude and exhibit the same shape factor.

However, if Option FS1 (Fast Sweep Capability) is enabled, the image response in the Swept SA measurement appears lower in amplitude and has a much wider shape factor compared to the real signal.

Full Bypass Enable

With **Full Bypass Enable** selected, the microwave preselector is bypassed. In addition, the low band/high band switch and microwave preamp are bypassed whenever *all* the following are true:

- The instrument is not in the Low Band, meaning:
- the start frequency is above 3.5 GHz and
- the stop frequency is above 3.6 GHz.
- the internal preamp is not installed or if installed, is set to **Off** or **Low Band**

Note that this means that, when any part of a sweep is done in Low Band, the Low Noise Path is not used, whether or not the **Full Bypass Enable** is selected in the user interface. Also, if the preamp is turned on, the Low Noise Path is not used, whether or not the **Full Bypass Enable** is selected in the user interface. The only time the Low Noise Path is used is when **Full Bypass Enable** is selected, the sweep is completely in High Band (> 3.6 GHz) and no preamp is in use.

CAUTION

When **Full Bypass Enable** is selected, and "Y Scale" on page 1929 is set to 0 dB, there will be a direct AC connection between the input and the first converter when the Low Noise Path switches in (when Start Freq >3.6 GHz and the Preamp is either not licensed, set to Low Band, or Off). This puts the first converter at considerable risk to be damaged by high AC power. Consequently, whenever **Full Bypass Enable** is selected, a warning message appears in the status bar:

"Full Bypass Enabled, maximum safe input power reduced"

Microwave Preselector Bypass Backwards Compatibility

Example	`:POW:MW:PRES OFF` Bypasses the microwave preselector
Notes	Included for Microwave Preselector Bypass backwards compatibility The `ON` parameter sets the `STD` path (`:POW:MW:PATH STD`) The `OFF` parameter sets path `MPB` (`:POW:MW:PATH MPB`)
Preset	`ON`
Backwards Compatibility SCPI	`[:SENSe]:POWer[:RF]:MW:PRESelector[:STATe] ON | OFF | 0 | 1` `[:SENSe]:POWer[:RF]:MW:PRESelector[:STATe]?`

Frequency Extender Preselection Bypass

Only applies to the high frequency path of the Frequency Extender, and only if the Frequency Extender allows it. For example, the V3050A high frequency path is 50 – 110 GHz and *does* allow control of the preselector bypass.

When the Frequency Extender's preselection is bypassed, flatness is improved, but will be subject to spurs from out-of-band interfering signals. For bandwidths greater than 2.5 [GHz], it is recommended that the signal bypass the Frequency Extender Preselector since the max bandwidth of the Preselector can be as narrow as 2.5 [GHz].

For most applications, the preset state is `OFF`, which gives the best remote-control throughput, minimizes acoustic noise from switching, minimizes out of band spurs, and minimizes the risk of wear in the hardware switches.

Preselector and Bandwidth Conflict

When the Frequency Extender Preselector is applied and the signal bandwidth is greater than 2.5 [GHz], then a settings alert message will show to warn the user that the signal may be distorted due to the limitation of the Frequency Extender Preselector bandwidth.

An example of the settings alert message is shown below.

Settings Alert message in the Status Bar at the bottom of the display.

Settings Alert message in the error queue

.

Software Preselection

Provided in some instruments, either to compensate for issues with provided hardware preselection or to provide the preselection function when there is no hardware preselector.

N9041B

Software Preselection compensates for the frequency range limit of the microwave preselector. Since the microwave preselector only goes up to 50 GHz, software preselection must be used to suppress and separate images above 50 GHz. The specific algorithm used for software preselection is specified by the SW Preselection Type selection – Normal or Advanced.

In N9041B, **Software Preselection** only applies for frequencies above 50 GHz, therefore it is only used for RF Input 2. Even if turned on, it is not used for other inputs, and never for frequencies below 50 GHz. This is why the label of this control contains the parenthetical note “(>~50 GHz)”.

Note that in N9041B, in Swept SA measurement, **Software Preselection** works even if the measurement is using an FFT Sweep Type. In measurements other than Swept SA, Software Preselection is not used if the measurement is using an FFT sweep type.

N9042B+V3050A

Software Preselection compensates for the frequency range limit of the microwave preselector. Since the microwave preselector only goes up to 50 GHz, software preselection must be used to suppress and separate images above 50 GHz. The specific algorithm used for software preselection is specified by the SW Preselection

Type selection – Normal or Advanced.

For N9042B+V3050A, Software Preselection only applies for frequencies above 50 GHz, therefore it is only used for External RF. Even if it is turned on, it will not be used for other inputs and never for frequencies below 50 GHz. This is why the label of this control contains the parenthetical note “(>~50 GHz)”.

Note that for N9042B+V3050A, in the Swept SA measurement, Software Preselection works even if the measurement is using an FFT Sweep Type. In measurements other than Swept SA, Software Preselection is not used if the measurement is using an FFT Sweep Type.

VXT models M9410A/11A

Software Preselection is used to provide the preselection function, as there is no hardware preselector in these models. Two background traces are taken and compared point by point, and the point with the lowest amplitude from the two traces is used. This provides a method to reduce spurs that are internally generated within the VXT, but you should note the following when using Software Preselection:

- There is some speed cost due to the need to take multiple captures
- Taking the point with the lowest amplitude in each trace will make the average noise level lower at all points that do not have a spur. This can reduce the accuracy of the measurement of noise and noise-like signals

Because of the difficulty in identifying spurs manually, you are recommended to leave Software Preselection `ON` at all times in VXT models M9410A/11A. If you turn it off in order to speed up your measurement or improve noise accuracy, be aware of unwanted onscreen spurs.

Remote Command	`[:SENSe]:POWer[:RF]:SWPResel:STATe 0 | 1 | ON | OFF` `[:SENSe]:POWer[:RF]:SWPresel:STAT?`
Example	`:POW:SWPR:STAT 1` `:POW:SWPR:STAT?`
Dependencies	Only appears in N9041B, N9042B+V2050A, and VXT models M9410A/11A. Does not appear in all measurements
Couplings	Affects **Sweep Time** **Auto Tune** supports **Software Preselection**, so **Auto Tune** should be performed after setting the **Software Preselection** state
Preset	N9041B: `OFF` N9042B+V3050A: `ON` M9410A/11A: `ON`
State Saved	Saved in instrument state

SW Preselection Type

Specifies the algorithm used for software preselection.

Two hidden sweeps occur in succession. The second sweep is offset in LO frequency by 2 * IF / N. For each point in each trace, the smaller amplitude from the two traces is taken and placed in that point in the selected trace. The Peak detector is auto-selected to improve the image suppression effectiveness. Responses of each trace that lie on top of one another will remain and are valid signals. Other signals are images, which are suppressed. The action of taking the smaller of the two traces will make the average noise level lower in all points that do not have an image, thus reducing the accuracy of the measurement of noise and noise-like signals.

- `NORMal` - mathematically removes all image and multiple responses of signals present at the input
- `ADVanced` - any trace processing (such as "max hold" or trace averaging) is performed on the points of both candidate traces before the "select minimum" operation occurs. This form of processing works better for non-stationary signals, such as pulsed-RF signals

Remote Command	`[:SENSe]:POWer[:RF]:SWPResel NORMal | ADVanced` `[:SENSe]:POWer[:RF]:SWPResel?`
Example	`:POW:SWPR NORM` `:POW:SWPR?`
Dependencies	Only appears in N9041B and N9042B+V3050A. Only appears in measurements that use the Swept method Grayed-out when "Software Preselection" on page 1971 is `OFF`. The grayout message is "Unavailable unless SW Presel enabled"
Preset	N9041B: `ADVanced` N9042B+V3050A: `NORMal`
State Saved	Saved in instrument state

SW Preselection BW

Specifies the effective bandwidth to be used for Software Preselection.

The options are:

- `NORMal` – when making Swept measurements, a software preselection algorithm is used which takes up to 4 background acquisitions, then post-processes the result. This algorithm can remove images from signals with an occupied

bandwidth up to around 3 GHz. (Default/Preset setting). When making FFT measurements, this algorithm is not used, instead the same algorithm is used as for NARRow (below)

– NARRow– a software preselection algorithm is used which takes two background acquisitions, then post-processes the result to detect and remove images from wideband signals with occupied bandwidths up to 2 GHz. This increases the risk of images failing to be rejected, but improves the measurement speed

Remote Command	`[:SENSe]:POWer[:RF]:SWPResel:BW NORMal | NARRow` `[:SENSe]:POWer[:RF]:SWPResel:BW?`
Example	`:POW:SWPR:BW NARR`
Dependencies	Only appears in N9041B and N9042B+V3050A. Only appears in measurements that use the Swept method Grayed-out when "Software Preselection" on page 1971 is OFF. The grayout message is "Unavailable unless SW Presel enabled" For N9042B+V3050A, the parameter is SCPI-only, and always set to NARRow when **Software Preselection** is enabled
Preset	N9041B: NORMal N9042B+V3050A: NARRow
State Saved	Saved in instrument state

High Freq Prefilter

Lets you set the state of Prefilter for center frequencies above 1310 MHz.

In VXT Models M9410A/11A, the Receiver RF path has a bank of filters that come after the RF Attenuator in the signal path. Since this bank of filters precedes the mixer they are known as the "Prefilter" bank. Their purpose is to eliminate unwanted in-band mixing products by filtering out all but the desired frequencies before the signals get to the mixer. There are 13 prefilter bands to cover the frequencies between 9 kHz and 6000 MHz. The Prefilter provides the necessary rejection of the unwanted signal.

Remote Command	`[:SENSe]:<measurement>:PFILter[:STATe] ON | OFF | 1 | 0` `[:SENSe]:<measurement>:PFILter[:STATe]?`

Example	Enable High Freq Prefilter for the Complex Spectrum Measurement in BASIC Mode:
	`:SPEC:PFIL ON`
	Enable High Freq Prefilter for the IQ Waveform Measurement, in multiple Modes:
	`:WAV:PFIL ON`
	Enable High Freq Prefilter for the Swept SA Measurement in SA Mode:

	`:SAN:PFIL ON`
Dependencies	Only appears in VXT models M9410A/11A with center frequency above 1310 MHz
Preset	See "Prefilter Presets" on page 1583 below
State Saved	Saved in instrument state

Prefilter Presets

Meas	Mode	Preset
SPEC	BASIC	OFF
WAV	BASIC, WCDMA, WLAN, LTEAFDD, LTEATDD, 5GNR, VMA	OFF
MON	WCDMA, WLAN, LTEAFDD, LTEATDD, 5GNR, VMA	OFF
RHO	WCDMA	OFF
CDP	WCDMA	OFF
PCON	WCDMA	OFF
EVMQ	WCDMA	OFF
CHP	WCDMA, WLAN, LTEAFDD, LTEATDD, 5GNR, VMA, SA	OFF
OBW	WCDMA, WLAN, LTEAFDD, LTEATDD, 5GNR, VMA, SA	OFF
ACP	WCDMA, LTEAFDD, LTEATDD, 5GNR, VMA, SA	OFF
SEM	WCDMA, WLAN, LTEAFDD, LTEATDD, 5GNR, VMA, SA	OFF
PST	WCDMA, WLAN, LTEAFDD, LTEATDD, 5GNR, VMA, SA	OFF
PVT	WLAN, LTEAFDD, LTEATDD, 5GNR	OFF
EVM	WLAN, LTEAFDD, LTEATDD, 5GNR	OFF
FLAT	WLAN	OFF
EVMM	WLAN	OFF
CEVM	LTEAFDD, LTEATDD	OFF
PAVT	5GNR, VMA	OFF
DDEM	VMA	OFF
OFDM	VMA	OFF
SAN	SA	ON
HARM	SA	ON

3.9.14 BW

Opens the Bandwidth (BW) menu, which contains controls for the Resolution Bandwidth functions of the instrument.

The Resolution BW functions control filter type. There are two filter types, Gaussian and Flattop. The Gaussian filters have a response curve that is parabolic on a log scale. The Flattop filter shape is a close approximation of a rectangular filter.

3.9.14.1 Settings

Contains basic Bandwidth functions. The only tab under BW.

RBW Filter Type

Selects the type of bandwidth filter that is used in Carriers and Offsets:

Option	SCPI	Behavior
Gaussian	GAUSsian	The selected filter is applied to carriers and all offsets
Flattop	FLATtop	
Auto Sense	ASENse	The filter type is automatically selected for each carrier and offset in a way such that measurement speed and accuracy are optimized Filter Auto Sense Rules: – Flattop is selected when "Enable Wideband IF for FFT" on page 1702 is ON – Flattop is selected for offsets close to the reference carrier – For all other cases, Gaussian is selected

Remote Command	[:SENSe]:SEMask:BANDwidth:SHAPe ASENse | GAUSsian | FLATtop [:SENSe]:SEMask:BANDwidth:SHAPe?
Example	:SEM:BAND:SHAP GAUS :SEM:BAND:SHAP?
Preset	ASENse
State Saved	Saved in instrument state
Range	Auto Sense (each offset and carrier) | Gaussian (all offsets and carriers) | Flattop (all offsets and carriers)

3.9.15 Display

Lets you configure display items for the current Mode, Measurement View or Window.

3.9.15.1 Meas Display

Contains controls for setting up the display for the current Measurement, View or Window.

Limit Lines

Toggles Limit Lines display for this measurement On or Off.

Remote Command	`:CALCulate:SEMask:LLINe:STATe ON | OFF | 1 | 0` `:CALCulate:SEMask:LLINe:STATe?`
Example	`:CALC:SEM:LLIN:STAT OFF` `:CALC:SEM:LLIN:STAT?`
Preset	ON
State Saved	Saved in instrument state
Range	ON|OFF

3.9.15.2 Annotation

Contains controls for setting up the annotation for the current Mode or Measurement.

Graticule

Turns the display graticule On or Off for all windows with graticules in all measurements in the current Mode. Also turns the graticule Y-Axis annotation on and off.

Remote Command	`:DISPlay:GRATicule[:STATe] OFF | ON | 0 | 1` `:DISPlay:GRATicule[:STATe]?`
Example	`:DISP:GRAT OFF`
Notes	The graticule is the set of horizontal and vertical lines that make up the grid/divisions for the X-Axis and Y-Axis
Preset	ON
State Saved	Saved in instrument state

Backwards Compatibility SCPI	`:DISPlay:WINDow[1]:TRACe:GRATicule:GRID[:STATe] OFF | ON | 0 | 1`
	`:DISPlay:WINDow[1]:TRACe:GRATicule:GRID[:STATe]?`
	This command is accepted for backwards compatibility with older instruments, but the `WINDow`, `TRACe` and `GRID` parameters are ignored

Screen Annotation

Controls the display of the annunciation and annotation around the graticule, including any annotation on lines (such as the display line, the threshold line, etc.)

and the Y-Axis annotation, for all windows with screen annotation in all measurements in the current Mode.

This does *not* include marker annotation (or the N dB result). When `OFF`, the graticule expands to fill the entire graticule area, leaving only the 1.5% gap above the graticule, as described in the **Trace** section.

Remote Command	`:DISPlay:ANNotation:SCReen[:STATe] OFF | ON | 0 | 1` `:DISPlay:ANNotation:SCReen[:STATe]?`
Example	`:DISP:ANN:SCR OFF`
Dependencies	Grayed-out and forced to `OFF` when **System Display Settings**, **Annotation** is `OFF`
Preset	`ON` This remains `OFF` through a Preset when **System Display Settings**, **Annotation** is set to `OFF`
State Saved	Saved in instrument state

Trace Annotation

Turns on and off the labels on the traces, showing their detector (or their Math Mode) as described in the **Trace** section, for all windows in all measurements in the current Mode for which Trace Annotation on/off is supported.

If Trace Math is being performed on a trace, then the Trace Math annotation replaces the detector annotation.

For measurements that support limit lines, this key also turns on and off the labels on the Limit Lines. The label is the Limit number annotation and Limit Comment displayed on the graph. If the length of the comment is greater than 20 characters, the first 8 characters and the last 8 characters are displayed, joined with **....**

Remote Command	`:DISPlay:ANNotation:TRACe[:STATe] ON | OFF | 1 | 0` `:DISPlay:ANNotation:TRACe[:STATe]?`
Example	`:DISP:ANN:TRAC OFF`
Preset	`OFF`
State Saved	Saved in instrument state

Control Annotation

Turns on and off the display of values on the Active Function controls for all measurements in the current Mode. This is a security feature.

Remote Command	`:DISPlay:ACTivefunc[:STATe] ON | OFF | 1 | 0` `:DISPlay:ACTivefunc[:STATe]?`
Example	`:DISP:ACT OFF`

Dependencies	Grayed out and forced to OFF when **System Display Settings**, **Annotation** is OFF
Preset	ON This remains OFF through a Preset when **System Display Settings**, **Annotation** is set to OFF
State Saved	Saved in instrument state

Frequency Annotation

Turns on and off the absolute frequency annotation in the main display for all windows in all measurements in the current Mode for which Frequency Annotation on/off is supported.

The affected annotations include Center Frequency, Start/Stop Frequency, Frequency Offset, Marker Frequency. Any relative frequency annotation such as Span and Marker Delta are not affected.

The frequency annotations in any other associated display, such as in Active Function, Softkey label, Limit Editor, Amp Corr Editor and Marker Table are not changed.

Frequency annotations that are not associated with the spectrum, such as RBW, IBW, Sweep Time, are excluded and they are shown regardless of this selection.

Remote Command	`:DISPlay:ANNotation:FREQuency[:STATe] ON | OFF | 1 | 0` `:DISPlay:ANNotation:FREQuency[:STATe]?`
Example	`:DISP:ANN:FREQ OFF`
Dependencies	Only appears in the Swept SA measurement in Spectrum Analyzer Mode
Preset	ON

Meas Bar

Turns the Measurement Bar at the top of the screen on and off for all measurements in the current Mode. When OFF, the graticule area expands to fill the area formerly occupied by the Measurement Bar.

Remote Command	`:DISPlay:ANNotation:MBAR[:STATe] OFF | ON | 0 | 1` `:DISPlay:ANNotation:MBAR[:STATe]?`
Example	`:DISP:ANN:MBAR OFF`
Dependencies	Grayed out and forced to OFF when **System Display Settings**, **Annotation** is OFF
Preset	ON This remains OFF through a Preset when **System Display Settings**, **Annotation** is set to OFF
State Saved	Saved in instrument state

Display Enable (Remote Command Only)

Turns the display on/off, including the display drive circuitry. The backlight stays lit to confirm that the instrument is on. The display enable setting is mode global. Theare three reasons for turning the display off:

1. To increase speed as much as possible by freeing the instrument from having to update the display
2. To reduce emissions from the display, drive circuitry
3. For security purposes

If you have turned off the display:

- and you are in local operation, the display can be turned back on by pressing any key or by sending `:SYSTem:DEFaults MISC` or `:DISPlay:ENABle ON` (neither `*RST` nor :SYSTem:PRESet enable the display)
- and you are in remote operation, the display can be turned back on by pressing the **Local** or **Esc** keys, or by sending `:SYSTem:DEFaults MISC` or `:DISPlay:ENABle ON` (neither `*RST` nor `:SYSTem:PRESet` enable the display)
- and you are using either the `:SYSTem:KLOCk` command or GPIB local lockout, then *no* front-panel key press will turn the display back on. You must turn it back on remotely.

If the display is `OFF`, many SCPI commands related to User Views and Multiscreen functionality do not work, and return the error messages "-221, Settings conflict; Screen SCPI cannot be used when Display is disabled" or "221, Settings conflict; View SCPI cannot be used while Display is disabled". These commands include:

Name	Command
Select User View	`:DISPlay:VIEW:ADVanced:SELect`
Rename User View	`:DISPlay:VIEW:ADVanced:REName`
Delete User View	`:DISPlay:VIEW:ADVanced:DELete`
Create User View	`:DISPlay:VIEW:ADVanced:NAME`
Select Screen	`:INSTrument:SCReen:SELect`
Delete Screen	`:INSTrument:SCReen:DELete`
Delete All But This Screen	`:INSTrument:SCReen:DELete:ALL`
Add Screen	`:INSTrument:SCReen:CREate`
Rename Screen	`:INSTrument:SCReen:REName`
Sequencer On/Off	`:SYSTem:SEQuencer`

Remote Command	`:DISPlay:ENABle OFF | ON | 0 | 1` `:DISPlay:ENABle?`
Example	`:DISP:ENAB OFF`
Couplings	`:DISP:ENAB OFF` turns Backlight `OFF` and `:DISP:ENAB ON` turns Backlight `ON`, but changing Backlight settings does *not* change the state of `:DISP:ENAB`
Preset	`ON` Set by `:SYST:DEF MISC`, but not affected by `*RST` or `:SYSTem:PRESet`
State Saved	Not saved in instrument state
Backwards Compatibility Notes	`:SYST:PRES` no longer turns on `:DISPlay:ENABle` as it did in legacy analyzers

3.9.15.3 View

See "Views" on page 1518

3.9.16 Frequency

Opens the **Frequency** menu, which contains controls that allow you to control the Frequency and Channel parameters of the instrument.

Some features in the **Frequency** menu are the same for all measurements in the current Mode – they do not change as you change measurements. Settings like these are called "Meas Global" and are unaffected by Meas Preset. For example, the **Center Freq** setting is the same for all measurements - it does not change as you change measurements.

3.9.16.1 Settings

Contains controls that pertain to the X axis parameters of the measurement. These parameters control how data on the vertical (X) axis is displayed, and control instrument settings that affect the horizontal axis.

Center Frequency

Sets the frequency that corresponds to the horizontal center of the graticule. While adjusting **Center Frequency**, **Span** is held constant.

This setting is the same for all measurements within a Mode, that is, it is Meas Global. Some Modes are also able to share a Mode Global Center Frequency value. If this is the case, the Mode has a **Global** tab in its **Meas Setup** menu.

Center Frequency sets (and queries) the center frequency for the currently selected input. If your instrument has multiple inputs, and you select another input, **Center Frequency** changes to the value for that input. SCPI commands are available to directly set **Center Frequency** for a specific input.

Center Frequency is remembered as you go from input to input. Thus you can set a **Center Frequency** of 10 GHz with the RF Input selected, change to BBIQ and set a **Center Frequency** of 20 MHz, then switch to External Mixing and set a **Center Frequency** of 60 GHz. When you go back to the RF Input, **Center Frequency** returns to 10 GHz; back to BBIQ and it is 20 MHz; back to External Mixing and it is 60 GHz.

See also:

- "Center Frequency Presets" on page 1591
- "VXT Models with Radio Heads/CIU Frequency Range" on page 1593
- "RF Center Freq" on page 1593
- "Ext Mix Center Freq" on page 1593
- "I/Q Center Freq" on page 1594

Remote Command	`[:SENSe]:FREQuency:CENTer <freq>` `[:SENSe]:FREQuency:CENTer?`

Example	Set **Center Frequency** to 50 MHz:
	`:FREQ:CENT 50 MHz`
	Increment **Center Frequency** by the value of "CF Step" on page 1595:
	`:FREQ:CENT UP`
	Return the current value of **Center Frequency**:
	`:FREQ:CENT?`

Notes	Sets the RF, External Mixing or I/Q Center Frequency depending on the selected input: – For RF input, equivalent to `:FREQ:RF:CENT` – For I/Q input, equivalent to `:FREQ:IQ:CENT` – For External Mixer, equivalent to `:FREQ:EMIX:CENT` Preset and Max values are dependent on Hardware Options If no terminator (for example. MHz) is sent, the terminator Hz is used. If a terminator with unit other than frequency is used, an invalid suffix error message is generated
Dependencies	Not available in the MSR, LTE-Advanced FDD/TDD and 5G NR Modes
Preset	Depends on instrument maximum frequency, Mode, measurement, and selected input See "Center Frequency Presets" on page 1591, and "RF Center Freq" on page 1593,, "Ext Mix Center Freq" on page 1593, "I/Q Center Freq" on page 1594 and "VXT Models with Radio Heads/CIU Frequency Range" on page 1593

State Saved	Saved in instrument state
Min/Max	Depends on instrument maximum frequency, Mode, measurement, and selected input See "Center Frequency Presets" on page 1591, "RF Center Freq" on page 1593, "I/Q Center Freq" on page 1594 and "VXT Models with Radio Heads/CIU Frequency Range" on page 1593
Annotation	Center <value> appears in the lower left corner of the display
Status Bits/OPC dependencies	Non-overlapped

Center Frequency Presets

The following table provides the Center Frequency Presets for the Spectrum Analyzer mode, and the Max Freq, for the various frequency options:

Freq Option	CF after Mode Preset	Stop Freq after Mode Preset	Max Freq (can't tune above)
503 (all but CXA)	1.805 GHz	3.6 GHz	3.7 GHz
503 (CXA)	1.505 GHz	3.0 GHz	3.08 GHz
507 (all but CXA)	3.505 GHz	7.0 GHz	7.1 GHz
507 (CXA)	3.755 GHz	7.5 GHz	7.58 GHz
508 (all but MXE)	1.805 GHz	3.6 GHz	8.5 GHz
508 (MXE)	4.205 GHz	8.4 GHz	8.5 GHz
513	6.805 GHz	13.6 GHz	13.8 GHz
526 (except CXA and MXE)	13.255 GHz	26.5 GHz	27.0 GHz*
526 (CXA)	13.255 GHz	26.5 GHz	26.55 GHz
526 (MXE)	1.805 GHz	3.6 GHz	27.0 GHz
532	16.005 GHz	32.0 GHz	32.5 GHz
540	20.005 GHz	40.0 GHz	40.5 GHz
543	21.505 GHz	43.0 GHz	43.0 GHz
544	22.005 GHz	44.0 GHz	45.0 GHz
550	25.005 GHz	50.0 GHz	52 GHz
F03 (CXA-m)	1.505 GHz	3.0 GHz	3.08 GHz
F07 (CXA-m)	3.755 GHz	7.5 GHz	7.575 GHz
F13 (CXA-m)	6.805 GHz	13.6 GHz	13.8 GHz
F26 (CXA-m)	13.255 GHz	26.5 GHz	26.55 GHz
504 (M9421A, M8920A)	2.145 GHz	3.88GHz	3.88 GHz
506 (M9421A, M8920A)	3.245 GHz	6.08GHz	6.08 GHz
F06 (M9410A/11A)	1.0 GHz	6.08 GHz	6.08 GHz

Freq Option	CF after Mode Preset	Stop Freq after Mode Preset	Max Freq (can't tune above)
F06 (M9415A)	1 GHz	1.08 GHz	6.6 GHz
F08 (M9415A)	1 GHz	1.08 GHz	8.6 GHz
F12 (M9415A)	1 GHz	1.08 GHz	12.9 GHz

*For option 526, the Max CF in RTSA is 26.999999995 GHz.

N9041B Center Freq Presets

Input	CF after Mode Preset	Stop Freq after Mode Preset	Max Freq (can't tune above)
Input 1, all models	25.005 GHz	50.0 GHz	52 GHz
Input 2, opt 585	42.505 GHz	85.0 GHz	86 GHz
Input 2, opt 590	45.005 GHz	90.0 GHz	92 GHz
Input 2, opt 5CX	55.005 GHz	110.0 GHz	110 GHz

Input 2, CXA and MXE

Model	CF after Mode Preset	Stop Freq after Mode Preset	Max Freq (can't tune above)
CXA opt C75	0.7505 GHz	1.5 GHz	1.58 GHz
MXE	505 MHz	1 GHz	1.000025 GHz

Tracking Generator Frequency Limits (CXA only)

Tracking Generator Option	Min Freq (clips to this freq when turn TG on and can’t tune below while TG on)	If above this Freq, Stop Freq clipped to this Freq when TG turned on	Max Freq (can't tune above) while TG on
T03	9 kHz	3.0 GHz	3.08 GHz
T06	9 kHz	6.0 GHz	6.05 GHz

Tracking Generator Frequency Limits(CXA-m only)

Tracking Generator Option	Min Freq (clips to this freq when turn TG on and can’t tune below while TG on)	If above this Freq, Stop Freq clipped to this Freq when TG turned on	Max Freq (can't tune above) while TG on
T03	2 MHz	3.08 GHz	3.08 GHz
T07	2 MHz	7.575 GHz	7.575 GHz
T13	2 MHz	13.8 GHz	13.8 GHz
T26	2 MHz	26.55 GHz	26.55 GHz

VXT Models with Radio Heads/CIU Frequency Range

The following table shows the Center Frequency Presets and Range for VXT modes with Radio Heads/CIU.

Products with Radio Heads/CIU	Preset	Start frequency	Stop frequency
M9421A + CIU	6 GHz	5.9 GHz	12 GHz
M9410A + CIU	6 GHz	5.9 GHz	12 GHz
M9410A + CIU + RRH	25 GHz	24.25 GHz	43.5 GHz

RF Center Freq

Specifies the RF Center Frequency. Sets the center frequency to use when the RF input is selected, even if the RF input is not the selected input at the time the command is sent. Note that **Center Frequency** in the **Frequency** menu on the front panel always applies to the currently-selected input.

Remote Command	`[:SENSe]:FREQuency:RF:CENTer <freq>` `[:SENSe]:FREQuency:RF:CENTer?`
Example	`:FREQ:RF:CENT 30 MHz` `:FREQ:RF:CENT?`
Notes	This command is the same in all Modes, but the parameter is Measurement Global, so the value is independent in each Mode and common across all the measurements in the Mode
Dependencies	If the electronic/soft attenuator is enabled, any attempt to set **Center Frequency** such that the Stop Frequency would be >3.6 GHz fails and results in an advisory message. If the equivalent SCPI command is sent, this same message is generated as part of a "-221, Settings conflict" warning
Preset	See "Center Frequency Presets" on page 1591 above
State Saved	Saved in instrument state
Min	-79.999995 MHz
Max	See "Center Frequency Presets" on page 1591 above. Basically, instrument maximum frequency - 5 Hz If the knob or step keys are being used, also depends on **Span**

Ext Mix Center Freq

Sets the center frequency to use when the External Mixer is selected, even if the External Mixer input is not the selected input at the time the command is sent. Note that **Center Frequency** in the **Frequency** menu on the front panel always applies to the currently selected input.

Remote Command	`[:SENSe]:FREQuency:EMIXer:CENTer <freq>` `[:SENSe]:FREQuency:EMIXer:CENTer?`
Example	`:FREQ:EMIX:CENT 60 GHz`

	`:FREQ:EMIX:CENT?`
Notes	This command is the same in all Modes, but the parameter is Measurement Global, so the value is independent in each Mode and common across all the measurements in the Mode
Couplings	When returning to External Mixing after having been switched to one of the other inputs (for example, RF), you will return to the settings that you had when you left External Mixing, so you will return to the band you were in with the **Center Frequency** that you had. However, **Span** is not an input-dependent parameter, so the **Span** setting from the other input will be retained. Therefore, the instrument retains the **Span** from the previous input, limited as necessary by the current mixer setup
Preset	When a **Mode Preset** is performed while in External Mixing, the Start frequency of the current Mode is set to the nominal Min Freq of the lowest harmonic range in the Harmonic Table for the current mixer setup. Similarly, the Stop frequency of the current Mode is set to the nominal Max Freq of the highest harmonic range in the Harmonic Table. Center Frequency thus presets to the point arithmetically equidistant from these two frequencies Note that, if the current measurement has a limited **Span** available to it, and cannot achieve the **Span** shown in the table (Span = Stop Freq – Start Freq), the instrument uses the maximum **Span** the measurement allows, and still sets **Center Frequency** to the midpoint of the Start and Stop Freq values in the Harmonic Table When **Restore Input/Output Defaults** is performed, the mixer presets to the 11970A, whose Start and Stop frequencies are 26.5 and 40 GHz respectively. The center of these two frequencies is 33.25 GHz Therefore, after **Restore Input/Output Defaults**, if you switch to External Mixing and do a Mode Preset while in Spectrum Analyzer Mode, the resulting **Center Frequency** is 33.25 GHz
State Saved	Yes
Min	The minimum frequency in the currently selected mixer band + 5 Hz If the knob or step keys are being used, also depends on Span
Max	The maximum frequency in the currently selected mixer band - 5 Hz If the knob or step keys are being used, also depends on Span

I/Q Center Freq

Sets the center frequency to use when the I/Q input is selected, even if the I/Q input is not the selected input at the time the command is sent. Note that **Center Frequency** in the **Frequency** menu on the front panel always applies to the currently selected input.

Remote Command	`[:SENSe]:FREQuency:IQ:CENTer <freq>` `[:SENSe]:FREQuency:IQ:CENTer?`
Example	`:FREQ:IQ:CENT 30 MHz`
Notes	This command is the same in all Modes, but the parameter is Measurement Global, so the value is independent in each Mode and common across all the measurements in the Mode
Preset	0 Hz
State Saved	Saved in instrument state

Min	-40.049995 MHz
Max	40.049995 MHz

CF Step

Changes the step size for "Center Frequency" on page 1589, and start and stop frequency functions. Once a step size has been selected and the **Center Frequency** function is active, the step keys (and the UP|DOWN parameters for **Center Frequency** from remote commands) change the center frequency by the step-size value. The step size function is useful for finding harmonics and sidebands beyond the current frequency span of the instrument.

Note that the start and stop frequencies also step by the **CF Step** value.

Remote Command	`[:SENSe]:FREQuency:CENTer:STEP[:INCRement] <freq>`
	`[:SENSe]:FREQuency:CENTer:STEP[:INCRement]?`
	`[:SENSe]:FREQuency:CENTer:STEP:AUTO OFF | ON | 0 | 1`
	`[:SENSe]:FREQuency:CENTer:STEP:AUTO?`

Example	`:FREQ:CENT:STEP 500 MHz`
	increases the current center frequency value by 500 MHz
	`:FREQ:CENT UP`
	`:FREQ:CENT:STEP?`
	`:FREQ:CENT:STEP:AUTO ON`
	`:FREQ:CENT:STEP:AUTO?`

Notes	Preset and Max values depend on Hardware Options
Dependencies	Not available in the MSR, LTE-A FDD/TDD and 5G NR Modes If the electronic/soft attenuator is enabled, any attempt to change the value of the **Center Frequency** >3.6 GHz by pressing the **Up**-arrow key, fails and results in an advisory message. If the equivalent SCPI command is sent, this same message is generated as part of a “-221, Settings conflict” warning
Couplings	When auto-coupled, the center frequency step size is set to 10% of the span
Preset	Auto `ON`
State Saved	Saved in instrument state
Min/Max	–/+ (The maximum frequency of the instrument) That is, 27 GHz max freq instrument has a CF step range of +/- 27 GHz. Note that this is the maximum frequency given the current settings of the instrument, so in External Mixing, for example, it is the maximum frequency of the current mixer band
Status Bits/OPC dependencies	non-overlapped

Freq Offset

Sets a frequency offset value, to compensate for frequency conversions outside of the instrument. This value is added to the display readout of the marker frequency, center frequency, start frequency, stop frequency, and all other absolute frequency settings in the instrument including frequency count. When a frequency offset is entered, the value appears below the center of the graticule. To eliminate an offset, perform a **Mode Preset** or set the frequency offset to 0 Hz.

See "More Information" on page 1596

Remote Command	`[:SENSe]:FREQuency:OFFSet <freq>` `[:SENSe]:FREQuency:OFFSet?`
Example	`:FREQ:OFFS 10 MHz` `:FREQ:OFFS?`
Notes	Preset and Max values depend on Hardware Options
Dependencies	Appears only in the Spectrum Analyzer Mode Not available in External Mixing. In this case the control is grayed-out and displays a value of zero. However, the value of **Center Frequency** Offset that was set for the RF Input is retained and restored when you switch back to the RF Input
Preset	0 Hz
State Saved	Saved in instrument state
Min	-500 GHz
Max	500 GHz
Annotation	If Frequency Offset is not zero, “Freq Offset <value>” appears on the upper line of the annotation, below the graticule, in the center
Status Bits/OPC dependencies	Non-overlapped
Backwards Compatibility SCPI	`:DISPlay:WINDow[1]:TRACe:X[:SCALe]:OFFSet` The `DISPlay` version of the command is supported for compatibility across platforms. It is not recommended for new development
Backwards Compatibility Notes	In pre-X-Series instruments, Frequency Offset could not be adjusted by the knob or step keys. That is no longer the case Some previous spectrum analyzers did not adjust frequency counter results for the Frequency Offset. X-Series *does* adjust the frequency counter for the offset

More Information

This command does not affect any bandwidths or the settings of relative frequency parameters such as delta markers or span. It does not affect the current hardware settings of the instrument, but only the displayed frequency values. Entering an offset does not affect the trace position or display, just the value of the start and stop frequency and the values represented by the trace data. The frequency values of exported trace data, queried trace data, markers, trace data used in calculations such as N dB points, trace math, etc., are all affected by **Freq Offset**. Changing the offset, even on a trace that is not updating will immediately change all of the above, without taking new data.

NOTE If a trace is exported with a nonzero **Freq Offset**, the exported data contains the trace data with the offset applied. Therefore, if that trace were to be imported back into the instrument, you would want **Freq Offset** to be 0, or the offset would be applied again to data that is already offset. No such care need be taken when saving a State+Trace file, because the data and state are saved together.

3.9.17 Marker

Enables you to select, set up and control the markers for the current measurement. If there are no active markers, **Marker** selects Marker 1, sets it to **Normal** (`POSition`) and places it at the center of the display. If the selected marker is `OFF`, it is set to **Normal** and placed at the center of the screen, on the trace determined by the **Marker Trace** rules.

3.9.17.1 Select Marker

Specifies the selected marker. The term “selected marker” is used throughout this document to specify which marker will be affected when you change marker settings, perform a Peak Search, etc.

This control appears above the menu panel, indicating that it applies to all controls in the **Marker** menu panels. **Select Marker** is blanked if you select a tab whose controls do *not* depend on the selected marker (for example, **Counter**).

In any menu that includes **Select Marker**, the first control is always **Marker Frequency|Time**.

Notes	The selected marker is remembered even when not in the **Marker** menu and is used if a search is done, or a Band Function is turned on, or for Signal Track or Continuous Peak
Preset	Marker 1
State Saved	The number of the selected marker is saved in instrument state
Annunciation	Appears in the marker results block label for **Normal** marker

3.9.17.2 Settings

The controls on this tab include the Marker active function and a radio button selection of the marker control mode (**Normal**, **Delta** or **Off**) for the selected marker, as well as additional functions that help you use markers.

Marker Frequency

Sets the marker X-Axis value in the current marker X-Axis Scale unit. Has no effect if the control mode is **Off,** but is the SCPI equivalent of entering an X value if the control mode is **Normal**.

Remote Command	`:CALCulate:SEMask:MARKer[1]|2|…|12:X <freq>` `:CALCulate:SEMask:MARKer[1]|2|…|12:X?`
Example	`:CALC:SEM:MARK3:X 1.0 GHz` `:CALC:SEM:MARK3:X?`
Notes	If no suffix is sent, uses the fundamental units for the current marker X-Axis Scale. If a suffix is sent that does not match the current marker X-Axis Scale unit, an error "Invalid suffix" is generated The query returns the marker's absolute X-Axis value if the control mode is **Normal**, or the offset from the marker's reference marker if the control mode is **Delta**. The query is returned in the fundamental units for the current marker X-Axis scale: Hz for **Frequency** and **Inverse Time**, seconds for **Period** and **Time**
Preset	After a preset, all markers are turned `OFF`, so the query returns Not A Number (`NAN`)
State Saved	Saved in instrument state
Min	-9.9E+37
Max	9.9E+37
Annotation	Mkr # <X value> and <Marker value> upper right on graph

Marker X Axis Position (Remote Command Only)

Sets the marker X-Axis Scale position in trace points. This setting has no effect if the control mode is **Off,** but is the SCPI equivalent of entering a value if the control mode is **Normal** or **Delta** - except in trace points rather than X-Axis Scale units. The entered value is immediately translated into the current X-Axis Scale units for setting the value of the marker.

Remote Command	`:CALCulate:SEMask:MARKer[1]|2|…|12:X:POSition <real>` `:CALCulate:SEMask:MARKer[1]|2|…|12:X:POSition?`
Example	`:CALC:SEM:MARK10:X:POS 1001` `:CALC:SEM:MARK10:X:POS?`
Notes	The query returns the marker's absolute X Axis value in trace points if the control mode is **Normal**, or the

	offset from the marker's reference marker in trace points if the control mode is **Delta**. The value is returned as a real number, not an integer, corresponding to the translation from X-Axis Scale units to trace points . When a Marker is turned on, it is placed center of the screen on the trace. Therefore, the default value depends on instrument condition. If the marker is **Off**, the response is Not A Number
Preset	After a preset, all markers are turned `OFF`, so the query returns Not A Number (`NAN`)
State Saved	Saved in instrument state
Min	-9.9E+37
Max	9.9E+37

Marker Y Axis Value (Remote Command only)

Returns the marker Y-Axis value in the current marker Y Axis unit.

Remote Command	`:CALCulate:SEMask:MARKer[1]|2|…|12:Y?`
Example	`:CALC:SEM:MARK11:Y?`
Notes	The query returns the marker Y-Axis result, if the control mode is **Normal**. If the marker is **Off,** the response is Not A Number
Preset	Result depends on Markers setup and signal source
State Saved	No
Backwards Compatibility SCPI	`:CALCulate:SEMask:MARKer[1]|2|…|12:FUNCtion:RESult?`

Marker Mode

Sets the marker control mode to `POSition` (**Normal**) or `OFF`.

If the selected marker is `OFF`, pressing **Marker** sets it to `POSition` and places it at the center of the screen, on the trace determined by the **Marker Trace** rules. At the same time, **Marker X Axis Value** appears on the Active Function area. If the current control mode for the measurement is `OFF`, there is no active function, and the active function is turned off.

Remote Command	`:CALCulate:SEMask:MARKer[1]|2|…|12:MODE POSition | OFF` `:CALCulate:SEMask:MARKer[1]|2|…|12:MODE?`
Example	`:CALC:SEM:MARK:MODE POS` `:CALC:SEM:MARK:MODE?`
Notes	Default Active Function: the active function for the selected marker's current control mode. If the current control mode is `OFF`, there is no active function, and the active function is turned off
Preset	`OFF|OFF|OFF|OFF|OFF|OFF|OFF|OFF|OFF|OFF|OFF|OFF`

State Saved	Saved in instrument state
Range	`POSition|OFF`
Annotation	Mkr# <X value> and <Marker value> upper right of graph

All Markers Off

Turns off all markers.

Remote Command	`:CALCulate:SEMask:MARKer:AOFF`
Example	`:CALC:SEM:MARK:AOFF`

Couple Markers

When this function is ON, moving any marker causes an equal X-Axis movement of every other marker that is not OFF. By “equal X-Axis movement” we mean that we preserve the difference between each marker’s X-Axis value (in the fundamental X-Axis units of the trace that marker is on) and the X-Axis value of the marker being moved (in the same fundamental X-Axis units).

This may result in markers going off screen.

Remote Command	`:CALCulate:SEMask:MARKer:COUPle[:STATe] ON	OFF	1	0` `:CALCulate:SEMask:MARKer:COUPle[:STATe]?`
Example	`:CALC:SEM:MARK:COUP ON` `:CALC:SEM:MARK:COUP?`
Preset	`OFF` Preset by **Mode Preset** and **All Markers Off**
State Saved	Saved in instrument state

3.9.17.3 Properties

The controls on this tab are used to set certain properties of the selected marker.

Marker Frequency

This is the fundamental control that you use to move a marker around on the trace. This is the same as "Marker Frequency" on page 1598 in the **Settings** tab.

Marker Trace

Selects the trace on which you want your marker placed. A marker is associated with one and only one trace. This trace is used to determine the placement, result, and X-Axis Scale of the marker. All markers have an associated trace; it is from that trace that they determine their attributes and behaviors, and it is to that trace that they go when they become Normal markers.

Specifying a Marker Trace manually or with this command associates the marker with the specified trace. If the marker is not `OFF`, it moves the marker from the trace it was on to the new trace. If the marker is `OFF` it stays off but is now associated with the specified trace.

The query returns the number of the trace on which the marker is currently placed.

Remote Command	`:CALCulate:SEMask:MARKer[1]|2|…|12:TRACe 1	2	3` `:CALCulate:SEMask:MARKer[1]|2|…|12:TRACe?`
Example	`:CALC:SEM:MARK2:TRAC 2` `:CALC:SEM:MARK2:TRAC?`
Notes	A marker may be placed on a blanked and/or inactive trace, even though the trace is not visible and/or updating An application may register a trace name to be displayed on the control instead of a trace number
Couplings	The state of **Marker Trace** is not affected by "Auto Couple" on page 1995 Sending the remote command causes the addressed marker to become selected
Preset	1
State Saved	Saved in instrument state

3.9.18 Meas Setup

Contains functions for setting up the measurement parameters and also contains functions for setting up parameters global to all measurements in the Mode.

3.9.18.1 Settings

Contains frequently used **Meas Setup** functions to which you will want the fastest access.

Avg/Hold Num

Toggles averaging On or Off, in addition to enabling you to set the number of measurement averages used to calculate the measurement result. The average is displayed at the end of each sweep. After the specified number of average counts, the average mode (termination control) setting determines the average action.

In the remote mode, use "Averaging On/Off" on page 1602 to turn Averaging on or off.

Remote Command	`[:SENSe]:SEMask:AVERage:COUNt <integer>` `[:SENSe]:SEMask:AVERage:COUNt?`
Example	`:SEM:AVER:COUN 100` `:SEM:AVER:COUN?`
Preset	10
State Saved	Saved in instrument state
Min/Max	1/10000

Averaging On/Off

Turns Averaging on or off.

NOTE: In this measurement, **Average Type** is preset to the `Log-Pwr Avg (Video)` method. Other averaging methods are not available.

Remote Command	`[:SENSe]:SEMask:AVERage[:STATe] ON | OFF | 1 | 0` `[:SENSe]:SEMask:AVERage[:STATe]?`
Example	`:SEM:AVER ON` `:SEM:AVER?`
Preset	`OFF`
State Saved	Saved in instrument state
Range	`ON|OFF`

Meas Method

Sets the measurement method:

Method	Option	Description
Integration BW	`0|OFF`	Enables you to set the channel integration bandwidth
RRC Weighted	`1|ON`	Selects Root Raised Cosine (RRC) filtering of the carriers. The a value (rolloff) for the filter is set to the value of the Filter Alpha parameter

Remote Command	`[:SENSe]:SEMask:FILTer[:RRC][:STATe] OFF | ON | 0 | 1` `[:SENSe]:SEMask:FILTer[:RRC][:STATe]?`

Example	`:SEM:FILT ON` `:SEM:FILT?`
Dependencies	WLAN: RRC Weight is not supported when the radio standard is WLAN 802.11ac (80+80MHz)
Preset	SA, LTEAFDD, LTEATDD, 5G NR, WLAN, MSR Modes: `OFF` WCDMA Mode: `ON`
State Saved	Saved in instrument state
Range	Integration BW|RRC Weighted

RRC Filter Alpha

Sets the alpha value for the RRC Filter.

Remote Command	`[:SENSe]:SEMask:FILTer[:RRC]:ALPHa <real>` `[:SENSe]:SEMask:FILTer[:RRC]:ALPHa?`
Example	`:SEM:FILT:ALPH 0.3` `:SEM:FILT:ALPH?`
Preset	0.22
State Saved	Saved in instrument state
Min/Max	0.01/1.0

Non-Contiguous Meas Region

Selects the region to measure for the non-contiguous frequency allocation.

Option	SCPI	Comments
Outer	`OUTer`	
Inner	`INNer`	
Outer & Inner	`OINNer`	Available only in 5G NR and LTE-Advanced FDD/TDD Modes

Remote Command	`[:SENSe]:SEMask:NCONtiguous:REGion INNer | OUTer | OINNer` `[:SENSe]:SEMask:NCONtiguous:REGion?`
Example	`:SEM:NCON:REG INN` `:SEM:NCON:REG?`
Dependencies	Available only in MSR, 5G NR and LTE-Advanced FDD/TDD Modes `OINNer` is available only in 5G NR and LTE-Advanced FDD/TDD Modes
Preset	`INNer`
State Saved	Yes
Range	Inner | Outer | Outer & Inner

Sweep Type Rules

Selects which set of rules will be used for automatic selection of "Sweep Type" on page 1627 when **Sweep Type** mode is **Auto**.

Rule	Option	Description
Best Dynamic Range	DRANge	The instrument selects either swept or FFT analysis with the primary goal of dynamic range optimization. If the dynamic range of swept and FFT is very close, then it chooses the faster one. In determining the Swept or FFT setting, the auto rules use the following approach: – If the RBW > 210 Hz, use swept; for the RBW <= 210 Hz, use FFT – If Sweep Time Mode is Man, the Sweep Type is always Swept for backwards compatibility
Best Speed	SPEed	The instrument selects either FFT or swept analysis based on the fastest instrument speed

Remote Command	`[:SENSe]:SEMask:SWEep:TYPE:AUTO:RULes SPEed | DRANge` `[:SENSe]:SEMask:SWEep:TYPE:AUTO:RULes?`
Dependencies	In modular products such as VXT, the value is always set to Best Dynamic Range and this control does not appear
Preset	DRANge
State Saved	Saved in instrument state

Spur Avoidance

Because VXT models M9410A/11A/15A are direct-conversion (zero-IF) receivers, feedthrough leakage from the local oscillator appears as a spurious signal (spur) at the Center Frequency. The **Spur Avoidance** function is provided to eliminate this spur, at the expense of some measurement speed. For Spur Avoidance, the instrument uses a software algorithm to remove this spur from the displayed measurement data.

Some measurements allow you to turn off **Spur Avoidance**, but in this measurement it is always enabled. Therefore, the **Spur Avoidance** switch is unavailable (grayed-out) and set to ON.

If you press the grayed-out switch, a popup message appears stating:

Always enabled in this measurement. See manual for details

Remote Command	`[:SENSe]:SEMask:SAVoid[:STATe]?`
Example	`:SEM:SAV?`

	Always returns ON
Dependencies	Only appears in VXT models M9410A/11A/15A
Preset	ON
State Saved	Saved in instrument state
Range	ON

Offset/Limits Config Table

Enables you to set up the measurement parameters for offset pairs and to set the power limits for start and stop frequencies of the selected offsets. For example, you can assign the start and stop frequencies, select the resolution bandwidth, and set the sweep time.

Before UE, the LTE-Advanced FDD/TDD standards gave the test specification requirements for BS intra-band contiguous aggregation and intra-band non-contiguous aggregation modes. However, for UE, only the requirements of intra-band contiguous aggregation modes are defined. So, the standards don’t support making the measurement in UE intra-band non-contiguous aggregation mode for LTE-Advanced FDD/TDD. As a result, the preset values of Inner Offset/Limits are temporarily set as those of Outer Offset/Limits for UE.

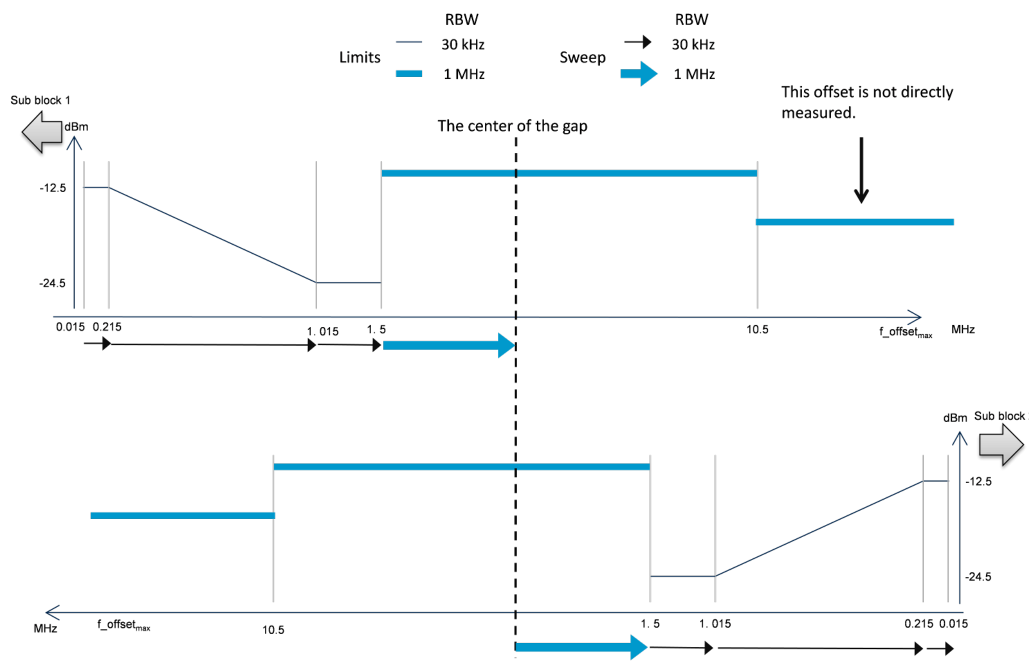
Limits for Inner Offsets

Since inner offsets are defined from the sub-block edges to the gap, limits from two sub-blocks overlap each other. Therefore, the limit used for inner offsets are the cumulative sum of limits from both sub-blocks. Offsets can have different RBWs, which must be compensated when accumulated.

For example, when offset A and D overlap, the limit of offset A is calculated as follows.

$$\text{Cumulated Limit of Offset A} = 10^{\frac{[\text{Offset A Limit in dBm}]}{10}} + \frac{\text{Offset A RBW}}{\text{Offset D RBW}} 10^{\frac{[\text{Offset D Limit in dBm}]}{10}}$$

The diagram below depicts what inner offset limits look like.



Offset (Bandwidth)

Enables you to set up the bandwidth measurement parameters for offset pairs. For example, you can assign the start and stop frequencies, and select the resolution bandwidth.

Offset Freq Define

Enables you to select offset frequency definition. Each standard defines each offset frequency from Carrier.

For example, 3GPP2 requires the "Carrier Center to Meas BW Edge" definition. LTE conformance test requires "Carrier Edge to Meas BW Center" and/or "Carrier Edge to Meas BW Edge" definition. The MSR standard requires "RF BW Edge to Meas BW Center" and/or "RF BW Edge to Meas Edge" definition.

"Meas BW Edge" means the edge frequency of resolution bandwidth closer to the carrier that is represented by Meas BW and Res BW settings. Actual center frequency of Meas BW and the limit line have ½ Meas BW offset when the Meas BW Edge is selected.

Note that the outermost (lowermost, uppermost) carrier at each side is determined by which carrier edge frequency is located outermost within the RF BW or each sub-block bandwidth, instead of which carrier center frequency is located outermost.

See also "Diagrams for Offset Freq Define" on page 1609.

Modes other than MSR, LTE-A, 5G NR

Options:

`CTOCenter`	From carrier center to the center of offset measuring filter*
`CTOEdge`	From carrier center to the nominal –3 dB point of the offset measuring filter* closer to the carrier
`ETOCenter`	From Center Frequency – Span of Ref Channel / 2 (for lower offset), Center Frequency + Span of Ref Channel / 2 (for upper offset) of the carrier closest to each offset to the center of offset measuring filter *
`ETOEdge`	From Center Frequency – Span of Ref Channel / 2 (for lower offset), Center Frequency + Span of Ref Channel / 2 (for upper offset) of the carrier closest to each offset to the nominal –3 dB point of the offset measuring filter * closer to the carrier

*Measuring filter = Meas BW (N) x Res BW

** RF BW = $BW_{channel,CA}$ which is defined in each 3GPP standard, regardless of "Measure Carrier" for the uppermost and the lowermost carriers being Enabled or Disabled. When **Number of Component Carriers** = 1, RF BW = $BW_{channel}$ = 2 x $F_{offset,RAT}$

Remote Command	`[:SENSe]:SEMask:OFFSet[1]|2:TYPE CTOCenter | CTOEdge | ETOCenter | ETOEdge` `[:SENSe]:SEMask:OFFSet[1]|2:TYPE?`
Example	`:SEM:OFFS:TYPE ETOC` `:SEM:OFFS:TYPE?`
Notes	`OFFSet1` is for BTS, 2 for MS. Default is BTS Note that Offset sub op code 2 is supported only in non-SA Modes. In SA Mode, Offset sub op code 1 is used for both BTS and MS
Preset	`CTOCenter`
State Saved	Saved in instrument state
Range	Carrier Center to Meas BW Center | Carrier Center to Meas BW Edge | Carrier Edge to Meas BW Center | Carrier Edge to Meas BW Edge

Mode: MSR, LTEAFDD, LTEATDD

Options:

`CTOCenter`	From the lowermost carrier center frequency (for lower offset), the uppermost carrier center frequency (for upper offset) to the center of offset measuring filter*
`CTOEdge`	From the lowermost carrier center frequency (for lower offset), the uppermost carrier center frequency (for upper offset) to the nominal -3 dB point of the

	offset measuring filter* closer to the carrier
ETOCenter	From the lowermost carrier center frequency - spacing of this carrier /2 (for lower offset), the uppermost carrier center frequency + spacing of this carrier /2 (for upper offset) to the center frequency of offset measuring filter*
ETOEdge	From the lowermost carrier center frequency - spacing of this carrier /2 (for lower offset), the uppermost carrier center frequency + spacing of this carrier /2 (for upper offset) to the nominal -3 dB point of the offset measuring filter* closer to the carrier
RTOCenter	From either the lower or upper RF BW** edge frequency to the center frequency of offset measuring filter*
RTOEdge	From either the lower or upper RF BW** edge frequency to the nominal -3 dB point of the offset measuring filter* closer to the carrier
RCTOCenter 5G NR Mode only	**From the center frequency of RF BW to the center frequency of offset measuring filter***

*Measuring filter = Meas BW (N) x Res BW

** RF BW = $BW_{channel,CA}$ which is defined in each 3GPP standard, regardless of "Measure Carrier" for the uppermost and the lowermost carriers being Enabled or Disabled. When **Number of Component Carriers** = 1, RF BW = $BW_{channel}$ = 2 x $F_{offset,RAT}$

Remote Command	`[:SENSe]:SEMask:OFFSet[1]|2[:OUTer]:TYPE CTOCenter | CTOEdge | ETOCenter | ETOEdge | RTOCenter | RTOEdge` `[:SENSe]:SEMask:OFFSet[1]|2[:OUTer]:TYPE?`
Example	`:SEM:OFFS:TYPE ETOC` `:SEM:OFFS:TYPE?`
Notes	`OFFSet1` is for BTS, 2 for MS. Default is BTS
Preset	MSR: `RTOCenter` LTEAFDD, LTEATDD: `ETOCenter`
State Saved	Saved in instrument state
Range	Carrier Center to Meas BW Center|Carrier Center to Meas BW Edge|Carrier Edge to Meas BW Center-|Carrier Edge to Meas BW Edge|RF BW Edge to Meas BW Center|RF BW Edge to Meas BW Edge

Mode: 5G NR

Options: see "Mode: MSR, LTEAFDD, LTEATDD" on page 1607 above.

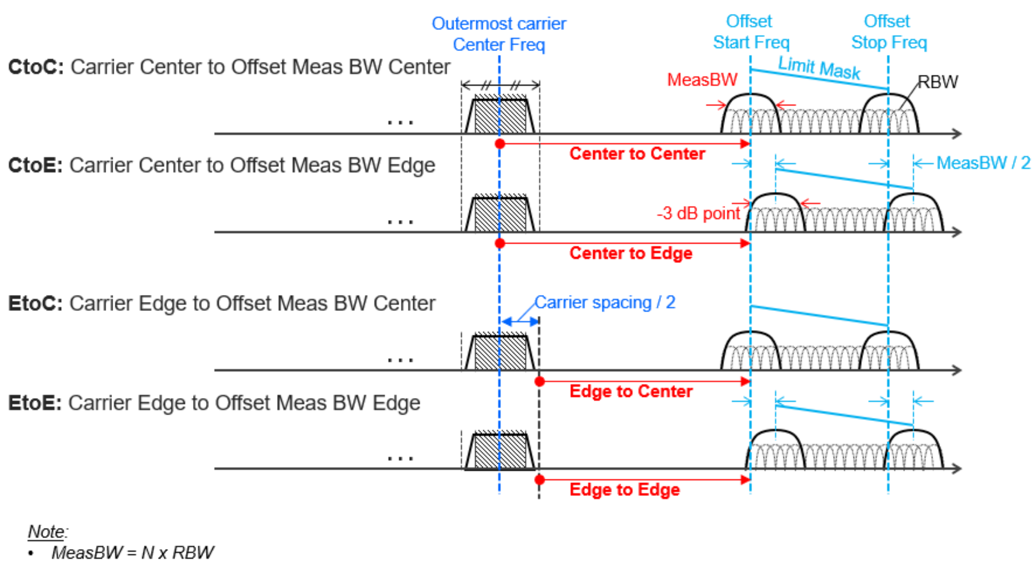
Remote Command	`[:SENSe]:SEMask:OFFSet[1]|2[:OUTer]:TYPE CTOCenter | CTOEdge | ETOCenter | ETOEdge | RTOCenter | RTOEdge | RCTOCenter` `[:SENSe]:SEMask:OFFSet[1]|2[:OUTer]:TYPE?`
Example	`:SEM:OFFS:TYPE ETOC`

	`:SEM:OFFS:TYPE?`
Notes	`OFFSet1` is for BTS, 2 for MS. Default is BTS
Preset	`ETOCenter`
State Saved	Saved in instrument state
Range	Carrier Center to Meas BW Center|Carrier Center to Meas BW Edge|Carrier Edge to Meas BW Center-|Carrier Edge to Meas BW Edge|RF BW Edge to Meas BW Center|RF BW Edge to Meas BW Edge|RF BW Center to Meas BW Center

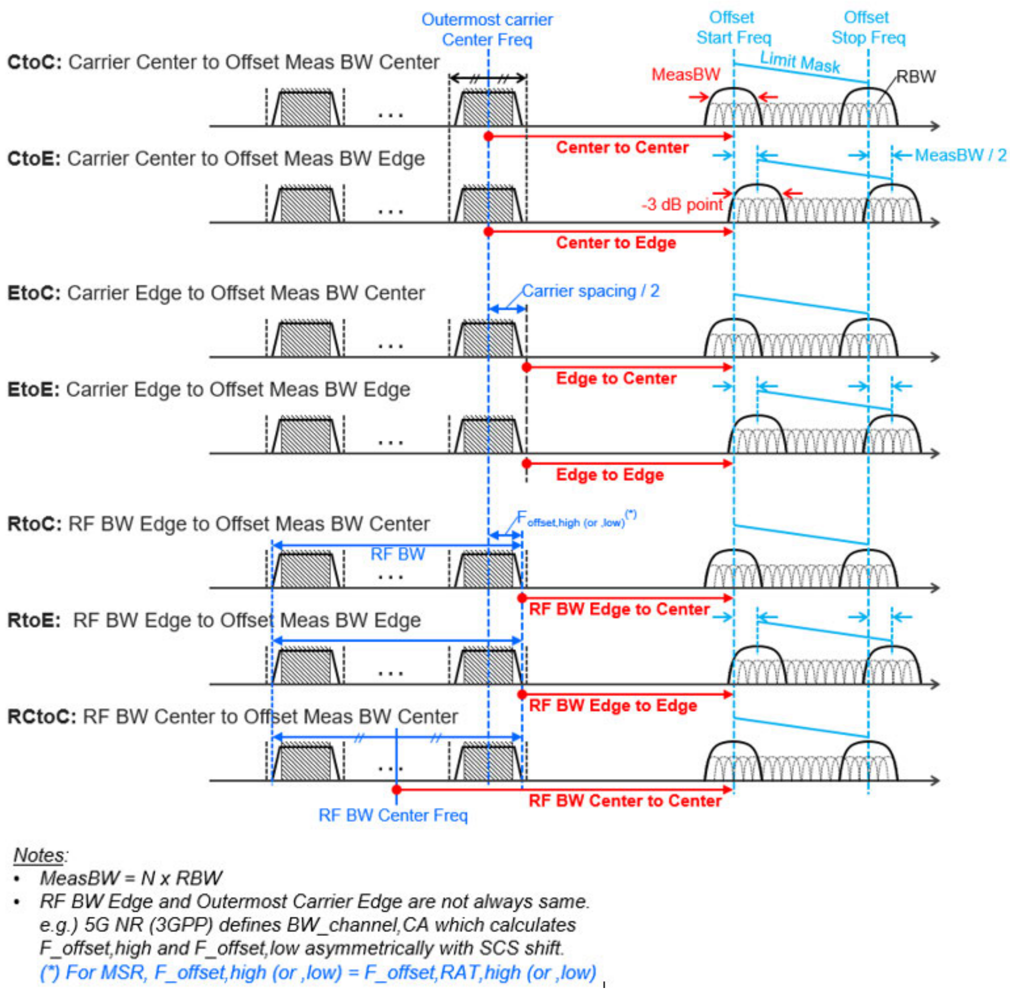
Diagrams for Offset Freq Define

Details depend on the selected mode.

Diagrams for Modes other than MSR, LTEAFDD/LTEATDD, 5G NR



Diagrams for MSR, LTEAFDD/LTEATDD, 5G NR



Offset Detector

Enables you to control the detector for offsets. The following choices are available:

`AUTO`	The detector selected depends on marker functions, trace functions, average type, and the trace averaging function
`NORMal`	The detector determines the peak of the CW-like signals, and it yields alternating maximums and minimums of noise-like signals. This is also referred to as Rosenfell detection
`AVERage`	The detector determines the average of the signal within the sweep points. The

	averaging method depends upon the Average Type selection (voltage, power or log scales)
POSitive Peak	The detector determines the maximum of the signal within the sweep points
SAMPle	The detector indicates the instantaneous level of the signal at the center of the sweep points represented by each display point
NEGative Peak	The detector determines the minimum of the signal within the sweep points

Remote Command	[:SENSe]:SEMask:DETector:OFFSet[:FUNCtion] AVERage | NEGative | NORMal | POSitive | SAMPle [:SENSe]:SEMask:DETector:OFFSet[:FUNCtion]? [:SENSe]:SEMask:DETector:OFFSet:AUTO ON | OFF | 1 | 0 [:SENSe]:SEMask:DETector:OFFSet:AUTO?
Example	:SEM:DET:OFFS AVER :SEM:DET:OFFS? :SEM:DET:OFFS:AUTO OFF :SEM:DET:OFFS:AUTO?
Notes	When you manually select a detector (instead of selecting Auto), that detector is used regardless of other instrument settings Note that this detector setting affects all offsets; there is no per-trace detector
Couplings	See Couplings in "Trace Type" on page 1905
Preset	POSitive ON
State Saved	Saved in instrument state
Range	AVERage|NEGative|NORMal|POSitive|SAMPle

Offset Average Type (Remote Command Only)

Select trace average type for the offsets.

Remote Command	[:SENSe]:SEMask:AVERage:OFFSet:TYPE RMS | LOG [:SENSe]:SEMask:AVERage:OFFSet:TYPE?
Example	:SEM:AVER:OFFS:TYPE LOG :SEM:AVER:OFFS:TYPE?
Preset	RMS
State Saved	Saved in instrument state

Start Freq

Specifies the start frequency for the currently selected offset. Also enables you to toggle that offset between On and Off.

When sending the remote command, missing values are not permitted; that is, if you want to change values 2 and 6, you must send all values up to 6. Subsequent values will remain unchanged. The query for this parameter returns 14 values for WLAN mode, 12 values for other modes.

Remote Command	`[:SENSe]:SEMask:OFFSet[1]|2[:OUTer]:LIST:FREQuency:STARt <freq>, …`
	`[:SENSe]:SEMask:OFFSet[1]|2[:OUTer]:LIST:FREQuency:STARt?`
	`[:SENSe]:SEMask:OFFSet[1]|2[:OUTer]:LIST:STATe ON | OFF | 1 | 0, …`
	`[:SENSe]:SEMask:OFFSet[1]|2[:OUTer]:LIST:STATe?`

Example	`:SEM:OFFS2:LIST:FREQ:STAR 2.515 MHz, 2.715 MHz, 3.515 MHz, 4.00 MHz, 8.00 MHz, 12.50 MHz`
	`:SEM:OFFS2:LIST:FREQ:STAR?`
	`:SEM:OFFS:LIST:STAT ON, ON, ON, OFF, OFF, OFF`
	`:SEM:OFFS:LIST:STAT?`

Notes	Comma-separated list of values `OFFSet1` is for BTS, 2 for MS. Default is BTS Note that Offset sub op code 2 is supported only in non-SA Modes. In SA Mode, Offset sub op code 1 is used for both BTS and MS If the offset is outside of the frequency range, the result spectrum will be invalid
Couplings	Coupled to Stop Freq. When the start freq goes above the stop freq, the stop freq is automatically adjusted to the start freq plus 100 Hz
Preset	When the max number of offsets is 6:

Mode	Values
SA	2.515 MHz, 2.715 MHz, 3.515 MHz, 4.00 MHz, 8.00 MHz, 12.50 MHz
WCDMA	2.515 MHz, 2.715 MHz, 3.515 MHz, 4.000 MHz, 8.000 MHz, 12.50 MHz|2.515MHz, 4.000 MHz, 7.500 MHz, 8.500 MHz, 12.5 MHz, 15 MHz

When the max number of offsets is 12 in these modes, the preset value of Offset G ~ L is the same as the Offset F value

Mode	Values
MSR	15 kHz, 215kHz, 1.015MHz, 1.5MHz, 10.5MHz, 15.00MHz, 30MHz, 30MHz, 30MHz, 30MHz, 30MHz, 30MHz | 15kHz, 215kHz, 1.015MHz, 1.5MHz, 10.5MHz, 15.00MHz, 30MHz, 30MHz, 30MHz, 30MHz, 30MHz, 30MHz
LTEAFDD,	50 kHz, 5.05 MHz, 10.5 MHz, 15.00 MHz, 30 MHz, 40 MHz, 40 MHz,40 MHz, 40

Mode	Values
LTEATDD	MHz,40 MHz, 40 MHz, 40 MHz | 15.00 kHz,1.5 MHz, 5.5 MHz, 6.5 MHz, 10 MHz, 20MHz, 20MHz, 20MHz, 20MHz, 20MHz, 20MHz, 20MHz
5G NR	50 kHz, 5.05 MHz, 10.5 MHz, 40.00 MHz, 100 MHz, 100 MHz, 100 MHz, 100 MHz, 100 MHz, 100 MHz, 100 MHz, 100 MHz | 15.00 kHz, 1.5 MHz, 5.5 MHz, 100.50 MHz, 105.00 MHz, 100 MHz, 100 MHz, 100 MHz, 100 MHz, 100 MHz, 100 MHz, 100 MHz

When the max number of offsets is 14 in these modes, the preset value of Offset G ~ N is the same as the Offset F value

WLAN Mode: See the table of "WLAN Mode Presets" on page 1613 below

When the max number of offsets is 6:

Mode	Values
SA	ON, ON, ON, ON, ON, OFF
WCDMA	ON, ON, ON, ON, ON, OFF | ON, ON, ON, ON, OFF, OFF

When the max number of offsets is 12 in these modes, the preset value of Offset G ~ L is the same as the Offset F value

MSR	ON, ON, ON, ON, ON, OFF, OFF, OFF, OFF, OFF, OFF, OFF | ON, ON, ON, ON, ON, OFF, OFF, OFF, OFF, OFF, OFF, OFF
LTEAFDD, LTEATDD	ON, ON, ON, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF | ON, ON, ON, ON, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF
5G NR	ON, ON, ON, ON, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF | ON, ON, ON, ON, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF

When the max number of offsets is 14 in these modes, the preset value of Offset G ~ N is the same as the Offset F value

Mode	Values
WLAN	See the table of "WLAN Mode Auto Function Presets" on page 1615 below

State Saved	Saved in instrument state Saved in instrument state
Min/Max	0 Hz/Depends on instrument maximum frequency Always Offset Stop Freq - 100 Hz

WLAN Mode Presets

Radio Std	Presets
802.11a/g (OFDM/DSSS-OFDM)/802.11n (20MHz)	9 MHz, 11 MHz, 20 MHz, 30 MHz, 40 MHz, 216 MHz, 216 MHz, 216 MHz, 216 MHz, 216 MHz, 216 MHz, 216 MHz, 216 MHz, 216 MHz

Radio Std	Presets
802.11b/g (DSSS/CCK/PBCC)	11 MHz, 22 MHz, 50 MHz, 70 MHz, 90 MHz, 100 MHz, 100 MHz, 100 MHz, 100 MHz, 100 MHz, 100 MHz, 100 MHz, 100 MHz, 100 MHz
802.11n(20MHz)	9 MHz, 11 MHz, 20 MHz, 30 MHz, 40 MHz, 100 MHz, 100 MHz, 100 MHz, 100 MHz, 100 MHz, 100 MHz, 100 MHz, 100 MHz, 100 MHz
802.11n(40MHz)	19 MHz, 21 MHz, 40 MHz, 60 MHz, 70 MHz, 100 MHz, 200 MHz, 200 MHz, 200 MHz, 200 MHz, 200 MHz, 200 MHz, 200 MHz, 200 MHz
802.11ac(20MHz)	9 MHz, 11 MHz, 20 MHz, 30 MHz, 40 MHz, 40 MHz, 40 MHz, 40 MHz, 40 MHz, 40 MHz, 40 MHz, 40 MHz, 40 MHz, 40 MHz
802.11ac(40MHz)	19 MHz, 21 MHz, 40 MHz, 60 MHz, 70 MHz, 70 MHz, 70 MHz, 70 MHz, 70 MHz, 70 MHz, 70 MHz, 70 MHz, 70 MHz, 70 MHz
802.11ac(80MHz)	39 MHz, 41 MHz, 80 MHz, 120 MHz, 125 MHz, 125 MHz, 125 MHz, 125 MHz, 125 MHz, 125 MHz, 125 MHz, 125 MHz, 125 MHz, 125 MHz
802.11ac(160MHz)	79 MHz, 81 MHz, 160 MHz, 240 MHz, 250 MHz, 250 MHz, 250 MHz, 250 MHz, 250 MHz, 250 MHz, 250 MHz, 250 MHz, 250 MHz, 250 MHz
802.11ac(80 MHz + 80MHz)	0MHz, 0 MHz, 40 MHz, 79 MHz, 159 MHz, 161 MHz, 200 MHz, 240 MHz, 240 MHz, 240 MHz, 240 MHz, 240 MHz, 240 MHz, 240 MHz
802.11ah(1MHz)	0.45 MHz, 0.6 MHz, 1 MHz, 1.5 MHz, 1.5 MHz, 1.5 MHz, 1.5 MHz, 1.5 MHz, 1.5 MHz, 1.5 MHz, 1.5 MHz, 1.5 MHz, 1.5 MHz, 1.5 MHz
802.11ah(2MHz)	0.9 MHz, 1.1 MHz, 2 MHz, 3 MHz, 3 MHz, 3 MHz, 3 MHz, 3 MHz, 3 MHz, 3 MHz, 3 MHz, 3 MHz, 3 MHz, 3 MHz
802.11ah(4MHz)	1.9 MHz, 2.1 MHz, 4 MHz, 6 MHz, 6 MHz, 6 MHz, 6 MHz, 6 MHz, 6 MHz, 6 MHz, 6 MHz, 6 MHz, 6 MHz, 6 MHz
802.11ah(8MHz)	3.9 MHz, 4.1 MHz, 8 MHz, 12 MHz, 12 MHz, 12 MHz, 12 MHz, 12 MHz, 12 MHz, 12 MHz, 12 MHz, 120 MHz, 120 MHz, 120 MHz
802.11ah(16MHz)	7.9 MHz, 8.1 MHz, 16 MHz, 24 MHz, 24 MHz, 24 MHz, 24 MHz, 24 MHz, 24 MHz, 24 MHz, 24 MHz, 24 MHz, 24 MHz, 24 MHz
802.11j/p(10MHz)	4.5 MHz, 5MHz, 5.5 MHz, 10 MHz, 15 MHz, 216 MHz, 216MHz, 216 MHz, 216MHz, 216MHz, 216MHz, 216MHz, 216MHz, 216MHz
802.11p(5MHz)	2.25 MHz, 2.5MHz, 2.75 MHz, 5 MHz, 7.5 MHz, 216 MHz, 216MHz, 216 MHz, 216MHz, 216MHz, 216MHz, 216MHz, 216MHz, 216MHz
802.11ax/be(20MHz)	9.75 MHz, 10.5 MHz, 20 MHz, 30 MHz, 40 MHz, 40 MHz, 40 MHz, 40 MHz, 40 MHz, 40 MHz, 40 MHz, 40 MHz, 40 MHz, 40 MHz
802.11ax/be(40MHz)	19.5 MHz, 20.5 MHz, 40 MHz, 60 MHz, 70 MHz, 70 MHz, 70 MHz, 70 MHz, 70 MHz, 70 MHz, 70 MHz, 70 MHz, 70 MHz, 70 MHz
802.11ax/be(80MHz)	39.5 MHz, 40.5 MHz, 80 MHz, 120 MHz, 125 MHz, 125 MHz, 125 MHz, 125 MHz, 125 MHz, 125 MHz, 125 MHz, 125 MHz, 125 MHz, 125 MHz
802.11ax/be(160MHz):	79.5 MHz, 80.5 MHz, 160 MHz, 240 MHz, 250 MHz, 250 MHz, 250 MHz, 250 MHz, 250 MHz, 250 MHz, 250 MHz, 250 MHz, 250 MHz, 250 MHz
802.11ax(80 MHz + 80MHz)	0MHz, 0 MHz, 40 MHz, 79 MHz, 159 MHz, 161 MHz, 200 MHz, 240 MHz, 240 MHz, 240 MHz, 240 MHz, 240 MHz, 240 MHz, 240 MHz
802.11af(6MHz)	2.85 MHz, 3.15 MHz, 6 MHz, 9 MHz, 9 MHz, 9 MHz, 9 MHz, 9 MHz, 9 MHz,

Radio Std	Presets
	9 MHz, 9 MHz, 9 MHz, 9 MHz, 9 MHz
802.11af(7MHz)	3.325 MHz, 3.675 MHz, 7 MHz, 10.5 MHz, 10.5 MHz, 10.5 MHz, 10.5 MHz, 10.5 MHz, 10.5 MHz, 10.5 MHz, 10.5 MHz, 10.5 MHz, 10.5 MHz, 10.5 MHz
802.11af(8MHz)	3.8 MHz, 4.2 MHz, 8 MHz, 12 MHz, 12 MHz, 12 MHz, 12 MHz, 12 MHz, 12 MHz, 12 MHz, 12 MHz, 12 MHz, 12 MHz, 12 MHz
802.11be (320MHz)	159.5 MHz, 160.5 MHz, 320 MHz, 480 MHz, 490 MHz, 490 MHz, 490 MHz, 490 MHz, 490MHz, 490 MHz, 490 MHz, 490 MHz, 490 MHz, 490 MHz

WLAN Mode Auto Function Presets

For X Series:

Radio Std	Presets
802.11b/g(DSSS/CCK/PBCC)	`ON, ON, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF`
802.11a/g/j/p 20MHz (OFDM/DSSS-OFDM) 802.11j/p 10MHz 802.11p 5MHz/802.11n (20MHz/40MHz)	`ON, ON, ON, ON, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF`
802.11ac/ax/be (20 MHz/ 40 MHz/ 80 MHz/ 160 MHz)	`ON, ON, ON, ON, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF`
802.11be (320 MHz)	`ON, ON, ON, ON, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF`
802.11ac/ax (80 MHz + 80 MHz)	`OFF, ON, ON, ON, ON, ON, ON, ON, OFF, OFF, OFF, OFF, OFF, OFF`
802.ah (1MHz/ 2MHz/ 4MHz/ 8MHz/ 16MHz)	`ON, ON, ON, ON, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF`
802.11af (6 MHz/ 7 MHz/ 8 MHz)	`ON, ON, ON, ON, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF`

For E6630A, E6640A, and M90XA:

Radio Std	Presets
802.11a/g(OFDM/DSSS-OFDM) 802.11n(20MHz/40MHz)	`ON, ON, ON, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF`
802.11ac/ax/be (20 MHz/ 40 MHz/ 80 MHz/ 160 MHz)	`ON, ON, ON, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF`
802.11be (320 MHz)	`ON, ON, ON, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF`
802.11ac/ax (80 MHz + 80 MHz)	`ON, ON, ON, OFF, ON, ON, ON, OFF, OFF, OFF, OFF, OFF, OFF, OFF`
802.11af (6 MHz/ 7 MHz/ 8 MHz)	`ON, ON, ON, ON, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF`

Stop Freq

Specifies the stop frequency for the currently selected offset.

When sending the remote command, missing values are not permitted; that is, if you want to change values 2 and 6, you must send all values up to 6. Subsequent values will remain unchanged. The query for this parameter returns 14 values for WLAN mode, 12 values for other modes.

Remote Command	`[:SENSe]:SEMask:OFFSet[1]|2[:OUTer]:LIST:FREQuency:STOP <freq>, …` `[:SENSe]:SEMask:OFFSet[1]|2[:OUTer]:LIST:FREQuency:STOP?`
Example	`:SEM:OFFS:LIST:FREQ:STOP 2.715 MHz, 3.515 MHz, 4.00 MHz, 8.00 MHz, 12.50 MHz, 15.0 MHz` `:SEM:OFFS:LIST:FREQ:STOP?`
Notes	Comma separated list of values `OFFSet1` is for BTS, 2 for MS. Default is BTS Note that Offset sub op code 2 is supported only in non-SA Modes. In SA Mode, Offset sub op code 1 is used for both BTS and MS If the offset is outside of the frequency range, the result spectrum will be invalid
Couplings	Coupled to Start Freq. When Stop Freq goes below Start Freq, Start Freq is automatically adjusted to Stop Freq minus 100 Hz
Preset	When the max number of offsets is 6:

Mode	Values
SA	2.715 MHz, 3.515 MHz, 4.00 MHz, 8.00 MHz, 12.50 MHz, 15.0 MHz
WCDMA	2.715 MHz, 3.515 MHz, 4.000 MHz, 8.000 MHz, 12.50 MHz, 15.0 MHz|3.485 MHz, 7.500 MHz, 8.500 MHz, 12.00 MHz, 15.00 MHz, 18.0 MHz

When the max number of offsets is 12 in these modes, the preset value of Offset G ~ L is the same as the Offset F value

Mode	Values
MSR	215 kHz, 1.015 MHz, 1.5 MHz, 10.5 MHz, 50 MHz, 50 MHz, 50 MHz, 50 MHz, 50 MHz, 50 MHz, 50 MHz, 50 MHz|215 kHz, 1.015 MHz, 1.5 MHz, 10.5 MHz, 50 MHz, 50 MHz, 50 MHz, 50 MHz, 50 MHz, 50 MHz, 50 MHz, 50 MHz
LTEAFDD, LTEATDD	5.05 MHz, 10.05 MHz, 15 MHz, 30 MHz, 40 MHz, 50 MHz, 50 MHz, 50 MHz, 50 MHz, 50 MHz, 50 MHz, 50 MHz | 985.0 kHz, 4.50 MHz, 5.5001 MHz, 9.50 MHz, 20 MHz, 40 MHz, 40 MHz, 40 MHz, 40 MHz, 40 MHz, 40 MHz, 40 MHz
5G NR	5.05 MHz, 10.05 MHz, 40 MHz, 100 MHz, 500 MHz, 500 MHz, 500 MHz, 500 MHz, 500 MHz, 500 MHz, 500 MHz, 500 MHz | 985.0 kHz, 4.50 MHz, 99.500 MHz, 104.5 MHz, 500 MHz, 500 MHz, 500 MHz, 500 MHz, 500 MHz, 500 MHz, 500 MHz, 500 MHz

When the max number of offsets is 14 in these modes, the preset value of Offset G ~ N is the same as

	the Offset F value **WLAN Mode**: See table of "WLAN Mode Presets" on page 1617 below
State Saved	Saved in instrument state
Min/Max	100 Hz/Depends on instrument maximum frequency. Same as the Max Span in Swept SA Measurement

WLAN Mode Presets

Radio Std	Presets
802.11a/g (OFDM/DSSS-OFDM) 802.11n (20MHz)	11 MHz, 20 MHz, 30 MHz, 40 MHz, 100 MHz, 250 MHz, 250 MHz, 250 MHz, 250 MHz, 250 MHz, 250 MHz, 250 MHz, 250 MHz, 250 MHz
802.11b/g (DSSS/CCK/PBCC)	22 MHz, 50 MHz, 70 MHz, 90 MHz, 100 MHz, 120 MHz, 120 MHz, 120 MHz, 120 MHz, 120 MHz, 120 MHz, 120 MHz, 120 MHz, 120 MHz
802.11n (20MHz)	11 MHz, 20 MHz, 30 MHz, 40 MHz, 100 MHz, 200 MHz, 200 MHz, 200 MHz, 200 MHz, 200 MHz, 200 MHz, 200 MHz, 200 MHz, 200 MHz
802.11n (40MHz)	21 MHz, 40 MHz, 60 MHz, 70 MHz, 100 MHz, 200 MHz, 300 MHz, 300 MHz, 300 MHz, 300 MHz, 300 MHz, 300 MHz, 300 MHz, 300 MHz
802.11ac (20MHz)	11 MHz, 20 MHz, 30 MHz, 40 MHz, 50 MHz, 50 MHz, 50 MHz, 50 MHz, 50 MHz, 50 MHz, 50 MHz, 50 MHz, 50 MHz, 50 MHz
802.11ac (40MHz)	21 MHz, 40 MHz, 60 MHz, 70 MHz, 100 MHz, 100 MHz, 100 MHz, 100 MHz, 100 MHz, 100 MHz, 100 MHz, 100 MHz, 100 MHz, 100 MHz
802.11ac (80MHz)	41 MHz, 80 MHz, 120 MHz, 125 MHz, 200 MHz, 200 MHz, 200 MHz, 200 MHz, 200 MHz, 200 MHz, 200 MHz, 200 MHz, 200 MHz, 200 MHz
802.11ac (160MHz)	81 MHz, 160 MHz, 240 MHz, 250 MHz, 400 MHz, 400 MHz, 400 MHz, 400 MHz, 400 MHz, 400 MHz, 400 MHz, 400 MHz, 400 MHz, 400 MHz
802.11ac (80 MHz + 80MHz)	100Hz, 40 MHz, 79 MHz, 81 MHz, 161 MHz, 200 MHz, 240 MHz, 250 MHz, 250 MHz, 250 MHz, 250 MHz, 250 MHz, 250 MHz, 250 MHz
802.11ah (1MHz)	0.6MHz, 1 MHz, 1.5 MHz, 2.5MHz, 2.5 MHz, 2.5 MHz, 2.5 MHz, 2.5 MHz, 2.5 MHz, 2.5 MHz, 2.5 MHz, 2.5 MHz, 2.5 MHz, 2.5 MHz
802.11ah (2MHz)	1.1 MHz, 2 MHz, 3 MHz, 5MHz, 5 MHz, 5 MHz, 5 MHz, 5 MHz, 5 MHz, 5 MHz, 5 MHz, 5 MHz, 5 MHz, 5 MHz
802.11ah (4MHz)	2.1 MHz, 4 MHz, 6 MHz, 10 MHz, 10 MHz, 10 MHz, 10 MHz, 10 MHz, 10 MHz, 10 MHz, 10 MHz, 10 MHz, 10 MHz, 10 MHz
802.11ah (8MHz)	4.1 MHz, 8 MHz, 12 MHz, 20 MHz, 20 MHz, 20 MHz, 20 MHz, 20 MHz, 20 MHz, 20 MHz, 20 MHz, 20 MHz, 20 MHz, 20 MHz
802.11ah (16MHz)	8.1 MHz, 16 MHz, 24 MHz, 40 MHz, 40 MHz, 40 MHz, 40 MHz, 40 MHz, 40 MHz, 40 MHz, 40 MHz, 40 MHz, 40 MHz, 40 MHz
802.11j/p (20MHz)	10MHz, 11 MHz, 20 MHz, 30 MHz, 50MHz, 50 MHz, 50 MHz, 50 MHz, 50 MHz, 50 MHz, 50 MHz, 50 MHz, 50 MHz, 50 MHz
802.11j/p (10MHz)	5MHz, 5.5 MHz, 10 MHz, 15 MHz, 25MHz, 250MHz, 250MHz, 250MHz, 250 MHz, 250MHz, 250MHz, 250MHz, 250MHz, 250MHz

Radio Std	Presets
802.11p (5MHz)	2.5MHz, 2.75MHz, 5 MHz, 7.5 MHz, 12.5MHz, 250MHz, 250MHz, 250MHz, 250 MHz, 250MHz, 250MHz, 250MHz, 250MHz, 250MHz
802.11ax/be (20MHz)	10.5 MHz, 20 MHz, 30 MHz, 40 MHz, 50 MHz, 50 MHz, 50 MHz, 50 MHz, 50 MHz, 50 MHz, 50 MHz, 50 MHz, 50 MHz, 50 MHz
802.11ax/be (40MHz)	20.5 MHz, 40 MHz, 60 MHz, 70 MHz, 100 MHz, 100 MHz, 100 MHz, 100 MHz, 100 MHz, 100 MHz, 100 MHz, 100 MHz, 100 MHz, 100 MHz
802.11ax/be (80MHz)	40.5 MHz, 80 MHz, 120 MHz, 125 MHz, 200 MHz, 200 MHz, 200 MHz, 200 MHz, 200 MHz, 200 MHz, 200 MHz, 200 MHz, 200 MHz, 200 MHz
802.11ax/be (160MHz)	80.5 MHz, 160 MHz, 240 MHz, 250 MHz, 400 MHz, 400 MHz, 400 MHz, 400 MHz, 400 MHz, 400 MHz, 400 MHz, 400 MHz, 400 MHz, 400 MHz
802.11ax (80 MHz + 80MHz)	100Hz, 40 MHz, 79 MHz, 81 MHz, 161 MHz, 200 MHz, 240 MHz, 250 MHz, 250 MHz, 250 MHz, 250 MHz, 250 MHz, 250 MHz, 250 MHz
802.11af (6MHz)	3.15MHz, 6 MHz, 9 MHz, 15MHz, 15 MHz, 15 MHz, 15 MHz, 15 MHz, 15 MHz, 15 MHz, 15 MHz, 15 MHz, 15 MHz, 15 MHz
802.11af (7MHz)	3.675 MHz, 7 MHz, 10.5 MHz, 17.5MHz, 17.5 MHz, 17.5 MHz, 17.5 MHz, 17.5 MHz, 17.5 MHz, 17.5 MHz, 17.5 MHz, 17.5 MHz, 17.5 MHz, 17.5 MHz
802.11af (8MHz)	4.2 MHz, 8 MHz, 12 MHz, 20 MHz, 20 MHz, 20 MHz, 20 MHz, 20 MHz, 20 MHz, 20 MHz, 20 MHz, 20 MHz, 20 MHz, 20 MHz
802.11be (320MHz)	160.5 MHz, 320 MHz, 480 MHz, 490 MHz, 800 MHz, 800 MHz, 800 MHz, 800 MHz, 800 MHz, 800 MHz, 800 MHz, 800 MHz, 800 MHz, 800 MHz

Res BW

Specifies which Resolution BW filter to use when measuring the currently selected offset.

Offset Res BW Mode allows the instrument to determine the optimum Resolution BW filter to use when measuring the currently selected offset.. When changing the Meas BW parameter, if the Res BW needs to be changed to adhere to the rule:

(N x Res BW) <= (Stop freq of the offset - Start freq of the offset),

where N is the multiplier, this setting will automatically be changed to manual.

When sending the remote command, missing values are not permitted; that is, if you want to change values 2 and 6, you must send all values up to 6. Subsequent values will remain unchanged. The query for this parameter returns 14 values for WLAN mode, 12 values for other modes.

Remote Command	`[:SENSe]:SEMask:OFFSet[1]|2[:OUTer]:LIST:BANDwidth[:RESolution] <bandwidth>, …`
	`[:SENSe]:SEMask:OFFSet[1]|2[:OUTer]:LIST:BANDwidth[:RESolution]?`
	`[:SENSe]:SEMask:OFFSet[1]|2[:OUTer]:LIST:BANDwidth[:RESolution]:AUTO OFF | ON | 1 | 0, …`

	`[:SENSe]:SEMask:OFFSet[1]|2[:OUTer]:LIST:BANDwidth[:RESolution]:AUTO?`

Example	`:SEM:OFFS2:LIST:BAND 30.0 kHz, 30.0 kHz, 30.0 kHz, 1.00 MHz,1.00 MHz, 1.00 MHz`
	`:SEM:OFFS2:LIST:BAND?`
	`:SEM:OFFS:LIST:BAND:AUTO 1,1,1,1,1,1`
	`:SEM:OFFS:LIST:BAND:AUTO?`

Notes	Comma separated list of values `OFFSet1` is for BTS, 2 for MS. Default is BTS Note that Offset sub op code 2 is supported only in non-SA modes. In the SA mode, Offset sub op code 1 is used for both BTS and MS
Couplings	Coupled to Start and Stop offset and Meas BW multiplier. This parameter must adhere to the rule (N x Res BW) <= (Stop freq of the offset - Start freq of the offset), where N is the multiplier. If the multiplier is changed, the Res BW will change to ensure this. When set manually, Res BW Coupling is set to manual The resolution bandwidth is coupled to the offset width determined by the start frequency and stop frequency
Preset	When the max number of offsets is 6:

Mode	Values
SA	30.0 kHz, 30.0 kHz, 30.0 kHz, 1.00 MHz,1.00 MHz, 1.00 MHz
WCDMA	30.00 kHz, 30.00 kHz, 30.00 kHz, 100.00 kHz, 1.000 MHz, 1.00 MHz|30.00 kHz, 1.000 MHz, 1.000 MHz, 1.000 MHz, 1.000 MHz, 1.00 MHz

When the max number of offsets is 12 in these modes, the preset value of Offset G ~ L is the same as the Offset F value

Mode	Values
LTEAFDD, LTEATDD, 5G NR	51 kHz, 100 kHz, 1.0 MHz, 1.0 MHz, 1.0 MHz, 1.0 MHz, 1.0 MHz, 1.0 MHz, 1.0 MHz, 1.0 MHz, 1.0 MHz, 1.0 MHz | 15.0 kHz, 510 kHz, 1.0 MHz, 1.0 MHz, 1.0 MHz, 1.0 MHz, 1.0 MHz, 1.0 MHz, 1.0 MHz, 1.0 MHz, 1.0 MHz, 1.0 MHz
MSR	30kHz, 30kHz, 30kHz, 1.0MHz,1.0MHz, 1.0MHz, 1.0MHz, 1.0MHz, 1.0MHz, 1.0MHz, 1.0MHz, 1.0MHz | 30kHz, 30kHz, 30kHz, 1.0MHz,1.0MHz, 1.0MHz, 1.0MHz, 1.0MHz, 1.0MHz, 1.0MHz, 1.0MHz,1.0MHz

When the max number of offsets is 14 in these modes, the preset value of Offset G ~ N is the same as the Offset F value

Mode	Values
WLAN	**100 kHz, 100 kHz, 100 kHz, 100 kHz, 100 kHz, 100 kHz, 100 kHz, 100 kHz, 100 kHz, 100 kHz, 100 kHz, 100 kHz, 100 kHz, 100 kHz**

When the max number of offsets is 6:

`OFF, OFF, OFF, OFF, OFF, OFF | OFF, OFF, OFF, OFF, OFF, OFF`

When the max number of offsets is 12:

`OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF | OFF, OFF, OFF,`

	OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF When the max number of offsets is 14: OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF | OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF
State Saved	Saved in instrument state Saved in instrument state
Range	Auto|Man
Min	1 Hz
Max	Option FS1 or FS2 is installed: 10 MHz Otherwise: 8 MHz
Backwards Compatibility SCPI	[:SENSe]:SEMask:OFFSet[1]|2:LIST:BWIDth[:RESolution] [:SENSe]:SEMask:OFFSet[1]|2:LIST:BWIDth[:RESolution]:AUTO

Meas BW

Allows you to specify a multiplier of Res BW for the measurement integration bandwidth.

Meas BW is multiplier integer number. It shows a ratio between Integration BW and Resolution BW of the measurement result.

Integ BW = Meas BW * Resolution BW

Integration BW is desired resolution bandwidth and Resolution BW is actual bandwidth for sweep. Measurement sweeps with Resolution BW and Meas BW compensates sweep resolution bandwidth to Integration BW.

If you set this value greater than 1, you can set Resolution BW narrower to avoid carrier power leakage effect to the offset power integration.

When sending the remote command, missing values are not permitted; that is, if you want to change values 2 and 6, you must send all values up to 6. Subsequent values will remain unchanged. The query for this parameter returns 14 values for WLAN mode, 12 values for other modes.

Remote Command	[:SENSe]:SEMask:OFFSet[1]|2[:OUTer]:LIST:BANDwidth:IMULti <integer>, … [:SENSe]:SEMask:OFFSet[1]|2[:OUTer]:LIST:BANDwidth:IMULti?
Example	:SEM:OFFS2:LIST:BAND:IMUL 1,1,1,1,1,1 :SEM:OFFS2:LIST:BAND:IMUL?
Notes	Comma separated list of values OFFSet1 is for BTS, 2 for MS. Default is BTS Note that Offset sub op code 2 is supported only in non-SA modes. In the SA mode, Offset sub op code 1 is used for both BTS and MS

Preset	When the max number of offsets is 6: **Mode** / **Values** SA: 1, 1, 1, 1, 1, 1 WCDMA: 1, 1, 1, 10, 1, 1|1, 1, 1, 1, 1, 1 When the max number of offsets is 12 in these modes, the preset value of Offset G ~ L is the same as the Offset F value **Mode** / **Values** MSR: 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1|1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1 LTEAFDD, LTEATDD, 5G NR: 2, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1|2, 2, 1, 1, 1,1, 1, 1, 1, 1, 1, 1 When the max number of offsets is 14in these modes, the preset value of Offset G ~ N is the same as the Offset F value **Mode** / **Values** WLAN: 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1
State Saved	Yes
Min/Max	1/1000
Backwards Compatibility SCPI	`[:SENSe]:SEMask:OFFSet[1]|2:LIST:BWIDth:IMULti`

Video BW

Changes the instrument post-detection filter.

When sending the remote command, missing values are not permitted; that is, if you want to change values 2 and 6, you must send all values up to 6. Subsequent values will remain unchanged. The query for this parameter returns 14 values for WLAN mode, 12 values for other modes.

Remote Command	`[:SENSe]:SEMask:OFFSet[1]|2[:OUTer]:LIST:BANDwidth:VIDeo <freq>, …`
	`[:SENSe]:SEMask:OFFSet[1]|2[:OUTer]:LIST:BANDwidth:VIDeo?`
	`[:SENSe]:SEMask:OFFSet[1]|2[:OUTer]:LIST:BANDwidth:VIDeo:AUTO OFF | ON | 0 | 1, …`
	`[:SENSe]:SEMask:OFFSet[1]|2[:OUTer]:LIST:BANDwidth:VIDeo:AUTO?`

Example	`:SEM:OFFS2:LIST:BAND:VID 3.00 kHz, 3.00 kHz, 3.00 kHz, 100.0 kHz,100.0 kHz, 100.0 kHz`
	`:SEM:OFFS2:LIST:BAND:VID?`
	`:SEM:OFFS2:LIST:BAND:VID:AUTO ON, ON, ON, ON, ON, ON`
	`:SEM:OFFS2:LIST:BAND:VID:AUTO?`

Notes	Comma separated list of values `OFFSet1` is for BTS, 2 for MS. Default is BTS Note that Offset sub op code 2 is supported only in non-SA modes. In the SA mode, Offset sub op code 1 is used for both BTS and MS

Preset	Automatically Calculated
	When the max number of offsets is 6:
	`ON, ON, ON, ON, ON, ON | ON, ON, ON, ON, ON, ON`
	When the max number of offsets is 12:
	`ON, ON, ON, ON, ON, ON, ON, ON, ON, ON, ON, ON, ON | ON, ON, ON, ON, ON, ON, ON, ON, ON, ON, ON, ON`
	When the max number of offsets is 14:
	`ON, ON, ON, ON, ON, ON, ON, ON, ON, ON, ON, ON, ON, ON`

State Saved	Saved in instrument state Saved in instrument state
Range	Auto|Man
Min/Max	1 Hz/50 MHz
Backwards Compatibility SCPI	`[:SENSe]:SEMask:OFFSet[1]|2:LIST:BWIDth:VIDeo` `[:SENSe]:SEMask:OFFSet[1]|2:LIST:BWIDth:VIDeo:AUTO`

VBW/RBW

Selects the ratio between the video and resolution bandwidths.

When sending the remote command, missing values are not permitted; that is, if you want to change values 2 and 6, you must send all values up to 6. Subsequent values will remain unchanged. The query for this parameter returns 14 values for WLAN mode, 12 values for other modes.

Remote Command	`[:SENSe]:SEMask:OFFSet[1]|2[:OUTer]:LIST:BANDwidth:VIDeo:RATio <real>, …`
	`[:SENSe]:SEMask:OFFSet[1]|2[:OUTer]:LIST:BANDwidth:VIDeo:RATio?`
	`[:SENSe]:SEMask:OFFSet[1]|2[:OUTer]:LIST:BANDwidth:VIDeo:RATio:AUTO OFF | ON | 0 | 1, …`
	`[:SENSe]:SEMask:OFFSet[1]|2[:OUTer]:LIST:BANDwidth:VIDeo:RATio:AUTO?`

Example	`:SEM:OFFS2:LIST:BAND:VID:RAT 0.1, 0.1, 0.1, 0.1, 0.1, 0.1`
	`:SEM:OFFS2:LIST:BAND:VID:RAT?`
	`:SEM:OFFS2:LIST:BAND:VID:RAT:AUTO ON, ON, ON, ON, ON, ON`
	`:SEM:OFFS2:LIST:BAND:VID:RAT:AUTO?`

Notes	Comma separated list of values `OFFSet1` is for BTS, 2 for MS. Default is BTS

	Note that Offset sub op code 2 is supported only in non-SA modes. In the SA mode, Offset sub op code 1 is used for both BTS and MS

Preset	**Modes other than LTEAFDD, LTEATDD, 5G NR, MSR, WLAN:**
	When the max number of offsets is 6:
	0.01, 0.01, 0.01, 0.01, 0.01, 0.01|0.01, 0.01, 0.01, 0.01, 0.01, 0.01
	When the max number of offsets is 12, the preset value of Offset G ~ L is the same as the Offset F value
	LTEAFDD, LTEATDD, 5G NR, MSR Modes:
	0.01, 0.01, 0.01, 0.01, 0.01, 0.01, 0.01, 0.01, 0.01, 0.01, 0.01, 0.01|0.01, 0.01, 0.01, 0.01, 0.01, 0.01, 0.01, 0.01, 0.01, 0.01, 0.01, 0.01
	When the max number of offsets is 14 in these modes, the preset value of Offset G ~ N is the same as the Offset F value
	WLAN Mode:
	802..11 ax/be: 0.075, 0.075, 0.075, 0.075, 0.075, 0.075, 0.075, 0.075, 0.075, 0.075, 0.075, 0.075, 0.075, 0.075
	All other formats: 0.3, 0.3, 0.3, 0.3, 0.3, 0.3, 0.3, 0.3, 0.3, 0.3, 0.3, 0.3, 0.3, 0.3
	Modes other than WLAN
	When the max number of offsets is 6:
	`OFF, OFF, OFF, OFF, OFF, OFF | OFF, OFF, OFF, OFF, OFF, OFF`
	When the max number of offsets is 12:
	`OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF | OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF`
	WLAN Mode:
	`OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF | OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF`

State Saved	Saved in instrument state Saved in instrument state
Range	Auto|Man
Min/Max	0.00001/3000000
Backwards Compatibility SCPI	`[:SENSe]:SEMask:OFFSet[1]|2:LIST:BWIDth:VIDeo:RATio` `[:SENSe]:SEMask:OFFSet[1]|2:LIST:BWIDth:VIDeo:RATio:AUTO`

Offset (Sweep)

Accesses a menu that enables you to set up the sweep measurement parameters for offset pairs.

Offset Freq Define

Same as "Offset Freq Define" on page 1606 under Offset (Bandwidth).

Offset Detector

Same as "Offset Detector" on page 1610 under Offset (Bandwidth).

Start Freq

Same as "Start Freq" on page 1612 under Offset (Bandwidth).

Stop Freq

Same as "Stop Freq" on page 1616 under Offset (Bandwidth).

Sweep Time

Specifies the **Sweep Time** for the currently selected offset and enables you to toggle the Sweep Time mode between Auto and Man.

When sending the remote command, missing values are not permitted; that is, if you want to change values 2 and 6, you must send all values up to 6. Subsequent values will remain unchanged. The query for this parameter returns 14 values for WLAN mode, 12 values for other modes.

NOTE: On non-sweeping hardware, this column is grayed out. The value shown on this column is an estimate. It is the turnaround time to complete the measurement of the entire offset span, which is the sum of signal acquisition time, FFT time, and other overhead time. If you need to specify the same “Sweep Time” as you would for sweeping hardware, send `[:SENSe]:SEMask:OFFSet[1]|2[:OUTer]:LIST:SWEep:TIME <time>`. The measurement emulates the “Sweep Time” effect, but this emulation is not straightforward, and therefore the behavior is not specified. Instead, we recommend using **Minimum Acquisition Time**, which provides better control.

Remote Command	`[:SENSe]:SEMask:OFFSet[1]|2[:OUTer]:LIST:SWEep:TIME <time>, …` `[:SENSe]:SEMask:OFFSet[1]|2[:OUTer]:LIST:SWEep:TIME?` `[:SENSe]:SEMask:OFFSet[1]|2[:OUTer]:LIST:SWEep:TIME:AUTO ON	OFF	1	0, …` `[:SENSe]:SEMask:OFFSet[1]|2[:OUTer]:LIST:SWEep:TIME:AUTO?`

Example	`:SEM:OFFS2:LIST:SWE:TIME 1.0 ms, 3.4 ms, 2.08 ms, 1.0 ms, 1.0 ms, 1.0 ms`
	`:SEM:OFFS2:LIST:SWE:TIME?`
	`:SEM:OFFS2:LIST:SWE:TIME:AUTO ON, ON, ON, ON, OFF, OFF`
	`:SEM:OFFS2:LIST:SWE:TIME:AUTO?`

Notes	Comma separated list of values OFFSet1 is for BTS, 2 for MS. Default is BTS Note that Offset sub op code 2 is supported only in non-SA modes. In the SA mode, Offset sub op code 1 is used for both BTS and MS
Dependencies	On non-sweeping hardware, this column is grayed out and the Auto/Man checkbox is invisible. The read-only value shows the estimated sweep time In those instruments, "Minimum Acquisition Time" on page 1625 is available
Couplings	When you manually set a value when in the Auto state, the state automatically changes to Man

Preset	Automatically calculated
	Modes other than LTEAFDD, LTEATDD, 5G NR, MSR, WLAN:
	When the max number of offsets is 6:
	`ON,ON,ON,ON,ON,ON`
	When the max number of offsets is 12:
	`ON,ON,ON,ON,ON,ON,ON,ON,ON,ON,ON,ON`
	Modes LTEAFDD, LTEATDD, 5G NR, MSR:
	`ON,ON,ON,ON,ON,ON,ON,ON,ON,ON,ON,ON | ON,ON,ON,ON,ON,ON,ON,ON,ON,ON,ON,ON`
	When the max number of offsets is 14:
	Mode WLAN:
	`ON,ON,ON,ON,ON,ON,ON,ON,ON,ON,ON,ON,ON,ON`

State Saved	Saved in instrument state Saved in instrument state
Range	Auto|Man
Min	Other than non-sweeping hardware Depends on Sweep Type: – Sweep Type “Swept”: 1 ms – Sweep Type “FFT”: 100 ns Non-sweeping hardware: N/A
Max	Other than non-sweeping hardware: 4000 s Non-sweeping hardware: N/A
Backwards Compatibility SCPI	`[:SENSe]:SEMask:OFFSet[1]|2:LIST:SWEep[:TIME]` `[:SENSe]:SEMask:OFFSet[1]|2:LIST:SWEep[:TIME]:AUTO`

Minimum Acquisition Time

Available on non-sweeping hardware.

Specifies the minimum acquisition time for each “chunk” of the measurement result. The instrument automatically divides Span into multiple chunks if needed.

Therefore, the total signal acquisition time for the entire offset span is ~(>~Minimum Acquisition Time) * (The number of chunks).

When in Auto, this parameter's value is determined by other parameters, such as Offset Start, Offset Stop, RBW and VBW.

You can manually increase this parameter value from this Auto value.

If increased, the instrument acquires signal for the specified time duration for each chunk. It performs additional FFTs, and averages or peak-holds the FFT results for a chunk, depending on Detector settings.

Note that the actual acquisition time for each chunk may exceed the Minimum Acquisition Time value, in order to satisfy FFT time required by other parameters, and to perform an integer number of FFTs.

Remote Command	`[:SENSe]:SEMask:OFFSet[1]|2[:OUTer]:LIST:SWEep:ACQuisition:TIME <time>, …`
	`[:SENSe]:SEMask:OFFSet[1]|2[:OUTer]:LIST:SWEep:ACQuisition:TIME?`
	`[:SENSe]:SEMask:OFFSet[1]|2[:OUTer]:LIST:SWEep:ACQuisition:TIME:AUTO ON | OFF | 1 | 0, …`
	`[:SENSe]:SEMask:OFFSet[1]|2[:OUTer]:LIST:SWEep:ACQuisition:TIME:AUTO?`

Example	`:SEM:OFFS2:LIST:SWE:ACQ:TIME 1.0 ms, 3.4 ms, 2.08 ms, 1.0 ms, 1.0 ms, 1.0 ms`
	`:SEM:OFFS2:LIST:SWE:ACQ:TIME?`
	`:SEM:OFFS2:LIST:SWE:ACQ:TIME:AUTO ON, ON, ON, ON, OFF, OFF`
	`:SEM:OFFS2:LIST:SWE:ACQ:TIME:AUTO?`

Dependencies	Available only on non-sweeping hardware
Couplings	Coupled to Offset Start Freq, Offset Stop Freq, RBW, and VBW when in the Auto state When you manually set a value when in the Auto state, the state automatically changes to Man
Preset	Automatically calculated ON
State Saved	Saved in instrument state
Min	100 ns
Max	4000 s

Sweep Time Annotation (Remote Query Only)

Returns the Sweep Time Annotation value. Available only on non-sweeping hardware.

The value returned is the estimated turnaround time of each acquisition, in seconds. The turnaround time is the sum of the signal acquisition time, FFT time, and other overhead time, to complete the entire offset span of each measurement cycle.

Remote Command	`[:SENSe]:SEMask:OFFSet[1]|2[:OUTer]:LIST:SWEep:ETIMe?`

Example	`:SEM:OFFS2:LIST:SWE:ETIM?`
Dependencies	Available only on non-sweeping hardware
Preset	Automatically calculated

Sweep Type

Specifies the **Sweep Type** for the currently selected offset, and enables you to toggle the **Sweep Type** mode between **Auto** and **Man**.

When sending the remote command, missing values are not permitted; that is, if you want to change values 2 and 6, you must send all values up to 6. Subsequent values will remain unchanged. The query for this parameter returns 14 values for WLAN mode, 12 values for other modes.

How to define Sweep Time and Sweep Type:

Sweep Type mode	Behavior
Auto	**Sweep Type** is automatically selected according to "Sweep Type Rules" on page 1604 **Sweep Time** is automatically calculated according to the selected **Sweep Type**
Man	**Sweep Type** is user-selected

–

Remote Command	`[:SENSe]:SEMask:OFFSet[1]|2[:OUTer]:LIST:SWEep:TYPE SWEep | FFT, …`
	`[:SENSe]:SEMask:OFFSet[1]|2[:OUTer]:LIST:SWEep:TYPE?`
	`[:SENSe]:SEMask:OFFSet[1]|2[:OUTer]:LIST:SWEep:TYPE:AUTO ON | OFF | 1 | 0, …`
	`[:SENSe]:SEMask:OFFSet[1]|2[:OUTer]:LIST:SWEep:TYPE:AUTO?`

Example	`:SEM:OFFS2:LIST:SWE:TYPE FFT,FFT,SWE`
	`:SEM:OFFS2:LIST:SWE:TYPE?`
	`:SEM:OFFS2:LIST:SWE:TYPE:AUTO ON, ON, ON, ON, OFF, OFF`
	`:SEM:OFFS2:LIST:SWE:TYPE:AUTO?`

Notes	Comma-separated list of values `OFFSet1` is for BTS, 2 for MS. Default is BTS Note that Offset sub op code 2 is supported only in non-SA Modes In SA Mode, Offset sub op code 1 is used for both BTS and MS
Dependencies	Not available in modular products, such as VXT
Couplings	When **Sweep Type** is set manually, Sweep Type mode is set to `OFF` (**Manual**) When **Sweep Type** mode is **Auto**, **Sweep Type** is automatically selected according to **Sweep Type Rules**

Preset	Automatically calculated
	LTEAFDD, LTEATDD, 5G NR, MSR Modes:
	`ON,ON,ON,ON,ON,ON,ON,ON,ON,ON,ON,ON|`
	`ON,ON,ON,ON,ON,ON,ON,ON,ON,ON,ON,ON`
	When the max number of offsets is 14:
	WLAN Mode:
	`ON,ON,ON,ON,ON,ON,ON,ON,ON,ON,ON,ON,ON,ON`
	All Other Modes:
	When the max number of offsets is 6:
	`ON,ON,ON,ON,ON,ON`
	When the max number of offsets is 12:
	`ON,ON,ON,ON,ON,ON,ON,ON,ON,ON,ON,ON`

State Saved	Saved in instrument state
Range	Auto|Man

Offset Side

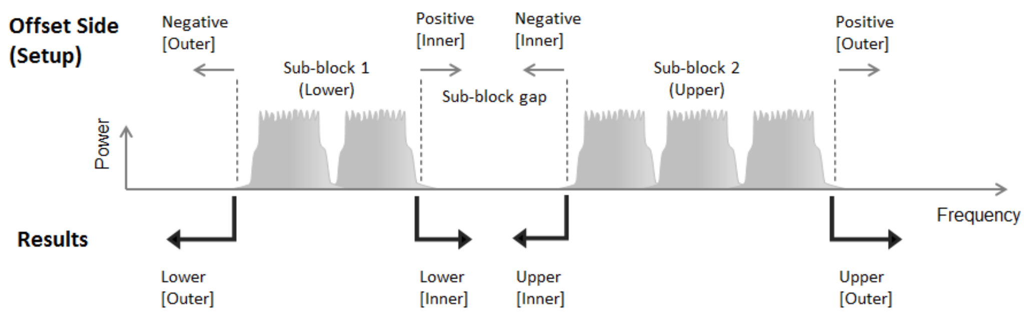
Specifies which offset side to measure.

You can turn off (not use) specific offsets with `[:SENSe]:SEMask:OFFSet[n][:OUTer]:LIST:STATe`.

`BOTH`	Both of the negative (lower) and positive (upper) sidebands
`NEGative`	Negative (lower) sideband only
`POSitive`	Positive (upper) sideband only

When sending the remote command, missing values are not permitted; that is, if you want to change values 2 and 6, you must send all values up to 6. Subsequent values remain unchanged. The query returns 14 values for WLAN Mode, and 12 values for other Modes.

The figure below shows the relation between the negative/positive offset side setups and the upper/lower results in the MSR, LTE-Advanced FDD/TDD and 5G NR Modes.



Remote Command	`[:SENSe]:SEMask:OFFSet[1]|2[:OUTer]:LIST:SIDE BOTH | NEGative | POSitive, …` `[:SENSe]:SEMask:OFFSet[1]|2[:OUTer]:LIST:SIDE?`
Example	`:SEM:OFFS:LIST:SIDE BOTH, NEG, NEG, POS, POS, POS` `:SEM:OFFS:LIST:SIDE?`
Notes	Comma-separated list of values `OFFSet1` is for BTS, 2 for MS. Default is BTS Note that Offset sub op code 2 is supported only in Modes other than SA. In SA Mode, Offset sub op code 1 is used for both BTS and MS

Preset	**Modes LTEAFDD,LTEATDD, 5G NR, MSR:**
	`BOTH, BOTH, BOTH, BOTH, BOTH, BOTH, BOTH, BOTH, BOTH, BOTH, BOTH, BOTH | BOTH, BOTH, BOTH, BOTH, BOTH, BOTH, BOTH, BOTH, BOTH, BOTH, BOTH, BOTH`
	When the max number of offsets is 14:
	Mode WLAN:
	`BOTH, BOTH, BOTH, BOTH, BOTH, BOTH, BOTH, BOTH, BOTH, BOTH, BOTH, BOTH, BOTH, BOTH`
	All Other Modes:
	When the max number of offsets is 6:
	`BOTH, BOTH, BOTH, BOTH, BOTH, BOTH`
	When the max number of offsets is 12:
	`BOTH, BOTH, BOTH, BOTH, BOTH, BOTH, BOTH, BOTH, BOTH, BOTH, BOTH, BOTH`

State Saved	Saved in instrument state
Range	`BOTH|NEGative|POSitive`

Limits

Enables you to set the power limits for start and stop frequencies of the selected offsets.

Start Freq

Same as "Start Freq" on page 1612 under **Offset (Bandwidth)**.

Stop Freq

Same as "Stop Freq" on page 1616 under **Offset (Bandwidth)**.

Abs Start

Sets the absolute power level limit at the start frequency for the selected offset. The absolute power level limit ranges from –200 to +50 dBm.

The fail condition for each offset channel is set remotely by `[:SENSe]:SEMask:OFFSet[n][:OUTer]:LIST:TEST`.

You can turn off (not use) specific offset channels remotely with `[:SENSe]:SEMask:OFFSet[n][:OUTer]:LIST:STAT`e.

The query returns values currently set to the absolute power test limits.

When sending the remote command, missing values are not permitted; that is, if you want to change values 2 and 6, you must send all values up to 6. Subsequent values remain unchanged. The query returns 14 values for WLAN Mode, or 12 values for other Modes.

Remote Command	`[:SENSe]:SEMask:OFFSet[1]|2[:OUTer]:LIST:STARt:ABSolute <real>, …` `[:SENSe]:SEMask:OFFSet[1]|2[:OUTer]:LIST:STARt:ABSolute?`
Example	`:SEM:OFFS2:LIST:STAR:ABS -12.50 dBm, -12.50 dBm, -24.50 dBm, -11.50 dBm, -11.50 dBm, -11.50 dBm` `:SEM:OFFS2:LIST:STAR:ABS?`
Notes	Comma-separated list of values `OFFSet1` is for BTS, 2 for MS. Default is BTS Note that Offset sub op code 2 is supported only in non-SA modes. In SA Mode, Offset sub op code 1 is used for both BTS and MS
Preset	When the max number of offsets is 6:

Mode	Values
SA	-14.00 dBm , -14.00 dBm , -26.00 dBm , -13.00 dBm , -13.00 dBm, -13.00 dBm
WCDMA	-12.50 dBm, -12.50 dBm, -24.50 dBm, -11.50 dBm, -11.50 dBm, -11.50 dBm|-69.6 dBm, -54.3 dBm, -54.3 dBm, -54.3 dBm, -54.3 dBm, -54.3 dBm
LTE, LTETDD	-5.5 dBm, -12.5 dBm, -15.0 dBm, -15.0 dBm, -15.0 dBm, -15.0 dBm|-13.5 dBm, -8.5 dBm, -11.5 dBm, -23.5 dBm, -23.5 dBm, -23.5 dBm

When the max number of offsets is 12 in these modes, the preset value of Offset G ~ L is the same as the Offset F value

	Mode	**Values**
	LTEAFDD, LTEATDD	-5.5 dBm, -12.5 dBm, -15.0 dBm, -15.0 dBm, -15.0 dBm, -15.0 dBm, -15.0 dBm, -15.0 dBm, -15.0 dBm, -15.0 dBm, -15.0 dBm, -15.0 dBm|-13.5 dBm, -8.5 dBm, -11.5 dBm, -23.5 dBm, -23.5 dBm, -23.5 dBm, -23.5 dBm, -23.5 dBm, -23.5 dBm, -23.5 dBm, -23.5 dBm, -23.5 dBm
	5G NR	-5.5 dBm, -12.5 dBm, -15.0 dBm, -15.0 dBm, -15.0 dBm, -15.0 dBm, -15.0 dBm, -15.0 dBm, -15.0 dBm, -15.0 dBm, -15.0 dBm, -15.0 dBm|-22.5 dBm, -8.5 dBm, -11.5 dBm, -23.5 dBm, -23.5 dBm, -23.5 dBm, -23.5 dBm, -23.5 dBm, -23.5 dBm, -23.5 dBm, -23.5 dBm, -23.5 dBm
	MSR	-12.5 dBm, -12.5 dBm, -24.5 dBm, -11.5 dBm, -15.0 dBm, -15.0 dBm, -15.0 dBm, -15.0 dBm, -15.0 dBm, -15.0 dBm, -15.0 dBm, -15.0 dBm| -12.5 dBm, -12.5 dBm, -24.5 dBm, -11.5 dBm, -15.0 dBm, -15.0 dBm, -15.0 dBm, -15.0 dBm, -15.0 dBm, -15.0 dBm, -15.0 dBm, -15.0 dBm
	When the max number of offsets is 14 in these Modes, the preset value of Offset G ~ N is the same as the Offset F value **WLAN Mode**: See the table of "WLAN Mode Presets" on page 1631 below	
State Saved	Saved in instrument state	
Min/Max	-200 dBm/50 dBm	

WLAN Mode Presets

Radio Std	Presets
802.11b/g(DSSS/CCK/PBCC)	-10 dBm, -30 dBm, -30 dBm, -30 dBm, -30 dBm, -30 dBm, -30 dBm, -30 dBm, -30 dBm, -30 dBm, -30 dBm, -30 dBm, -30 dBm, -30 dBm
802.11a/g(OFDM/DSSS-OFDM) 802.11n/ac/ax/be (20MHz)	-63.00 dBm, -63.00 dBm, -63.00 dBm, -63.00 dBm, -63.00 dBm, -63.00 dBm, -63.00 dBm, -63.00 dBm, -63.00 dBm, -63.00 dBm, -63.00 dBm, -63.00 dBm, -63.00 dBm, -63.00 dBm
802.11n/ac/ax/be (40MHz)	-66.00 dBm, -66.00 dBm, -66.00 dBm, -66.00 dBm, -66.00 dBm, -66.00 dBm, -66.00 dBm, -66.00 dBm, -66.00 dBm,-66.00 dBm, -66.00 dBm,-66.00 dBm, -66.00 dBm
802.11ac/ax(80MHz/160MHz)	-69.00 dBm, -69.00 dBm, -69.00 dBm, -69.00 dBm, -69.00 dBm, -69.00 dBm, -69.00 dBm, -69.00 dBm, -69.00 dBm, -69.00 dBm, -69.00 dBm, -69.00 dBm, -69.00 dBm, -69.00 dBm
802.11be (80MHz/160MHz/320MHz)	-49.00 dBm, -49.00 dBm, -49.00 dBm, -49.00 dBm, -49.00 dBm, -49.00 dBm, -49.00 dBm, -49.00 dBm, -49.00 dBm, -49.00 dBm, -49.00 dBm, -49.00 dBm, -49.00 dBm, -49.00 dBm
802.11ac/ax (80 MHz + 80 MHz)	-69.00 dBm, -69.00 dBm, -69.00 dBm, -69.00 dBm, -69.00 dBm, -69.00 dBm, -69.00 dBm, -69.00 dBm, -69.00 dBm, -69.00 dBm, -69.00 dBm, -69.00 dBm, -69.00 dBm, -69.00 dBm
802.11ah (1MHz)	16.00 dBm, -4.00 dBm, -12.00 dBm, -60.00 dBm, -60.00 dBm, -60.00 dBm, -60.00 dBm, -60.00 dBm, -60.00 dBm, -60.00 dBm, -

Radio Std	Presets
	60.00 dBm, -60.00 dBm, -60.00 dBm, -60.00 dBm
802.11ah (2MHz)	16.00 dBm, -4.00 dBm, -12.00 dBm, -63.00 dBm, -63.00 dBm, -63.00 dBm, -63.00 dBm, -63.00 dBm, -63.00 dBm, -63.00 dBm, -63.00 dBm, -63.00 dBm, -63.00 dBm, -63.00 dBm
802.11ah (4MHz)	16.00 dBm, -4.00 dBm, -12.00 dBm, -66.00 dBm, -66.00 dBm, -66.00 dBm,-66.00 dBm, -66.00 dBm, -66.00 dBm, -66.00 dBm,-66.00 dBm, -66.00 dBm,-66.00 dBm, -66.00 dBm
802.11ah (8MHz/16MHz)	16.00 dBm, -4.00 dBm, -12.00 dBm, -69.00 dBm, -69.00 dBm, -69.00 dBm, -69.00 dBm, -69.00 dBm, -69.00 dBm, -69.00 dBm, -69.00 dBm, -69.00 dBm, -69.00 dBm, -69.00 dBm
802.11j/p (20MHz)	16.00 dBm, -4.00 dBm, -12.00 dBm, -63.00 dBm, -63.00 dBm, -63.00 dBm, -63.00 dBm, -63.00 dBm, -63.00 dBm, -63.00 dBm, -63.00 dBm, -63.00 dBm, -63.00 dBm, -63.00 dBm
802.11j/p (10MHz)	16.00 dBm, -4.00 dBm, -12.00 dBm, -60.00 dBm, -60.00 dBm, -60.00 dBm, -60.00 dBm, -60.00 dBm, -60.00 dBm, -60.00 dBm, -60.00 dBm, -60.00 dBm, -60.00 dBm, -60.00 dBm
802.11p (5MHz)	16.00 dBm, -4.00 dBm, -12.00 dBm, -57.00 dBm, -57.00 dBm, -57.00 dBm, -57.00 dBm, -57.00 dBm, -57.00 dBm, -57.00 dBm, -57.00 dBm, -57.00 dBm, -57.00 dBm, -57.00 dBm
802.11af (6MHz)	16.00 dBm, -4.00 dBm, -12.00 dBm, -66.00 dBm, -66.00 dBm, -66.00 dBm, -66.00 dBm, -66.00 dBm, -66.00 dBm, -66.00 dBm, -66.00 dBm, -66.00 dBm, -66.00 dBm, -66.00 dBm
802.11af (7MHz)	16.00 dBm, -4.00 dBm, -12.00 dBm, -66.00 dBm, -66.00 dBm, -66.00 dBm, -66.00 dBm, -66.00 dBm, -66.00 dBm, -66.00 dBm, -66.00 dBm, -66.00 dBm, -66.00 dBm, -66.00 dBm
802.11af (8MHz)	16.00 dBm, -4.00 dBm, -12.00 dBm, -66.00 dBm, -66.00 dBm, -66.00 dBm, -66.00 dBm, -66.00 dBm, -66.00 dBm, -66.00 dBm, -66.00 dBm, -66.00 dBm, -66.00 dBm, -66.00 dBm

Abs Stop

Sets the absolute power level limit at the stop frequency for the selected offset. The absolute power level limit ranges from –200 to +50 dBm. You can also toggle this function between **Couple** (`COUPle` = `ON`) and **Manual** (`COUPle` = `OFF`). If set to **Couple**, the **Abs Stop** power level limit is coupled to **Abs Start** to result in a flat limit line. If set to **Man**, Abs Start and Abs Stop take different values, resulting in a sloped limit line.

The query returns values currently set to the offset stop absolute power limits.

When sending the remote command, missing values are not permitted; that is, if you want to change values 2 and 6, you must send all values up to 6. Subsequent values remain unchanged. The query returns 14 values for WLAN Mode, or 12 values for other Modes.

Remote Command	`[:SENSe]:SEMask:OFFSet[1]|2[:OUTer]:LIST:STOP:ABSolute <real>, …`
	`[:SENSe]:SEMask:OFFSet[1]|2[:OUTer]:LIST:STOP:ABSolute?`
	`[:SENSe]:SEMask:OFFSet[1]|2[:OUTer]:LIST:STOP:ABSolute:COUPle ON | OFF | 1 | 0, …`
	`[:SENSe]:SEMask:OFFSet[1]|2[:OUTer]:LIST:STOP:ABSolute:COUPle?`

Example	`:SEM:OFFS:LIST:STOP:ABS -12.50 dBm, -24.50 dBm, -24.50 dBm, -11.50 dBm, -11.50 dBm, -11.50 dBm`
	`:SEM:OFFS1:LIST:STOP:ABS?`
	`:SEM:OFFS:LIST:STOP:ABS:COUP ON, OFF, ON, ON, ON, ON`
	`:SEM:OFFS:LIST:STOP:ABS:COUP?`

Notes	Comma-separated list of values OFFSet 1 is for BTS, 2 for MS. Default is BTS Note that Offset sub op code 2 is supported only in Modes other than SA. In SA Mode, Offset sub op code 1 is used for both BTS and MS
Couplings	Coupled to **Abs Start** if **Auto** is selected, that is, the Stop value is equal to the Start value
Preset	When the max number of offsets is 6:

Mode	Values
SA	-14.00 dBm, -26.00 dBm, -26.00 dBm, -13.00 dBm, -13.00 dBm, -13.00 dBm
WCDMA	-12.50 dBm, -24.50 dBm, -24.50 dBm, -11.50 dBm, -11.50 dBm, -11.50 dBm|-69.6 dBm, -54.3 dBm, -54.3 dBm, -54.3 dBm, -54.3 dBm, -54.3 dBm
LTE, LTETDD	-12.5 dBm, -12.5 dBm, -15.0 dBm, -15.0 dBm, -15.0 dBm, -15.0 dBm| -13.5 dBm, -8.5 dBm, -11.5 dBm, -23.5 dBm, -23.5 dBm, -23.5 dBm

When the max number of offsets is 12 in these modes, the preset value of Offset G ~ L is the same as the Offset F value

Mode	Values
LTEAFDD, LTEATDD	-12.5 dBm, -12.5 dBm, -15.0 dBm, -15.0 dBm, -15.0 dBm, -15.0 dBm, -15.0 dBm, -15.0 dBm, -15.0 dBm, -15.0 dBm, -15.0 dBm, -15.0 dBm| -13.5 dBm, -8.5 dBm, -11.5 dBm, -23.5 dBm, -23.5 dBm, -23.5 dBm -23.5 dBm, -23.5 dBm, -23.5 dBm, -23.5 dBm, -23.5 dBm, -23.5 dBm
5G NR	-12.5 dBm, -12.5 dBm, -15.0 dBm, -15.0 dBm, -15.0 dBm, -15.0 dBm, -15.0 dBm, -15.0 dBm, -15.0 dBm, -15.0 dBm, -15.0 dBm, -15.0 dBm| -22.5 dBm, -8.5 dBm, -11.5 dBm, -23.5 dBm, -23.5 dBm, -23.5 dBm, -23.5 dBm, -23.5 dBm, -23.5 dBm, -23.5 dBm, -23.5 dBm, -23.5 dBm
MSR	-12.5 dBm, -24.5 dBm, -11.5 dBm, -15.0 dBm, -15.0 dBm, -15.0 dBm, -15.0 dBm, -15.0 dBm, -15.0 dBm, -15.0 dBm, -15.0 dBm, -15.0 dBm| -12.5 dBm, -24.5 dBm, -11.5 dBm, -15.0 dBm, -15.0 dBm, -15.0 dBm, -15.0 dBm, -15.0 dBm, -15.0 dBm, -15.0 dBm, -15.0 dBm, -15.0 dBm

When the max number of offsets is 14 in these modes, the preset value of Offset G ~ N is the same as the Offset F value

	WLAN Mode: See the table of "WLAN Mode Presets" on page 1634 below When the max number of offsets is 6: **Mode** / **Values** SA: `ON, OFF, ON, ON, ON, ON` WCDMA: `ON, OFF, ON, ON, ON, ON | ON, ON, ON, ON, ON, ON` LTE, LTETDD: `OFF, ON, ON, ON, ON, ON | ON, ON, ON, ON, ON, ON` When the max number of offsets is 12 in these modes, the preset value of Offset G ~ L is the same as the Offset F value **Mode** / **Values** LTEAFDD, LTEATDD, 5G NR: `OFF, ON, ON, ON, ON, ON, ON, ON, ON, ON, ON, ON | ON, ON, ON, ON, ON, ON, ON, ON, ON, ON, ON, ON` MSR: `ON, OFF, OFF, OFF, ON, OFF, OFF, OFF, OFF, OFF, OFF, OFF | ON, OFF, OFF, OFF, ON, OFF, OFF, OFF, OFF, OFF, OFF, OFF` When the max number of offsets is 14 in these modes, the preset value of Offset G ~ N is the same as the Offset F value **WLAN Mode**: See the table of "WLAN Mode Auto Function Presets" on page 1635 below
State Saved	Saved in instrument state Saved in instrument state
Range	Auto|Man
Min/Max	-200 dBm/50 dBm

WLAN Mode Presets

Radio Std	Presets
802.11b/g (DSSS/CCK/PBCC)	-4.00 dBm, -12.00 dBm, -24.00 dBm, -24.00 dBm, -24.00 dBm, -24.00 dBm, -24.00 dBm, -24.00 dBm, -24.00 dBm, -24.00 dBm, -24.00 dBm, -24.00 dBm, -24.00 dBm, -24.00 dBm
802.11a/g (OFDM/DSSS-OFDM)	-10 dBm, -30 dBm, -30 dBm, -30 dBm, -30 dBm, -30 dBm, -30 dBm, -30 dBm, -30 dBm, -30 dBm, -30 dBm, -30 dBm, -30 dBm, -30 dBm
802.11n/ac/ax/be (20MHz)	-4.00 dBm, -12.00 dBm, -24.00 dBm, -63.00 dBm, -63.00 dBm, -63.00 dBm, -63.00 dBm, -63.00 dBm, -63.00 dBm, -63.00 dBm, -63.00 dBm, -63.00 dBm, -63.00 dBm, -63.00 dBm
802.11n/ac/ax/be (40MHz)	-4.00 dBm, -12.00 dBm, -24.00 dBm, -66.00 dBm, -66.00 dBm, -66.00 dBm, -66.00 dBm, -66.00 dBm, -66.00 dBm, -66.00 dBm, -66.00 dBm, -66.00 dBm, -66.00 dBm, -66.00 dBm
802.11ac/ax (80MHz/160MHz)	-69.00 dBm, -69.00 dBm, -69.00 dBm, -69.00 dBm, -69.00 dBm, -69.00 dBm,-69.00 dBm, -69.00 dBm, -69.00 dBm,-69.00 dBm, -

Radio Std	Presets
	69.00 dBm, -69.00 dBm, -69.00 dBm, -69.00 dBm
802.11be (80MHz/160MHz/320MHz)	-49.00 dBm, -49.00 dBm, -49.00 dBm, -49.00 dBm, -49.00 dBm, -49.00 dBm, -49.00 dBm, -49.00 dBm, -49.00 dBm, -49.00 dBm, -49.00 dBm, -49.00 dBm, -49.00 dBm, -49.00 dBm
802.11ac/ax (80 + 80 MHz)	-69.00 dBm, -69.00 dBm, -69.00 dBm, -69.00 dBm, -69.00 dBm, -69.00 dBm, -69.00 dBm, -69.00 dBm, -69.00 dBm, -69.00 dBm, -69.00 dBm, -69.00 dBm, -69.00 dBm, -69.00 dBm
802.11ah (1MHz)	-4.00 dBm, -12.00 dBm, -24.00 dBm, -60.00 dBm, -60.00 dBm, -60.00 dBm, -60.00 dBm, -60.00 dBm, -60.00 dBm, -60.00 dBm, -60.00 dBm, -60.00 dBm, -60.00 dBm, -60.00 dBm
802.11ah (2MHz)	-4.00 dBm, -12.00 dBm, -24.00 dBm, -63.00 dBm, -63.00 dBm, -63.00 dBm, -63.00 dBm, -63.00 dBm, -63.00 dBm, -63.00 dBm, -63.00 dBm, -63.00 dBm, -63.00 dBm, -63.00 dBm
802.11ah (4MHz)	-4.00 dBm, -12.00 dBm, -24.00 dBm, -66.00 dBm, -66.00 dBm, -66.00 dBm, -66.00 dBm, -66.00 dBm, -66.00 dBm, -66.00 dBm, -66.00 dBm, -66.00 dBm, -66.00 dBm, -66.00 dBm
802.11ah (8MHz/16MHz)	-4.00 dBm, -12.00 dBm, -24.00 dBm, -69.00 dBm, -69.00 dBm, -69.00 dBm,-69.00 dBm, -69.00 dBm, -69.00 dBm,-69.00 dBm, -69.00 dBm, -69.00 dBm, -69.00 dBm, -69.00 dBm
802.11j/p (10MHz)	-4.00 dBm, -12.00 dBm, -24.00 dBm, -60.00 dBm, -60.00 dBm, -60.00 dBm, -60.00 dBm, -60.00 dBm, -60.00 dBm, -60.00 dBm, -60.00 dBm, -60.00 dBm, -60.00 dBm, -60.00 dBm
802.11j/p (5MHz)	-4.00 dBm, -12.00 dBm, -24.00 dBm, -57.00 dBm, -57.00 dBm, -57.00 dBm, -57.00 dBm, -57.00 dBm, -57.00 dBm, -57.00 dBm, -57.00 dBm, -57.00 dBm, -57.00 dBm, -57.00 dBm
802.11af (6MHz)	-4.00 dBm, -12.00 dBm, -24.00 dBm, -66.00 dBm, -66.00 dBm, -66.00 dBm, -66.00 dBm, -66.00 dBm, -66.00 dBm, -66.00 dBm, -66.00 dBm, -66.00 dBm, -66.00 dBm, -66.00 dBm
802.11af (7MHz)	-4.00 dBm, -12.00 dBm, -24.00 dBm, -66.00 dBm, -66.00 dBm, -66.00 dBm, -66.00 dBm, -66.00 dBm, -66.00 dBm, -66.00 dBm, -66.00 dBm, -66.00 dBm, -66.00 dBm, -66.00 dBm
802.11af (8MHz)	-4.00 dBm, -12.00 dBm, -24.00 dBm, -66.00 dBm, -66.00 dBm, -66.00 dBm, -66.00 dBm, -66.00 dBm, -66.00 dBm, -66.00 dBm, -66.00 dBm, -66.00 dBm, -66.00 dBm, -66.00 dBm

WLAN Mode Auto Function Presets

Radio Std	Presets
802.11a/g (OFDM/DSSS-OFDM) 802.11n (20MHz/40MHz) 802.11 ac/ax/be (20MHz/40MHz/80MHz/160MHz)	`OFF, OFF, OFF, ON, ON, ON, ON, ON, ON, ON, ON, ON, ON, ON`

Radio Std	Presets
802.11 be (320MHz)	
802.11ah (1MHz/2MHz/4MHz/8MHz/16MHz)	
802.11af (6MHz/7MHz/8MHz)	
802.11 ac/ax (80+80 MHz)	`ON, ON, ON, ON, ON, ON, ON, ON, ON, ON, ON, ON, ON, ON`
802.11b/g (DSSS/CCK/PBCC)	`ON, ON, ON, ON, ON, ON, ON, ON, ON, ON, ON, ON, ON, ON`
802.11j/p 20M, j/p 10M, p5M	`OFF, OFF, OFF, ON, ON, ON, ON, ON, ON, ON, ON, ON, ON, ON`

Rel Start

Sets a relative power level limit at the start frequency for the selected offset. The relative power level limit ranges from –200 to +50 dBc.

The fail condition is set remotely by `[:SENSe]:SEMask:OFFSet[n][:OUTer]:LIST:TEST` for each offset channel test.

You can turn off (not use) specific offset channels remotely with `[:SENSe]:SEMask:OFFSet[n][:OUTer]:LIST:STATe`.

The query returns values currently set to the relative power test limits.

When sending the remote command, missing values are not permitted; that is, if you want to change values 2 and 6, you must send all values up to 6. Subsequent values remain unchanged. The query returns 14 values for WLAN Mode, or12 values for other Modes.

Remote Command	`[:SENSe]:SEMask:OFFSet[1]|2[:OUTer]:LIST:STARt:RCARrier <rel_ampl>, …` `[:SENSe]:SEMask:OFFSet[1]|2[:OUTer]:LIST:STARt:RCARrier?`
Example	`:SEM:OFFS:LIST:STAR:RCAR -30, -30, -30, -30, -30, -30` `:SEM:OFFS:LIST:STAR:RCAR?`
Notes	Comma-separated list of values OFFSet 1 is for BTS, 2 for MS. Default is BTS Note that Offset sub op code 2 is supported only in Modes other than SA. In SA mode, Offset sub op code 1 is used for both BTS and MS
Preset	When the max number of offsets is 6:

Mode	Values
SA	-30.00 dB, -30.00 dB,-30.00 dB, -30.00 dB, -30.00 dB, -30.00 dB
WCDMA	-30.00 dB, -30.00 dB, -30.00 dB, -30.00 dB, -30.00 dB, -30.00 dB|-33.73 dB, -34.00 dB, -37.50 dB, -47.50 dB, -47.50 dB, -47.50 dB

	When the max number of offsets is 12 in these modes, the preset value of Offset G ~ L is the same as the Offset F value **Mode** / **Values** LTEAFDD, LTEATDD, 5G NR, MSR: 0 dB, 0 dB, 0 dB, 0 dB, 0 dB, 0 dB, 0 dB, 0 dB, 0 dB, 0 dB, 0 dB, 0 dB|0 dB, 0 dB, 0 dB, 0 dB, 0 dB, 0 dB, 0 dB, 0 dB, 0 dB, 0 dB, 0 dB, 0 dB When the max number of offsets is 14 in these modes, the preset value of Offset G ~ N is the same as the Offset F value **WLAN Mode**: See table of "WLAN Mode Presets" on page 1637 below
State Saved	Saved in instrument state
Min/Max	-200 dB/50 dB

WLAN Mode Presets

802.11a/g (OFDM/DSSS-OFDM)	0 dB, -20.00 dB, -28.00 dB, -40.00 dB, -40.00 dB, -47.00 dB, -47.00 dB, -47.00 dB, -47.00 dB, -47.00 dB, -47.00 dB, -47.00 dB, -47.00 dB, -47.00 dB
802.11b/g (DSSS/CCK/PBCC)	-30 dB, -50 dB, -50 dB, -50 dB, -50 dB, -50 dB, -50 dB, -50 dB, -50 dB, -50 dB, -50 dB, -50 dB, -50 dB, -50 dB
802.11n (20MHz/40MHz)	0 dB, -20.00 dB, -28.00 dB, -45.00 dB, -45.00 dB, -45.00 dB, -45.00 dB, -45.00 dB, -45.00 dB, -45.00 dB, -45.00 dB, -45.00 dB, -45.00 dB, -45.00 dB
802.11ac/ax/be (20 MHz/ 40 MHz/ 80 MHz/ 160 MHz)	0 dB, -20.00 dB, -28.00 dB, -40.00 dB, -40.00 dB, -40.00 dB, -40.00 dB, -40.00 dB, -40.00 dB, -40.00 dB, -40.00 dB, -40.00 dB, -40.00 dB, -40.00 dB
802.11ac/ax (80 MHz + 80 MHz)	-40dB, -40.00 dB, -28.00 dB, -20 dB, 0 dB, - 20 dB, -28 dB, -40 dB, -40 dB, -40.00 dB, -40.00 dB, -40.00 dB, -40.00 dB, -40.00 dB
802.11ah (1 MHz/ 2 MHz/ 4 MHz/ 8 MHz/ 16 MHz)	0 dB, -20.00 dB, -28.00 dB, -40.00 dB, -40.00 dB, -40.00 dB, -40.00 dB, -40.00 dB, -40.00 dB, -40.00 dB, -40.00 dB, -40.00 dB, -40.00 dB, -40.00 dB
802.11j/p 20M, j/p 10M, p5M	0 dB, -20.00 dB, -28.00 dB, -40.00 dB, -40.00 dB, -40.00 dB, -40.00 dB, -40.00 dB, -40.00 dB, -40.00 dB, -40.00 dB, -40.00 dB, -40.00 dB, -40.00 dB
802.11af (6MHz/ 7MHz/ 8MHz)	0 dB, -20.00 dB, -28.00 dB, -40.00 dB, -40.00 dB, -40.00 dB, -40.00 dB, -40.00 dB, -40.00 dB, -40.00 dB, -40.00 dB, -40.00 dB, -40.00 dB, -40.00 dB
802.11be (320MHz)	-4.00 dBm, -12.00 dBm, -24.00 dBm, -69.00 dBm, -69.00 dBm, -69.00 dBm,-69.00 dBm, -69.00 dBm, -69.00 dBm,-69.00 dBm, -69.00 dBm, -69.00 dBm, -69.00 dBm, -69.00 dBm

Rel Stop

Sets a relative power level limit at the stop frequency for the selected offset. The relative power level limit ranges from –200 to +50 dBc.

The fail condition is set remotely by `[:SENSe]:SEMask:OFFSet[n][:OUTer]:LIST:TEST` for each offset channel.

You can turn off (not use) specific offset channels remotely with `[:SENSe]:SEMask:OFFSet[n][:OUTer]:LIST:STATe`.

The query returns values currently set to the offset stop relative power limits.

When sending the remote command, missing values are not permitted; that is, if you want to change values 2 and 6, you must send all values up to 6. Subsequent values remain unchanged. The query returns 14 values for WLAN Mode, or 12 values for other Modes.

Remote Command	`[:SENSe]:SEMask:OFFSet[1]|2[:OUTer]:LIST:STOP:RCARrier <rel_ampl>, …`
	`[:SENSe]:SEMask:OFFSet[1]|2[:OUTer]:LIST:STOP:RCARrier?`
	`[:SENSe]:SEMask:OFFSet[1]|2[:OUTer]:LIST:STOP:RCARrier:COUPle ON | OFF | 1 | 0, …`
	`[:SENSe]:SEMask:OFFSet[1]|2[:OUTer]:LIST:STOP:RCARrier:COUPle?`

Example	`:SEM:OFFS:LIST:STOP:RCAR -30, -30, -30, -30, -30, -30`
	`:SEM:OFFS:LIST:STOP:RCAR?`
	`:SEM:OFFS:LIST:STOP:RCAR:COUP ON, ON, ON, ON, ON, ON`
	`:SEM:OFFS:LIST:STOP:RCAR:COUP?`

Notes	Comma-separated list of values OFFSet 1 is for BTS, 2 for MS. Default is BTS Note that Offset sub op code 2 is supported only in Modes other than SA. In SA mode, Offset sub op code 1 is used for both BTS and MS
Couplings	Coupled to Rel Start if “Auto” is selected, that is, Start is made the same as Stop
Preset	When the max number of offsets is 6:

Mode	Values
SA	-30.00 dB, -30.00 dB, -30.00 dB, -30.00 dB, -30.00 dB, -30.00 dB
WCDMA	-30.00 dB, -30.00 dB, -30.00 dB, -30.00 dB, -30.00 dB, -30.00 dB|-48.28 dB, -37.50 dB, -47.50 dB, -47.50 dB, -47.50 dB, -47.50 dB

When the max number of offsets is 12 in these modes, the preset value of Offset G ~ L is the same as the Offset F value

Mode	Values
LTEAFDD, LTEATDD, 5G NR, MSR	0 dB, 0 dB, 0 dB, 0 dB, 0 dB, 0 dB, 0 dB, 0 dB, 0 dB, 0 dB, 0 dB, 0 dB|0 dB, 0 dB, 0 dB, 0 dB, 0 dB, 0 dB, 0 dB, 0 dB, 0 dB, 0 dB, 0 dB, 0 dB

When the max number of offsets is 14 in these modes, the preset value of Offset G ~ N is the same as the Offset F value

WLAN Mode: See table of "WLAN Mode Presets" on page 1639 below

When the max number of offsets is 6:

Mode	Values
SA	`ON, ON, ON, ON, ON, ON`
WCDMA	`ON, ON, ON, ON, ON, ON | OFF, OFF, OFF, ON, ON, ON`

When the max number of offsets is 12 in these modes, the preset value of Offset G ~ L is the same as the Offset F value

Mode	Values
LTEAFDD, LTEATDD, 5G NR, MSR	`ON, ON, ON, ON, ON, ON, ON, ON, ON, ON, ON, ON | ON, ON, ON, ON, ON, ON, ON, ON, ON, ON, ON, ON`

When the max number of offsets is 14 in these modes, the preset value of Offset G ~ N is the same as the Offset F value

WLAN Mode: See table of "WLAN Mode Auto Function Presets" on page 1640 below

State Saved	Saved in instrument state Saved in instrument state
Range	Auto|Man
Min/Max	-200 dB/50 dB

WLAN Mode Presets

Radio Std	Presets
802.11a/g (OFDM/DSSS-OFDM)	-20.00 dB, -28.00 dB, -40.00 dB, -40.00 dB, -47.00 dB, -47.00 dB, -47.00 dB, -47.00 dB, -47.00 dB, -47.00 dB, -47.00 dB, -47.00 dB, -47.00 dB, -47.00 dB
802.11b/g (DSSS/CCK/PBCC)	-30 dB, -50 dB, -50 dB, -50 dB, -50 dB, -50 dB, -50 dB, -50 dB, -50 dB, -50 dB, -50 dB, -50 dB, -50 dB, -50 dB
802.11n (20MHz/40MHz)	-20.00 dB, -28.00 dB, -45.00 dB, -45.00 dB, -45.00 dB, -45.00 dB, -45.00 dB, -45.00 dB, -45.00 dB, -45.00 dB, -45.00 dB, -45.00 dB, -45.00 dB, -45.00 dB
802.11ac/ax/be (20 MHz/ 40 MHz/ 80 MHz/	-20.00 dB, -28.00 dB, -40.00 dB, -40.00 dB, -40.00 dB, -40.00 dB, -40.00 dB, -40.00 dB, -40.00 dB, -40.00 dB, -40.00 dB, -40.00 dB, -40.00

Radio Std	Presets
160 MHz)	dB, -40.00 dB
802.11be (320 MHz)	-20.00 dB, -28.00 dB, -40.00 dB, -40.00 dB, -40.00 dB, -40.00 dB, -40.00 dB, -40.00 dB, -40.00 dB, -40.00 dB, -40.00 dB, -40.00 dB, -40.00 dB, -40.00 dB
802.11ac/ax (80 MHz + 80MHz)	-40dB, -28.00 dB, -20.00 dB, 0 dB, -20.00 dB, -28.00 dB, -40.00 dB, -40.00 dB, -40.00 dB, -40.00 dB, -40.00 dB, -40.00 dB, -40.00 dB, -40.00 dB
802.11ah (1MHz/ 2 MHz/ 4 MHz/ 8 MHz/ 16 MHz)	-20.00 dB, -28.00 dB, -40.00 dB, -40.00 dB, -40.00 dB, -40.00 dB, -40.00 dB, -40.00 dB, -40.00 dB, -40.00 dB, -40.00 dB, -40.00 dB, -40.00 dB, -40.00 dB
802.11 j/p 10M, p5M	-20.00 dB, -28.00 dB, -40.00 dB, -40.00 dB, -40.00 dB, -47.00 dB, -47.00 dB, -47.00 dB, -47.00 dB, -47.00 dB, -47.00 dB, -47.00 dB, -40.00 dB, -40.00 dB
802.11af (6MHz/ 7MHz/ 8MHz)	-20.00 dB, -28.00 dB, -40.00 dB, -40.00 dB, -40.00 dB, -40.00 dB, -40.00 dB, -40.00 dB, -40.00 dB, -40.00 dB, -40.00 dB, -40.00 dB, -40.00 dB, -40.00 dB

WLAN Mode Auto Function Presets

Radio Std	Presets
802.11a/g (OFDM/DSSS-OFDM) 802.11n (20MHz/ 40MHz)	`OFF, OFF, OFF, ON, ON, ON, ON, ON, ON, ON, ON, ON, ON, ON`
802.11b/g (DSSS/CCK/PBCC)	`ON, ON, ON, ON, ON, ON, ON, ON, ON, ON, ON, ON, ON, ON`
802.11ac/ax/be (20 MHz/ 40 MHz/ 80 MHz/ 160 MHz)	`OFF, OFF, OFF, ON, ON, ON, ON, ON, ON, ON, ON, ON, ON, ON`
802.11be (320 MHz)	`OFF, OFF, OFF, ON, ON, ON, ON, ON, ON, ON, ON, ON, ON, ON`
802.11ac/ax (80 MHz + 80MHz)	`OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF`
802.11ah (1MHz/2 MHz/ 4 MHz/ 8 MHz/ 16 MHz)	`OFF, OFF, OFF, ON, ON, ON, ON, ON, ON, ON, ON, ON, ON, ON`
802.11j/p (20M/ 10M) /11p(5M)	`OFF, OFF, OFF, ON, ON, ON, ON, ON, ON, ON, ON, ON, ON, ON`
802.11af (6 MHz/ 7 MHz/ 8 MHz)	`OFF, OFF, OFF, ON, ON, ON, ON, ON, ON, ON, ON, ON, ON, ON`

Fail Mask

Selects one of the logics for fail conditions between the measurement results and the test limits:

- `ABSolute` and `RELative` both check the results against the respective limit
- `OR` checks against both limits, failing if either of the limits is broken
- `AND` only displays a fail if both of the limits are broken

The absolute or relative power limit value for each offset channel can be set remotely with `[:SENSe]:SEMask:OFFSet[n][:OUTer]:LIST:ABSolute` or `[:SENSe]:SEMask:OFFSet[n][:OUTer]:LIST:RCARrier`.

You can turn off (not use) specific offset channels remotely with `[:SENSe]:SEMask:OFFSet[n][:OUTer]:LIST:STATe`.

When sending the remote command, missing values are not permitted; that is, if you want to change values 2 and 6, you must send all values up to 6. Subsequent values remain unchanged. The query returns 14 values for WLAN Mode, or 12 values for other Modes.

Remote Command	`[:SENSe]:SEMask:OFFSet[1]|2[:OUTer]:LIST:TEST ABSolute | AND | OR | RELative, …` `[:SENSe]:SEMask:OFFSet[1]|2[:OUTer]:LIST:TEST?`
Example	`:SEM:OFFS:LIST:TEST ABS, ABS, ABS, ABS, ABS, ABS` `:SEM:OFFS:LIST:TEST?`
Notes	Comma-separated list of values Note that Offset sub op code 2 is supported only in Modes other than SA. In SA Mode, Offset sub op code 1 is used for both BTS and MS
Preset	When the max number of offsets is 6: (see tables below)
State Saved	Saved in instrument state
Range	Absolute|Relative|Abs AND Rel|Abs OR Rel

Preset — when the max number of offsets is 6:

Mode	Values
SA	ABS, ABS, ABS, ABS, ABS, ABS
WCDMA	ABS, ABS, ABS, ABS, ABS, ABS | AND, AND, AND, AND, AND, AND
LTE, LTETDD	ABS, ABS, ABS, ABS, ABS, ABS

When the max number of offsets is 12 in these modes, the preset value of Offset G ~ L is the same as the Offset F value

Mode	Values
LTEAFDD, LTEATDD, 5G NR, MSR	ABS, ABS, ABS, ABS, ABS, ABS, ABS, ABS, ABS, ABS, ABS, ABS | ABS, ABS, ABS, ABS, ABS, ABS, ABS, ABS, ABS, ABS, ABS, ABS

When the max number of offsets is 14 in these modes, the preset value of Offset G ~ N is the same as the Offset F value

WLAN Mode: See the table of "WLAN Mode Presets" on page 1642 below

WLAN Mode Presets

Radio Std	Presets
802.11b/g (DSSS/CCK/PBCC)	REL, REL, REL, REL, REL, REL, REL, REL, REL, REL, REL, REL, REL, REL
802.11a/g (OFDM/DSSS-OFDM)	REL, REL, REL, AND, AND, AND, AND, AND, AND, AND, AND, AND, AND, AND
802.11n/ac/ax/be (20 MHz/ 40 MHz/ 80 MHz/80 MHz + 80MHz / 160 MHz/320MHz)	AND, AND, AND, AND, AND, AND, AND, AND, AND, AND, AND, AND, AND, AND
802.11ah (1MHz/ 2 MHz/ 4 MHz/ 8 MHz/ 16 MHz)	REL, REL, REL, AND, AND, AND, AND, AND, AND, AND, AND, AND, AND, AND
802.11j/p 10M, p5M	REL, REL, REL, AND, AND, AND, AND, AND, AND, AND, AND, AND, AND, AND
802.11af (6 MHz/ 7 MHz/ 8 MHz)	REL, REL, REL, AND, AND, AND, AND, AND, AND, AND, AND, AND, AND, AND

Show Abs2 Limit

Shows or hides Abs2 limit parameters.

Remote Command	`:DISPlay:SEMask:OFFSet:SABSolute ON | OFF | 1 | 0` `:DISPlay:SEMask:OFFSet:SABSolute?`
Example	`:DISP:SEM:OFFS:SABS 1` `:DISP:SEM:OFFS:SABS?`
Preset	0
State Saved	Yes
Range	ON|OFF

Abs2 Start

Sets the 2nd absolute power level limit at the start frequency for the selected offset, ranging from –200 to +50 dBm.

The fail condition for each offset channel is set remotely using:

`[:SENSe]:SEMask:OFFSet[n][:OUTer]:LIST:TEST:SABSolute`

You can turn off (not use) specific offset channels remotely using:

`[:SENSe]:SEMask:OFFSet[n][:OUTer]:LIST:STATe`

The query returns values currently set to the 2nd absolute power test limits.

When sending the command, missing values are not permitted; that is, if you want to change values 2 and 6, you must send all values up to 6. Subsequent values remain unchanged. The query returns 14 values for WLAN Mode, or 12 values for other Modes.

Remote Command	`[:SENSe]:SEMask:OFFSet[1]|2[:OUTer]:LIST:STARt:SABSolute <real>, …` `[:SENSe]:SEMask:OFFSet[1]|2[:OUTer]:LIST:STARt:SABSolute?`
Example	`:SEM:OFFS:LIST:STAR:SABS -12.50 dBm, -12.50 dBm, -24.50 dBm, -11.50 dBm, -11.50 dBm, -11.50 dBm` `:SEM:OFFS:LIST:STAR:SABS?`
Notes	Comma-separated list of values `OFFSet1` is for BTS, 2 for MS. Default is BTS
Preset	For WLAN Mode: 0 dBm, 0 dBm, 0 dBm, 0 dBm, 0 dBm, 0 dBm, 0 dBm, 0 dBm, 0 dBm, 0 dBm, 0 dBm, 0 dBm, 0 dBm, 0 dBm For other Modes: 0 dBm, 0 dBm, 0 dBm, 0 dBm, 0 dBm, 0 dBm, 0 dBm, 0 dBm, 0 dBm, 0 dBm, 0 dBm, 0 dBm | 0 dBm, 0 dBm, 0 dBm, 0 dBm, 0 dBm, 0 dBm, 0 dBm, 0 dBm, 0 dBm, 0 dBm, 0 dBm, 0 dBm
State Saved	Saved in instrument state
Min	-200 dBm
Max	50 dBm

Abs2 Stop

Sets the 2nd absolute power level limit at the stop frequency for the selected offset, ranging from –200 to +50 dBm. You can also toggle this function between **Couple** and **Manual**. If **Couple** = `ON`, the **Abs2 Stop** power level limit is coupled to "Abs2 Start" on page 1642, resulting in a flat limit line. If set to **Man** (**Couple** = `OFF`), **Abs2 Start** and **Abs2 Stop** take different values, resulting in a sloped limit line.

The query returns values currently set to the offset stop absolute2 power limits.

When sending the command, missing values are not permitted; that is, if you want to change values 2 and 6, you must send all values up to 6. Subsequent values remain unchanged. The query returns 14 values for WLAN Mode, or 12 values for other Modes.

Remote Command	`[:SENSe]:SEMask:OFFSet[1]|2[:OUTer]:LIST:STOP:SABSolute <real>, …`
	`[:SENSe]:SEMask:OFFSet[1]|2[:OUTer]:LIST:STOP:SABSolute?`
	`[:SENSe]:SEMask:OFFSet[1]|2[:OUTer]:LIST:STOP:SABSolute:COUPle ON | OFF | 1 | 0, …`
	`[:SENSe]:SEMask:OFFSet[1]|2[:OUTer]:LIST:STOP:SABSolute:COUPle?`

Example	`:SEM:OFFS:LIST:STOP:SABS -12.50 dBm, -24.50 dBm, -24.50 dBm, -11.50 dBm, -11.50 dBm, -11.50 dBm`

	`:SEM:OFFS:LIST:STOP:SABS?`
	`:SEM:OFFS:LIST:STOP:SABS:COUP ON, ON, ON, ON, ON, ON`
	`:SEM:OFFS:LIST:STOP:SABS:COUP?`

Notes	Comma separated list of values `OFFSet` 1 is for BTS, 2 for MS. Default is BTS
Couplings	Coupled to Abs2 Start if **Auto** is selected, that is, the Stop value is equal to the Start value

Preset	For WLAN Mode:
	0 dBm, 0 dBm, 0 dBm, 0 dBm, 0 dBm, 0 dBm, 0 dBm, 0 dBm, 0 dBm, 0 dBm, 0 dBm, 0 dBm, 0 dBm, 0 dBm
	For other Modes:
	0 dBm, 0 dBm, 0 dBm, 0 dBm, 0 dBm, 0 dBm, 0 dBm, 0 dBm, 0 dBm, 0 dBm, 0 dBm, 0 dBm | 0 dBm, 0 dBm, 0 dBm, 0 dBm, 0 dBm, 0 dBm, 0 dBm, 0 dBm, 0 dBm, 0 dBm, 0 dBm, 0 dBm
	For WLAN Mode:
	`ON, ON, ON, ON, ON, ON, ON, ON, ON, ON, ON, ON, ON, ON`
	For other Modes:
	`ON, ON, ON, ON, ON, ON, ON, ON, ON, ON, ON, ON | ON, ON, ON, ON, ON, ON, ON, ON, ON, ON, ON, ON`

State Saved	Saved in instrument state Saved in instrument state
Range	Auto|Man
Min	-200 dBm
Max	50 dBm

Fail Mask2

Selects the logic operation for fail conditions between the measurement results and the test limits:

(Primary Fail Mask selection) OR Abs2	`OR`	Checks against both Primary and Abs2 limits. The test fails if either of the limits is broken
(Primary Fail Mask selection) AND Abs2	`AND`	Checks against both Primary and Abs2 limits. The test fails if both of the limits are broken
Abs2 Disabled	`OFF`	Fail Mask2 is disabled

Note that the Primary Fail Mask selection is set by "Fail Mask" on page 1640.

Examples:

- when Fail Mask is Abs **AND** Rel and Fail Mask2 is **OR** Abs2, “(Abs AND Rel) OR Abs2” is displayed in the column
- when Fail Mask is Absolute and Fail Mask2 is And Abs2, “(Absolute) AND Abs2” is displayed in the column

You can turn off (not use) specific offset channels remotely using:

[:SENSe]:SEMask:OFFSet[n][:OUTer]:LIST:STATe

When sending the command, missing values are not permitted; that is, if you want to change values 2 and 6, you must send all values up to 6. Subsequent values remain unchanged. The query returns 14 values for WLAN Mode, or 12 values for other Modes.

Remote Command	[:SENSe]:SEMask:OFFSet[1]|2[:OUTer]:LIST:TEST:SABSolute AND | OR | OFF, … [:SENSe]:SEMask:OFFSet[1]|2[:OUTer]:LIST:TEST:SABSolute?
Example	:SEM:OFFS:LIST:TEST:SABS AND, AND, OR, OFF, OFF, OFF :SEM:OFFS:LIST:TEST:SABS?
Notes	Comma-separated list of values
Preset	For WLAN: OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF For other Modes: OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF | OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF
State Saved	Saved in instrument state
Range	OR Abs2|AND Abs2|Abs2 Disabled

Offset Freq Define

Enables you to select offset frequency definition. Each standard defines each offset frequency from Carrier.

For example, 3GPP2 requires the “Carrier Center to Meas BW Edge” definition, and LTE conformance test requires “Carrier Edge to Meas BW Center” and/or “Carrier Edge to Meas BW Edge” definition. MSR standard requires “RF BW Edge to Meas BW Center” and/or “RF BW Edge to Meas Edge” definition.

“Meas BW Edge” means the edge frequency of resolution bandwidth closer to the carrier that is represented by Meas BW and Res BW settings. Actual center frequency of Meas BW and the limit line have ½ Meas BW offset when the Meas BW Edge is selected.

Option	SCPI	Definition
Carrier Center to Meas BW Center	CTOCenter	From the lowermost carrier center frequency (for lower offset), the uppermost carrier center frequency (for upper offset) to the center of offset measuring filter*
Carrier Center to Meas BW Edge	CTOEdge	From the lowermost carrier center frequency (for lower offset), the uppermost carrier center frequency (for upper offset) to the nominal -3 dB point of the offset measuring filter* closer to the carrier

Option	SCPI	Definition
Carrier Edge to Meas BW Center	ETOCenter	From the lowermost carrier center frequency - spacing of this carrier /2 (for lower offset), the uppermost carrier center frequency + spacing of this carrier /2 (for upper offset) to the center frequency of offset measuring filter*
Carrier Edge to Meas BW Edge	ETOEdge	From the lowermost carrier center frequency - spacing of this carrier /2 (for lower offset), the uppermost carrier center frequency + spacing of this carrier /2 (for upper offset) to the nominal -3 dB point of the offset measuring filter* closer to the carrier
Sub-block Edge to Meas BW Center	STOCenter	From either the lower or upper sub-block edge frequency to the center frequency of offset measuring filter*
Sub-block Edge to Meas BW Edge	STOEdge	From either the lower or upper sub-block edge frequency to the nominal -3 dB point of the offset measuring filter* closer to the carrier
Sub-block Center to Meas BW Center 5G NR Mode only	SCTOCenter	**From the center frequency of sub-block to** the center frequency of offset measuring filter*

*Measuring filter = Meas BW (N) x Res BW

** sub-block (bandwidth) = $BW_{channel,block}$ which is defined in each 3GPP standard, regardless of "Measure Carrier" for the uppermost and the lowermost carriers being Enabled or Disabled. When the **Number of Component Carriers** within each sub-block = 1, sub-block (bandwidth) = $BW_{channel} = 2 \times F_{offset,RAT}$.

See "Diagrams for Offset Freq Define" on page 1648.

Mode: MSR, LTEAFDD, LTEATDD

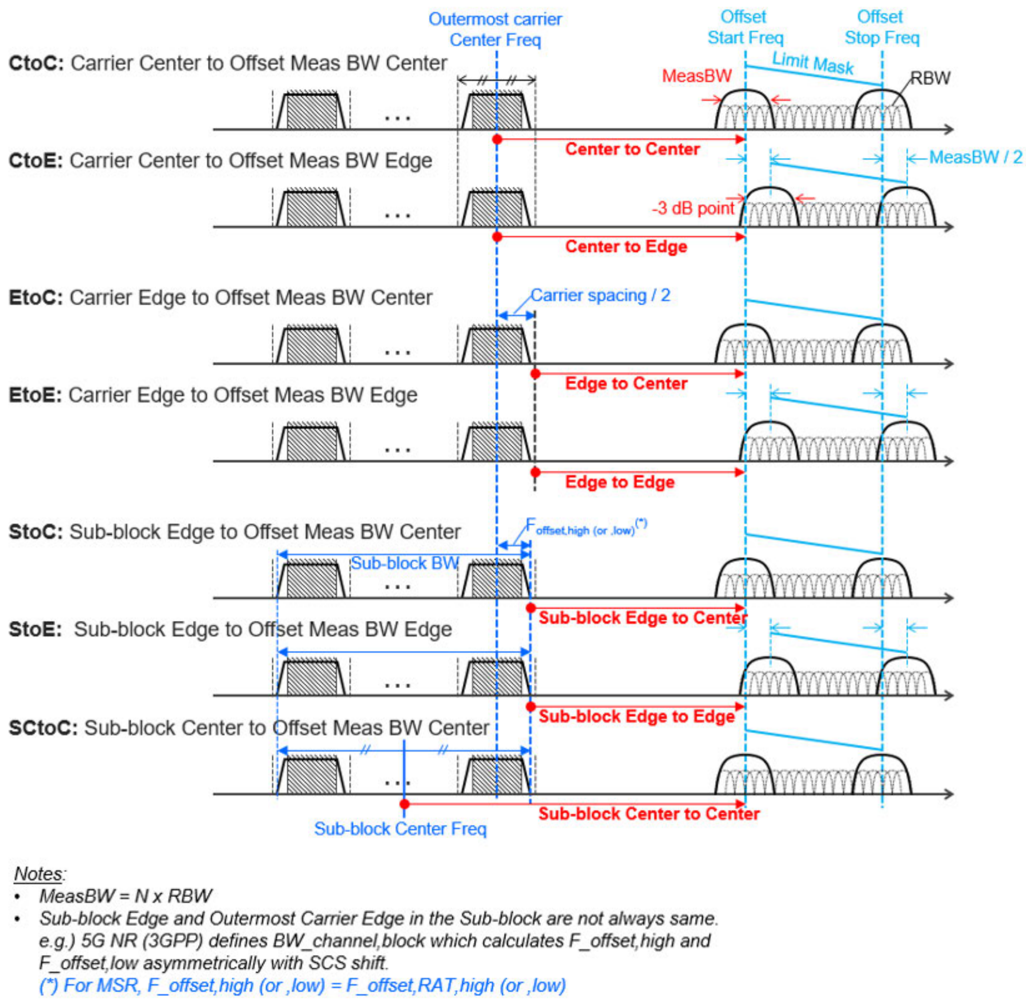
Remote Command	[:SENSe]:SEMask:OFFSet[1]|2:INNer:TYPE CTOCenter | CTOEdge | ETOCenter | ETOEdge | STOCenter | STOEdge [:SENSe]:SEMask:OFFSet[1]|2:INNer:TYPE?
Example	:SEM:OFFS:INN:TYPE ETOC :SEM:OFFS:INN:TYPE?
Preset	STOCenter
State Saved	Saved in instrument state
Range	Carrier Center to Meas BW Center | Carrier Center to Meas BW Edge | Carrier Edge to Meas BW Center |

	Carrier Edge to Meas BW Edge | Sub-block Edge to Meas BW Center | Sub-block Edge to Meas BW Edge

Mode: 5G NR

Remote Command	`[:SENSe]:SEMask:OFFSet[1]|2:INNer:TYPE CTOCenter | CTOEdge | ETOCenter | ETOEdge | STOCenter | STOEdge | SCTOCenter` `[:SENSe]:SEMask:OFFSet[1]|2:INNer:TYPE?`
Example	`:SEM:OFFS:INN:TYPE ETOC` `:SEM:OFFS:INN:TYPE?`
Preset	`STOCenter`
State Saved	Saved in instrument state
Range	Carrier Center to Meas BW Center | Carrier Center to Meas BW Edge | Carrier Edge to Meas BW Center | Carrier Edge to Meas BW Edge | Sub-block Edge to Meas BW Center | Sub-block Edge to Meas BW Edge | Sub-block Center to Meas BW Center

Diagrams for Offset Freq Define



Offset Detector

See "Offset Detector" on page 1610.

Cumulate Mask

Selects whether inner offset limit masks are cumulated or not.

Remote Command	`[:SENSe]:SEMask:OFFSet[1]|2:INNer:CMASk[:STATe] ON | OFF | 0 | 1` `[:SENSe]:SEMask:OFFSet[1]|2:INNer:CMASk[:STATe]?`
Example	`:SEM:OFFS:INN:CMAS 0` `:SEM:OFFS:INN:CMAS?`
Notes	OFFSet 1 is for BTS, 2 for MS. Default is BTS
Preset	1|0
State Saved	Yes
Range	ON|OFF

Cumulate Mask Stop Frequency

Specifies stop frequency of summing limit masks. For outside of the stop frequency, the limit masks are not cumulated.

Remote Command	`[:SENSe]:SEMask:OFFSet[1]|2:INNer:CMASk:FREQuency:STOP <freq>` `[:SENSe]:SEMask:OFFSet[1]|2:INNer:CMASk:FREQuency:STOP?`
Example	`:SEM:OFFS:INN:CMAS:FREQ:STOP 500E6` `:SEM:OFFS:INN:CMAS:FREQ:STOP?`
Notes	OFFSet 1 is for BTS, 2 for MS. Default is BTS
Dependencies	Valid only when "Cumulate Mask " on page 1648 is ON
Preset	10.5 MHz
State Saved	Yes
Min/Max	0 Hz/10 GHz

Start Freq

Specifies the start frequency for the currently selected offset. Also, enables you to toggle that offset between On and Off. When sending the remote command, missing values are not permitted; that is, if you want to change values 2 and 6, you must send all values up to 6. Subsequent values remain unchanged. The query for this parameter always returns 12 values.

Remote Command	`[:SENSe]:SEMask:OFFSet[1]|2:INNer:LIST:FREQuency:STARt <freq>, …`
	`[:SENSe]:SEMask:OFFSet[1]|2:INNer:LIST:FREQuency:STARt?`
	`[:SENSe]:SEMask:OFFSet[1]|2:INNer:LIST:STATe ON | OFF | 1 | 0, …`
	`[:SENSe]:SEMask:OFFSet[1]|2:INNer:LIST:STATe?`

Example	`:SEM:OFFS2:INN:LIST:FREQ:STAR 2.515 MHz, 2.715 MHz, 3.515 MHz, 4.00 MHz, 8.00 MHz, 12.50 MHz` `:SEM:OFFS2:INN:LIST:FREQ:STAR?`

	`:SEM:OFFS:INN:LIST:STAT ON, ON, ON, OFF, OFF, OFF` `:SEM:OFFS:INN:LIST:STAT?`
Notes	Comma-separated list of values OFFSet 1 is for BTS, 2 for MS. Default is BTS If the offset is outside the frequency range, the result spectrum will be invalid
Couplings	Coupled to "Stop Freq" on page 1650. If **Start Freq** exceeds **Stop Freq**, **Stop Freq** is automatically adjusted to (**Start Freq** + 100 Hz)
Preset	(see tables below)

Mode	Values
MSR	15 kHz, 215 kHz, 1.015 MHz, 1.5 MHz, 10.5 MHz, 15.00 MHz, 30 MHz, 30 MHz, 30 MHz, 30 MHz, 30 MHz, 30 MHz | 15 kHz, 215 kHz, 1.015 MHz, 1.5 MHz, 10.5 MHz, 15.00 MHz, 30 MHz, 30 MHz, 30 MHz, 30 MHz, 30 MHz, 30 MHz
5G NR	50 kHz, 5.05 MHz, 10.5 MHz, 40.00 MHz, 100 MHz, 100 MHz, 100 MHz, 100 MHz, 100 MHz, 100 MHz, 100 MHz, 100 MHz | 15.00 kHz, 1.5 MHz, 5.5 MHz, 100.50 MHz, 105.00 MHz, 100 MHz, 100 MHz, 100 MHz, 100 MHz, 100 MHz, 100 MHz, 100 MHz
LTEAFDD, LTEATDD	50 kHz, 5.05 MHz, 10.5 MHz, 15.00 MHz, 30 MHz, 40 MHz, 40 MHz, 40 MHz, 40 MHz, 40 MHz, 40 MHz, 40 MHz | 15.00 kHz, 1.5 MHz, 5.5 MHz, 6.5 MHz, 10 MHz, 20MHz, 20MHz, 20MHz, 20MHz, 20MHz, 20MHz, 20MHz

Mode	Values
`MSR`	`ON, ON, ON, ON, ON, OFF, OFF, OFF, OFF, OFF, OFF, OFF | ON, ON, ON, ON, ON, OFF, OFF, OFF, OFF, OFF, OFF, OFF`
`5GNR`	`ON, ON, ON, ON, OFF, OFF, OFF, OFF, OFF, OFF, OFF,OFF | ON, ON, ON, ON, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF`
`LTEAFDD` `LTEATDD`	`ON, ON, ON, OFF, OFF, OFF,OFF, OFF, OFF, OFF,OFF,OFF | ON, ON, ON, ON, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF`

State Saved	Saved in instrument state Saved in instrument state
Range	`ON|OFF`
Min/Max	0 Hz/Depends on instrument maximum frequency. It's always Offset Stop Freq -100 Hz

Stop Freq

Specifies the stop frequency for the currently selected offset.

When sending the remote command, missing values are not permitted; that is, if you want to change values 2 and 6 you must send all values up to 6. Subsequent values remain unchanged. The query for this parameter always returns 12 values.

Remote Command	`[:SENSe]:SEMask:OFFSet[1]|2:INNer:LIST:FREQuency:STOP <freq>, …`

	`[:SENSe]:SEMask:OFFSet[1]|2:INNer:LIST:FREQuency:STOP?`
Example	`:SEM:OFFS:INN:LIST:FREQ:STOP 2.715 MHz, 3.515 MHz, 4.00 MHz, 8.00 MHz, 12.50 MHz, 15.0 MHz` `:SEM:OFFS:INN:LIST:FREQ:STOP?`
Notes	Comma-separated list of values OFFSet 1 is for BTS, 2 for MS. Default is BTS If the offset is outside the frequency range, the result spectrum will be invalid
Couplings	Coupled to "Start Freq" on page 1649. If **Stop Freq** is lower than **Start Freq**, **Start Freq** is automatically adjusted to (**Stop Freq** - 100 Hz)
Preset	(see table below)
State Saved	Saved in instrument state
Min/Max	100 Hz/Depends on instrument maximum frequency. Same as the Max Span on Swept SA Measurement

Preset:

Mode	Values
MSR	215 kHz, 1.015 MHz, 1.5 MHz, 10.5 MHz, 50 MHz, 50 MHz, 50 MHz, 50 MHz, 50 MHz, 50 MHz, 50 MHz, 50 MHz
5G NR	5.05 MHz, 10.05 MHz, 40 MHz, 100 MHz, 500 MHz, 500 MHz, 500 MHz, 500 MHz, 500 MHz, 500 MHz, 500 MHz, 500 MHz | 985.0 kHz, 4.50 MHz, 99.500 MHz, 104.5 MHz, 500 MHz, 500 MHz, 500 MHz, 500 MHz, 500 MHz, 500 MHz, 500 MHz, 500 MHz
LTEAFDD, LTEATDD	5.05 MHz, 10.05 MHz, 15 MHz, 30 MHz, 40 MHz, 50 MHz, 50 MHz, 50 MHz, 50 MHz, 50 MHz, 50 MHz, 50 MHz | 985.0 kHz, 4.50 MHz, 5.5001 MHz, 9.50 MHz,20 MHz, 40 MHz , 40 MHz, 40 MHz, 40 MHz, 40 MHz, 40 MHz, 40 MHz

Res BW

Specifies which Resolution BW filter to use when measuring the currently selected offset.

Offset Res BW Mode allows the instrument to determine the optimum Resolution BW filter to use when measuring the currently selected offset. using front panel and all the offsets using SCPI. When changing the Meas BW parameter, if the Res BW needs to be changed to adhere to the rule:

(N x Res BW) <= (Stop freq of the offset – Start freq of the offset),

where N is the multiplier, this setting will automatically be changed to manual.

When sending the remote command, missing values are not permitted; that is, if you want to change values 2 and 6, you must send all values up to 6. Subsequent values remain unchanged. The query for this parameter always returns 12 values.

Remote Command	`[:SENSe]:SEMask:OFFSet[1]|2:INNer:LIST:BANDwidth[:RESolution] <bandwidth>, …`

	`[:SENSe]:SEMask:OFFSet[1]|2:INNer:LIST:BANDwidth[:RESolution]?`
	`[:SENSe]:SEMask:OFFSet[1]|2:INNer:LIST:BANDwidth[:RESolution]:AUTO OFF | ON | 1 | 0, …`
	`[:SENSe]:SEMask:OFFSet[1]|2:INNer:LIST:BANDwidth[:RESolution]:AUTO?`

Example	`:SEM:OFFS2:INN:LIST:BAND 30.0 kHz, 30.0 kHz, 30.0 kHz, 1.00 MHz,1.00 MHz, 1.00 MHz`
	`:SEM:OFFS2:INN:LIST:BAND?`
	`:SEM:OFFS:INN:LIST:BAND:AUTO 1,1,1,1,1,1`
	`:SEM:OFFS:INN:LIST:BAND:AUTO?`

Notes	Comma-separated list of values OFFSet 1 is for BTS, 2 for MS. Default is BTS
Couplings	Coupled to Start and Stop offset and "Meas BW" on page 1652 multiplier. This parameter must adhere to the rule: (N x Res BW) <= (Stop freq of the offset - Start freq of the offset), where N is the multiplier If the multiplier is changed, the Res BW changes to ensure conformance to the rule. When set manually, Res BW Coupling is set to manual The resolution bandwidth is coupled to the offset width, determined by "Start Freq" on page 1649 and "Stop Freq" on page 1650
Preset	**Mode** / **Values**: MSR: 30 kHz, 30 kHz, 30 kHz, 1.0 MHz,1.0 MHz, 1.0 MHz, 1.0 MHz, 1.0 MHz, 1.0 MHz, 1.0 MHz, 1.0 MHz, 1.0 MHz | 30 kHz, 30 kHz, 30 kHz, 1.0 MHz,1.0 MHz, 1.0 MHz, 1.0 MHz, 1.0 MHz, 1.0 MHz, 1.0 MHz, 1.0 MHz,1.0 MHz LTEAFDD, LTEATDD, 5G NR: 51 kHz, 100 kHz, 1.0 MHz, 1.0 MHz,1.0 MHz, 1.0 MHz,1.0 MHz, 1.0 MHz,1.0 MHz, 1.0 MHz, 1.0 MHz, 1.0 MHz | 15.0 kHz, 510 kHz,1.0 MHz,1.0 MHz, 1.0 MHz, 1.0 MHz, 1.0 MHz, 1.0 MHz,1.0 MHz, 1.0 MHz, 1.0 MHz, 1.0 MHz `OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF | OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF`
State Saved	Saved in instrument state Saved in instrument state
Range	Auto|Man
Min	1 Hz
Max	When Option FS1 or FS2 is installed:10 MHz Otherwise: 8 MHz

Meas BW

Allows you to specify a multiplier of Res BW for the measurement integration bandwidth.

Meas BW is multiplier integer, which defines a ratio between Integration BW and **Res BW** of the measurement result:

Integration BW = Meas BW * "Res BW" on page 1651

Integration BW is the desired resolution bandwidth, and **Res BW** is the actual bandwidth for sweep. Measurement sweeps with **Res BW**, and **Meas BW** compensates sweep resolution bandwidth to Integration BW.

If you set this parameter greater than 1, you can set **Res BW** narrower to avoid carrier power leakage effect to the offset power integration.

When sending the remote command, missing values are not permitted; that is, if you want to change values 2 and 6, you must send all values up to 6. Subsequent values remain unchanged. The query for this parameter always returns 12 values.

Remote Command	`[:SENSe]:SEMask:OFFSet[1]|2:INNer:LIST:BANDwidth:IMULti <integer>, …` `[:SENSe]:SEMask:OFFSet[1]|2:INNer:LIST:BANDwidth:IMULti?`
Example	`:SEM:OFFS2:INN:LIST:BAND:IMUL 1,1,1,1,1,1` `:SEM:OFFS2:INN:LIST:BAND:IMUL?`
Notes	Comma-separated list of values OFFSet 1 is for BTS, 2 for MS. Default is BTS
Couplings	This parameter must adhere to the rule: (N x Res BW) <= (Stop freq of the offset - Start freq of the offset), where N is the multiplier If **Res BW** is changed, the multiplier changes to conform to the rule
Preset	**Mode** / **Values**: MSR: 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1 | 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1 LTEAFDD, LTEATDD, 5G NR: 2, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1 | 2, 2, 1, 1, 1,1, 1, 1, 1, 1, 1, 1
State Saved	Yes
Min/Max	1/1000

Preset table:

Mode	Values
MSR	1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1 | 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1
LTEAFDD, LTEATDD, 5G NR	2, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1 | 2, 2, 1, 1, 1,1, 1, 1, 1, 1, 1, 1

Video BW

Changes the instrument post–detection filter.

When sending the remote command, missing values are not permitted; that is, if you want to change values 2 and 6, you must send all values up to 6. Subsequent values remain unchanged. The query for this parameter always returns 12 values.

Remote Command	`[:SENSe]:SEMask:OFFSet[1]|2:INNer:LIST:BANDwidth:VIDeo <freq>, …`
	`[:SENSe]:SEMask:OFFSet[1]|2:INNer:LIST:BANDwidth:VIDeo?`
	`[:SENSe]:SEMask:OFFSet[1]|2:INNer:LIST:BANDwidth:VIDeo:AUTO OFF | ON | 0 | 1, …`
	`[:SENSe]:SEMask:OFFSet[1]|2:INNer:LIST:BANDwidth:VIDeo:AUTO?`

Example	`:SEM:OFFS2:INN:LIST:BAND:VID 3.00 kHz, 3.00 kHz, 3.00 kHz, 100.0 kHz,100.0`

	kHz, 100.0 kHz :SEM:OFFS2:INN:LIST:BAND:VID? :SEM:OFFS2:INN:LIST:BAND:VID:AUTO ON, ON, ON, ON, ON, ON :SEM:OFFS2:INN:LIST:BAND:VID:AUTO?
Notes	Comma-separated list of values OFFSet 1 is for BTS, 2 for MS. Default is BTS
Couplings	When the **Auto** state is ON, **Video BW** is basically coupled with other parameters
Preset	Automatically Calculated ON, ON, ON, ON, ON, ON, ON, ON, ON, ON, ON, ON | ON, ON, ON, ON, ON, ON, ON, ON, ON, ON, ON, ON
State Saved	Saved in instrument state Saved in instrument state
Range	Auto|Man
Min/Max	1 Hz/50 MHz

Offset Freq Define

Same as "Offset Freq Define" on page 1645 under **Inner Offset (BW)**

Offset Detector

Same as "Offset Detector" on page 1610 under **Inner Offset (BW)**

Cumulate Mask

Same as "Cumulate Mask " on page 1648 under **Inner Offset (BW)**

Cumulate Mask Stop Frequency

Same as "Cumulate Mask Stop Frequency" on page 1649, under **Inner Offset (BW)**

Start Freq

Same as "Start Freq" on page 1649, under **Inner Offset (BW)**

Stop Freq

Same as "Stop Freq" on page 1650, under **Inner Offset (BW)**

Sweep Time

Specifies the sweep time for the currently selected offset and enables you to toggle the **Sweep Time** mode between **Auto** and **Man**.

When sending the remote command, missing values are not permitted; that is, if you want to change values 2 and 6, you must send all values up to 6. Subsequent values remain unchanged. The query for this parameter always returns 12 values.

NOTE: On non-sweeping hardware, this column is grayed-out. The value shown on this column is an estimate of the turnaround time to complete the measurement of the entire offset span, which is the sum of signal acquisition time, FFT time, and other overhead time. If you need to specify the same **Sweep Time** as you would for sweeping hardware, send `[:SENSe]:SEMask:OFFSet[1]|2:INNer:LIST:SWEep:TIME <time>`. The measurement emulates the **Sweep Time** effect, but this emulation is not straightforward, and therefore the behavior is not specified. Instead, we recommend using "Minimum Acquisition Time" on page 1656, which provides better control.

Remote Command	`[:SENSe]:SEMask:OFFSet[1]|2:INNer:LIST:SWEep:TIME <time>, …` `[:SENSe]:SEMask:OFFSet[1]|2:INNer:LIST:SWEep:TIME?` `[:SENSe]:SEMask:OFFSet[1]|2:INNer:LIST:SWEep:TIME:AUTO ON	OFF	1	0, …` `[:SENSe]:SEMask:OFFSet[1]|2:INNer:LIST:SWEep:TIME:AUTO?`

Example	`:SEM:OFFS2:INN:LIST:SWE:TIME 1.0 ms, 3.4 ms, 2.08 ms, 1.0 ms, 1.0 ms, 1.0 ms`
	`:SEM:OFFS2:INN:LIST:SWE:TIME?`
	`:SEM:OFFS2:INN:LIST:SWE:TIME:AUTO ON, ON, ON, ON, OFF, OFF`
	`:SEM:OFFS2:INN:LIST:SWE:TIME:AUTO?`

Notes	OFFSet 1 is for BTS, 2 for MS. Default is BTS
Dependencies	On non-sweeping hardware, this column is grayed-out and the **Auto/Man** checkbox is invisible. The read-only column shows estimated sweep time In those instruments, "Minimum Acquisition Time" on page 1656 is available
Couplings	When you manually set a value while in **Auto** , the state automatically changes to **Man**
Preset	Automatically calculated (see table below)
State Saved	Saved in instrument state Saved in instrument state

Mode	Values
MSR	`ON,ON,ON,ON,ON,ON,ON,ON,ON,ON,ON,ON`
LTEAFDD, LTEATDD, 5G NR	`ON,ON,ON,ON,ON,ON,ON,ON,ON,ON,ON,ON |` `ON,ON,ON,ON,ON,ON,ON,ON,ON,ON,ON,ON`

Min	Other than non-sweeping hardware Depends on Sweep Type: – Sweep Type “Swept”: 1 ms – Sweep Type “FFT”: 100 ns Non-sweeping hardware: N/A
Max	Sweeping hardware: 10 s Non-sweeping hardware: N/A
Min/Max	Depends on "Sweep Type" on page 1627: **Sweep Type** / **Min/Max** Swept: 1ms/10 s FFT: 100ns/10 s

Minimum Acquisition Time

Available on non-sweeping hardware.

Specifies the minimum acquisition time for each “chunk” of the measurement result. The instrument automatically divides **Span** into multiple chunks if needed. Therefore, the total signal acquisition time for the entire offset span is:

~(>~Minimum Acquisition Time) * (The number of chunks).

When in **Auto**, this parameter’s value is determined by other parameters, such as **Offset Start**, **Offset Stop**, **RBW** and **VBW**.

You can manually increase this parameter value from this **Auto** value.

If increased, the instrument acquires signal for the specified time duration for each chunk. It performs additional FFTs, and averages or peak-holds the FFT results for a chunk, depending on **Detector** settings.

Note that the actual acquisition time for each chunk may exceed the **Minimum Acquisition Time** value, in order to satisfy FFT time required by other parameters, and to perform an integer number of FFTs.

Remote Command	`[:SENSe]:SEMask:OFFSet[1]|2:INNer:LIST:SWEep:ACQuisition:TIME <time>, …`
	`[:SENSe]:SEMask:OFFSet[1]|2:INNer:LIST:SWEep:ACQuisition:TIME?`
	`[:SENSe]:SEMask:OFFSet[1]|2:INNer:LIST:SWEep:ACQuisition:TIME:AUTO ON | OFF | 1 | 0, …`
	`[:SENSe]:SEMask:OFFSet[1]|2:INNer:LIST:SWEep:ACQuisition:TIME:AUTO?`

Example	`:SEM:OFFS2:INN:LIST:SWE:ACQ:TIME 1.0 ms, 3.4 ms, 2.08 ms, 1.0 ms, 1.0 ms, 1.0 ms` `:SEM:OFFS2:INN:LIST:SWE:ACQ:TIME?`

	`:SEM:OFFS2:INN:LIST:SWE:ACQ:TIME:AUTO ON, ON, ON, ON, OFF, OFF` `:SEM:OFFS2:INN:LIST:SWE:ACQ:TIME:AUTO?`
Dependencies	Available only on non-sweeping hardware
Couplings	Coupled to **Offset Start Freq**, **Offset Stop Freq**, **RBW**, and **VBW** when in the **Auto** state When you manually set a value while in **Auto**, the state automatically changes to **Man**
Preset	Automatically calculated `ON`
State Saved	Saved in instrument state
Min	100 ns
Max	4000 s

Sweep Time Annotation (Remote Query Only)

Returns the **Sweep Time Annotation** value. Available only on non-sweeping hardware.

The value returned is the estimated turnaround time of each acquisition, in seconds. The turnaround time is the sum of the signal acquisition time, FFT time, and other overhead time, to complete the entire offset span of each measurement cycle.

Remote Command	`[:SENSe]:SEMask:OFFSet[1]|2:INNer:LIST:SWEep:ETIMe?`
Example	`:SEM:OFFS2:INN:LIST:SWE:ETIM?`
Dependencies	Available only on non-sweeping hardware
Preset	Automatically calculated

Sweep Type

Specifies the **Sweep Type** for the currently selected offset and enables you to toggle **Sweep Type** mode between **Auto** and **Man**.

When sending the remote command, missing values are not permitted; that is, if you want to change values 2 and 6, you must send all values up to 6. Subsequent values remain unchanged. The query for this parameter always returns 12 values.

How to define Sweep Time and Sweep Type

Sweep Type Mode	Behavior
Auto	**Sweep Type** is automatically selected depending on Rules **Sweep Time** is automatically calculated, according to the selected **Sweep Type**
Man	**Sweep Type** is user-selected

–

Remote Command	`[:SENSe]:SEMask:OFFSet[1]|2:INNer:LIST:SWEep:TYPE SWEep | FFT, …`
	`[:SENSe]:SEMask:OFFSet[1]|2:INNer:LIST:SWEep:TYPE?`
	`[:SENSe]:SEMask:OFFSet[1]|2:INNer:LIST:SWEep:TYPE:AUTO ON | OFF | 1 | 0, …`
	`[:SENSe]:SEMask:OFFSet[1]|2:INNer:LIST:SWEep:TYPE:AUTO?`

Example	`:SEM:OFFS2:INN:LIST:SWE:TYPE FFT,FFT,SWE`
	`:SEM:OFFS2:INN:LIST:SWE:TYPE?`
	`:SEM:OFFS2:INN:LIST:SWE:TYPE:AUTO ON, ON, ON, ON, OFF, OFF`
	`:SEM:OFFS2:INN:LIST:SWE:TYPE:AUTO?`

Notes	Comma-separated list of values OFFSet 1 is for BTS, 2 for MS. Default is BTS
Dependencies	Not available in modular products, such as VXT
Couplings	When **Sweep Type** is set manually, **Sweep Type** Mode is set to `MANual` When **Sweep Type** Mode is **Auto**, **Sweep Type** is automatically selected according to "Sweep Type Rules" on page 1604
Preset	Automatically calculated `ON,ON,ON,ON,ON,ON,ON,ON,ON,ON,ON,ON`
State Saved	Saved in instrument state
Range	Auto|Man

Offset Side

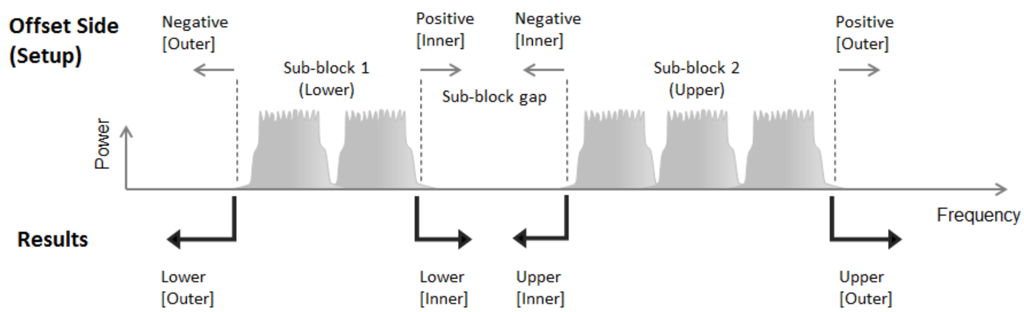
Specifies which offset side to measure.

You can turn off (not use) specific offsets with `[:SENSe]:SEMask:OFFSet[n]:INNer:LIST:STATe`.

`BOTH`	Both sides in the sub-block gap are enabled.
`NEGative`	The upper side in the sub-block gap only (i.e., negative sideband of the upper sub-block) is enabled
`POSitive`	The lower side in the sub-block gap only (i.e., positive sideband of the lower sub-block) is enabled.

When sending the remote command, missing values are not permitted; that is, if you want to change values 2 and 6, you must send all values up to 6. Subsequent values remain unchanged. The query for this parameter always returns 12 values.

The figure below shows the relation between the negative/positive offset side setups and the upper/lower results in the MSR and LTE-Advanced FDD/TDD Modes.



Remote Command	`[:SENSe]:SEMask:OFFSet[1]|2:INNer:LIST:SIDE BOTH | NEGative | POSitive, …` `[:SENSe]:SEMask:OFFSet[1]|2:INNer:LIST:SIDE?`
Example	`:SEM:OFFS:INN:LIST:SIDE BOTH, NEG, NEG, POS, POS, POS` `:SEM:OFFS:INN:LIST:SIDE?`
Notes	Comma-separated list of values OFFSet1 is for BTS, 2 for MS. Default is BTS
Preset	see table below
State Saved	Saved in instrument state
Range	`BOTH|NEGative|POSitive`

Preset:

Mode	Values
MSR	BOTH, BOTH, BOTH, BOTH, BOTH, BOTH, BOTH, BOTH, BOTH, BOTH, BOTH, BOTH
LTEAFDD, LTEATDD, 5GNR	BOTH, BOTH, BOTH, BOTH, BOTH, BOTH, BOTH, BOTH, BOTH, BOTH, BOTH, BOTH | BOTH, BOTH, BOTH, BOTH, BOTH, BOTH, BOTH, BOTH, BOTH, BOTH, BOTH, BOTH

Start Freq

Same as "Start Freq" on page 1649 under **Inner Offset (BW)**

Stop Freq

Same as "Stop Freq" on page 1650 under **Inner Offset (BW)**

Abs Start

Sets the absolute power level limit at the start frequency for the selected inner offset, ranging from –200 to +50 dBm.

The fail condition for each inner offset channel is set remotely by `[:SENSe]:SEMask:OFFSet[n]:INNer:LIST:TEST`.

You can turn off (not use) specific inner offset channels remotely with `[:SENSe]:SEMask:OFFSet[n]:INNer:LIST:STATe`.

The query returns values currently set to the absolute power test limits.

When sending the remote command, missing values are not permitted; that is, if you want to change values 2 and 6, you must send all values up to 6. Subsequent values remain unchanged. The query for this parameter always returns 12 values.

Remote Command	`[:SENSe]:SEMask:OFFSet[1]|2:INNer:LIST:STARt:ABSolute <real>, …` `[:SENSe]:SEMask:OFFSet[1]|2:INNer:LIST:STARt:ABSolute?`
Example	`:SEM:OFFS2:INN:LIST:STAR:ABS -12.50 dBm, -12.50 dBm, -24.50 dBm, -11.50 dBm, -11.50 dBm, -11.50 dBm` `:SEM:OFFS2:INN:LIST:STAR:ABS?`
Notes	Comma-separated list of values OFFSet 1 is for BTS, 2 for MS. Default is BTS
Preset	see table below
State Saved	Saved in instrument state
Min/Max	-200 dBm/50 dBm

Preset:

Mode	Values
MSR	-12.5 dBm, -12.5 dBm, -24.5 dBm, -11.5 dBm, -15.0 dBm, -15.0 dBm, -15.0 dBm, -15.0 dBm, -15.0 dBm, -15.0 dBm, -15.0 dBm, -15.0 dBm| -12.5 dBm, -12.5 dBm, -24.5 dBm, -11.5 dBm, -15.0 dBm, -15.0 dBm, -15.0 dBm, -15.0 dBm, -15.0 dBm, -15.0 dBm, -15.0 dBm, -15.0 dBm
5G NR	-5.5 dBm, -12.5 dBm, -15.0 dBm, -15.0 dBm, -15.0 dBm, -15.0 dBm, -15.0 dBm, -15.0 dBm, -15.0 dBm, -15.0 dBm, -15.0 dBm, -15.0 dBm|-22.5 dBm, -8.5 dBm, -11.5 dBm, -23.5 dBm, -23.5 dBm, -23.5 dBm, -23.5 dBm, -23.5 dBm, -23.5 dBm, -23.5 dBm, -23.5 dBm, -23.5 dBm
LTEAFDD, LTEATDD	-5.5 dBm, -12.5 dBm, -15.0 dBm, -15.0 dBm, -15.0 dBm, -15.0 dBm, -15.0 dBm, -15.0 dBm, -15.0 dBm, -15.0 dBm, -15.0 dBm, -15.0 dBm|-13.5 dBm, -8.5 dBm, -11.5 dBm, -23.5 dBm, -23.5 dBm, -23.5 dBm, -23.5 dBm, -23.5 dBm, -23.5 dBm, -23.5 dBm, -23.5 dBm, -23.5 dBm

Abs Stop

Sets the absolute power level limit at the stop frequency for the selected inner offset, ranging from –200 to +50 dBm. You can also toggle this function between **Couple** (`COUPle = ON`) and **Manual** (`COUPle = OFF`). If set to **Couple**, the Abs Stop power level limit is coupled to Abs Start to result in a flat limit line. If set to **Man**, Abs Start and Abs Stop take different values to result in a sloped limit line.

The query returns values currently set to the inner offset stop absolute power limits.

When sending the remote command, missing values are not permitted; that is, if you want to change values 2 and 6, you must send all values up to 6. Subsequent values remain unchanged. The query for this parameter always returns 12 values.

Remote Command	`[:SENSe]:SEMask:OFFSet[1]|2:INNer:LIST:STOP:ABSolute <real>, …`
	`[:SENSe]:SEMask:OFFSet[1]|2:INNer:LIST:STOP:ABSolute?`
	`[:SENSe]:SEMask:OFFSet[1]|2:INNer:LIST:STOP:ABSolute:COUPle ON | OFF | 1 | 0, …`
	`[:SENSe]:SEMask:OFFSet[1]|2:INNer:LIST:STOP:ABSolute:COUPle?`

Example	`:SEM:OFFS:INN:LIST:STOP:ABS -12.50 dBm, -24.50 dBm, -24.50 dBm, -11.50 dBm, -11.50 dBm, -11.50 dBm`
	`:SEM:OFFS1:INN:LIST:STOP:ABS?`
	`:SEM:OFFS:INN:LIST:STOP:ABS:COUP ON, OFF, ON, ON, ON, ON`
	`:SEM:OFFS:INN:LIST:STOP:ABS:COUP?`

Notes	Comma-separated list of values OFFSet 1 is for BTS, 2 for MS. Default is BTS
Couplings	Coupled to Abs Start if **Auto** is selected, that is, the Stop value is equal to the Start value
Preset	(see tables below)

Preset:

Mode	Values
MSR	-12.5 dBm, -24.5 dBm, -11.5 dBm, -15.0 dBm, -15.0 dBm, -15.0 dBm, -15.0 dBm, -15.0 dBm, -15.0 dBm, -15.0 dBm, -15.0 dBm, -15.0 dBm| -12.5 dBm, -24.5 dBm, -11.5 dBm, -15.0 dBm, -15.0 dBm, -15.0 dBm, -15.0 dBm, -15.0 dBm, -15.0 dBm, -15.0 dBm, -15.0 dBm, -15.0 dBm
5G NR	-12.5 dBm, -12.5 dBm, -15.0 dBm, -15.0 dBm, -15.0 dBm, -15.0 dBm, -15.0 dBm, -15.0 dBm, -15.0 dBm, -15.0 dBm, -15.0 dBm, -15.0 dBm| -22.5 dBm, -8.5 dBm, -11.5 dBm, -23.5 dBm, -23.5 dBm, -23.5 dBm, -23.5 dBm, -23.5 dBm, -23.5 dBm, -23.5 dBm, -23.5 dBm, -23.5 dBm
LTEAFDD, LTEATDD	-12.5 dBm, -12.5 dBm, -15.0 dBm, -15.0 dBm, -15.0 dBm, -15.0 dBm, -15.0 dBm, -15.0 dBm, -15.0 dBm, -15.0 dBm, -15.0 dBm, -15.0 dBm| -13.5 dBm, -8.5 dBm, -11.5 dBm, -23.5 dBm, -23.5 dBm, -23.5 dBm -23.5 dBm, -23.5 dBm, -23.5 dBm, -23.5 dBm, -23.5 dBm, -23.5 dBm

Mode	Values
MSR	`ON, OFF, OFF, OFF, ON, OFF, OFF, OFF, OFF, OFF, OFF, OFF | ON, OFF, OFF, OFF, ON, OFF, OFF, OFF, OFF, OFF, OFF, OFF`
LTEAFDD, LTEATDD, 5G NR	`OFF, ON, ON, ON, ON, ON, ON, ON, ON, ON, ON, ON | ON, ON, ON, ON, ON, ON, ON, ON, ON, ON, ON, ON`

State Saved	Saved in instrument state Saved in instrument state
Range	Auto|Man
Min/Max	-200 dBm/50 dBm

Rel Start

Sets a relative power level limit at the start frequency for the selected inner offset, ranging from –200 to +50 dBc.

The fail condition is set remotely by `[:SENSe]:SEMask:OFFSet[n]:INNer:LIST:TEST` for each inner offset channel test.

You can turn off (not use) specific inner offset channels remotely with `[:SENSe]:SEMask:OFFSet[n]:INNer:LIST:STATe`.

The query returns values currently set to the relative power test limits.

When sending the remote command, missing values are not permitted; that is, if you want to change values 2 and 6, you must send all values up to 6. Subsequent values remain unchanged. The query for this parameter always returns 12 values.

Remote Command	`[:SENSe]:SEMask:OFFSet[1]|2:INNer:LIST:STARt:RCARrier <rel_ampl>, …` `[:SENSe]:SEMask:OFFSet[1]|2:INNer:LIST:STARt:RCARrier?`
Example	`:SEM:OFFS:INN:LIST:STAR:RCAR -30, -30, -30, -30, -30, -30` `:SEM:OFFS:INN:LIST:STAR:RCAR?`
Notes	Comma-separated list of values OFFSet 1 is for BTS, 2 for MS. Default is BTS
Preset	0 dB, 0 dB, 0 dB, 0 dB, 0 dB, 0 dB, 0 dB, 0 dB, 0 dB, 0 dB, 0 dB, 0 dB | 0 dB, 0 dB, 0 dB, 0 dB, 0 dB, 0 dB, 0 dB, 0 dB, 0 dB, 0 dB, 0 dB, 0 dB
State Saved	Saved in instrument state
Min/Max	-200 dB/50 dB

Rel Stop

Sets a relative power level limit at the stop frequency for the selected inner offset, ranging from –200 to +50 dBc.

The fail condition is set remotely by `[:SENSe]:SEMask:OFFSet[n]:INNer:LIST:TEST` for each inner offset channel.

You can turn off (not use) specific inner offset channels remotely with `[:SENSe]:SEMask:OFFSet[n]:INNer:LIST:STATe`.

The query returns values currently set to the inner offset stop relative power limits.

When sending the remote command, missing values are not permitted; that is, if you want to change values 2 and 6, you must send all values up to 6. Subsequent values remain unchanged. The query for this parameter always returns 12 values.

Remote	`[:SENSe]:SEMask:OFFSet[1]|2:INNer:LIST:STOP:RCARrier <rel_ampl>, …`

Command	[:SENSe]:SEMask:OFFSet[1]|2:INNer:LIST:STOP:RCARrier? [:SENSe]:SEMask:OFFSet[1]|2:INNer:LIST:STOP:RCARrier:COUPle ON | OFF | 1 | 0, … [:SENSe]:SEMask:OFFSet[1]|2:INNer:LIST:STOP:RCARrier:COUPle?
Example	:SEM:OFFS:INN:LIST:STOP:RCAR -30, -30, -30, -30, -30, -30 :SEM:OFFS:INN:LIST:STOP:RCAR? :SEM:OFFS:INN:LIST:STOP:RCAR:COUP ON, ON, ON, ON, ON, ON :SEM:OFFS:INN:LIST:STOP:RCAR:COUP?
Notes	Comma-separated list of values OFFSet 1 is for BTS, 2 for MS. Default is BTS
Couplings	Coupled to Rel Start if “Auto” is selected, that is, Start is made the same as Stop
Preset	0 dB, 0 dB, 0 dB, 0 dB, 0 dB, 0 dB, 0 dB, 0 dB, 0 dB, 0 dB, 0 dB, 0 dB | 0 dB, 0 dB, 0 dB, 0 dB, 0 dB, 0 dB, 0 dB, 0 dB, 0 dB, 0 dB, 0 dB, 0 dB ON, ON, ON, ON, ON, ON, ON, ON, ON, ON, ON, ON | ON, ON, ON, ON, ON, ON, ON, ON, ON, ON, ON, ON
State Saved	Saved in instrument state Saved in instrument state
Range	Auto|Man
Min/Max	-200 dB/50 dB

Fail Mask

Selects one of the logics for fail conditions between the measurement results and the test limits:

- ABSolute and RELative both check the results against the respective limit
- OR checks against both limits, failing if either of the limits is broken
- AND only displays a fail if both of the limits are broken

The absolute or relative power limit value for each inner offset channel can be set remotely with [:SENSe]:SEMask:OFFSet[n]:INNer:LIST:ABSolute or [:SENSe]:SEMask:OFFSet[n]:INNer:LIST:RCARrier.

You can turn off (not use) specific inner offset channels remotely with [:SENSe]:SEMask:OFFSet[n]:INNer:LIST:STATe.

When sending the remote command, missing values are not permitted; that is, if you want to change values 2 and 6, you must send all values up to 6. Subsequent values remain unchanged. The query for this parameter always returns 12 values.

Remote Command	[:SENSe]:SEMask:OFFSet[1]|2:INNer:LIST:TEST ABSolute | AND | OR | RELative, …

	[:SENSe]:SEMask:OFFSet[1]|2:INNer:LIST:TEST?
Example	:SEM:OFFS:INN:LIST:TEST ABS, ABS, ABS, ABS, ABS, ABS :SEM:OFFS:INN:LIST:TEST?
Notes	Comma-separated list of values
Preset	ABS, ABS, ABS, ABS, ABS, ABS, ABS, ABS, ABS, ABS, ABS, ABS
State Saved	Saved in instrument state
Range	Absolute | Relative | Abs AND Rel | Abs OR Rel

Show Abs2 Limit

Same as "Show Abs2 Limit" on page 1664 under Limits.

Abs2 Start

Sets the 2nd absolute power level limit at the start frequency for the selected inner offset, ranging from –200 to +50 dBm.

The fail condition for each inner offset channel is set remotely using:

`[:SENSe]:SEMask:OFFSet[n]:INNer:LIST:TEST:SABSolute`

You can turn off (not use) specific inner offset channels remotely using:

`[:SENSe]:SEMask:OFFSet[n]:INNer:LIST:STATe`

The query returns values currently set to the 2nd absolute power test limits.

When sending the command, missing values are not permitted; that is, if you want to change values 2 and 6, you must send all values up to 6. Subsequent values remain unchanged. The query always returns 12 values.

Remote Command	[:SENSe]:SEMask:OFFSet[1]|2:INNer:LIST:STARt:SABSolute <real>, … [:SENSe]:SEMask:OFFSet[1]|2:INNer:LIST:STARt:SABSolute?
Example	:SEM:OFFS:INN:LIST:STAR:SABS -12.50 dBm, -12.50 dBm, -24.50 dBm, -11.50 dBm, -11.50 dBm, -11.50 dBm :SEM:OFFS:INN:LIST:STAR:SABS?
Notes	Comma-separated list of values OFFSet 1 is for BTS, 2 for MS. Default is BTS
Preset	0 dBm, 0 dBm, 0 dBm, 0 dBm, 0 dBm, 0 dBm, 0 dBm, 0 dBm, 0 dBm, 0 dBm, 0 dBm, 0 dBm|0 dBm, 0 dBm, 0 dBm, 0 dBm, 0 dBm, 0 dBm, 0 dBm, 0 dBm, 0 dBm, 0 dBm, 0 dBm, 0 dBm
State Saved	Saved in instrument state
Min	-200 dBm
Max	50 dBm

Abs2 Stop

Sets the 2nd absolute power level limit at the stop frequency for the selected inner offset, ranging from –200 to +50 dBm. You can also toggle this function between **Couple** and **Manual**. If set to **Couple** = `ON`, the **Abs2 Stop** power level limit is coupled to "Abs2 Start" on page 1664, resulting in a flat limit line. If set to **Man** (**Couple** = `OFF`), **Abs2 Start** and **Abs2 Stop** take different values, resulting in a sloped limit line.

The query returns values currently set to the offset stop 2nd absolute power limits.

When sending the command, missing values are not permitted; that is, if you want to change values 2 and 6, you must send all values up to 6. Subsequent values remain unchanged. The query always returns 12 values.

Remote Command	`[:SENSe]:SEMask:OFFSet[1]|2:INNer:LIST:STOP:SABSolute <real>, …`
	`[:SENSe]:SEMask:OFFSet[1]|2:INNer:LIST:STOP:SABSolute?`
	`[:SENSe]:SEMask:OFFSet[1]|2:INNer:LIST:STOP:SABSolute:COUPle ON | OFF | 1 | 0, …`
	`[:SENSe]:SEMask:OFFSet[1]|2:INNer:LIST:STOP:SABSolute:COUPle?`

Example	`:SEM:OFFS:INN:LIST:STOP:SABS -12.50 dBm, -24.50 dBm, -24.50 dBm, -11.50 dBm, -11.50 dBm, -11.50 dBm`
	`:SEM:OFFS:INN:LIST:STOP:SABS?`
	`:SEM:OFFS:INN:LIST:STOP:SABS:COUP ON, ON, ON, ON, ON, ON`
	`:SEM:OFFS:INN:LIST:STOP:SABS:COUP?`

Notes	Comma-separated list of values `OFFSet` 1 is for BTS, 2 for MS. Default is BTS
Couplings	Coupled to Abs Start if **Auto** is selected, that is, the Stop value is equal to the Start value
Preset	0 dBm, 0 dBm, 0 dBm, 0 dBm, 0 dBm, 0 dBm, 0 dBm, 0 dBm, 0 dBm, 0 dBm, 0 dBm, 0 dBm|0 dBm, 0 dBm, 0 dBm, 0 dBm, 0 dBm, 0 dBm, 0 dBm, 0 dBm, 0 dBm, 0 dBm, 0 dBm, 0 dBm `ON, ON, ON, ON, ON, ON, ON, ON, ON, ON, ON, ON | ON, ON, ON, ON, ON, ON, ON, ON, ON, ON, ON, ON`
State Saved	Saved in instrument state Saved in instrument state
Range	Auto|Man
Min	-200 dBm
Max	50 dBm

Fail Mask2

Selects one of the logical operations for fail conditions between the measurement results and the test limits:

(Primary Fail Mask selection) OR Abs2	OR	Checks against both Primary and Abs2 limits. The test fails if either of the limits is broken
(Primary Fail Mask selection) AND Abs2	AND	Checks against both Primary and Abs2 limits. The test fails if both of the limits are broken
Abs2 Disabled	OFF	Fail Mask2 is disabled

For examples, see "Fail Mask2" on page 1644.

Note that the Primary Fail Mask selection is set by "Fail Mask" on page 1663.

You can turn off (not use) specific inner offset channels remotely using:

`[:SENSe]:SEMask:OFFSet[n]:INNer:LIST:STATe`

When sending the command, missing values are not permitted; that is, if you want to change values 2 and 6, you must send all values up to 6. Subsequent values remain unchanged. The query always returns 12 values.

Remote Command	`[:SENSe]:SEMask:OFFSet[1]|2:INNer:LIST:TEST:SABSolute AND	OR	OFF, …` `[:SENSe]:SEMask:OFFSet[1]|2:INNer:LIST:TEST:SABSolute?`
Example	`:SEM:OFFS:INN:LIST:TEST:SABS AND, AND, OR, OFF, OFF, OFF` `:SEM:OFFS:INN:LIST:TEST:SABS?`
Notes	Comma-separated list of values
Preset	`OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF	OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF, OFF`
State Saved	Saved in instrument state
Range	OR Abs2 | AND Abs2 | Abs2 Disabled

Meas Setup Summary Table

Lets you view and access many of the parameters in the **Meas Setup** menus on one screen.

Auto Couple

Immediately puts all **Auto/Man** functions into **Auto**. **Auto Couple** is confined to the current measurement only. It does not affect other measurements in the Mode.

In the **Auto** state, **Auto/Man** functions are said to be “coupled”, meaning their values change as you make changes to other values in the measurement. This helps ensure accurate measurements and optimum dynamic range. **Auto Couple** is an immediate action function, and when it is executed, all the **Auto/Man** controls for the current measurement are set to **Auto**, and all measurement settings coupled to the **Auto/Man** parameters are automatically set to their optimal values.

For further details of measurement-specific settings (if any), see "Measurement-Specific Details" on page 1667 below.

Remote Command	`:COUPle ALL`
Example	`:COUP ALL`
Backwards Compatibility SCPI	`:COUPLE ALL | NONE`
Backwards Compatibility Notes	`:COUP:NONE` puts all Auto/Man parameters in manual mode, decoupling all the coupled instrument parameters. It is retained for backwards compatibility and is *not* recommended for making measurements or new designs

All **Auto/Man** parameter couplings in the measurement are set to **Auto**. This includes couplings that may be unavailable or grayed-out due to the current state. For example, in the Swept SA measurement, there is no **Auto/Man** coupling for **RBW** while in Zero Span. Nonetheless, if **Auto Couple** were executed while in Zero Span, it would set **RBW** to Auto "behind the scenes" so that, on exit from Zero Span, it would be in **Auto**.

Any **Auto/Man** selection specific (local) to the other measurements in the current Mode are not affected by **Auto Couple**. Any functions that are *not* coupled with other instrument parameters, such as ranging or leveling variables, such as **AutoRange** or **AutoScale**, are not affected.

Executing **Auto Couple** generates the informational message, "All Auto/Man functions have been set to Auto".

Each parameter, upon being set to **Auto**, selects and sets the appropriate auto-coupled value based on that parameter's coupling rules. The Dependency Resolver orchestrates the couplings for parameters that depend on one or more other parameters. The coupling and dependency rules for each parameter are defined in the section describing that parameter.

Executing **Auto Couple***does not* affect markers, marker functions, trace or display attributes, or any other instrument setting other than those specifically mentioned above.

Measurement-Specific Details

TOI (SA Mode only)

Parameters affected by **Auto Couple** are:

- Center Frequency Step
- Resolution Bandwidth

- Span/RBW Ratio
- Sweep Time
- Video BANDwidth VBW/RBW ratio
- Upper and Lower Tone (set to Sense)
- Zero span measurement Resolution Bandwidth
- Zero span measurement Dwell Time

Harmonics (SA Mode only)

Parameters affected by **Auto Couple** are:

- Resolution Bandwidth
- Fundamental Frequency
- Dwell Time
- Range Table Resolution Bandwidths
- Range Table Dwell Times

Meas Preset

Restores all the measurement parameters to their default values.

Remote Command	`:CONFigure:SEMask`
Example	`:CONF:SEM`
Couplings	Restores all measurement parameters to their default values

3.9.18.2 Carrier

Used to set up parameters that define how the reference channel is measured.

Integ BW

Specifies the integration bandwidth used to calculate the power in the reference channel.

Remote Command	`[:SENSe]:SEMask:BANDwidth[1]|2:INTegration <bandwidth>`

	`[:SENSe]:SEMask:BANDwidth[1]|2:INTegration?`
Example	`:SEM:BAND:INT 10 MHz` `:SEM:BAND:INT?`
Notes	10% . 100% of Channel Span Parameter Value Bandwidth sub op code, 1 is for BTS, 2 for MS. Default is BTS Note that Bandwidth sub op code 2 is supported only in non-SA Modes. In SA Mode, Bandwidth sub op code 1 is used for both BTS and MS If the ref channel is outside the frequency range, the result spectrum will be invalid
Dependencies	Not shown in MSR, LTE-Advanced FDD/TDD and 5G NR Modes In order to maintain backwards compatible with legacy LTE FDD/TDD Modes, the remote command is supported in LTE & LTE-A converged application
Couplings	Cannot be higher than the channel **Span**. If lower than 1/10 of channel **Span**, then the channel **Span** is reduced to be 10 times the Integ BW
Preset	**Mode** / **Value** `SA`: 3.84 MHz `WCDMA`: 3.84 MHz|3.84 MHz `WLAN`: See the table of "WLAN Mode Presets" on page 1669 below
State Saved	Saved in instrument state
Min/Max	1 kHz/Depends on instrument maximum frequency
Backwards Compatibility SCPI	`[:SENSe]:SEMask:BWIDth[1]|2:INTegration`

WLAN Mode Presets

Radio Std	Presets
802.11a/g (OFDM/DSSS-OFDM)	18 MHz
802.11n/ac (20 MHz)	
802.11b/g (DSSS/CCK/PBCC)	22 MHz
802.11n (40MHz)/ 802.11ac (40 MHz)	38 MHz
802.11ac (80 MHz)	78 MHz
802.11ac (160 MHz)	158 MHz
802.11ac (80 MHz + 80 MHz)	78 MHz
802.11ah (1 MHz)	0.9 MHz
802.11ah (2 MHz)	1.8 MHz
802.11ah (4 MHz)	3.8 MHz
802.11ah (8 MHz)	7.8 MHz

Radio Std	Presets
802.11ah (16 MHz)	15.8 MHz
802.11j/p (20 MHz)	18 MHz
802.11j/p (10 MHz)	9 MHz
802.11p (5 MHz)	4.5 MHz
802.11ax/be (20 MHz)	19.5 MHz
802.11ax/be (40 MHz)	39.0 MHz
802.11ax/be (80 MHz)	79.0 MHz
802.11ax/be (160 MHz)	159.0 MHz
802.11be (320 MHz)	319.0 MHz
802.11ax (80 MHz + 80 MHz)	79.0 MHz
802.11af (6 MHz)	5.7 MHz
802.11af (7 MHz)	6.65 MHz
802.11af (8 MHz)	7.6 MHz

Span

Specifies the span used to calculate the power in the reference channel.

Remote Command	`[:SENSe]:SEMask:FREQuency[1]|2:SPAN <freq>`
	`[:SENSe]:SEMask:FREQuency[1]|2:SPAN?`
	`[:SENSe]:SEMask:FREQuency[1]|2:SPAN:AUTO ON | OFF | 1 | 0`
	`[:SENSe]:SEMask:FREQuency[1]|2:SPAN:AUTO?`

Example	`:SEM:FREQ:SPAN 3MHz`
	`:SEM:FREQ:SPAN?`
	`:SEM:FREQ:SPAN:AUTO OFF`
	`:SEM:FREQ:SPAN:AUTO?`

Notes	Frequency sub op code, 1 is for BTS, 2 for MS. Default is BTS Note that Frequency sub op code 2 is supported only in non-SA Modes. In SA Mode, Frequency sub op code 1 is used for both BTS and MS If the ref channel is outside the frequency range, the result spectrum will be invalid
Dependencies	Not shown in MSR Mode In order to maintain backwards compatible with legacy LTE FDD/TDD Modes, the channel span key is supported in LTE & LTE-A converged application. The **Auto/Man** toggle is added to this key. This key is enabled and can be changed only in single carrier. The span state is always **Auto** in Multi-carriers Span **Auto/Man** state is only available in LTE/LTE-Advanced FDD/TDD and 5G NR Modes
Couplings	Range 1 kHz to 50 MHz (although restricted by Chan Integ BW). If you set the channel **Span** lower than channel **Integ BW**, they will both track each other. As you increase the channel **Span**, **Integ BW** also increases if it is less than 1/10 of the channel **Span**

	For WLAN 802.11ac (80 + 80 MHz), the channel span is coupled with the difference between the center frequencies of the two carriers. When the difference is either less than 80 MHz, or greater than 565 MHz, a "setting conflict" error message is displayed Chan Span = Carrier Spacing + Chan IntegBW When the state of Span is **Auto**, the span value is automatically determined by multi-carrier configuration. Otherwise, the span value depends on user input When the span value is set manually, the state of span is automatically changes to **Man** This key is enabled and can be changed only in single carrier. The span state is always **Auto** in Multi-carriers
Preset	**Mode** / **Value**: `SA`: 5.0 MHz `WCDMA`: 5.0 MHz|5.0 MHz `LTEAFDD, LTEATDD`: 5 MHz `5GNR`: Automatically calculated `WLAN`: See the table of "WLAN Mode Presets" on page 1671 below `ON`
State Saved	Saved in instrument state Yes
Range	Auto|Man
Min/Max	1 kHz/Depends on instrument maximum frequency

WLAN Mode Presets

Radio Std	Presets
802.11a/g (OFDM/DSSS-OFDM)	18 MHz
802.11n/ac (20 MHz)	
802.11b/g (DSSS/CCK/PBCC)	22 MHz
802.11n/ac (40 MHz)	38 MHz
802.11ac (80 MHz)	78 MHz
802.11ac (160 MHz)	158 MHz
802.11ac (80 MHz + 80 MHz)	320 MHz
802.11ah (1 MHz)	0.9 MHz
802.11ah (2 MHz)	1.8 MHz
802.11ah (4 MHz)	3.8 MHz
802.11ah (8 MHz)	7.8 MHz
802.11ah (16 MHz)	15.8 MHz
802.11j/p (20 MHz)	18 MHz

Radio Std	Presets
802.11j/p (10 MHz)	9 MHz
802.11p (5 MHz)	4.5 MHz
802.11ax/be (20 MHz)	19.5 MHz
802.11ax/be (40 MHz)	39.0 MHz
802.11ax/be (80 MHz)	79.0 MHz
802.11ax/be (160 MHz)	159.0 MHz
802.11be (320 MHz)	319.0 MHz
802.11ax (80 MHz + 80 MHz)	320.0 MHz
802.11af (6 MHz)	5.7 MHz
802.11af (7 MHz)	6.65 MHz
802.11af (8 MHz)	7.6 MHz

Sweep Time

Used to calculate the power in the reference channel. **Sweep Time** can be set manually or put into **Auto** mode.

For instruments with non-sweeping acquisitions, such as VXT, the time value is the acquisition time for an individual FFT segment, not the cumulated time for all FFT segments in the channel.

NOTE On non-sweeping hardware, this control is grayed-out. The value shown on this control is an estimate, which is the turnaround time to complete the measurement of the entire carrier span, which is the sum of signal acquisition time, FFT time, and other overhead time. If you need to specify the same **Sweep Time** as you would for sweeping hardware, send `[:SENSe]:SEMask:SWEep[1]|2:TIME <time>`. The measurement emulates the **Sweep Time** effect, but this emulation is not straightforward, and therefore the behavior is not specified. Instead, we recommend using "Minimum Acquisition Time" on page 1673, which provides better control.

Remote Command	`[:SENSe]:SEMask:SWEep[1]|2:TIME <time>`
	`[:SENSe]:SEMask:SWEep[1]|2:TIME?`
	`[:SENSe]:SEMask:SWEep[1]|2:TIME:AUTO OFF | 0 | ON | 1`
	`[:SENSe]:SEMask:SWEep[1]|2:TIME:AUTO?`

Example	`:SEM:SWE:TIME 9ms`
	`:SEM:SWE:TIME?`
	`:SEM:SWE:TIME:AUTO OFF`
	`:SEM:SWE:TIME:AUTO?`

Notes	Sub op code 1 is for BTS, 2 for MS. Default is BTS Note that Sweep sub op code 2 is supported only in non-SA Modes. In SA Mode, Sweep sub op code 1 is used for both BTS and MS
Dependencies	On non-sweeping hardware, this control is grayed out and the **Auto/Man** checkbox is invisible. The read-only value shows the estimated sweep time In those instruments, "Minimum Acquisition Time" on page 1673 is available
Couplings	When the time is set manually, **Auto** is set to `OFF` If state is **Auto**, coupled with **Channel Detector** selection, **Channel Resolution BW**, **Channel Video BW** When set to **Auto**, the Time is automatically calculated
Preset	Automatically calculated `ON`
State Saved	Saved in instrument state Yes
Range	`OFF|ON`
Min	Sweeping hardware Depends on Channel "Sweep Type" on page 1675: **Sweep Type** / **Min**: Swept – 1 ms; FFT – 100 ns Non-sweeping hardware: N/A
Max	Sweeping hardware: 4000 s Non-sweeping hardware: N/A
Backwards Compatibility SCPI	`[:SENSe]:SEMask:SWEep[1]|2[:TIME]` `[:SENSe]:SEMask:SWEep[1]|2[:TIME]:AUTO`

Sweep Type	Min
Swept	1 ms
FFT	100 ns

Minimum Acquisition Time

Available on non-sweeping hardware.

Specifies the minimum acquisition time for each “chunk” of the measurement result. The instrument automatically divides **Span** into multiple chunks if needed. Therefore, the total signal acquisition time for the entire carrier span is:

~(>~Minimum Acquisition Time) * (The number of chunks)

When in **Auto**, this parameter’s value is determined by other parameters, such as **Span**, **RBW** and **VBW**.

You can manually increase this parameter value from this **Auto** value.

If increased, the instrument acquires signal for the specified time duration for each chunk. It performs additional FFTs, and averages or peak-holds the FFT results for a chunk, depending on **Detector** settings.

Note that the actual acquisition time for each chunk may exceed the **Minimum Acquisition Time** value, in order to satisfy FFT time required by other parameters, and to perform an integer number of FFTs.

Remote Command	`[:SENSe]:SEMask:SWEep:ACQuisition:TIME <time>`
	`[:SENSe]:SEMask:SWEep:ACQuisition:TIME?`
	`[:SENSe]:SEMask:SWEep:ACQuisition:TIME:AUTO OFF | ON | 0 | 1`
	`[:SENSe]:SEMask:SWEep:ACQuisition:TIME:AUTO?`

Example	`:SEM:SWE:ACQ:TIME 500 ms`
	`:SEM:SWE:ACQ:TIME?`
	`:SEM:SWE:ACQ:TIME:AUTO OFF`
	`:SEM:SWE:ACQ:TIME:AUTO?`

Dependencies	Available only on non-sweeping hardware
Couplings	Coupled to **Span**, **RBW**, and **VBW** when in the **Auto** state If you manually set a value when in the **Auto** state, the state automatically changes to **Man**
Preset	Automatically calculated `ON`
State Saved	Saved in instrument state
Min	100 ns
Max	4.00 ks

Sweep Time Annotation (Remote Query Only)

Returns the **Sweep Time Annotation** value. Available only on non-sweeping hardware.

The value returned is the estimated turnaround time of each acquisition, in seconds. The turnaround time is the sum of the signal acquisition time, FFT time, and other overhead time, to complete the entire carrier span of each measurement cycle.

Remote Command	`[:SENSe]:SEMask:SWEep:ETIMe?`
Example	`:SEM:SWE:ETIM?`
Dependencies	Available only on non-sweeping hardware
Preset	Automatically calculated

Sweep Type

Sets the **Sweep Type** used to calculate the power in the reference channel. **Sweep Type** can be set manually or put into **Auto** mode.

How to define Channel Sweep Time and Channel Sweep Type:

Channel Sweep Type Mode	Behavior
Auto	Channel **Sweep Type** is automatically selected depending on Sweep Type Rules Channel **Sweep Time** is automatically calculated depending on the selected sweep type
Man	Channel **Sweep Type** is user-selected

–

Remote Command	`[:SENSe]:SEMask:SWEep[1]|2:TYPE SWEep | FFT`
	`[:SENSe]:SEMask:SWEep[1]|2:TYPE?`
	`[:SENSe]:SEMask:SWEep[1]|2:TYPE:AUTO OFF | 0 | ON | 1`
	`[:SENSe]:SEMask:SWEep[1]|2:TYPE:AUTO?`

Example	`:SEM:SWE:TYPE FFT`
	`:SEM:SWE:TYPE?`
	`:SEM:SWE:TYPE:AUTO OFF`
	`:SEM:SWE:TYPE:AUTO?`

Notes	Sub op code, 1 is for BTS, 2 for MS. Default is BTS Note that Sweep sub op code 2 is supported only in non-SA Modes. In SA Mode, Sweep sub op code 1 is used for both BTS and MS
Dependencies	Grayed-out in VXT models M9410A/11A
Couplings	If **Sweep Type** is set manually, **Sweep Type** mode is set to `MANual` When **Channel Sweep Type** mode is **Auto**, **Sweep Type** is automatically selected according to **Sweep Type Rules**
Preset	Automatically calculated `ON`
State Saved	Saved in instrument state Yes
Range	`OFF|ON`

Res BW

Sets the resolution bandwidth used to calculate the power in the reference channel. The Channel Resolution BW can be set manually or put into auto mode.

MSR Auto RBW:

In the MSR Mode, resolution bandwidth is predefined for each radio format. When carriers are configured with multiple radio formats, the narrowest RBW is selected.

Radio Format		RBW (kHz)
LTE	1.4 MHz	13 kHz
	3 MHz	27 kHz
	5 MHz	47 kHz
	10 MHz	91 kHz
	15 MHz	150 kHz
	20 MHz	180 kHz
	200 kHz (NB-IoT, only available in FDD)	10 kHz
W-CDMA		75 kHz

5G NR Auto RBW:

Radio Format		RBW
5G NR	5 MHz	47 kHz
	10 MHz	91 kHz
	15 MHz	150 kHz
	20 MHz	180 kHz
	25 MHz	240 kHz
	30 MHz	270 kHz
	35 MHz	330 kHz
	40 MHz	390 kHz
	45 MHz	430 kHz
	50 MHz	470 kHz
	60 MHz	560 kHz
	70 MHz	680 kHz
	80 MHz	750 kHz
	90 MHz	820 kHz
	100 MHz	910 kHz
	200MHz	1.8 MHz
	400 MHz	3 MHz

Radio Format	RBW
800 MHz	3 MHz
1600 MHz	3 MHz
2000 MHz	3 MHz

In the LTE-Advanced (both FDD and TDD) and 5G NR modes, the resolution bandwidth is predefined based on the corresponding bandwidth of the single carrier, which is listed above. When **Res BW** mode is **Auto**, the narrowest RBW is selected.

Remote Command	`[:SENSe]:SEMask:BANDwidth[1]|2[:RESolution] <bandwidth>`
	`[:SENSe]:SEMask:BANDwidth[1]|2[:RESolution]?`
	`[:SENSe]:SEMask:BANDwidth[1]|2[:RESolution]:AUTO OFF | ON | 1 | 0`
	`[:SENSe]:SEMask:BANDwidth[1]|2[:RESolution]:AUTO?`

Example	`:SEM:BAND 100 kHz`
	`:SEM:BAND?`
	`:SEM:BAND:AUTO ON`
	`:SEM:BAND:AUTO?`

Notes	Bandwidth sub op code, 1 is for BTS, 2 for MS. Default is BTS Note that Bandwidth sub op code 2 is supported only in non-SA modes. In SA Mode, Bandwidth sub op code 1 is used for both BTS and MS
Couplings	If **Res BW** is set manually, **Channel Resolution BW** mode is set to `MANual` Coupled with **Channel Detector** selection, **Channel Sweep Time** and **Channel Video BW** When set to **Auto**, the resolution bandwidth is automatically calculated
Preset	(see table below) `ON`
State Saved	Saved in instrument state Saved in instrument state
Range	Auto | Man
Min	1 Hz
Max	When Option FS1 or FS2 is installed: 10 MHz Otherwise: 8 MHz
Backwards Compatibility	`[:SENSe]:SEMask:BWIDth[1]|2[:RESolution]`

Preset:

Mode	Values
SA	100 kHz
WCDMA	75 kHz
LTE, LTETDD, MSR, LTEAFDD, LTEATDD	Auto (47 kHz)
5G NR	Auto
WLAN	100 kHz

`ON`

SCPI	`[:SENSe]:SEMask:BWIDth[1]|2[:RESolution]:AUTO`

Video BW

Sets the video bandwidth used to calculate the power in the reference channel. The **Channel Video BW** can be set manually or put into **Auto** mode.

Remote Command	`[:SENSe]:SEMask:BANDwidth[1]|2:VIDeo <bandwidth>`
	`[:SENSe]:SEMask:BANDwidth[1]|2:VIDeo?`
	`[:SENSe]:SEMask:BANDwidth[1]|2:VIDeo:AUTO OFF | ON | 1 | 0`
	`[:SENSe]:SEMask:BANDwidth[1]|2:VIDeo:AUTO?`

Example	`:SEM:BAND:VID 100 kHz`
	`:SEM:BAND:VID?`
	`:SEM:BAND:VID:AUTO ON`
	`:SEM:BAND:VID:AUTO?`

Notes	Bandwidth sub op code, 1 is for BTS, 2 for MS. Default is BTS Note that Bandwidth sub op code 2 is supported only in non-SA Modes. In SA Mode, Bandwidth sub op code 1 is used for both BTS and MS
Couplings	If **Video BW** is set manually, **Channel Video BW** mode is set to `MANual` Coupled with **Channel Detector** selection, **Channel Sweep Time** and **Channel Resolution BW** When set to **Auto**, the video bandwidth is automatically calculated
Preset	<table><tr><th>Mode</th><th>Values</th></tr><tr><td>SA</td><td>100 kHz</td></tr><tr><td>WCDMA</td><td>75 kHz</td></tr><tr><td>LTE, LTEAFDD, LTETDD, LTEATDD, 5G NR, WLAN, MSR</td><td>Auto</td></tr></table>`ON`
State Saved	Saved in instrument state Yes
Range	Auto | Man
Min/Max	1 Hz/50 MHz
Backwards Compatibility SCPI	`[:SENSe]:SEMask:BWIDth[1]|2:VIDeo` `[:SENSe]:SEMask:BWIDth[1]|2:VIDeo:AUTO`

VBW/RBW

Sets the Video BW/Resolution BW ratio to calculate the Channel Resolution BW and Channel Video BW. The VBW/RBW Ratio can be set manually or put into **Auto** mode.

Remote Command	`[:SENSe]:SEMask:BANDwidth[1]|2:VIDeo:RATio <real>`
	`[:SENSe]:SEMask:BANDwidth[1]|2:VIDeo:RATio`
	`[:SENSe]:SEMask:BANDwidth[1]|2:VIDeo:RATio:AUTO OFF | ON | 1 | 0`
	`[:SENSe]:SEMask:BANDwidth[1]|2:VIDeo:RATio:AUTO?`

Example	`:SEM:BAND:VID:RAT 0.1`
	`:SEM:BAND:VID:RAT?`
	`:SEM:BAND:VID:RAT:AUTO ON`
	`:SEM:BAND:VID:RAT:AUTO?`

Notes	Bandwidth sub op code, 1 is for BTS, 2 for MS. Default is BTS Note that Bandwidth sub op code 2 is supported only in non-SA Modes. In SA Mode, Bandwidth sub op code 1 is used for both BTS and MS
Couplings	When **Video BW/Res BW** is set manually, **Channel VBW/RBW Ratio** mode is set to `MANual` When set to **Auto**, the **VBW/RBW Ratio** is automatically calculated
Preset	SA, WCDMA: 1.0 LTE, LTETDD, LTEAFDD, LTEATDD, 5G NR, WLAN, MSR: Auto `ON`
State Saved	Saved in instrument state Saved in instrument state
Range	Auto | Man
Min/Max	0.00001/3000000
Backwards Compatibility SCPI	`[:SENSe]:SEMask:BWIDth[1]|2:VIDeo:RATio` `[:SENSe]:SEMask:BWIDth[1]|2:VIDeo:RATio:AUTO`

Channel Detector

Accesses a menu of functions that enable you to control the detectors for reference channel. The following choices are available:

`AUTO`	The detector selected depends on marker functions, trace functions, average type, and the trace averaging function
`NORMal`	The detector determines the peak of the CW-like signals, and it yields alternating maximums and minimums of noise-like signals. This is also referred to as Rosenfell detection
`AVERage`	The detector determines the average of the signal within the sweep points. The averaging method depends upon the Average Type selection (voltage, power or log scales)
`POSitive` Peak	The detector determines the maximum of the signal within the sweep points

SAMPle	The detector indicates the instantaneous level of the signal at the center of the sweep points represented by each display point
NEGative Peak	The detector determines the minimum of the signal within the sweep points

Remote Command	[:SENSe]:SEMask:DETector:CARRier[:FUNCtion] AVERage | NEGative | NORMal | POSitive | SAMPle [:SENSe]:SEMask:DETector:CARRier[:FUNCtion]? [:SENSe]:SEMask:DETector:CARRier:AUTO ON | OFF | 1 | 0 [:SENSe]:SEMask:DETector:CARRier:AUTO?
Example	:SEM:DET:CARR NEG :SEM:DET:CARR? :SEM:DET:CARR:AUTO OFF :SEM:DET:CARR:AUTO?
Notes	When you manually select a detector (instead of selecting **Auto**), that detector is used regardless of other instrument settings Note: This detector setting affects the reference channel. There is no per-trace detector
Couplings	See Couplings in "Trace Type" on page 1905
Preset	AVERage ON
State Saved	Saved in instrument state
Range	AVERage|NEGative|NORMal|POSitive|SAMPle

Reference Carrier Average Type (Remote Command Only)

Select trace average type for the reference carrier.

Remote Command	[:SENSe]:SEMask:AVERage:CARRier:TYPE RMS | LOG [:SENSe]:SEMask:AVERage:CARRier:TYPE?
Example	:SEM:AVER:CARR:TYPE LOG :SEM:AVER:CARR:TYPE?
Preset	RMS
State Saved	Saved in instrument state

Offset/Limits Config Table

This function is the same as "Offset/Limits Config Table" on page 1605 under the "Settings" on page 1601 tab.

Sets the power reference in the carrier that will be used to compute the relative values for the offsets.

3.9.18.3 Reference

Lets you set the Reference Power and parameters related to the Reference Power for SEM measurements.

Measurement Type

Accesses a menu that enables you to select one of the following measurement reference types:

Total Pwr Ref	`TPRef`	Sets the reference to the total carrier power and the measured data is shown in dBc and dBm
PSD Ref	`PSDRef`	Sets the reference to the mean power spectral density of the carrier and the measured data is shown in dB and dBm/Hz
Spectrum Peak Ref	`SPRef`	Sets the reference to the spectrum peak power of the carrier and the measured data is shown in dB and dBm

Remote Command	`[:SENSe]:SEMask:TYPE PSDRef | TPRef | SPRef` `[:SENSe]:SEMask:TYPE?`
Example	`:SEM:TYPE PSDR` `:SEM:TYPE?`
Preset	WLAN Mode: `SPRef` All other Modes: `TPRef`
State Saved	Saved in instrument state
Range	Total Pwr Reference | PSD Reference | Spectrum Peak Reference

Reference Power

Toggles between Measured Power (`ON`) and Manual Power (`OFF`) for Total Power Ref, PSD Ref, and Spectrum Peak Ref.

Remote Command	`[:SENSe]:SEMask:CARRier:AUTO[:STATe] OFF | ON | 1 | 0` `[:SENSe]:SEMask:CARRier:AUTO[:STATe]?`

Example	Set to Manual:
	`:SEM:CARR:AUTO OFF`
	Set to Measured:
	`:SEM:CARR:AUTO ON`
	`:SEM:CARR:AUTO?`

Notes	Available for all "Measurement Type" on page 1681s
Dependencies	Not available in MSR, LTEAFDD, LTEATDD, and 5G NR Modes
Preset	ON
State Saved	Saved in instrument state Saved in instrument state
Range	Auto | Man

Total Power Ref

Sets the power in the carrier (ref channel) that is used to compute the relative power values for the offsets. For modes other than MSR, LTEAFDD, LTEATDD, and 5GNR, when "Reference Power" on page 1681 is set to Measured, this value is set to the measured carrier reference power. When set to Manual, the result takes on the last measured value, or can be manually entered.

For WLAN 802.11ac (80 MHz + 80 MHz), the higher of the power readouts of the two carriers is used for computing the relative power values for the offset.

Remote Command	`[:SENSe]:SEMask:CARRier[:POWer] <real>` `[:SENSe]:SEMask:CARRier[:POWer]?`
Example	`:SEM:CARR 100dBm` `:SEM:CARR?`
Notes	The min and max values given are for "Measurement Type" on page 1681 = Total Pwr Ref
Couplings	Coupled with **Measurement Type**. Active when **Measurement Type** is set to Total Power Ref. Otherwise, grayed-out In MSR, LTE-A and 5G NR Modes, the control is active when **Measurement Type** is set to Total Power and **Power Ref** is set to Manual
Preset	Measured carrier reference power
State Saved	Saved in instrument state
Min/Max	-200 dBm/200 dBm
Annotation	Value is displayed on the left top of the Results window with the Channel Integ BW

PSD Ref

Sets the power spectral density in the carrier that is used to compute the relative power spectral density values for the offsets when "Measurement Type" on page 1681 is set to PSD Ref. When the state is set to **Auto**, this will be set to the measured carrier power spectral density.

For WLAN 802.11ac (80 MHz + 80 MHz), the higher of the power density readouts of the two carriers is used for computing the relative PSD values for the offset.

Remote Command	`[:SENSe]:SEMask:CARRier:CPSD <real>` `[:SENSe]:SEMask:CARRier:CPSD?`
Example	`:SEM:CARR:CPSD -80` `:SEM:CARR:CPSD?`
Notes	Although the default value is defined, the value is recalculated by the measurement result just after completing the measurement Carrier sub op code. 1 for BTS, 2 for MS. Default is BTS
Couplings	Coupled with "Measurement Type" on page 1681. Active if **Measurement Type** is PSD. Otherwise, grayed-out In MSR, LTE-A and 5G NR Modes, active when **Measurement Type** is PSD and **Power Ref** is Manual
Preset	Measured carrier PSD reference power
State Saved	Saved in instrument state
Min/Max	-200/200
Annotation	Value is displayed on the right top of the Results window. If Meas Type selection is PSD Ref, the string is “PSD Ref” with BOLD font, otherwise, hide annotation

Spectrum Pk Ref

Sets the spectrum peak power in the carrier that is used to compute the relative power spectral density values for the offsets when "Measurement Type" on page 1681 is Spectrum Peak. When the state is set to **Auto**, this is set to the measured carrier spectrum peak power. When set to **Manual**, the result takes on the last measured value, or can be manually entered

Remote Command	`[:SENSe]:SEMask:CARRier:PEAK[:POWer] <real>` `[:SENSe]:SEMask:CARRier:PEAK[:POWer]?`
Example	`:SEM:CARR:PEAK -80` `:SEM:CARR:PEAK:POWER?`
Notes	Although the default value is defined, the value is recalculated by the measurement result just after completing the measurement Carrier sub op code. 1 for BTS, 2 for MS. Default is BTS
Couplings	Coupled with "Measurement Type" on page 1681. Active when **Measurement Type** is "Spectrum Peak Ref". Otherwise, grayed-out In MSR, LTE-A and 5G NR Modes, active when **Measurement Type** is Spectrum Peak Ref and **Power Ref** is Manual
Preset	Measured carrier Spectrum Peak reference power
State Saved	Saved in instrument state
Min/Max	-200/200
Annotation	Value is displayed on the right top of the Results window. If Meas Type selection is Spectrum Peak Ref, the string is “Spectrum Peak Ref” with BOLD font, otherwise, hide annotation

Offset/Limits Config Table

This function is the same as "Offset/Limits Config Table" on page 1605 under the "Settings" on page 1601 tab.

Sets the power reference in the carrier that will be used to compute the relative values for the offsets.

3.9.18.4 Meas Standard

Contains controls that allow you to preset the PowerSuite measurements to conform to various communications standards.

Radio Standard Presets

Lets you specify the Radio Standard to be used. Spectrum Analyzer Mode supports many Radio Standards. You can select the desired Radio Standard using the **Radio Std Presets** dialog, which is a cascading list of standards. When you have the selected the desired Standard, press **OK** and the measurement settings will change to reflect that standard.

Remote Command	`[:SENSe]:RADio:STANdard[:SELect] NONE | JSTD | IS95a | IS97D | IS98D | GSM | W3GPP | C2000MC1 | C20001X | NADC | PDC | BLUEtooth | TETRa | WL802DOT11A | WL802DOT11B | WL802DOT11G | HIPERLAN2 | DVBTLSN | DVBTGPN | DVBTIPN | FCC15 | SDMBSE | UWBINDOOR | LTEB1M4 | LTEB3M | LTEB5M | LTEB10M | LTEB15M | LTEB20M | WL11N20M | WL11N40M | WL11AC20M | WL11AC40M | WL11AC80M | WL11AC160M | WL11AX20M | WL11AX40M | WL11AX80M | WL11AX160M | WL11BE20M | WL11BE40M | WL11BE80M | WL11BE160M | WL11BE320M | WL11AD2G | WL11AY2G16 | WL11AY4G32 | WL11AY6G48 | WL11AY8G64 | NR5GFR1B100M` `[:SENSe]:RADio:STANdard[:SELect]?`
Example	`:RAD:STAN NONE` `:RAD:STAN?`
Dependencies	Some selections appear only when support license is valid
Couplings	By changing the radio standard, the measurement parameters will be automatically set to an appropriate default value
State Saved	Saved in instrument state

The **Radio** column in the table lets you specify the device to be used. It is a global setting that affects the Device selection, between Mobile (MS) and Base Station (BTS) settings, for all relevant PowerSuite measurements. The Device SCPI command has the same effect as a selection in the **Radio** column:

Remote Command	`[:SENSe]:RADio:STANdard:DEVice BTS | MS` `[:SENSe]:RADio:STANdard:DEVice?`

Example	`:RAD:STAN:DEV MS` `:RAD:STAN:DEV?`
Preset	`BTS`
State Saved	Saved in instrument state
Range	`BTS|MS`

Chart for Standard and Available Measurements

Note that not every measurement in Spectrum Analyzer Mode is available for every standard. The chart below describes which measurements are available for each Radio Standard.

For TOI or Harmonics measurements, *no* Radio Standards are available.

	Swept SA	CHP	OBW	ACP	CCDF	Burst Power	Spurious Emission	SEM	List Sweep
None	X	X	X	X	X	X	X	X	(X)
3GPP 5G NR	(X)	X	X	X	X			X	(X)
3GPP LTE	(X)	X	X	X	X			X	(X)
3GPP W-CDMA	(X)	X	X	X	X	X		X	(X)
GSM/EDGE	(X)				X	X			(X)
cdma2000 1x	(X)	X	X	X	X	X			(X)
IS-95A	(X)	X	X	X	X	X			(X)
J-STD-008	(X)	X	X	X	X	X			(X)
IS-97D/98D	(X)	X	X	X	X				(X)
NADC	(X)	X	X	X	X	X			(X)
PDC	(X)	X	X	X	X	X			(X)
Bluetooth	(X)				X	X			(X)
W-LAN 802.11a	(X)							X	(X)
W-LAN 802.11b	(X)							X	(X)
W-LAN 802.11g	(X)							X	(X)
W-LAN 802.11n	(X)	X	X		X			X	(X)
W-LAN 802.11ac	(X)	X	X		X			X	(X)
W-LAN 802.11ax	(X)	X	X		X			X	(X)
W-LAN 802.11be	(X)	X	X		X			X	(X)
W-LAN 802.11ad	(X)	X	X		X			X	(X)
W-LAN	(X)	X	X		X			X	(X)

	Swept SA	CHP	OBW	ACP	CCDF	Burst Power	Spurious Emission	SEM	List Sweep
802.11ay									
W-LAN HiperLAN/2	(X)							X	(X)
TETRA	(X)	X		X					(X)
DVB-T L/SECAM/NICAM	(X)	X			X				(X)
FCC Part 15 Subpart F	(X)	X			X				(X)
DVBT-T G/PAL/NICAM	(X)	X			X				(X)
DVB-T I/PAL/NICAM	(X)						X		(X)
S-DMB System E	(X)	X	X	X					(X)
UWB Indoor	(X)						X		(X)

General Radio Standards

The table below lists the settings and provides an example for each general Radio Standard.

None	Command Example	:RAD:STAN NONE
	IBW	2 MHz
	Span	3 MHz
	RBW	Auto rules
	VBW	Auto rules
TETRA	Command Example	:RAD:STAN TETR
	IBW	18 kHz
	Span	27 kHz
	RBW	1.2 kHz
	VBW	Auto rules
	RRC Filter	On
	RRC Filter Alpha	0.35
FCC Part15 Subpart F	Command Example	:RAD:STAN FCC15

Video Radio Standards

The table below lists the settings and provides an example for each video Radio Standard.

DVB-T L/SECAM/NICAM	Command Example	:RAD:STAN DVBTLSN
	IBW	7.61 MHz
	Span	24 MHz
	RBW	3.9 kHz
	VBW	Auto rules
	Sweep Points	8001
DVB-T G/PAL/NICAM	Command Example	:RAD:STAN DVBTGPN
	IBW	7.61 MHz
	Span	24 MHz
	RBW	3.9 kHz
	VBW	Auto rules
	Sweep Points	8001
DVB-T I/PAL/NICAM	Command Example	:RAD:STAN DVBTIPN
	IBW	7.61 MHz
	Span	24 MHz
	RBW	3.9 kHz
	VBW	Auto rules
	Sweep Points	8001
S-DMB System E	Command Example	:RAD:STAN SDMBSE
	IBW	25 MHz
	Span	37.5 MHz
	RBW	360 kHz
	VBW	Auto rules
	RRC Filter	Off
	RRC Filter Alpha	0.22

Cellular Radio Standards

The table below lists the CHP settings and provides an example for each cellular Radio Standard.

GSM/EDGE	Command Example	:RAD:STAN GSM

3GPP 5G NR	Command Example	:RAD:STAN NR5GFR1B100M
	IBW	100 MHz
	Span	150 MHz
	RBW	Auto rules
	VBW	Auto rules
3GPP W-CDMA	Command Example	:RAD:STAN W3GPP
	IBW	5 MHz
	Span	7.5 MHz
	RBW	240 kHz
	VBW	Auto rules
	RRC Filter	Off
	RRC Filter Alpha	0.22
3GPP LTE 1.4 MHz	Command Example	:RAD:STAN LTEB1M4
	IBW	1.4 MHz
	Span	2.1 MHz
	RBW	Auto rules
	VBW	Auto rules
3GPP LTE 3 MHz	Command Example	:RAD:STAN LTEB3M
	IBW	3 MHz
	Span	4.5 MHz
	RBW	Auto rules
	VBW	Auto rules
3GPP LTE 5 MHz	Command Example	:RAD:STAN LTEB5M
	IBW	5 MHz
	Span	7.5 MHz
	RBW	Auto rules
	VBW	Auto rules
3GPP LTE 10 MHz	Command Example	:RAD:STAN LTEB10M
	IBW	10 MHz
	Span	15 MHz
	RBW	Auto rules
	VBW	Auto rules

3GPP LTE 15 MHz	Command Example	:RAD:STAN LTEB15M
	IBW	15 MHz
	Span	22.5 MHz
	RBW	Auto rules
	VBW	Auto rules
3GPP LTE 20 MHz	Command Example	:RAD:STAN LTEB20M
	IBW	20 MHz
	Span	30 MHz
	RBW	Auto rules
	VBW	Auto rules
cdma2000	Command Example	:RAD:STAN C20001X :RAD:STAN C2000MC1 :RAD:STAN? (Query always returns C20001X)
	IBW	1.23 MHz
	Span	1.845 MHz
	RBW	24 kHz
	VBW	Auto rules
IS-95A	Command Example	:RAD:STAN IS95
	IBW	1.23 MHz
	Span	1.845 MHz
	RBW	24 kHz
	VBW	Auto rules
J-STD-008	Command Example	:RAD:STAN JSTD
	IBW	1.23 MHz
	Span	1.845 MHz
	RBW	24 kHz
	VBW	Auto rules
NADC	Command Example	:RAD:STAN NADC
	IBW	32.8 kHz
	Span	49.2 kHz
	RBW	1.2 kHz
	VBW	Auto rules

PDC	Command Example	:RAD:STAN PDC
	IBW	21 kHz
	Span	31.5 kHz
	RBW	6.2 kHz
	VBW	Auto rules
IS-97D/98D	Command Example	:RAD:STAN IS97D :RAD:STAN IS98D :RAD:STAN IS95C :RAD:STAN? Query always returns `IS97D`
	IBW	1.23 MHz
	Span	1.845 MHz
	RBW	24kHz
	VBW	Auto rules

Band Class (IS-97D/98D only)

The following function is only available when you have selected the standard: IS-97D/98D. It lets you select the band class.

Remote Command	`[:SENSe]:RADio:STANdard:BAND:CLASs BC0 | BC1` `[:SENSe]:RADio:STANdard:BAND:CLASs?`
Example	`:RAD:STAN:BAND:CLAS BC0` `:RAD:STAN:BAND:CLAS?`
Preset	`BC0`
State Saved	Saved in instrument state
Range	0 (800 MHz Band)|1 (1900 MHz Band)

Wireless Radio Standards

The table below lists the CHP settings and provides an example for each wireless Radio Standard.

WLAN 802.11a	Command Example	:RAD:STAN WL802DOT11A
	IBW	20 MHz
	Span	30 MHz
	RBW	100 kHz
	VBW	Auto rules

WLAN 802.11g	Command Example	:RAD:STAN WL802DOT11G
	IBW	20 MHz
	Span	30 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11b	Command Example	:RAD:STAN WL802DOT11B
	IBW	25 MHz
	Span	37.5 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11n 20 MHz	Command Example	:RAD:STAN WL11N20M
	IBW	20 MHz
	Span	30 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11n 40 MHz	Command Example	:RAD:STAN WL11N40M
	IBW	40 MHz
	Span	60 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11ac 20 MHz	Command Example	:RAD:STAN WL11AC20M
	IBW	20 MHz
	Span	30 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11ac 40 MHz	Command Example	:RAD:STAN WL11AC40M
	IBW	40 MHz
	Span	60 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11ac 80 MHz	Command Example	:RAD:STAN WL11AC80M
	IBW	80 MHz
	Span	120 MHz
	RBW	100 kHz
	VBW	Auto rules

WLAN 802.11ac 160 MHz	Command Example	:RAD:STAN WL11AC160M
	IBW	160 MHz
	Span	240 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11ax 20 MHz	Command Example	:RAD:STAN WL11AX20M
	IBW	20 MHz
	Span	30 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11ax 40 MHz	Command Example	:RAD:STAN WL11AX40M
	IBW	40 MHz
	Span	60 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11ax 80 MHz	Command Example	:RAD:STAN WL11AX80M
	IBW	80 MHz
	Span	120 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11ax 160 MHz	Command Example	:RAD:STAN WL11AX160M
	IBW	160 MHz
	Span	240 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11be 20 MHz	Command Example	:RAD:STAN WL11BE20M
	IBW	20 MHz
	Span	30 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11be 40 MHz	Command Example	:RAD:STAN WL11BE40M
	IBW	40 MHz
	Span	60 MHz
	RBW	100 kHz
	VBW	Auto rules

WLAN 802.11be 80 MHz	Command Example	:RAD:STAN WL11BE80M
	IBW	80 MHz
	Span	120 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11be 160 MHz	Command Example	:RAD:STAN WL11BE160M
	IBW	160 MHz
	Span	240 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11be 320 MHz	Command Example	:RAD:STAN WL11BE320M
	IBW	320 MHz
	Span	480 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11ad 2 GHz	Command Example	:RAD:STAN WL11AD2G
	IBW	2.16 GHz
	Span	3.24 GHz
	RBW	1 MHz
	VBW	Auto rules
WLAN 802.11ay 2.16 GHz	Command Example	:RAD:STAN WL11AY2G16
	IBW	2.16 GHz
	Span	3.24 GHz
	RBW	1 MHz
	VBW	Auto rules
WLAN 802.11ay 4.32 GHz	Command Example	:RAD:STAN WL11AY4G32
	IBW	4.32 GHz
	Span	6.48 GHz
	RBW	1 MHz
	VBW	Auto rules
WLAN 802.11ay 6.48 GHz	Command Example	:RAD:STAN WL11AY6G48
	IBW	6.48 GHz
	Span	9.72 GHz
	RBW	1 MHz
	VBW	Auto rules

WLAN 802.11ay 8.64 GHz	Command Example	:RAD:STAN WL11AY8G64
	IBW	8.64 GHz
	Span	12.96 GHz
	RBW	1 MHz
	VBW	Auto rules
3GPP 5G NR 5G NR FR1 100MHz	Command Example	:RAD:STAN NR5GFR1B100M
	IBW	100 MHz
	Span	150 MHz
	RBW	Auto rules
	VBW	Auto rules
WLAN HiperLAN/2	Command Example	`:RAD:STAN HIPERLAN2`
	UWB Indoor	Command Example R A D : S T A N U W B I N D O O R
	Bluetooth	Command Example R A D : S T A N B L U E

Packet Type (Bluetooth only)

The command below sets the packet type for the Bluetooth measurement

Remote Command	`[:SENSe]:RADio:STANdard:PACKet DH1 | DH3 | DH5` `[:SENSe]:RADio:STANdard:PACKet?`
Example	`:RAD:STAN:PACK DH1` `:RAD:STAN:PACK?`
Notes	The packet length is: DH1: 366 µs DH3: 1622 µs DH5: 2870 µs
Preset	DH1
State Saved	Saved in instrument state
Range	DH1 | DH3 | DH5

Radio Standard Presets Hierarchy

General	None	
	TETRA	BTS
		MS
	FCC Part 15 Subpart F	
	APCO-25	
	DMR	
	dPMR	
Video	DVB-T	L/SECAM/NICAM
		G/PAL/NICAM
		I/PAL/NICAM
	S-DMB System E	

Cellular	3GPP 5G NR	BTS	FR1 100 MHz
		MS	FR1 100 MHz
	3GPP LTE	BTS	1.4 MHz (6 RB)
			3 MHz (15 RB)
			5 MHz (25 RB)
			10 MHz (50 RB)
			15 MHz (75 RB)
			20 MHz (100 RB)
		MS	1.4 MHz (6 RB)
			3 MHz (15 RB)
			5 MHz (25 RB)
			10 MHz (50 RB)
			15 MHz (75 RB)
			20 MHz (100 RB)
	3GPP W-CDMA	BTS	
		MS	
	GSM/EDGE	BTS	
		MS	
	cdma2000 1x	BTS	
		MS	
	IS-95A	BTS	
		MS	
	J-STD-008	BTS	
		MS	
	IS-97D/98D	BTS	Band Class 0
			Band Class 1
		MS	Band Class 0
			Band Class 1
	NADC	BTS	
		MS	
	PDC	BTS	
		MS	

Wireless	W-LAN	802.11a	
		802.11b	
		802.11g	
		802.11n	20 MHz
			40 MHz
		802.11ac	20 MHz
			40 MHz
			80 MHz
			160 MHz
		802.11ax	20 MHz
			40 MHz
			80 MHz
			160 MHz
		802.11be	20 MHz
			40 MHz
			80 MHz
			160 MHz
			320 MHz
		802.11ad	
		802.11ay	2.16 GHz
			4.32 GHz
			6.48 GHz
			8.64 GHz
		HiperLAN/2	
	Bluetooth	DH1	
		DH3	
		DH5	
	UWB Indoor		

Each Radio Standard has the preset parameter set for the measurement.

When a standard is selected, the default value of the measurement parameters are overwritten by those preset values.

When the standard is NONE, or the standard does not specify the firm RBW requirement, then the table displays “auto”, and the following definition is used to compute the proper RBW setting:

1. Compute the guard-band = [Offset Freq A] - 0.5*([Chan Integ BW] + [Ref BW])

2. Divide by 4.5. Call the result GuardbandGoalRBW

3. Compute the greater of the Reference and Offset A integration bandwidths. Divide that result by 100 and call it the ChannelWidthGoalRBW
4. Find the smallest integration bandwidth of any of the offsets; divide it by two and call the result IntegBWGoalRBW
5. Compute AutoRBWGoal = min(IntegBWGoal, max(GuardbandGoalRBW, ChannelWidthGoalRBW))
6. Compute the RBW to be selected to be the largest available RBW that is smaller than AutoRBWGoal

Measurements that are unavailable for a particular Radio Standard are grayed-out. Radio Standards that are unavailable for the current active measurement are also grayed-out.

However, remote operations, such as `:CONF` allow the measurement to be active even if it is not a supported format. In this case, the measurement configuration should be set to `NONE`.

Enable Non-Std Meas

Lets you specify whether all measurements and radio standards are enabled or not.

By default, **Enable Non-Std Measurements** is set to `NO`, so you can select only valid combinations of preset available standards and measurements. Combinations of measurement and standard that would have no valid preset value are grayed-out.

When **Enable Non-Std Measurements** is set to `YES`, all measurements and standard selections are enabled, so you can select any combination.

NOTE **If you select an unavailable measurement or unavailable radio standard using the Enable Non-Std Meas control, the measurement results may not conform to the selected standard.**

Remote Command	`[:SENSe]:RADio:STANdard:EAMeas YES | NO` `[:SENSe]:RADio:STANdard:EAMeas?`
Example	`:RAD:STAN:EAM YES` `:RAD:STAN:EAM?`
Preset	`NO`
State Saved	Saved in instrument state
Range	`YES|NO`

3.9.18.5 Advanced

Contains controls for setting advanced instrument functions.

This tab does not appear in EXM, VXT.

Noise Floor Extension

Allows you to turn on/configure the **Noise Floor Extension** (NFE) function. Some Modes (such as Spectrum Analyzer Mode), support two states of NFE, Full and Adaptive. The ON state (in Modes that do not support Adaptive NFE) matches the FULL state (in Modes that *do* support Adaptive NFE).

In ON or FULL NFE, the expected noise power of the instrument (derived from a factory calibration) is subtracted from the trace data. This usually reduces the apparent noise level by about 10 dB in low band, and 8 dB in high band (>~3.6 GHz).

In Adaptive NFE, there is not the same dramatic visual impact on the noise floor as there is in Full NFE. Adaptive NFE controls the amount of correction that is applied based on other instrument settings like RBW, averaging and sweep time. Adaptive NFE controls the degree of potential improvement in the noise floor to give more improvement for those instrument settings that can make good use of the potential improvement, such as settings that provide more averaging. The result is that when not much averaging is being performed, the signal displays more like the NFE-off case; and when lots of averaging is being performed, the signal displays more like the full-NFE case.

Adaptive NFE (in Modes that support it) is recommended for general-purpose use. For fully ATE (automatic test equipment) applications, where the distraction of a person using the instrument is not a risk, Full NFE is recommended.

NFE works with any RBW, VBW, detector, any setting of Average Type, any amount of trace averaging, and any signal type. It is ineffective when the trace is not smoothed (smoothing processes include narrow VBWs, trace averaging, and long sweep times with the detector set to **Average** or **Peak**). It works best with extreme amounts of smoothing, and with the average detector, with Average Type set to **Power**.

In those cases where the cancellation is ineffective, it nonetheless has no undesirable side-effects. There is no significant speed impact to having **Noise Floor Extension**ON.

The best accuracy is achieved when substantial smoothing occurs in each point before trace averaging. Thus, when using the average detector, results are better with long sweep times and fewer trace averages. When using the sample detector, the VBW filter should be set narrow with less trace averaging, instead of a wide VBW filter with more trace averaging.

NOTE **Noise Floor Extension has no effect unless the RF Input is selected, therefore it does nothing when External Mixing is selected.**

In Modes that support Adaptive NFE, the default state of NFE is Adaptive. In Modes that do not support Adaptive NFE, the default state of NFE is `OFF`. Prior to the introduction of Adaptive NFE (firmware version A.18.00), the default state of NFE was `OFF` for all Modes.

With the introduction of Adaptive NFE, the menu control is changed from On|Off to Full|Adaptive|Off. For SCPI Backwards Compatibility, the existing SCPI command to turn NFE on and off was retained, and a new command was added to set the state to turn Adaptive On and Off

`[:SENSe]:CORRection:NOISe:FLOor ON|OFF|1|0` is retained, default changed to On for modes which support Adaptive NFE

`[:SENSe]:CORRection:NOISe:FLOor:ADAPtive ON|OFF|1|0` is added (for certain Modes), default=On

FULL = `:CORRection:NOISe:FLOor ON plus :CORRection:NOISe:FLOor:ADAPtive ON`

Remote Command	`[:SENSe]:CORRection:NOISe:FLOor ON | OFF | 1 | 0` `[:SENSe]:CORRection:NOISe:FLOor?`
Example	`:CORR:NOIS:FLO ON`
Dependencies	Only appears in instruments with the NFE or NF2 license installed. In all others, the control does not appear, but the remote command will be accepted without error (but has no effect)
Couplings	When NFE is enabled in any Mode manually, a prompt is displayed reminding you to perform the Characterize Noise Floor operation if it is needed. If NFE is enabled via SCPI and a Characterize Noise Floor operation is needed, an error will be entered in the system error queue
Preset	Unaffected by **Mode Preset**. Turned `ON` at startup and by **Restore Mode Defaults** in Modes that support Adaptive. Turned `OFF` at startup and by **Restore Mode Defaults** in Modes that do not support Adaptive
State Saved	No

Remote Command	`[:SENSe]:CORRection:NOISe:FLOor:ADAPtive ON | OFF | 1 | 0` `[:SENSe]:CORRection:NOISe:FLOor:ADAPtive?`

Example	First turn NFE on, this is FULL mode:
	`:CORR:NOIS:FLO ON`
	Then set it to Adaptive:
	`:CORR:NOIS:FLO:ADAP ON`

Dependencies	Only available in Modes that support Adaptive NFE Only appears in instruments with the NFE or NF2 license installed. In all others, the control does not appear, but the remote command is accepted without error (but has no effect)
Couplings	Sending `:CORR:NOIS:FLO ON` turns NFE Adaptive `OFF` for backwards compatibility. To turn Adaptive `ON`, you must issue the commands in the proper order, as shown in the example above

Preset	Not affected by **Mode Preset**, but set to ON at startup and by **Restore Mode Defaults**
State Saved	No

More Information

The instrument is characterized in the factory (or during a field calibration) with a model of the noise, referred to the input mixer, versus frequency in each band and path combination. Bands are 0 (low band) and 1 through 4 (high band) in a 26.5 GHz instrument, for example. Paths include normal paths, preamp paths, the electronic attenuator, etc.

In most band/path combinations, the noise can be well characterized based on just two parameters and the instrument frequency response before compensation for frequency-dependent losses.

After the noise density at the input mixer is estimated, the effects of the input attenuator, RBW, detector, etc. are computed to get the estimated input-port-referred noise level.

In the simplest case, the measured power (signal plus analyzer noise) in each display point (bucket) is compensated by subtracting the estimated noise power, leaving just the signal power. This is the operation when the detector is **Average**, and the Average Type is set to **Power**.

In other cases, operation is often not quite as good but still highly effective. With peak detection, the noise floor is estimated based on the RBW and the duration of the bucket using the same equations used in the noise marker function. The voltage of the noise is subtracted from the voltage of the observed signal-plus-noise measurement to compute the estimated signal voltage. The peak detector is one example of processing that varies with detector to give good estimates of the signal level without the analyzer noise.

For best operation, the average detector and the power scale are recommended, as already stated. **Peak** detection for pulsed-RF can still give excellent effectiveness. FFT analysis does not work well, and does not do NFE well, with pulsed-RF signals, so this combination is not recommended. **Negative peak** detection is not very useful, either. **Sample** detection works well but is never better than the average detector because it does not smooth as well. The **Normal** detector is a combination of peak and negative peak behaviors and works about as well as these.

For best operation, extreme smoothing is desirable, as already stated. Using narrow VBWs works well but using very long bucket durations and the average detector works best. Reducing the number of trace points makes the buckets longer.

For best operation, the power scale (Average Type = **Power**) is optimum. When making CW measurements in the presence of noise without NFE, averaging on the decibel scale has the advantage of reducing the effect of noise. When using NFE, the NFE does an even better job than using the log scale ever could. Using NFE with the log scale is not synergistic, though; NFE with the power scale works a little better than NFE with log averaging type.

The results from NFE with internal preamp can often be lower than the theoretical noise in a signal source at room temperature, a noise density of -174 dBm/Hz. This is expected and useful behavior, because NFE is designed to report the amount of input signal that is in excess of the thermal noise, not the amount that includes the thermal noise. This can be a useful behavior because thermal noise often interferes with what you want to measure, instead of being part of what you want to measure. Note that NFE is not adequately accurate to always be able to read below kTB.

Adaptive NFE provides an alternative to fully-on and fully-off NFE. Fully-on NFE can, notably in cases with little or no averaging of the spectrum, result in a display that is distractingly unfamiliar in the variability in response to low level signals. Fully-off NFE fails to achieve the potential improvement in dynamic range and associated accuracy of measurement of low-level signals. Adaptive NFE controls the degree of potential improvement in the noise floor to give more improvement for those instrument settings that can make good use of the potential improvement — those settings with high degrees of variance reduction through some variant of averaging. When the potential improvement is small, the display acts like the NFE-off case, and when it is high, it acts like the fully-on case, and in-between, application is a compromise between attractiveness and effectiveness.

On instruments with the NF2 license installed, the calibrated Noise Floor used by **Noise Floor Extension** should be refreshed periodically. Keysight recommends that the **Characterize Noise Floor** operation be performed after the first 500 hours of operation, *and* once every calendar year. The control to perform this is located in the **System, Alignments, Advanced** menu. If you have not done this yourself at the recommended interval, then when you turn on **Noise Floor Extension**, the instrument will prompt you to do so with a dialog that says:

“This action will take several minutes to perform. Please disconnect all cables from the RF input and press Enter to proceed. Press ESC to cancel, or Postpone to postpone for a week”

If you **Cancel**, you will be prompted again the next time you turn NFE on. If you postpone, you will be prompted again after a week passes and you then turn NFE on.

Enable Wideband IF for FFT

When `OFF`, the maximum FFT BW is limited to 40 MHz. When `ON`, FFT with more wideband IF is supported depending on the instrument. For example, the max FFT BW is 510 MHz with option B5X. When ON for R10/R20/R40, the max FFT BW is 1GHz.

When this parameter is on and the following conditions are met, the measurement is performed with a single I/Q acquisition.

- Stop Freq of the outermost Offset range is within the available IQ acquisition BW
- Same RBW, VBW, Detector Type settings across all Offset ranges and Carrier
- Sweep Type = FFT and Sweep Time = Auto across all Offset ranges and Carrier

Remote Command	`[:SENSe]:SEMask:WBFFt:ENABle ON | OFF | 1 | 0` `[:SENSe]:SEMask:WBFFt:ENABle?`
Example	`:SEM:WBFF:ENAB 1` `:SEM:WBFF:ENAB?`
Dependencies	The maximum FFT BW depends on the µW preselector and the current frequency. In hi-band, the µW preselector must be disabled to apply the FFT with wideband IF. Otherwise, the maximum FFT BW is limited to 40 MHz
Preset	`OFF`
State Saved	Saved in instrument state
Range	`ON|OFF`

3.9.18.6 Global

The controls in this menu apply to all Modes in the instrument.

Some controls (for example, "Global Center Freq" on page 2013) allow you to switch certain Meas Global parameters to a Mode Global state. These switches apply to all Modes that support global settings. For example, no matter what Mode you are in when you set **Global Center Freq** to ON, it applies to all Modes that support Global settings.

Other controls (for example, **Extend Low Band**) are actually set in this menu, but apply to all Modes.

Global Center Freq

The software maintains a Mode Global value called **Global Center Freq**.

When **Global Center Freq** is switched ON, the current Mode's center frequency is copied into the **Global Center Frequency**, and from then on all Modes that support global settings use the **Global Center Frequency**, so you can switch between any of these Modes and the **Center Frequency** remains unchanged.

Adjusting the **Center Frequency** of any Mode that supports Global Settings, while **Global Center Freq** is ON, modifies the **Global Center Freq**.

When **Global Center Freq** is switched OFF, the **Center Frequency** of the current Mode is unchanged, but now the **Center Frequency** of each Mode is once again independent.

When **Mode Preset** is pressed while **Global Center Freq** is ON, the **Global Center Freq** is preset to the preset **Center Frequency** of the current Mode.

This function resets to OFF when "Restore Defaults" on page 2016 is pressed, or when **System**, **Restore Defaults**, **All Modes** is pressed.

Remote Command	:INSTrument:COUPle:FREQuency:CENTer ALL | NONE :INSTrument:COUPle:FREQuency:CENTer?
Example	:INST:COUP:FREQ:CENT ALL :INST:COUP:FREQ:CENT?
Preset	Set to OFF on **Global** Settings, **Restore Defaults** and **System, Restore Defaults, All Modes**
Range	ALL|NONE

Preset	OFF
Backwards Compatibility SCPI	:GLOBal:FREQuency:CENTer[:STATe] 1 | 0 | ON | OFF :GLOBal:FREQuency:CENTer[:STATe]?

Global EMC Std

When this control is switched ON, the current Mode's EMC Std is copied into the **Global EMC Std**, and from then on all Modes that support global settings use the **Global EMC Std**, so you can switch between any of these Modes and the EMC Std remains unchanged.

Adjusting the EMC Std of any Mode that supports Global settings, while **Global EMC Std** is ON modifies the **Global EMC Std**.

When **Global EMC Std** is switched OFF, the EMC Std of the current Mode remains unchanged, but now the EMC Std of each Mode is once again independent. When **Mode Preset** is pressed while **Global EMC Std** is ON, **Global EMC Std** is preset to the preset EMC Std of the current Mode.

This function resets to OFF when "Restore Defaults" on page 2016 is pressed, or when **System, Restore Defaults, All Modes** is pressed.

Remote Command	:INSTrument:COUPle:EMC:STANdard ALL | NONE :INSTrument:COUPle:EMC:STANdard?
Example	:INST:COUP:EMC:STAN ALL :INST:COUP:EMC:STAN?
Dependencies	Only available if Option EMC is installed
Preset	Set to OFF on **Global** Settings, **Restore Defaults** and **System, Restore Defaults, All Modes**
Range	ALL | NONE

Global Limit Lines (Freq and Amptd)

When this control is set to `ALL`, the current Mode's Limit Line is copied into the **Global Limit Lines**, and from there to all Modes that support Global settings and use **Global Limit Lines**, so you can switch between any of these Modes and the Limit Lines remain unchanged.

Adjusting the Limit Lines of any Mode that supports **Global** Settings, while **Global Limit Lines** is `ALL`, modifies the **Global Limit Lines**.

When **Global Limit Lines** is set to `NONE`, the Limit Lines of the current Mode are unchanged, but now the Limit Lines of each Mode are once again independent. When **Mode Preset** is pressed while **Global Limit Lines** is `ALL`, **Global Limit Lines** is preset to the preset Limit Lines of the current Mode.

This function is reset to `NONE` when "Restore Defaults" on page 2016 is pressed, or when **System**, **Restore Defaults**, **All Modes** is pressed.

Remote Command	`:INSTrument:COUPle:LLINe ALL | NONE` `:INSTrument:COUPle:LLINe?`
Example	`:INST:COUP:LLIN ALL | NONE` `:INST:COUP:LLIN?`
Preset	Set to `OFF` on **Global** Settings, **Restore Defaults** and **System, Restore Defaults, All Modes**
Range	`ALL | NONE`

Extend Low Band

The software maintains a Mode Global value called **Extend Low Band**.

Under the current sweep configuration crossing over two bands, when **Extend Low Band** is turned `ON`, the instrument checks whether one band can cover the whole sweep frequency range or not. If it can, then the instrument locks the band; otherwise, it does nothing (the band crossover occurs).

This function does *not* work when **Band Lock** under **System > Service > Lock Functions** is not -1 (no Band Lock). In that case, **Band Lock** takes priority over **Extend Low Band**.

This function resets to `OFF` when "Restore Defaults" on page 2016 is pressed, or when **System**, **Restore Defaults**, **All Modes** is pressed.

Remote Command	`:INSTrument:COUPle:FREQuency:BAND:EXTend 0 | 1 | ON | OFF` `:INSTrument:COUPle:FREQuency:BAND:EXTend?`
Example	`:INST:COUP:FREQ:BAND:EXT 1` `:INST:COUP:FREQ:BAND:EXT?`

Preset	Set to `OFF` by **Global** Settings > **Restore Defaults** and **System** > **Restore Defaults** > **All Modes**
Range	`ON`|`OFF`

Restore Defaults

Resets all functions in the **Global** settings menu to `OFF`. Pressing **System**, **Restore Defaults**, **All Modes** has the same effect.

Remote Command	`:INSTrument:COUPle:DEFault`
Example	`:INST:COUP:DEF`
Backwards Compatibility SCPI	`:GLOBal:DEFault`

3.9.19 Sweep

Accesses controls to configure and control the acquisition of data, and the X-axis parameters of the instrument.

Depending on the selected mode and measurement, these controls might include: **Sweep Time**, **Continuous/Single**, **Pause/Resume**, **X Scale** and **Number of Points**.

3.9.19.1 Sweep/Control

Accesses controls that let you operate the sweep and control functions of the instrument, such as **Sweep Time** and **Continuous/Single**.

Sweep/Measure

Lets you toggle between **Continuous** and **Single** sweep or measurement operation. The single/continuous state is Meas Global, so the setting affects all measurements.

The front-panel key **Single/Cont** performs exactly the same function

See "More Information" on page 1707

Remote Command	`:INITiate:CONTinuous OFF | ON | 0 | 1` `:INITiate:CONTinuous?`

Example	Put instrument into **Single** measurement operation:
	`:INIT:CONT 0`
	`:INIT:CONT OFF`
	Put instrument into **Continuous** measurement operation:
	`:INIT:CONT 1`

	`:INIT:CONT ON`
Preset	`ON` Note that `:SYST:PRES` sets `:INIT:CONT` to `ON`, but `*RST` sets `:INIT:CONT` to `OFF`
State Saved	Saved in instrument state
Annunciation	The **Single/Continuous** icon in the Meas Bar changes depending on the setting: – A line with an arrow is **Single** – A loop with an arrow is **Continuous**
Backwards Compatibility Notes	X-Series A-models had **Single** and **Cont** hardkeys in place of the **SweepSingleCont** softkey. In the X-Series A-models, if in single measurement, the **Cont** hardkey (and `INIT:CONT ON`) switched to continuous measurement, but never restarted a measurement and never reset a sweep X-Series B-models have a **Cont/Single** toggle control instead of **Single** and **Cont** hardkeys, but it is still true that, if in single measurement, the **Cont/Single** toggle control never restarts a measurement and never resets a sweep

More Information

Continuous Mode	The instrument takes repetitive sweeps, averages, measurements, etc., when in continuous mode. If in average or Max/Min Hold, and the average/hold count reaches the **Average/Hold Num**, the count stops incrementing, but the instrument keeps sweeping See the **Trace** key description under **Trace Average** for the averaging formula used both before and after the **Average/Hold Num** is reached. The trigger condition must be met prior to each sweep The type of trace processing for multiple sweeps is set under the **Trace** key, with choices of **Trace Average**, **Max Hold**, or **Min Hold**
Single Mode	The instrument takes a single sweep when in **Single** mode, or if in average or Max/Min Hold, or if there is a **Waterfall** window displayed, it takes multiple sweeps until the average/hold count reaches the **Average/Hold Num**, then the count stops incrementing, and the instrument stops sweeping See the **Trace** key description under **Trace Average** for the averaging formula used. The trigger condition must be met prior to the sweep The type of trace processing for multiple sweeps is set under the **Trace** key, with choices of **Trace Average**, **Max Hold**, or **Min Hold**

If the instrument is in **Single** measurement mode, pressing the **Cont/Single** toggle control does not zero the count and does not cause the sweep to be reset; the only action is to put the instrument into Continuous measurement operation.

If the instrument is already in **Continuous** sweep:

– `:INIT:CONT 1` has no effect

– `:INIT:CONT 0` places the instrument in Single Sweep but has no effect on the current sequence until k = N, at which point the current sequence will stop and the instrument will go to the idle state

See "Restart" on page 2018 for details of `:INIT:IMMediate`.

If the instrument is already in **Single** sweep, `:INIT:CONT OFF` has no effect.

If the instrument is already in **Single** sweep, then pressing **Cont/Single** in the middle of a sweep does not restart the sweep or sequence. Similarly, pressing **Cont/Single** does not restart the sweep or sequence if the sweep is not in the idle state (for example, if you are taking a very slow sweep, or the instrument is waiting for a trigger). Even though pressing **Cont/Single** in the middle of a sweep does not restart the sweep, sending `:INIT:IMM` *does* reset it.

If the instrument is in **Single** sweep, and *not* Averaging/Holding, and you want to take one more sweep, press **Restart**.

If the instrument is in **Single** sweep, *and* Averaging/Holding, and you want to take one more sweep without resetting the Average trace or count, go to **Meas Setup** and increment the average count by 1 by pressing the **Step-Up** key while **Average/Hold Num** is the active function. You can also do this by sending `:CALC:AVER:TCON UP`.

Restart

Restarts the current sweep, or measurement, or set of averaged/held sweeps or measurements. If you are Paused, pressing **Restart** performs a Resume.

The front-panel key **Restart** performs exactly the same function.

The **Restart** function is accessed in several ways:

- Pressing the **Restart** key
- Sending `:INIT:IMM`
- Sending `:INIT:REST`

See "More Information" on page 1709

Remote Command	`:INITiate[:IMMediate]` `:INITiate:RESTart`
Example	`:INIT:IMM` `:INIT:REST`
Notes	`:INIT:REST` and `:INIT:IMM` perform exactly the same function
Couplings	Resets average/hold count k. For the first sweep overwrites all active (update = on) traces with new current data. For application modes, it resets other parameters as required by the measurement
Status Bits/OPC	This is an Overlapped command

dependencies	The STATus:OPERation register bits 0 through 8 are cleared , *except* bit 6 (Waiting for Periodic Sync). Initiating a measurement and Waiting for Periodic Sync could be asynchronous The STATus:QUEStionable register bit 9 (INTegrity sum) is cleared The SWEEPING bit is set The MEASURING bit is set
Backwards Compatibility Notes	For Spectrum Analysis Mode in ESA and PSA, the **Restart** hardkey and the :INIT:REST command restarted trace averages (displayed average count reset to 1) for a trace in **Clear Write**, but did not restart **Max Hold** and **Min Hold** In X-Series, the **Restart** hardkey and the :INIT:REST command restart not only **Trace Average**, but **MaxHold** and **MinHold** traces as well

More Information

The **Restart** function first aborts the current sweep or measurement as quickly as possible. It then resets the sweep and trigger systems, sets up the measurement and initiates a new data measurement sequence with a new data acquisition (sweep) taken once the trigger condition is met.

If the instrument is in the process of aligning when a **Restart** is executed, the alignment finishes before the restart function is performed.

Even when set for **Single** operation, multiple sweeps may be taken when **Restart** is pressed (for example, when averaging/holding is on). Thus, when we say that **Restart** "restarts a measurement", depending on the current settings, we may mean that it:

- Restarts the current sweep
- Restarts the current measurement
- Restarts the current set of sweeps if any trace is in Trace Average, Max Hold or Min Hold
- Restarts the current set of measurements if Averaging, or Max Hold, or Min Hold is on for the measurement

If there is no Average or Max/Min Hold function (no trace in Trace Average or Hold, or **Average/Hold Num** set to 1), and no **Waterfall** window is being displayed, a single sweep is equivalent to a single measurement. A single sweep is taken after the trigger condition is met; and the instrument stops sweeping once that sweep has completed. However, with **Average/Hold Num** >1, and at least one trace set to Trace Average, Max Hold, or Min Hold, or a **Waterfall** window being displayed, multiple sweeps/data acquisitions are taken for a single measurement. The trigger condition must be met prior to each sweep. The sweep is stopped when the average count k equals the number N set for **Average/Hold Num**.

Once the full set of sweeps has been taken, the instrument goes to the idle state. To take one more sweep without resetting the average count, increment the average count by 1, by pressing the **Step-Up** key while **Average/Hold Number** is the active function, or by sending the remote command `:CALC:AVER:TCON UP`.

Trace Update

The numeric results are not blanked at any time during the restart cycle.

For slow sweeps (see **Trace Update** section in **Trace/Detector**), the traces are updated real-time during the sweep. There may be a special circumstance in application mode measurements where an exception is made and the traces and/or results need to be blanked before displaying the new results.

To summarize, the following list shows what happens to the trace data on various events:

Event	Trace Effect
Clear/Write pressed (even if already in Clear/Write)	Set to mintracevalue
Max Hold pressed (even if already in Max Hold)	Set to mintracevalue
Min Hold pressed (even if already in Min Hold)	Set to maxtracevalue
Trace Average pressed (even if already in Trace Average)	Trace data unaffected but start new sweep/avg/hold
Restart pressed	Trace data unaffected but start new sweep/avg/hold
Parameter requiring restart changed (e.g., RBW)	Trace data unaffected but start new sweep/avg/hold

Sweep and Trigger Reset

Resetting the sweep system resets the average/hold count k to 0. It also resets the set point counter to 0. Resetting the trigger system resets the internal auto trig timer to the value set by the **Auto Trig** control.

Averaging

The weighting factor used for averaging is k. This k is also the average/hold count for how many valid sweeps (data acquisitions) have been done. This k is used for comparisons with N, as those comparisons always needs to be based on valid completed sweeps.

The displayed average/hold, K, shows the count for the sweep (data acquisition) in progress. K = k + 1, with a limit of N. The displayed value K changes from its previous value to 1 as soon as the trigger condition for the first data acquisition (sweep) is met.

Pause/Resume

Pauses a measurement after the current data acquisition is complete.

When paused, the label on the control changes to **Resume**. Pressing **Resume** un-pauses the measurement. When paused, pressing **Restart** performs a Resume.

Remote Command	`:INITiate:PAUSe` `:INITiate:RESume`
Example	`:INIT:PAUS` `:INIT:RES`
Dependencies	Not displayed in Modes that do not support pausing
Annotation	Only on control

Abort (Remote Command Only)

Stops the current measurement. Aborts the current measurement as quickly as possible, resets the sweep and trigger systems, and puts the measurement into an "idle" state. If the instrument is in the process of aligning when `:ABORt` is sent, the alignment finishes *before* the abort function is performed, so `:ABORt` does not abort an alignment.

If the instrument is set for **Continuous** measurement, it sets up the measurement and initiates a new data measurement sequence with a new data acquisition (sweep) taken once the trigger condition is met.

If the instrument is set for **Single** measurement, it remains in the "idle" state until an `:INIT:IMM` command is received.

Remote Command	`:ABORt`
Example	`:ABOR`
Notes	If :`INIT:CONT` is `ON`, then a new continuous measurement will start immediately, with sweep (data acquisition) occurring once the trigger condition has been met If :`INIT:CONT` is `OFF`, then `:INIT:IMM` is used to start a single measurement, with sweep (data acquisition) occurring once the trigger condition has been met
Dependencies	For continuous measurement, `:ABORt` is equivalent to the **Restart** key Not all measurements support this command
Status Bits/OPC dependencies	The `STATus:OPERation` register bits 0 through 8 are cleared , *except* bit 6 (Waiting for Periodic Sync). Initiating a measurement and Waiting for Periodic Sync could be asynchronous The `STATus:QUEStionable` register bit 9 (`INTegrity` sum) is cleared Since all the bits that feed into OPC are cleared by `:ABORt`, the Abort command will cause the `*OPC` query to return true

3.9.19.2 X Scale

Accesses controls that enable you to set the horizontal scale parameters.

Ref Value

Sets the X reference value.

Remote Command	`:DISPlay:SEMask:WINDow[1]:TRACe:X[:SCALe]:RLEVel <freq>` `:DISPlay:SEMask:WINDow[1]:TRACe:X[:SCALe]:RLEVel?`
Example	`:DISP:SEM:WIND:TRAC:X:RLEV 10` `:DISP:SEM:WIND:TRAC:X:RLEV?`
Couplings	If "Auto Scaling" on page 1544 is ON, this value is automatically determined by the measurement result. If you set this value manually, **Auto Scaling** automatically changes to OFF
Preset	1.0 GHz
State Saved	Saved in instrument state
Min	-1000 GHz
Max	1000 GHz
Backwards Compatibility SCPI	`:DISPlay:SEMask:VIEW[1]:WINDow[1]:TRACe:X[:SCALe]:RLEVel`

Scale/Div

Sets the horizontal scale.

Remote Command	`:DISPlay:SEMask:WINDow[1]:TRACe:X[:SCALe]:PDIVision <freq>` `:DISPlay:SEMask:WINDow[1]:TRACe:X[:SCALe]:PDIVision?`
Example	`:DISP:SEM:WIND:TRAC:X:PDIV 500` `:DISP:SEM:WIND:TRAC:X:PDIV?`
Couplings	If **Auto Scaling** is ON, this value is automatically determined by the measurement result. When you set this value manually, **Auto Scaling** automatically changes to OFF
Preset	Automatically Calculated
State Saved	Yes Saved in instrument state
Min	1 Hz
Max	100 GHz
Backwards Compatibility SCPI	`:DISPlay:SEMask:VIEW[1]:WINDow[1]:TRACe:X[:SCALe]:PDIVision`

Ref Position

Sets the reference position for the X axis to Left, Center or Right.

Remote Command	`:DISPlay:SEMask:WINDow[1]:TRACe:X[:SCALe]:RPOSition LEFT | CENTer | RIGHt` `:DISPlay:SEMask:WINDow[1]:TRACe:X[:SCALe]:RPOSition?`
Example	`:DISP:SEM:WIND:TRAC:X:RPOS LEFT` `:DISP:SEM:WIND:TRAC:X:RPOS?`
Preset	`CENTer`
State Saved	Saved in instrument state
Range	Left|Center|Right
Backwards Compatibility SCPI	`:DISPlay:SEMask:VIEW[1]:WINDow[1]:TRACe:X[:SCALe]:RPOSition`

Auto Scaling

Toggles the scale coupling function On or Off.

Remote Command	`:DISPlay:SEMask:WINDow[1]:TRACe:X[:SCALe]:COUPle 0 | 1 | OFF | ON` `:DISPlay:SEMask:WINDow[1]:TRACe:X[:SCALe]:COUPle?`
Example	`:DISP:SEM:WIND:TRAC:X:COUP ON` `:DISP:SEM:WIND:TRAC:X:COUP?`
Couplings	When **Auto Scaling** is `ON` and the **Restart** front-panel key is pressed, this function automatically determines the scale per division and reference values based on the measurement results When you set a value to either "Scale/Div" on page 1712 or "Ref Value" on page 1712 manually, **Auto Scaling** automatically changes to `OFF`
Preset	`ON`
State Saved	Saved in instrument state
Range	`OFF`|`ON`
Backwards Compatibility SCPI	`:DISPlay:SEMask:VIEW[1]:WINDow[1]:TRACe:X[:SCALe]:COUPle`

3.9.19.3 Sweep Config

Accesses controls that enable you to configure the Sweep and Control functions of the instrument, such as Sweep Rules.

Points

Sets the number of points displayed in the traces. The current value of points is displayed in the bottom-right corner of the display.

Remote Command	`[:SENSe]:SEMask:SWEep:POINts <integer>` `[:SENSe]:SEMask:SWEep:POINts?`
Example	`:SEM:SWE:POIN 4001` `:SEM:SWE:POIN?`
Preset	2001
State Saved	Saved in instrument state
Min	201
Max	10001
Annotation	On second line of annotations in bottom right corner

IF Dithering

Lets you turn IF Dithering on or off. This is a technique used in unpreselected instruments (such as Keysight's modular instruments) to enhance the rejection of images and internally-generated spurious signals.

Remote Command	`[:SENSe]:SWEep:IF:DITHer OFF | ON | 0 | 1` `[:SENSe]:SWEep:IF:DITHer?`
Dependencies	Only appears in Spectrum Analyzer Mode in VXT models
Preset	`OFF`
State Saved	Saved in instrument state

Image Protection

Lets you turn IF Protection on or off. This is a technique used in unpreselected instruments (such as Keysight's modular instruments) to detect and suppress images and spurs that may be present in non-preselected hardware.

IF Protection takes two sweeps and by correlating the data between them, provides a single, correct power-versus-frequency trace.

Remote Command	`[:SENSe]:SWEep:IMAGeprot OFF | ON | 0 | 1` `[:SENSe]:SWEep:IMAGeprot?`
Dependencies	Only appears in Spectrum Analyzer Mode in VXT model M9421A
Preset	`ON`
State Saved	Saved in instrument state

3.9.20 Trace

Lets you control the acquisition, display, storage, detection and manipulation of trace data for the available traces. The Trace Control tab of this menu contains radio-button selections for the trace type (**Clear/Write, Trace Average, Max Hold, Min Hold**) and **View/Blank** setting for the selected trace.

3.9.20.1 Select Trace

Specifies the *selected trace*, which is the trace that will be affected when you change trace settings.

Select Trace appears above the menu panel, indicating that it applies to *all* controls in the menu panel. **Select Trace** is blanked if you select a tab whose controls do *not* depend on the selected trace (for example, **Trace Function**).

Notes	The selected trace is remembered even when not in the **Trace** menu
Dependencies	For the Swept SA measurement: – In Image Suppress mode, when you select a trace it becomes the active trace, and the formerly active trace goes into View – When you turn on Image Suppress, Update turns off for all traces except the selected trace For the ACP measurement, when **Meas Method** is `RBW`, `FAST` or `FPOWer`, **Select Trace** is disabled
Preset	Trace 1
State Saved	Yes

3.9.20.2 Trace Control

The controls on this tab allow you to set the "Trace Type" on page 1905 and its update mode.

There are four Trace Types:

- **Clear/Write**
- **Trace Average**
- **Max Hold**
- **Min Hold**

Each type handles data in a different way.

Each trace also has two values that determine whether it is being written or not, and whether it is being displayed or not. These values, **Update** and **Display,** are described fully in the "View/Blank" on page 1721 control description. Essentially, when **Update** is `ON`, a trace is updating, and when **Update** is `OFF` it is not. When **Display** is `ON`, it is visible and when **Display** is `OFF` it is not. These terms are used throughout the descriptions in this section.

Trace Type

There are four trace Types:

Option	Parameter	SCPI Example	Details
Clear/Write	`WRITe`	`:TRAC2:TYPE WRIT`	See: "Clear/Write" on page 1719
Trace Average	`AVERage`	`:TRAC2:TYPE AVER`	See: "Trace Average" on page 1719
Maximum Hold	`MAXHold`	`:TRAC3:TYPE MAXH`	See: "Max Hold" on page 1720
Minimum Hold	`MINHold`	`:TRAC5:TYPE MINH`	See: "Min Hold" on page 1720

Full descriptions of each type are provided below. You may select one of these types for each trace. Re-selecting the current **Trace Type** initiates the same action that selecting it the first time did, even though it is already selected. For example, selecting **Clear/Write** while **Clear/Write** is already selected will nonetheless clear the trace and begin rewriting it.

Besides the **Trace Type**, the "View/Blank" on page 1721 state must be set to **Active** (**Update**: `ON`, **Display**: `ON`) for a trace to be updating and visible. Selecting any **Trace Type** automatically makes the trace **Active**.

See also: "Trace Mode Backwards Compatibility Commands" on page 1717

Remote Command	For Swept SA Measurement (in SA Mode):
	`:TRACe[1]|2|…|6:TYPE WRITe | AVERage | MAXHold | MINHold`
	`:TRACe[1]|2|…|6:TYPE?`
	For all other measurements:
	`:TRACe[1]|2|3:<meas>:TYPE WRITe | AVERage | MAXHold | MINHold`
	`:TRACe[1]|2|3:<meas>:TYPE?`
	where `<meas>` is the identifier for the current measurement

Example	`:TRAC:TYPE WRIT` `:TRAC:TYPE?`
Couplings	Selecting a **Trace Type** (by pressing any of the Trace Type selections or sending `:TRAC:TYPE`) sets the Trace to **Active** (**Update**: `ON`, **Display**: `OFF`), even if the same trace type was already selected When Detector setting is "Auto" (`[:SENSe]:<meas>:DETector:AUTO?)`, Detector `([:SENSe]:<meas>:DETector[:FUNCtion]?)` switches aligning with the switch of this parameter: "`NORMal`" with `WRITe` (Clear Write), "`AVERage`" with `AVERage`, "`POSitive` (peak)" with `MAXHold`, and "`NEGative` (peak)" with `MINHold`

Preset	Swept SA and Monitor Spectrum: WRITe All other measurements: AVERage Following **Preset**, all traces are cleared (all trace points set to mintracevalue)
State Saved	The type of each trace is saved in instrument state
Annunciation	The type for each trace is indicated in the Trace annunciator panel on the Measurement Bar

Trace Mode Backwards Compatibility Commands

In earlier instruments, the “Trace Modes” were: Clear/Write, Max Hold, Min Hold, View and Blank. Averaging was global to all traces and was controlled under the **BW/Avg** menu.

In X-Series, trace averaging can be done on a per-trace basis. The Trace Modes (now called Trace Types) are Clear/Write, Trace Average, Max Hold and Min Hold. View and Blank are set separately under "View/Blank" on page 1721.

While this provides more flexibility, it also gives rise to potential backwards compatibility problems. To mitigate these, the old Trace Mode command has been retained and a new Trace Type command has been added. The :TRACe:MODE command is retained for backwards compatibility, and the :TRACe:TYPE, :TRACe:UPDate and :TRACe:DISPlay commands introduced for ongoing use. The old Trace Modes are selected using :TRAC:MODE, whose parameters are mapped into calls to :TRACe:TYPE, :TRACe:UPDate and :TRACe:DISPlay, and the old global Averaging command [:SENSe]:AVERage[:STATe] is provided for backwards compatibility. See the individual command descriptions for details.

When **Average/Hold** in the **Meas Setup**, **Legacy Compatibility** menu is ON, the following is true for traces in Max Hold and Min Hold:

- They ignore the **Average/Hold** number; **Single** for Max Hold causes one sweep only, so switching to **Single** stops after the current sweep, and switching to **Cont** starts again without clearing the accumulated result
- Max Hold is not cleared on a **Restart**, **Single** or :INIT:IMM, but changing a measurement parameter, like frequency or bandwidth etc., still restarts the Max Hold

Preset	WRITe
State Saved	The trace mode is an alias only
Backwards Compatibility SCPI	:TRACe[1]|2|…|6:MODE WRITe | MAXHold | MINHold | VIEW | BLANk :TRACe[1]|2|…|6:MODE?
Backwards Compatibility Notes	The legacy :TRACe:MODE command is retained for backwards compatibility. In conjunction with the legacy :AVErage command, it works as follows: – :AVErage ON|OFF sets/clears a variable that we will call average for the sake of this discussion. This variable is maintained by the instrument solely for backwards compatibility. See

	the `[:SENSe]:AVERage[:STATe]` command description below – `:TRACe:MODE WRITe` sets `:TRACe:TYPE WRITe` (Clear/Write) unless average is true, in which case it sets it to `:TRACe:TYPE AVErage`. It also sets `:TRACe:UPDate ON`, `:TRACe:DISPlay ON`, for the selected trace – `:TRACe:MODE MAXHold` sets `:TRACe:TYPE MAXHold` (Max Hold). It also sets `:TRACe:UPDate ON`, `:TRACe:DISPlay ON`, for the selected trace – `:TRACe:MODE MINHold` sets `:TRACe:TYPE MINHold` (Min Hold). It also sets `:TRACe:UPDate ON`, `:TRACe:DISPlay ON`, for the selected trace – `:TRACe:MODE VIEW` sets `:TRACe:UPDate OFF`, `:TRACe:DISPlay ON`, for the selected trace – `:TRACe:MODE BLANk` sets `:TRACe:UPDate OFF`, `:TRACe:DISPlay OFF`, for the selected trace The query returns the same value as `:TRACe:TYPE?`, meaning that if you set `:TRACe:MODE:VIEW` or `:TRACe:MODE:BLANk`, the query response will not be what you sent `:TRACe[n]:MODE` was formerly used to set the type or "writing mode" of the trace. At that time, View and Blank were writing modes. The new `:TRACe:TYPE` command should be used in the future, but `:TRACe:MODE` is retained to provide backwards compatibility In X-Series, unlike earlier instruments, Max Hold and Min Hold now obey the Average Number and counts up to a terminal value as Average always has As the **Average/Hold Number** now affects **Min Hold** and **Max Hold**, the operations that restart Averaging (for example, the **Restart** key) now also restart **Min Hold** and **Max Hold** As a result of these changes, legacy code that restarts averaging while retaining a running Max Hold will need to be rewritten, because the Max Hold will now restart when the Average does Also, previous to X-Series: – Pressing **Max Hold** while already in **Max Hold** (or doing so remotely) had no effect. Now it will clear the trace and restart the sweep and the Max Hold sequence – Changing the vertical scale (Log/Lin or dB/div) of the display restarted **Max Hold** and **Min Hold**. This is no longer the case
Preset	`OFF`
State Saved	The state of Average is saved in Instrument State for ghosting purposes
Backwards Compatibility SCPI	`[:SENSe]:AVERage[:STATe] ON | OFF | 1 | 0` `[:SENSe]:AVERage[:STATe]?`
Backwards Compatibility Notes	Previous to X-Series, Averaging (also sometimes known as trace averaging) was global to all traces, that is, it was either on or off for all active traces. The legacy command `[:SENSe]:AVERage [:STATe] ON|OFF|1|0` was used to turn Averaging on or off In X-Series, Averaging is turned on or off on a per-trace basis, so it can be on for one trace and off for another For backwards compatibility, the old global Average State variable is retained solely as a legacy

variable, turned on and off and queried by the legacy command `[:SENSe]:AVERage[:STATe] OFF|ON|0|1.` When Average is turned on, any trace in Clear/Write will get put into Average. While Average is on, any trace put into Clear/Write by the old `:TRAC:MODE` command will instead get put into Average. When Average is turned off, any trace in Average will get put into Clear/Write

Trace Type Details

Clear/Write

Each trace update replaces the old data in the trace with new data.

Pressing **Clear/Write** for the selected trace, or sending `:TRAC:TYPE WRIT` for the specified trace, sets the trace type to **Clear/Write** and clears the trace, even if you are already in **Clear/Write**. Then a new sweep is initiated. Trigger conditions must be met before the sweep actually starts, and if in **Single** the sweep won't start until **Restart** is pressed.

Pressing **Clear/Write** stops the current sweep and initiates a new one, so **Trace Average, Max Hold** and **Min Hold** data may be interrupted in mid-sweep when **Clear/Write** is pressed, and therefore may not accurately reflect the displayed count. Therefore, when **Clear/Write** is pressed for one trace, **Trace Average, Max Hold** and **Min Hold** must restart for all traces.

When in **Clear/Write**, if a measurement-related instrument setting is changed (that is, one which requires new data to be taken, like **Center Frequency** or **Attenuation**), a new sweep is initiated but the trace is not cleared.

Trace Average

The instrument maintains and displays an average trace, which represents the cumulative average on a point-by-point basis of the new trace data and previous averaged trace data.

Pressing **Trace Average** (for the selected trace), or sending `:TRAC:TYPE AVER` (for the specified trace), sets the trace type to **Trace Average**, clears the trace, initiates a new sweep, and restarts the Average sequence.

Details of the count limiting behavior and the averaging calculations may be found under **Avg|Hold Number** and **Average Type** under **Meas Setup.**

When in **Trace Average**, if a measurement-related instrument setting is changed (that is, one which requires new data to be taken, like Center Frequency or Attenuation), the average restarts and a new sweep is initiated but the trace is not cleared.

Restarting the average means:

– The average/hold count k is set to 1, so that the next time the average trace is displayed it simply represents one trace of new data

– A new sweep is initiated

– Once the new sweep starts, the trace is overwritten with current trace data as the first trace of the new average

Remember that restarting averaging also restarts **Max Hold** and **Min Hold**, as there is only one count for Trace Average and Hold.

Max Hold

The instrument maintains and displays a max hold trace, which represents the maximum data value on a point-by-point basis of the new trace data and previous trace data. Details of the count limiting behavior may be found under **Avg|Hold Number** under **Meas Setup.**

Pressing **Max Hold** for the selected trace, or sending `:TRAC:TYPE MAXH` for the specified trace, sets the Trace Type to **Max Hold,** clears the trace , initiates a new sweep, and restarts the hold sequence, even if you are already in **Max Hold**.

When in **Max Hold**, if a measurement-related instrument setting is changed(that is, one which requires new data to be taken, like **Center Frequency** or **Attenuation**), the **Max Hold** sequence restarts and a new sweep is initiated but the trace is not cleared.

Restarting the **Max Hold** sequence means:

– The average/hold count k is set to 1, so that the next time the max hold trace is displayed it simply represents one trace of new data

– A new sweep is initiated.

Remember that restarting **Max Hold** also restarts averaging and **Min Hold**, as there is only one count for Trace Average and Hold.

Min Hold

The instrument maintains and displays a min hold trace, which represents the minimum data value on a point-point basis of the new trace data and previous trace data. Details of the count limiting behavior may be found under **Avg|Hold Number** under the **Meas Setup** functions.

Pressing **Min Hold** for the selected trace, or sending `:TRAC:TYPE MINH` for the specified trace, sets the Trace Type to **Min Hold,** clears the trace, initiates a new sweep, and restarts the hold sequence, even if you are already in **Min Hold**.

When in **Min Hold**, if a measurement-related instrument setting is changed(that is, one which requires new data to be taken, like **Center Frequency** or **Attenuation**), the **Min Hold** sequence restarts and a new sweep is initiated but the trace is not cleared.

Restarting the **Min Hold** sequence means:

- The average/hold count k is set to 1, so that the next time the min hold trace is displayed it simply represents one trace of new data
- A new sweep is initiated

Remember that restarting **Min Hold** also restarts **Max Hold** and averaging, because there is only one count for Trace Average and Hold.

Clear and Write | Restart Averaging | Restart Max/Min Hold

Starts the trace writing, as though the "Trace Type" on page 1905 had just been selected. The effect is exactly the same as reselecting the current **Trace Type** again – the control is provided because it may not be obvious that reselecting the same selection from a radio button menu will take any action.

This control displays different labels, depending on the selected Trace Type:

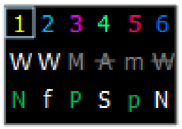
- **Clear/Write**: Clear and Write
- **Trace Average**: Restart Averaging
- **Max Hold**: Restart Max Hold
- **Min Hold**: Restart Min Hold

View/Blank

Lets you set the state of the two trace variables: **Update** and **Display**. The choices available in this dropdown menu are:

Active	Update and Display both ON
View	Update OFF; Display ON
Blank	Update OFF; Display OFF
Background	Update ON, Display OFF Allows a trace to be blanked *and* continue to update "in the background", which was not possible in the past

In the Swept SA measurement, a trace with **Display**OFF is indicated by a strikethrough of the type letter in the trace annotation panel in the Measurement Bar. A trace with **Update**OFF is indicated by dimming the type letter in the trace annotation panel in the Measurement Bar. In the example below, Traces 3, 4, 5 and 6 have **Update**`OFF`, and Traces 4 and 6 have **Display**`OFF`.



See: "More Information" on page 1723

Notes	For the commands to control the two variables, Update and Display, see "Trace Update State On/Off" on page 1722 and "Trace Display State On/Off" on page 1723 below
Dependencies	When Signal ID is on, this key is grayed-out
Couplings	Selecting a Trace Type for a trace (pressing the key or sending the equivalent command) puts the trace in **Active** (Update ON and Display ON), even if that trace type was already selected Selecting a detector for a trace (pressing the key or sending `[:SENS]:DET:TRAC`) puts the trace in **Active** (**Update**ON and **Display**ON), even if that detector was already selected Selecting a "Math Function" on page 1724 other than `OFF` for a trace (pressing the key or sending the equivalent command) puts the trace in **Active** (**Update**ON and **Display**ON), even if that Math Mode was already selected Loading a trace from a file puts that trace in **View** regardless of the state it was in when it was saved; as does being the target of a **Copy** or a participant in an **Exchange**

Trace Update State On/Off

Remote Command	For Swept SA Measurement (in SA Mode):
	`:TRACe[1]|2|…|6:UPDate[:STATe] ON | OFF | 1 | 0`
	`:TRACe[1]|2|…|6:UPDate[:STATe]?`
	For all other measurements:
	`:TRACe[1]|2|3:<meas>:UPDate[:STATe] ON | OFF | 1 | 0`
	`:TRACe[1]|2|3:<meas>:UPDate[:STATe]?`
	where <meas> is the identifier for the current measurement

Example	Make trace 2 inactive (stop updating): `:TRAC2:UPD 0`
Couplings	Whenever you set **Update** to ON for any trace, the **Display** is set to ON for that trace

Preset	For Swept SA Measurement (in SA Mode):
	`1|0|0|0|0|0`
	ON for Trace 1; `OFF` for 2–6
	For all other measurements:
	`1|0|0`
	ON for Trace 1; `OFF` for 2 &3

State Saved	Saved in instrument state

Trace Display State On/Off

Remote Command	For Swept SA Measurement (in SA Mode):
	`:TRACe[1]|2|…|6:DISPlay[:STATe] ON | OFF | 1 | 0`
	`:TRACe[1]|2|…|6:DISPlay[:STATe]?`
	For all other measurements:
	`:TRACe[1]|2|3:<meas>:DISPlay[:STATe] ON | OFF | 1 | 0`
	`:TRACe[1]|2|3:<meas>:DISPlay[:STATe]?`
	where <meas> is the identifier for the current measurement

Example	Make trace 1 visible:
	`:TRAC2:DISP 1`
	Blank trace 3:
	`:TRAC3:DISP 3`

Couplings	Whenever you set **Update** to `ON` for any trace, the **Display** is set to `ON` for that trace

Preset	For Swept SA Measurement (in SA Mode):
	`1|0|0|0|0|0`
	`ON` for Trace 1; `OFF` for 2–6
	For all other measurements:
	`1|0|0`
	`ON` for Trace 1; `OFF` for 2 &3

State Saved	Saved in instrument state

More Information

When a trace becomes inactive, any update from the `:SENSe` system (detectors) immediately stops, without waiting for the end of the sweep. The trace data remains unchanged, but stops updating. If the trace is blanked, this still does not affect the data in the trace. Traces that are blanked (**Display**=`OFF`) do not display nor appear on printouts, but their data stays intact, they may be queried, and markers may be placed on them

In most cases, inactive traces are static and unchanging; however, there are cases when an inactive trace will update, specifically:

- if data is written to that trace from remote
- if trace data is loaded from mass storage
- if the trace is the target of a **Copy** or participant in an **Exchange**
- if the trace is cleared using **Clear Trace**

Inactive traces that are also being displayed (traces in **View**) are displayed at half intensity. Traces in **View** display across the entire X-Axis of the instrument. Their horizontal placement does not change, even if X-Axis settings subsequently are changed, although Y-Axis settings do affect the vertical placement of data.

When a trace becomes active (**Update**=ON), the trace is cleared, the average count is reset, and a new sweep is initiated.

Note that putting a trace into **Display**=OFF and/or **Update**=OFF does *not* restart the sweep and does *not* restart Averaging or Hold functions for any traces.

3.9.20.3 Math

Lets you turn on and configure Trace Math functions.

Math Function

Trace Math functions perform mathematical operations between traces and, in some cases, user-specified offsets. When in a Trace Math function, the indicated function is performed during the sweep with the math function used in place of a detector. The trace operands for the math function are set using the "Operand 1 / Operand 2" on page 1730 controls.

– See "How trace math is processed" on page 1728

Remote Command	For option details, see "Trace Math Options" on page 1726
	For Swept SA Measurement (in SA Mode):
	`:CALCulate:MATH <trace_num>, PDIFference | PSUM | LOFFset | LDIFference | OFF, <trace_num>, <trace_num>, <real>,<real>`
	`:CALCulate:MATH? <trace_num>`
	where `<trace_num>` is any one of:
	`TRACE1|…|TRACE6`
	For all other measurements:
	`:CALCulate:<meas>:MATH <trace_num>, PDIFference | PSUM | LOFFset | LDIFference | OFF, <trace_num>, <trace_num>, <real>,<real>`
	`:CALCulate[:<meas>]:MATH? <trace_num>`
	where:
	`<meas>` is the identifier for the current measurement, and
	`<trace_num>` is any one of:
	`TRACe1|TRACe2|TRACe3`
	Note that the format of the `TRACe<n>` parameter differs from that for the Swept SA Measurement

Example	`:CALC:MATH TRACE3,PDIF,TRACE1,TRACE2,0,0` Sets Trace 3 to Power Diff trace math function, and sets the First Trace operand (for Trace 3) to Trace 1 and the Second Trace operand (for Trace 3) to Trace 2

	`:CALC:MATH TRACE3,PSUM,TRACE1,TRACE2,0,0`
	Sets Trace 3 to Power Sum trace math function and sets the First Trace operand (for Trace 3) to Trace 1 and the Second Trace operand (for Trace 3) to Trace 2
	`:CALC:MATH TRACE3,LOFF,TRACE1,TRACE2,-6.00,0`
	Sets Trace 3 to Log Offset trace math function, sets the First Trace operand (for Trace 3) to Trace 1, leaves the Second Trace operand (for Trace 3) unchanged (it is irrelevant for this function) and sets the Log Offset (for Trace 3) to -6 dB
	`:CALC:MATH TRACE3,LDIF,TRACE1,TRACE2,0,-6.00`
	Sets Trace 3 to Log Diff trace math function, sets the First Trace operand (for Trace 3) to Trace 1, sets the Second Trace operand (for Trace 3) to Trace 2, and sets the Log Difference reference (for Trace 3) to -6 dBm
	`:CALC:MATH TRACE1,OFF,TRACE2,TRACE3,0,0`
	Turns off trace math for trace 1

Notes	The Trace Math Function command has 6 main set of parameters:
	- Set 1 defines the “result trace”:
	`TRACE1|…|TRACE6`
	-Set 2 defines the “function”:
	`PDIFference|PSUM|LOFFset|LDIFference|OFF`
	- Set 3 is a “trace operand” (1):
	`TRACE1|…|TRACE6`
	- Set 4 is a “trace operand” (2):
	`TRACE1|…|TRACE6`
	- Set 5 defines the “Log Offset” (in dB)
	- Set 6 defines the “Log Difference Reference” (in dBm)
	Note that the trace math mode is an enumeration; that is, when a math function is set for a trace, it turns off any math function that is on for that trace, then sets the new math function
	The parameters sent in the command are reflected in the values in the control menu. There is no default for any parameter; all 6 parameters must be sent to satisfy the parser. Failure to specify a parameter will result in a missing parameter message
	The query returns the math mode, the operand traces, the offset and the reference for the specified trace, all separated by commas

Dependencies	Trace Math is not available if **Normalize** is on Trace Math is not available if Signal ID is on None of the trace operands can be the destination trace. If any of the three trace math commands is sent with a destination trace number matching one of the operands, a warning is generated and the function does not turn on
Couplings	When a math function is changed for a trace, that trace is set to Display = ON; and Update = ON
Preset	For Swept SA Measurement (in SA Mode): `OFF,TRACE5,TRACE6,0,0 | OFF,TRACE6,TRACE1,0,0 | OFF,TRACE1,TRACE2,0,0 | OFF,TRACE2,TRACE3,0,0 | OFF,TRACE3,TRACE4,0,0 | OFF,TRACE4,TRACE5,0,0`

	For all other measurements: `OFF,TRACE2,TRACE3,0,0 | OFF,TRACE3,TRACE1,0,0 | OFF,TRACE1,TRACE2,0,0`
State Saved	The trace math function for each trace is saved in instrument state
Annunciation	An "f" is shown on the trace annunciation panel in the Measurement Bar when a math function is on; and the function is annotated on the trace if Trace Annotation is on
Status Bits/OPC dependencies	`*OPC` can be used to detect the completion of a sweep, which will also correspond to the completion of the math operation, since all math takes place during the sweep

Trace Math Options

IMPORTANT

To generate a trace math result, *you must take a sweep*. The trace math engine, described below, operates in concert with the sweep engine in the instrument. Until a sweep has been taken, even if the constituent traces are not in Update mode, no result is generated.

Note that certain events can affect the trace in ways that affects all points at once. This can happen in any number of ways, including:

- A trace clear taking place
- A trace being loaded from the file system
- Trace data being sent in from the remote interface
- A copy or exchange of trace data

You should try to avoid these occurrences during a sweep, as they will tend to invalidate the math result being accumulated.

The Trace Math functions are:

Power Diff (Op1 - Op2)

Calculates a power difference between the `First Trace` operand and the `Second Trace` operand and puts the result in the destination trace.

During the sweep, the following formula is executed for each point in the trace operands, and the corresponding point is generated for the destination trace:

```
DestinationTrace = 10 log(10(1/10)(FirstTrace) – 10(1/10)(SecondTrace))
```

The values of the trace points are assumed to be in a decibel scale, as they are internally stored.

If a point in `FirstTrace` is equal to `maxtracevalue`, the resultant point is also `maxtracevalue`.

Otherwise, if the result of the subtraction is less than or equal to 0, the resultant point is `mintracevalue`.

Power Sum (Op1 + Op2)

Calculates a power sum between the `First Trace` operand and the `Second Trace` operand and puts the result in the destination trace.

During the sweep, the following formula is executed for each point in the trace operands, and the corresponding point is generated for the destination trace.

```
DestinationTrace = 10 log(10(1/10)(FirstTrace) + 10(1/10)(SecondTrace))
```

The values of the trace points are assumed to be in a decibel scale, as they are internally stored.

If a point in either trace operand is equal to `maxtracevalue`, the resultant point is also `maxtracevalue`.

Log Offset (Op1 + Offset)

Calculates a log offset from the `First Trace` operand and puts the result in the destination trace. This is like the B-DL function in some older instruments. The offset is entered on the `Offset` control, which only appears when this math function is in force for the selected trace. Each destination trace has its own offset.

During the sweep, the following formula is executed for each point in the trace operand, and the corresponding point is generated for the destination trace.

```
DestinationTrace = FirstTrace + Offset
```

The values of the trace points are assumed to be in dBm (as they are internally stored) and the offset is in dB.

If a point in the trace operand is equal to `maxtracevalue`, the resultant point is also `maxtracevalue`.

If a point in the trace operand is equal to `mintracevalue`, the resultant point is also `mintracevalue`.

Example: If offset is 25 dB, then our destination trace will be higher than the operand trace by 25 dB.

Note that the `Second Trace` operand is not used for this function.

Log Diff (Op1 - Op2 + Ref)

Offsets the difference between the `First Trace` operand and the `Second Trace` operand by a reference and puts the result in the destination trace. This is like the A-B+DL function in some older instruments. The Reference is entered on the **Reference** control, which only appears when this math function is in force for the selected trace. Each destination trace has its own reference.

Offsets the difference between the `First Trace` operand and the `Second Trace` operand by a reference and puts the result in the destination trace. This is like the A-B+DL function in some older instruments. The Reference is entered on the **Reference** control, which only appears when this math function is in force for the selected trace. Each destination trace has its own reference.

During the sweep, the following formula is executed for each point in the trace operands, and the corresponding point is generated for the destination trace.

```
DestinationTrace = (FirstTrace - SecondTrace) + Reference
```

The values of the operand trace points are assumed to be in decibel units (as they are internally stored) and the reference is in dBm so the result is in dBm.

Example: If the first operand trace 1 is at 5 dBm, the second operand trace 2 is at –5 dBm, and the reference is –25 dBm, then the destination trace will be –15 dBm.

Example: If the first operand trace1 is at 60 dBuV, the second operand trace 2 is at 50 dBuV, and the reference is 35 dBuV, then the destination trace will be 45 dBuV.

If a point in `FirstTrace` is equal to `maxtracevalue`, the resultant point is also `maxtracevalue`.

If a point in `FirstTrace` is equal to `mintracevalue`, the resultant point is also `mintracevalue`.

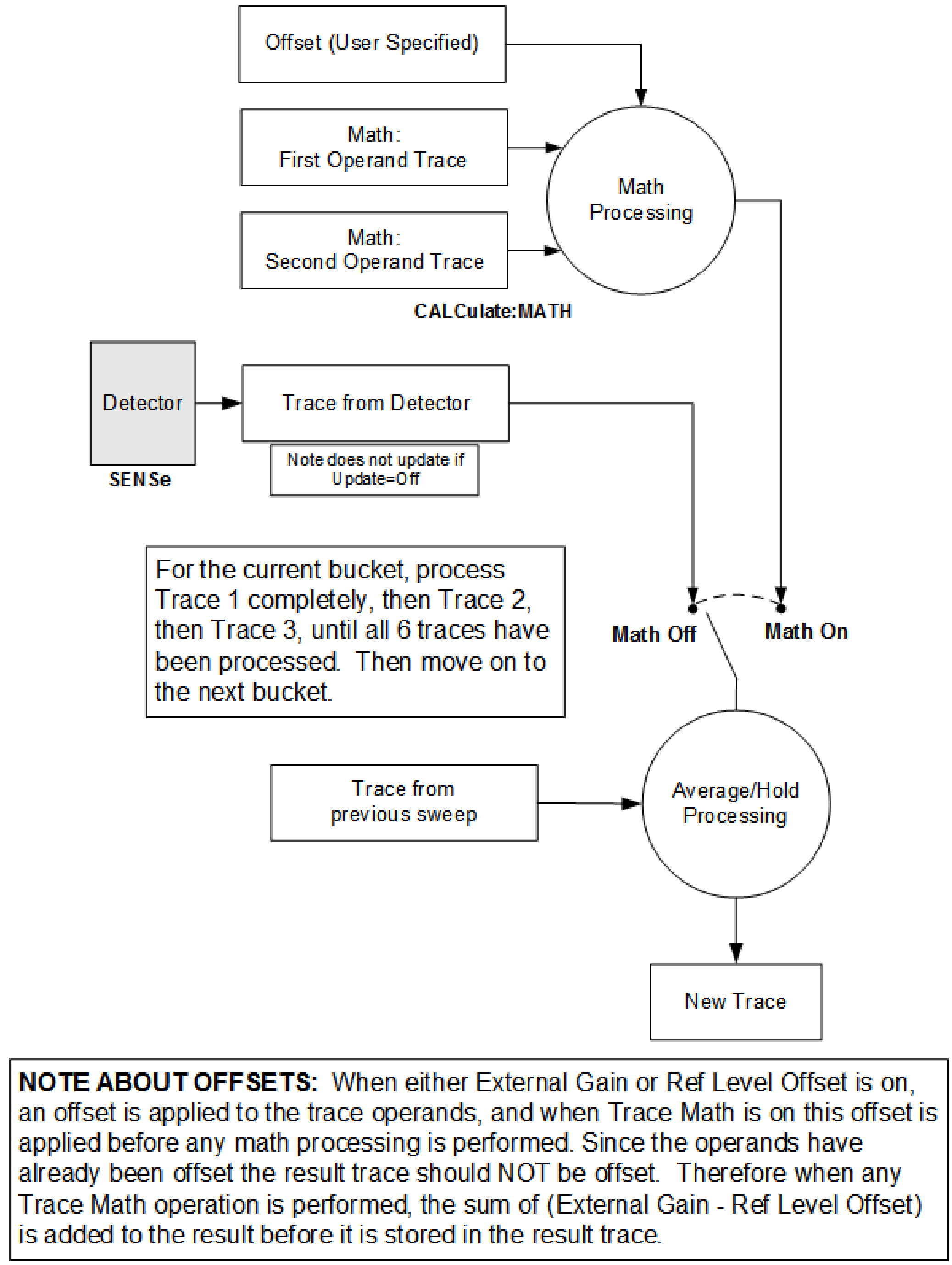
If neither of the above is true for a given point, then:

- If that point in `SecondTrace` is equal to `maxtracevalue`, the resultant point is `mintracevalue`.
- If that point in `SecondTrace` is equal to `mintracevalue`, the resultant point is `maxtracevalue`.

How trace math is processed

Whenever a trace math function is turned on, or the parameters and/or operands of an existing trace math function are changed, the destination trace is cleared. After the trace is cleared, all x-axis values in the trace, and the domain of the trace, are set to match the X-Axis settings of the first trace operand. When this is complete, a new sweep is initiated.

The process of acquiring data, processing it using the math and Average/Hold functions, and presenting it as trace data, consists of several functional blocks, as shown below:



For each active trace, the current trace point is processed for `Trace 1`, then `Trace 2`, then `Trace 3`, etc. Trace data is taken from either the detector for that trace, or

from the mathematical result of up to two other traces and an offset, depending on whether trace math is on or not. The resultant data is then fed to the Average/Hold processing block, where (if the trace type is **Average**, **Max Hold**, or **Min Hold**) it is processed with previous trace data. The new trace data resulting from this process is then available for display, storage or remote output.

When the processing is complete for `Trace 1`, `Trace 2` is processed, and so on until all six traces have been processed. This allows a downstream trace to use as one of its math components a fully processed upstream trace. In other words, if math is `ON` for `Trace 4`, and its operand traces are `Trace 2` and `Trace 3`, then all detector, math, average and hold processing for Traces 2 and 3 is completed before the math is performed for `Trace 4`. When the current trace point is completed for all traces, the instrument moves on to the next trace point.

This allows very flexible and powerful math functions to be configured. For example, `Trace 1` can be an average trace, which can be fed with an offset to `Trace 2`, which can also be in **Max Hold**, allowing you to obtain the **Max Hold** of an Average trace.

Note that none of this processing is performed on inactive traces.

Note also that for any active trace with math `ON`, the Operand traces should have *lower* numbers than the trace (for example, using `Trace 4` as an operand for `Trace 1` will cause the data coming from `Trace 4` to be delayed by one sweep).

Operand 1 / Operand 2

These two controls select the first and second trace operands to be used for the trace math functions for the destination trace. The operands are common to all math functions for a given trace. The most recently sent `:CALCulate:MATH` command for a given trace sets the operands for that trace. Those settings are displayed on the trace operand controls for that trace.

Example	The following examples are for the Swept SA measurement
	Set Trace 3 to Power Diff trace math function. Set the First Trace operand (for Trace 3) to Trace 1 and the Second Trace operand (for Trace 3) to Trace 2:
	`:CALC:MATH TRACE3,PDIF,TRACE1,TRACE2,0,0`
	Set Trace 3 to Log Offset trace math function. Set the First Trace operand (for Trace 3) to Trace 1, leave the Second Trace operand (for Trace 3) unchanged (it is irrelevant for this function) and set the Log Offset (for Trace 3) to -6 dB:
	`:CALC:MATH TRACE3,LOFF,TRACE1,TRACE2,-6.00,0`

Notes	See "Math Function" on page 1724 for how to specify Operands 1 and 2 using `:CALCulate:MATH`
Dependencies	The destination trace cannot be an operand. The destination trace number is grayed-out on the dropdown
Preset	Operand 1: Trace number minus 2 (wraps at 1). For example, for Trace 1, Operand 1 presets to Trace

	5; for Trace 6, it presets to Trace 4 Operand 2: Trace number minus 1 (wraps at 1). For example, for Trace 1, Operand 2 presets to Trace 6; for Trace 6, it presets to Trace 5
State Saved	Operands 1 and 2 for each trace are stored in instrument state

Offset

Used by the Log Offset math function.

Example	The following example is for the Swept SA measurement Set Trace 3 to Log Offset trace math function, set the First Trace operand (for Trace 3) to Trace 1, leave the Second Trace operand (for Trace 3) unchanged (it is irrelevant for this function) and set the Log Offset (for Trace 3) to -6 dB: `:CALC:MATH TRACE3,LOFF,TRACE1,TRACE2,-6.00,0`
State Saved	The Log Offset value for each trace is saved in Instrument State
Min	–100 dB
Max	100 dB

Reference

Used by the Log Diff math function.

Example	The following example is for the Swept SA measurement Set Trace 3 to Log Diff trace math function, set the First Trace operand (for Trace 3) to Trace 1, set the Second Trace operand (for Trace 3) to Trace 2, and set the Log Difference reference (for Trace 3) to -6 dBm: `:CALC:MATH TRACE3,LDIF,TRACE1,TRACE2,0,-6.00`
State Saved	The Log Difference reference value for each trace is saved in instrument state
Min/Max	Same as reference level

3.9.20.4 Trace Function

Contains controls to:

– Copy and Exchange traces

– Preset or Clear all traces

From Trace

Selects the trace to be copied to or exchanged with the "To Trace" on page 1732 when a "Copy" on page 1732 or "Exchange" on page 1733 is performed

Preset	1

To Trace

Selects the trace to be copied from or exchanged with the "From Trace" on page 1732 when a "Copy" on page 1732 or "Exchange" on page 1733 is performed

Preset	2

Copy

Executes a Trace Copy based on the "From Trace" on page 1732 and "To Trace" on page 1732 parameters. The copy operation is from the **From Trace** to the **To Trace**. The action is performed once.

The X-Axis settings and domain of a trace are also copied.

Remote Command	For Swept SA Measurement (in SA Mode):
	`:TRACe:COPY TRACE1 | … | TRACE6, TRACE1 | … | TRACE6`
	For all other measurements:
	`:TRACe:<meas>:COPY TRACe1 | TRACe2 | TRACe3, TRACe1 | TRACe2 | TRACe3`
	where `<meas>` is the identifier for the current measurement
	Note that the format of the `TRACe<n>` parameter differs from that for the Swept SA Measurement

Example	Copy Trace 1 to Trace 3 and put Trace 3 in Update=Off, Display=On `:TRAC:COPY TRACE1,TRACE3`
Notes	The command is of the form: `:TRACe:COPY <source_trace>,<dest_trace>`
Dependencies	When Signal ID is on, this key is grayed-out
Couplings	The destination trace is put in **View** (Update = Off, Display = On) after the copy

Preset	For Swept SA Measurement (in SA Mode):
	`TRACE1, TRACE2`
	For all other measurements:
	`TRACe1, TRACe2`

Exchange

Executes a Trace Exchange based on the "From Trace" on page 1732 and "To Trace" on page 1732 parameters. The **From Trace** and **To Trace** values are exchanged with each other. The action is performed once.

The X-Axis settings and domain of a trace are also copied when it is exchanged with another trace.

Remote Command	For Swept SA Measurement (in SA Mode):
	`:TRACe:EXCHange TRACE1 | … | TRACE6, TRACE1 | … | TRACE6`
	For all other measurements:
	`:TRACe:<meas>:EXCHange TRACe1 | TRACe2 | TRACe3, TRACe1 | TRACe2 | TRACe3`
	where `<meas>` is the identifier for the current measurement
	Note that the format of the `:TRACe<n>` parameter differs from that for the Swept SA Measurement

Example	Exchange Trace 1 and Trace 2 and put both traces in Update=`OFF`, Display=`ON`: `:TRAC:EXCH TRACE1,TRACE2`
Notes	The command is of the form: `:TRACe:EXCHange <trace_1>,<trace_2>`
Couplings	Both traces are put in **View** (Update=Off, Display=On) after the exchange

Preset All Traces

Turns on Trace 1 and blanks all other traces. This is useful when you have many traces on and you want to return to having only Trace 1 on the display. Does not affect the trace type, detector or any other aspect of the trace system.

Remote Command	`:TRACe[:<meas>]:PRESet:ALL`
Example	`:TRAC:PRES:ALL`
Dependencies	When Signal ID is on, this key is grayed-out

Clear All Traces

Clears all traces. Does not affect the state of any function or variable in the instrument. Loads `mintracevalue` into all of the points for all traces, except traces in **Min Hold**, in which case it loads `maxtracevalue`, even if **Update** = `OFF`.

Remote Command	`:TRACe[:<meas>]:CLEar:ALL`
Example	`:TRAC:CLE:ALL`
Dependencies	When Signal ID is on, this key is grayed-out

3.9.20.5 Advanced

Contains controls for setting advanced trace functions of the instrument.

Measure Trace

Specifies which trace's scalar results are displayed in the **Metrics** window, and retrieved by sending a `:READ` or `:FETCh` query:

- Trace 1
- Trace 2
- Trace 3

Remote Command	`:CALCulate:<meas>:MTRace TRACe1 | TRACe2 | TRACe3`
	`:CALCulate:<meas>:MTRace?`
	`<meas>` is the identifier for the current measurement; any one of `CHPower | ACPower | OBWidth | SEMask | SPURious | PVTime`

Example	Channel Power
	`:CALC:CHP:MTR TRAC1`
	`:CALC:CHP:MTR?`

Dependencies	In the ACP measurement, this control is grayed-out when **Meas Method** is set to `RBW` or `FAST`, and only Trace 1 is enabled
Preset	`TRACe1`
State Saved	No
Range	Trace 1 | Trace 2 | Trace 3

3.10 TOI Measurement

IMPORTANT: This measurement is not supported in VXT models M9410A/11A/15A/16A.

The TOI measurement allows a simple (one-button) measurement of the third-order intercept of a two-tone signal. It also allows a more accurate (zero-span) measurement of that signal.

Measurement Commands

These commands are used to initialize the measurement, and to retrieve results.

All returned frequencies are affected by Frequency Offset, and all absolute amplitudes are affected by Ref Level Offset. Amplitudes are returned in dBm regardless of the Y Axis Unit.

For more information see "Measurement Details" on page 1737.

For measurement results and views, see "Views" on page 1738.

The general functionality of "CONFigure" on page 2732, "INITiate" on page 2733, "FETCh" on page 2733, "MEASure" on page 2735, and "READ" on page 2734 are described in the section **SCPI Operation and Results Query** in the topic **Programming the Instrument**.

`:INITiate:TOI`	Initiates a trigger cycle for the measurement, but does not return any data Does not change any measurement settings
`:CONFigure:TOI`	Selects the measurement with Meas Setup settings in their preset states. This is the same as "Meas Preset" on page 1810
`:CONFigure:TOI:NDEFault`	Selects `TOI` measurement *without* affecting settings
`:CONFigure?`	Returns the name of the measurement: `TOI`

The following queries are used to retrieve data. The type of data returned depends on the value of `n`.

Command	n	Return Value

`:FETCh:TOI[n]?`
`:MEASure:TOI[n]?`
`:READ:TOI[n]?`
	0	Returns the trace data, in interleaved X/Y pairs

`:FETCh:TOI[n]?`
`:MEASure:TOI[n]?`
`:READ:TOI[n]?`
	1	Returns 6 scalar results, in the following order

<table>
<tr><th>Command</th><th>n</th><th>Return Value</th></tr>
<tr><td></td><td></td><td>
<table>
<tr><th>#</th><th>Item</th><th>Unit</th></tr>
<tr><td>1</td><td>The worst-case Output Intercept Power value</td><td>dBm</td></tr>
<tr><td>2</td><td>The worst-case Output Intermod Point</td><td>Hz</td></tr>
<tr><td>3</td><td>The lower Output Intercept Power value</td><td>dBm</td></tr>
<tr><td>4</td><td>The lower Output Intermod Point</td><td>Hz</td></tr>
<tr><td>5</td><td>The upper Output Intercept Power value</td><td>dBm</td></tr>
<tr><td>6</td><td>The upper Output Intermod Point</td><td>Hz</td></tr>
</table>
</td></tr>
<tr><td></td><td>2</td><td>Returns 13 scalar results, in the following order
<table>
<tr><th>#</th><th>Item</th><th>Unit</th></tr>
<tr><td>1</td><td>The worst-case Output Intermod Point value</td><td>Hz</td></tr>
<tr><td>2</td><td>The worst-case Output Intermod Power value</td><td>dBm</td></tr>
<tr><td>3</td><td>The worst-case Output Intercept Power value</td><td>dBm</td></tr>
<tr><td>4</td><td>The lower base frequency value</td><td>Hz</td></tr>
<tr><td>5</td><td>The lower base power value</td><td>dBm</td></tr>
<tr><td>6</td><td>The upper base frequency value</td><td>Hz</td></tr>
<tr><td>7</td><td>The upper base power value</td><td>dBm</td></tr>
<tr><td>8</td><td>The lower Output Intermod Point</td><td>Hz</td></tr>
<tr><td>9</td><td>The lower Output Intermod Power value</td><td>dBm</td></tr>
<tr><td>10</td><td>The lower Output Intercept Power value</td><td>dBm</td></tr>
<tr><td>11</td><td>The upper Output Intermod Point</td><td>Hz</td></tr>
<tr><td>12</td><td>The upper Output Intermod Power value</td><td>dBm</td></tr>
<tr><td>13</td><td>The upper Output Intercept Power value</td><td>dB</td></tr>
</table>
</td></tr>
<tr><td>:FETCh:TOI:IP3?
:MEASure:TOI:IP3?
:READ:TOI:IP3?</td><td>1</td><td>Returns the worst-case Output Intercept Power value, in dBm</td></tr>
</table>

Backwards Compatibility SCPI

Each of the following commands translates to the equivalent :TOI command.

Backwards Compatibility Command	Current Command
`:CONFigure:TOIntercept`	`:CONFigure:TOI`
`:CONFigure:TOIntercept:NDEFault`	`:CONFigure:TOI:NDEFault`
`:INITiate:TOIntercept`	`:INITiate:TOI`
`:FETCh:TOIntercept[n]?`	`:FETCh:TOI[n]?`

Backwards Compatibility Command	Current Command
:MEASure:TOINtercept[n]?	:MEASure:TOI[n]?
:READ:TOINtercept[n]?	:READ:TOI[n]?
:FETCh:TOINtercept[n]:IP3?	:FETCh:TOI:IP3?
:MEASure:TOINtercept[n]:IP3?	:MEASure:TOI:IP3?
:READ:TOINtercept[n]:IP3?	:READ:TOI:IP3?

Measurement Details

The TOI measurement begins by taking a sweep using the current center frequency and span. It chooses the two highest peaks as the lower and upper tone frequencies, F_{Lower} and F_{Upper}. Then the third-order intermod frequencies are computed as:

$I_{Lower} = 2F_{Lower} - F_{Upper}$

$I_{Upper} = 2F_{Upper} - F_{Lower}$

The power is then measured at the four frequencies (unless either intermod frequency falls outside the span).

The third order intercept level is defined (all values expressed in dBm) as:

$$\mathrm{TOI}_{Lower} = \frac{P_{Upper}}{2} + P_{Lower} - \frac{P_{LowerIntermod}}{2}$$

$$\mathrm{TOI}_{Upper} = \frac{P_{Lower}}{2} + P_{Upper} - \frac{P_{UpperIntermod}}{2}$$

The third order delta level is defined (all values expressed in dBm) as:

$$\Delta_{Lower} = P_{LowerIntermod} - \frac{2 \times P_{Lower} + P_{Upper}}{3}$$

$$\Delta_{Upper} = P_{UpperIntermod} - \frac{2 \times P_{Upper} + P_{Lower}}{3}$$

Both values are computed, and the TOI is reported as the worst of the two measurements.

There are two approaches to TOI measurement acquisition. The first approach is a simple method to use a single sweep. This method gives the quickest approximate measurement and highest usability. (The span must be sufficient to encompass both the lower and upper intermod frequencies.)

The second approach is to supplement the above with zero-span acquisitions at the intermod frequencies. Because we spend the majority of our acquisition time at key frequencies, this technique gives more accurate measurement of low-power intermodulation distortion signals.

3.10.1 Views

The TOI measurement has two predefined views, both of which are multiple-window views. When in a multiple window view, you select a window by touching it. The menu controls may sometimes change depending on which window is selected.

The table below shows the Views and Windows for this measurement:

View	Result
"Normal" on page 1738	"Graph" on page 1739
	"Metrics" on page 1740
"Zero Span" on page 1739	"Graph" on page 1739
	"Metrics" on page 1740

Whenever the View changes, the default menu is **Frequency**, unless otherwise specified in the View description.

Remote Command	`:DISPlay:VIEW[:SELect] NORMal | ZSPan`
Example	`:DISP:VIEW ZSP`
Preset	`NORMal`
State Saved	Saved in instrument state

3.10.1.1 Normal

Windows:

- "Graph" on page 1739
- "Metrics" on page 1740

Multiple-window view of the frequency domain.

Example	`:DISP:VIEW NORM`

3.10.1.2 Zero Span

Windows:

– "Graph" on page 1739

– "Metrics" on page 1740

Multiple-window view of the zero span.

Example	`:DISP:VIEW NORM`

3.10.2 Windows

The following windows are available in this measurement:

1	"Graph" on page 1739
2	"Metrics" on page 1740

3.10.2.1 Graph

Window #1

This is the fundamental window used in the TOI measurement view. It displays Amplitude versus frequency information. The data and graticule are identical to those for the Swept SA measurement, except that the base and intermod peaks are annotated with a number in white:

1. lower intermod
2. lower base
3. upper base
4. upper intermod

The **Graph** window appears in both views, as follows:

View	Size	Position
"Normal" on page 1738	Half height, full width	Top
"Zero Span" on page 1739	Half height, full width	Top

When zero-span measurement is on, the intercept frequencies are measured in zero span (typically with a lower resolution bandwidth), and the results of that measurement are superimposed on the graticule in the form of a blue box displayed behind the trace data. The box has 50% transparency, height equal to the power measured by the zero-span measurement, and width equal to twice the resolution bandwidth.

3.10.2.2 Metrics

Window #2

The TOI Metrics result is displayed in a table below the graticule. The TOI number is the worse (lower) of the two calculated intercept points, while the **Δ** is the worse (higher) of the measured dBc values.

Absolute amplitude results are presented in the current Y Axis Unit.

3.10.3 Amplitude

Activates the **Amplitude** menu and selects **Reference Level** or **Reference Value** as the active function, depending on the measurement.

Some features in this menu apply to multiple measurements. Some other features apply only to specific measurements and their controls are blanked or grayed-out in measurements that do not support the feature.

3.10.3.1 Y Scale

Contains controls that pertain to the Y axis parameters of the measurement. These parameters control how data on the vertical (Y) axis is displayed and control instrument settings that affect the vertical axis.

Ref Value

Sets the value for the absolute power reference. The reference line is at the top, center, or bottom of the graticule, depending on the value of the Ref Position function.

Remote Command	`:DISPlay:TOI:VIEW:WINDow:TRACe:Y[:SCALe]:RLEVel <amplitude>` `:DISPlay:TOI:VIEW:WINDow:TRACe:Y[:SCALe]:RLEVel?`
Example	`:DISP:TOI:VIEW:WIND:TRAC:Y:RLEV -10 dBm` `:DISP:TOI:VIEW:WIND:TRAC:Y:RLEV?`
Couplings	"Attenuation" on page 1932 is coupled to **Ref Value** "Ref Level Offset" on page 1746 affects **Ref Value**
Preset	0 dBm
State Saved	Saved in instrument state

Min/Max	–/+250.00 dBm
Annotation	Ref <value> top left of graph

Scale/Div

For measurements that support a logarithmic Y-Axis, **Scale/Div** sets the height of one division of the graticule in the current Y-Axis unit.

Scale/Div also determines the displayed amplitude range in the log plot graph. Since there are usually 10 vertical graticule division on the display, the total amplitude range of the graph is typically 10x this amount. For example, if **Scale/Div** is 10 dB, then the total range of the graph is 100 dB.

In measurements that support both Log and Lin scales, this function is only available when Display Scale (Log) is selected, and the vertical scale is power. When Display Scale (Lin) is selected, **Scale/Div** is grayed out.

For the Harmonics measurement: The displayed Scale/Div is identical for all harmonics displayed.

Remote Command	`:DISPlay:TOI:VIEW:WINDow:TRACe:Y[:SCALe]:PDIVision <relative amplitude>` `:DISPlay:TOI:VIEW:WINDow:TRACe:Y[:SCALe]:PDIVision?`
Example	`:DISP:TOI:VIEW:WIND:TRAC:Y:PDIV 5` `:DISP:TOI:VIEW:WIND:TRAC:Y:PDIV?`
Preset	10.00 dB / Div
State Saved	Saved in instrument state
Min	0.10 dB
Max	20 dB
Annotation	<value> dB/ left upper of graph ! all measurements unless noted

Y Axis Unit

Displays a dropdown menu that enables you to change the vertical (Y) axis amplitude unit. This setting affects how the data is read over the remote interface. When using the remote interface, only numerical values are returned, so you must know what the Y Axis Unit is to interpret the results. This is described in more detail in "Amplitude Data Query and Y Axis Unit" on page 1744 below.

For measurements that support both Log and Lin scales, the instrument retains the entered Y Axis Unit separately for both Log and Lin amplitude Display Scales. For example, if Display Scale has been set to Log, and you set Y Axis Unit to dBm, pressing **Display Scale (Log)** sets the Y Axis Unit to dBm. If Display Scale has been set to Lin and you set Y Axis Unit to V, pressing **Display Scale (Lin)** sets the Y Axis Unit to V. Pressing **Display Scale (Log)** again sets the Y Axis Unit back to dBm.

If an Amplitude Correction is being applied that has an associated Transducer Unit, all selections but **Xducer Unit** are grayed-out. For more information, see "Transducer Unit" on page 1745 below.

Remote Command	`:UNIT:POWer DBM | DBMV | DBMA | V | W | A | DBUV | DBUA | DBPW | DBUVM | DBUAM | DBPT | DBG` `:UNIT:POWer?`

Example	`:UNIT:POW dBmV`
	`:UNIT:POW?`
	See also "Remote Interface Examples" on page 1743 below

Notes	The Y axis unit has either logarithmic or linear characteristics. The set of units that is logarithmic consists of dBm, dBmV, dBmA, dBmV, dBmA, dBmV/m, dBmA/m, dBpT, and dBG. The set of units that are linear consists of V, W, and A. The chosen unit will determine how the reference level and all the amplitude-related outputs like trace data, marker data, etc., read out
Dependencies	Appears only in Spectrum Analyzer Mode If an amplitude correction with a Transducer Unit other than None is applied and enabled: – The Transducer Unit selection is forced, and is the only Y Axis Unit available. The specific Transducer Unit is shown in square brackets in the dropdown, and all other Y Axis Unit choices are grayed-out – If you turn off that correction or set Apply Corrections to NO, the Y Axis Unit that existed before the Transducer Unit was applied is restored When Normalize is ON (in the **Trace**, **Normalize** menu), Y Axis Unit is grayed-out, and forced to dBm
Couplings	The instrument retains the entered Y Axis Unit separately for both Log and Lin amplitude Display Scales
Preset	dBm for log scale, V for linear. The true ‘preset’ value is dBm, since at preset the Y Display Scale is set to logarithmic
State Saved	Saved in instrument state
Annotation	The Y Axis Unit is shown after Ref Level value at the top of the graticule

Unit	Example	Notes
dBm	`:UNIT:POW DBM`	Y Axis Unit is set to dBm
dBmV	`:UNIT:POW DBMV`	Y Axis Unit is set to dBmV
dBmA	`:UNIT:POW DBMA`	Y Axis Unit is set to dBmA
W	`:UNIT:POW W`	Y Axis Unit is set to W
V	`:UNIT:POW V`	Y Axis Unit is set to V
A	`:UNIT:POW A`	Y Axis Unit is set to A
dBmV	`:UNIT:POW DBUV`	Y Axis Unit is set to dBmV
dBmA	`:UNIT:POW DBUA`	Y Axis Unit is dBmA. The unit dBuA can also appear as a Transducer Unit

Unit	Example	Notes
dBpW	:UNIT:POW DBPW	Y Axis Unit is set to dBpW

Remote Interface Examples

Command examples and details appear in the table below. Note that each of the commands below sets the amplitude unit only for the *selected* amplitude scale (Log or Lin), the other scale is unaffected.

Unit	Example	Notes
dBm	:UNIT:POW DBM	dB relative to one milliwatt
dBmV	:UNIT:POW DBMV	dB relative to one millivolt
dBmA	:UNIT:POW DBMA	dB relative to one milliamp
W	:UNIT:POW W	Watts
V	:UNIT:POW V	Volts
A	:UNIT:POW A	Amperes
dBmV	:UNIT:POW DBUV	dB relative to one microvolt
dBmA	:UNIT:POW DBUA	dB relative to one microamp The unit dBuA can also appear as a "Transducer Unit" on page 1745 When querying the Y-Axis unit, you can query the Transducer Unit to distinguish between regular dBuA and the dBuA transducer unit. If :CORR:CSET:ANT? returns NOC (for No Conversion), you are using a normal Y Axis dBuA. If it returns UA, you are using a Transducer Unit dBuA
dBpW	:UNIT:POW DBPW	dB relative to one picowatt
dBmV/m (Transducer Unit)	:UNIT:POW DBUVM	Sets the amplitude unit for the selected amplitude scale (log/lin) to dBmV/meter. This selection is only available if a Correction is turned on, and the Transducer Unit for that Correction is not None See "Transducer Unit" on page 1745
dBmA/m (Transducer Unit)	:UNIT:POW DBUAM	Sets the amplitude unit for the selected amplitude scale (log/lin) to dBmA/meter. This selection is only available if a Correction is turned on, and the Transducer Unit for that Correction is not None See "Transducer Unit" on page 1745
dBpT (Transducer Unit)	:UNIT:POW DBPT	Sets the amplitude unit for the selected amplitude scale (log/lin) to dBpT (dB relative to one picotesla). This selection is only available if a Correction is turned on, and the Transducer Unit for that Correction is not None See "Transducer Unit" on page 1745
dBG (Transducer	:UNIT:POW DBG	Sets the amplitude unit for the selected amplitude scale (log/lin) to dBG (dB relative to one Gauss). This selection is only available if a Correction is turned on, and the Transducer Unit for that Correction is not None

Unit	Example	Notes
Unit)		See "Transducer Unit" on page 1745
dBmA (Transducer Unit)	`:UNIT:POW DBUA`	Sets the amplitude unit for the selected amplitude scale (log/lin) to dBmA. This selection is only available as a Transducer Unit if a Correction is turned on, and the Transducer Unit for that Correction is not None See "Transducer Unit" on page 1745 The unit dBuA can also appear as a normal Y Axis Unit (see above) dBuA as a Transducer Unit is used when using current probes, because current probes are often supplied with conversion tables that provide the transducer factors. When dBuA is used as a Transducer Unit, the normal conversion from power to amps for dBuA (based on the instrument input impedance) is not done, but instead the conversion is based solely on the Correction that contains the transducer factors. This is what distinguishes dBuA as a normal unit from dBuA as a transducer unit When querying the Y-Axis unit, you can query the Transducer Unit to distinguish between regular dBuA and the dBuA Transducer Unit. If `:CORR:CSET:ANT?` returns `NOC` (for No Conversion), you are using a normal Y-Axis dBuA. If it returns `UA`, you are using a Transducer Unit dBuA

Amplitude Data Query and Y Axis Unit

The settings of Y-Axis Unit and Display Scale affect how the data is returned over the remote interface in response to a query. When using the remote interface, no unit is returned, so you must know what the Y-Axis unit is to interpret the results:

Example 1

Set the following:

- Display Scale (Log)
- Y Axis Unit, dBm
- Scale/Div, 1 dB
- Ref Level, 10 dBm

This sets the top line to 10 dBm with each vertical division representing 1 dB. Thus, if a point on trace 1 is on the fifth graticule line from the top, it represents 5 dBm and will read out remotely as 5.

Example 2

Set the following:

- Display Scale (Lin)
- Y Axis Unit, Volts
- Ref Level, 100 mV (10 mV/div)

This sets the top line to 100 mV and the bottom line to 0 V, so each vertical division represents 10 mV. Thus, if a point on trace 1 is on the fifth graticule line from the top, it represents 50 mV and will read out remotely as 50.

NOTE **The units of current (A, dBmA, dBuA) are calculated based on 50 Ω input impedance.**

Transducer Unit

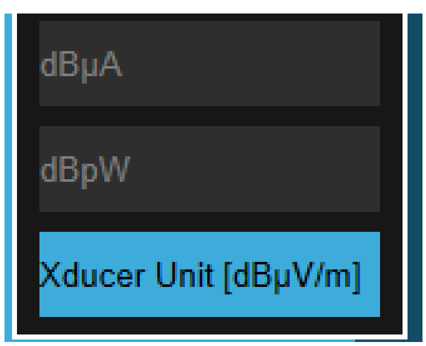
Transducer Units (formerly called Antenna Units) are units of field strength rather than amplitude, and are used when correcting the response of device such as antennas whose amplitude characteristics are measured in units of field strength. All five of the Transducer Units (dBmA/m, dBmV/m, dBG, dBpT, dBmA) are treated by the instrument exactly as though they were dBmV, when uncorrected. You must load an appropriate correction factor using Input/Output, Corrections for accurate and meaningful results.

If a remote command is sent to the instrument that uses one of the Transducer Units as a terminator, the instrument treats it as though DBUV had been sent as the terminator.

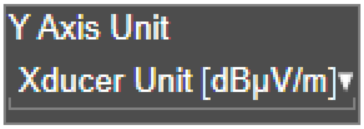
When a Correction is turned on that uses a Transducer Unit, the Y Axis Unit changes to that Transducer Unit. All of the selections in the **Y-Axis Unit** dropdown are then grayed-out, except the Transducer Unit selection. The unit being used is shown on this selection in square brackets, and appears on the control in square brackets preceded by **Xducer Unit**.

Example:

If the Transducer Unit in the Correction is dBmV/m, then the selection in the dropdown looks like this:



And on the control it looks like this:



NOTE

If a Transducer Unit is set, it is displayed as **Xducer Unit** in the **Y Axis Unit** dropdown. However, you can only *change* the Transducer Unit via the **Edit Correction** dialog in the **Input/Output**, **Corrections** menu. In that dialog, tap **Settings** then **Transducer Unit**. You can also turn off Transducer Unit from the same menu, by selecting **None**.

If a Transducer Unit is set, it is displayed as **Xducer Unit** in the **Y Axis Unit** dropdown. However, you can only *change* the Transducer Unit via the **Edit Correction** dialog in the **Input/Output**, **Corrections** menu. In that dialog, tap **Settings** then **Transducer Unit**. You can also turn off Transducer Unit from the same menu, by selecting **None**.

The Transducer Units are:

Units	Example
dBmV/m	`:UNIT:POW DBUVM`
dBmA/m	`:UNIT:POW DBUAM`
dBpT	`:UNIT:POW DBPT`
dBG	`:UNIT:POW DBG`
dBmA	`:UNIT:POW DBUA`
None	n/a

Ref Level Offset

Adds an offset value to the displayed reference level. The reference level is the absolute amplitude represented by the top graticule line on the display.

The on/off switch turns **Ref Level Offset** on or off. Setting a specific value turns **Ref Level Offset** ON.

Remote Command	`:DISPlay:WINDow[1]:TRACe:Y[:SCALe]:RLEVel:OFFSet <rel_ampl>` `:DISPlay:WINDow[1]:TRACe:Y[:SCALe]:RLEVel:OFFSet?`

Example	Set **Ref Level Offset** to 12.7 dB. The only valid suffix is dB. If no suffix is sent, dB is assumed:
	`:DISP:WIND:TRAC:Y:RLEV:OFFS 12.7`
	`:DISP:WIND:TRAC:Y:RLEV:OFFS?`

Preset	0 dBm

State Saved	Saved in instrument state
Min	Variable. Limited to values that keep the reference level within the range –327.6 dB to 327.6 dB
Max	327.6 dB
Annotation	The offset is displayed as "Ref Offset <value>" to the right of the reference level annotation if nonzero. When the offset is zero, no annotation is shown

Auto Function

Remote Command	`:DISPlay:WINDow[1]:TRACe:Y[:SCALe]:RLEVel:OFFSet:STATe OFF | ON | 0 | 1` `:DISPlay:WINDow[1]:TRACe:Y[:SCALe]:RLEVel:OFFSet:STATe?`
Example	`:DISP:WIND:TRAC:Y:RLEV:OFFS:STAT ON` Turns **Ref Level Offset** On
Preset	`OFF`

Ref Position

Positions the reference level at the top, center, or bottom of the Y Scale display. Changing the reference position does not change the reference level value.

Remote Command	`:DISPlay:TOI:VIEW[1]:WINDow[1]:TRACe:Y[:SCALe]:RPOSition TOP | CENTer | BOTTom` `:DISPlay:TOI:VIEW[1]:WINDow[1]:TRACe:Y[:SCALe]:RPOSition?`
Example	`:DISP:TOI:VIEW:WIND:TRAC:Y:RPOS BOTT` `:DISP:TOI:VIEW:WIND:TRAC:Y:RPOS?`
Preset	`TOP`
State Saved	Saved in instrument state
Range	`TOP|CENTer|BOTTom`
Annotation	The greater than (>) and less than (<) symbols are displayed on both sides of the graph to indicate the **Ref Position**

3.10.3.2 Attenuation

Controls the attenuator functions and interactions between the attenuation system components.

There are two attenuator configurations in the X-Series. One is a Dual-Attenuator configuration consisting of a mechanical attenuator and an optional electronic attenuator. The other configuration uses a single attenuator with combined mechanical and electronic sections that controls all the attenuation functions. Different models in the X-Series come with different configurations.

- See "Dual-Attenuator Configurations" on page 1748
- See "Single-Attenuator Configuration" on page 1749

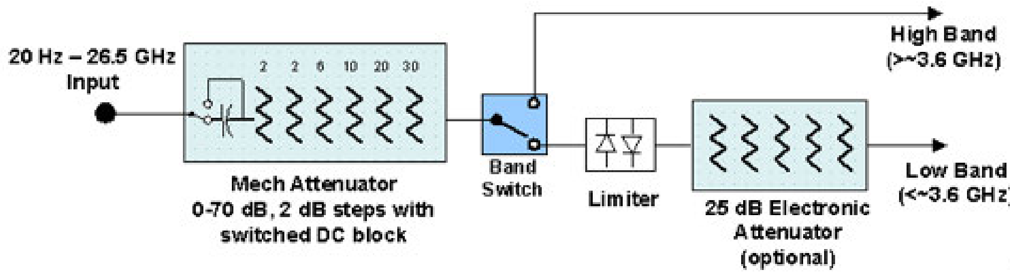
Most attenuation settings are the same for all measurements – they do not change as you change measurements. Settings like these are called “Meas Global” and are unaffected by **Meas Preset**.

Only available when the hardware set includes an input attenuator, which is typically only the case for Keysight’s benchtop instruments. For example, this tab does *not* appear in VXT models M9421A/10A/11A, nor in UXM. In UXM, all **Attenuation** and **Range** settings are disabled, as the expected input power level is handled by the Call Processing App that drives the DUT power control.

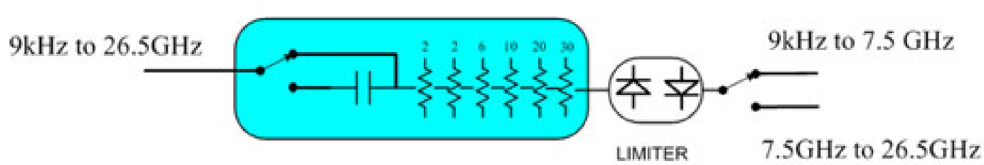
Dependencies	In measurements that support the I/Q inputs, unavailable when I/Q is the selected input. Replaced by the **Range** tab in that case

Dual-Attenuator Configurations

Configuration 1: Mechanical attenuator + optional electronic attenuator

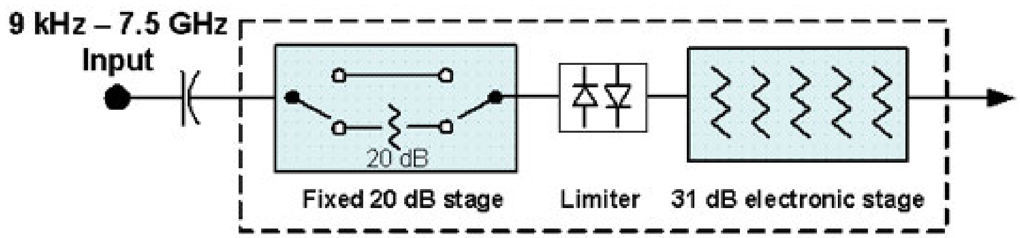


Configuration 2: Mechanical attenuator, no optional electronic attenuator



Note that Configuration 2 is not strictly speaking a dual-section attenuator, since there is no electronic section available. However, it behaves exactly like Configuration 1 without the Electronic Attenuator Option EA3, therefore for the sake of this document it is grouped into the “Dual-Attenuator” configuration.

Single-Attenuator Configuration



You can tell which attenuator configuration you have by pressing the Attenuation tab, which (in most Modes) opens the Attenuation menu. If the first control in the Attenuation menu says **Mech Atten** you have the Dual-Attenuator configuration. If the first control says **Atten** you have the Single-Attenuator configuration.

Dual Attenuator **Single Attenuator**

(Note that depending on the measurement, there may be no Auto/Man functionality on the Mech Atten control.)

In the Single-Attenuator configuration, you control the attenuation with a single control, as the fixed stage has only two states. In the Dual-Attenuator configuration, both stages have significant range, so you are given separate control of the mechanical and electronic attenuator stages.

When you have the Dual-Attenuator configuration, you may still have only a Single-Attenuator, because unless Option EA3 (the Electronic Attenuator option) is available, and you purchase it, you will have only the mechanical attenuator.

Full Range Atten

This control and **Attenuator Summary** only appear in N9041B, when the RF input is selected, the RF Input Port is set to RF Input 2, and the Full Range Attenuator is installed. The Full Range Attenuator adds a second input attenuator in front of RF Input 2, which enhances the protection and optimizes the performance of the extra internal mixers used by RF Input 2.

Remote Command	`[:SENSe]:POWer[:RF]:FRATten <rel_ampl>` `[:SENSe]:POWer[:RF]:FRATten?`
Example	`:POW:FRAT 14`

	:POW:FRAT?
Notes	When you enter an amplitude value that falls between valid values, the value will be incremented to the next smallest valid value
Dependencies	Only appears if input RF is selected, RF Input Port 2 is selected, and the Full Range Attenuator exists
Couplings	This value is never changed by any coupling, but other couplings use this value. See **Reference Level** and "Mech Atten" on page 1935 command descriptions
Preset	20 dB
State Saved	Saved in instrument state
Min	0 dB
Max	Only valid values are 0, 6, 14, 20 dB
Annotation	When the **Input** is **RF**, and the **Input Port** is **RF Input 2**, and the Full Range Attenuator is installed: On the Meas Bar, the field “Atten” displays as follows: – If the sweep is entirely < 50 GHz, the value shown after “Atten:” is equal to Mech Atten + Elec Atten + Full Range Atten – If the sweep is entirely > 50 GHz, the value shown after “Atten:” is equal to Full Range Atten – If the sweep straddles 50 GHz, the value shown after “Atten:” is preceded by the symbol “>=” and is equal to Full Range Atten In the **Amplitude**, "Y Scale" on page 1929 menu, and the Atten **Meas Bar** dropdown menu panel, a summary is displayed as follows: “Total Atten below 50 GHz” followed by the value of Full Range Atten + Mech Atten + Elec Atten “Total Atten above 50 GHz” followed by the value of Full Range Atten For example, if Mech Atten = 6 dB, Elec Atten = 4 dB, and Full Range Atten = 20 dB, the summary below is shown: – Attenuator summary: – Total Atten below 50 GHz: 30 dB – Total Atten above 50 GHz: 20 dB

Mech Atten

Labeled **Mech Atten** in Dual-Attenuator models and **Atten** in Single-Attenuator models. In the Dual-Attenuator configuration, this control only affects the mechanical attenuator.

Lets you modify the attenuation applied to the RF input signal path. This value is normally auto-coupled to the Ref Level, the Internal Preamp Gain, any External Gain that is entered, and the Max Mixer Level, as described in the table below.

See "Attenuator Configurations and Auto/Man" on page 1752

Remote Command	`[:SENSe]:POWer[:RF]:ATTenuation <rel_ampl>`
	`[:SENSe]:POWer[:RF]:ATTenuation?`
	`[:SENSe]:POWer[:RF]:ATTenuation:AUTO OFF | ON | 0 | 1`
	`[:SENSe]:POWer[:RF]:ATTenuation:AUTO?`

Example	`:POW:ATT 20`
	Dual-Attenuator configuration: sets the mechanical attenuator to 20 dB
	Single-Attenuator mode: sets the main attenuation to 20 dB (see below for definition of “main” attenuation)
	In either case, if the attenuator was in Auto, it is set to Manual
	`:POW:ATT:AUTO ON`
	Turn Auto Mech Atten ON

Dependencies	Some measurements do not support Auto setting of "Mech Atten" on page 1750. In these measurements, the **Auto/Man** selection is not available, and the Auto/Man toggle function is not available In Dual-Attenuator configurations, when the electronic attenuator is enabled, the mechanical attenuator has no auto setting, and the Auto/Man toggle function is not available. The state of Auto/Man is remembered and restored when the electronic attenuator is once again disabled. This is described in more detail in "Elec Atten" on page 1937 See "Attenuator Configurations and Auto/Man" on page 1752 for more information on the Auto/Man functionality `:POW:ATT:AUTO` is only available in measurements that support Mech Atten Auto, such as Swept SA
Couplings	If the RF Input Port is the RF Input: – If the USB Preamp is connected to USB, use 0 dB for Mech Atten – Otherwise compute the auto-selected value of Mech Atten based on **Reference Level**, Int Preamp, External Gain, Ref Level Offset, Max Mixer Level, µW Path Control and IF Gain settings. Limit this value to be no less than 6 dB (total attenuation below 6 dB can never be chosen by Auto) – In the N9041B, if the RF Input Port is RF Input 2, use the formula above and subtract the Full Range Atten value from the result to determine the Mech Atten. Limit the value so that it is never lower than 0 dB and so that total attenuation, including Full Range Atten, is never less than 6 dB (total attenuation, including Full Range Atten below 6 dB, can never be chosen by Auto) In External Mixing and BBIQ, where the Attenuator is not in the signal path, the Attenuator setting changes as described above when "Mech Atten" on page 1750 is in Auto, but no changes are made to the actual attenuator hardware setting until the input is changed back to the RF Input For CXA-m with option FSA (Fine-Step Attenuator or 2 dB steps), the FSA-like behavior is only available when the frequency setting is <= 7.5 GHz. So, when the frequency is changed from below 7.5 GHz to above 7.5 GHz, the attenuation setting will be changed to a multiple of 10 dB which will be no smaller than the previous setting. For example, 4 dB attenuation will be changed to 10 dB
Preset	The preset for Mech Attenuation is “Auto” The Auto value of attenuation is 10 dB ON

State Saved	Saved in instrument state
Min	0 dB The attenuation set by this control cannot be decreased below 6 dB with the knob or step keys. Values below 6 dB must be directly entered from the keypad or via SCPI. This protects against setting a dangerously small attenuation value, which can put the instrument at risk of damage to input circuitry. If the current mechanical attenuation is below 6 dB, it can be increased with the knob and step keys, but not decreased
Max	CXA Option 503 or 507: 50 dB EXA: 60 dB All other models: 70 dB Note that in the Single-Attenuator configuration, the total of ATT and EATT cannot exceed 50 dB. So, if the EATT is set to 24 dB first, the main attenuation cannot be greater than 26 dB and will be reduced accordingly; if the main attenuator is set to 40 dB first, EATT cannot be greater than 10 dB
Annotation	The current value for Total Atten is displayed in the Measurement Bar at the top of the display. A value appears for Electronic Attenuation only if the Electronic Attenuator is enabled. The annotation appears as Atten: <total> dB (e<elec>) The e letter is in amber in Single-Attenuator configurations For example: Dual-Attenuator configuration: Atten: 24 dB (e14) Indicating the total attenuation is at 24 dB and the electronic attenuation is at 14 dB Single-Attenuator configuration: A: 24 dB (e14) Indicating the total attenuation is at 24 dB and the “soft” attenuation is at 14 dB (see below for definition of “soft” attenuation) When in Manual, a # sign appears in front of Atten in the annotation

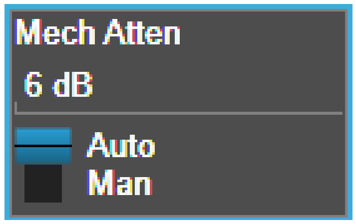
Attenuator Configurations and Auto/Man

As described under "Y Scale" on page 1929, there are two distinct attenuator configurations available in the X-Series, the single attenuator and Dual-Attenuator configurations. In Dual-Attenuator configurations, we have the mechanical attenuation and the electronic attenuation, and the current total attenuation is the sum of the electronic + mechanical attenuation. In Single-Attenuator configurations, we refer to the attenuation set using "Mech Atten" on page 1750 (or `:POW:ATT`) as the “main” attenuation; and the attenuation that is set by `:POW:EATT` as the “soft” attenuation (`:POW:EATT` is honored even in the Single-Attenuator configuration, for compatibility purposes). Then the current total attenuation is the sum of the main + soft attenuation.

See "Elec Atten" on page 1937 for more about “soft” attenuation.

NOTE

In some measurements, the **Mech Atten** control has an Auto/Man function. In these measurements, an Auto/Man switch is shown on the **Mech Atten** control:



Note that in configurations that include an Electronic Attenuator, this switch is only shown when the Electronic Attenuator is disabled.

In other measurements, **Mech Atten** has no Auto/Man function. In these measurements, no switch is shown on the **Mech Atten** control:

Mech Atten also appears with no switch, as above, in configurations that include an Electronic Attenuator but when the Electronic Attenuator is enabled.

Elec Atten

Controls the Electronic Attenuator in Dual-Attenuator configurations. Does not appear in Single-Attenuator configurations, because the control of both the mechanical and electronic stages of the Single-Attenuator is integrated into the single **Atten** control.

This control includes an **Enable/Disable** toggle switch; it is only possible to enter a value for the Electronic Attenuator when this switch is in the **Enable** position.

For more details about the Electronic Attenuator, see "More Information" on page 1755

Remote Command	`[:SENSe]:POWer[:RF]:EATTenuation <rel_ampl>`
	`[:SENSe]:POWer[:RF]:EATTenuation?`
	`[:SENSe]:POWer[:RF]:EATTenuation:STATe OFF | ON | 0 | 1`
	`[:SENSe]:POWer[:RF]:EATTenuation:STATe?`

Example	`:POW:EATT 10`
	`:POW:EATT?`
	`:POW:EATT:STAT ON`
	`:POW:EATT:STAT?`

Notes	Electronic Attenuation's specification is defined only when Mechanical Attenuation is 6 dB
Dependencies	Only appears in Dual-Attenuator models with an Electronic Attenuator installed and licensed. Does not appear in models with the Single-Attenuator configuration, because in the Single-Attenuator configuration there is no "electronic attenuator"; there is only a single integrated attenuator (which has both a mechanical and electronic stage). However, in the Single-Attenuator configuration, EATT SCPI commands are accepted for compatibility with other X-series instruments, and set a "soft" attenuation. The "soft" attenuation is treated as an addition to the "main" attenuation value set by the **Attenuation** control or `:POW:ATT`, and affects the total attenuation displayed on the **Attenuation** control and the Meas Bar The electronic attenuator, and the "soft" attenuation function provided in Single-Attenuator configurations, are unavailable above the low band (0-3.6 GHz, 0-3.4 GHz, 0-3 GHz, depending on the model). If the low band range is from 0-3.6 GHz, and Stop Frequency of the instrument is > 3.6 GHz, then the **Enabled/Disabled** section of the **Elec Atten** control will be `OFF` and grayed-out If "Internal Preamp" on page 1959 is `ON` (that is, set to Low Band or Full), the electronic attenuator (and the "soft" attenuation function provided in Single-Attenuator configurations) is unavailable. In this case the **Enabled/Disabled** section of the **Elec Atten** control will be `OFF` and grayed-out If either of the above is true, and the SCPI command is sent, an error indicating that the electronic attenuator is unavailable is returned If both the above are true, pressing the control generates error message -221, in other words, the frequency range lockout takes precedence If the electronic/soft Attenuator is enabled, then the **Stop Freq** of the instrument is limited to 3.6 GHz and **Internal Preamp** is unavailable If "LNA" on page 1960 is `ON`, the electronic attenuator (and the "soft" attenuation function provided in Single-Attenuator configurations) is unavailable. In this case the **Enabled/Disabled** section of the **Elec Atten** control will be `OFF` and grayed-out. This coupling works in the following modes/measurements: – Channel Power, Occupied BW, ACP, SEM, Spurious Emissions, Power Stat CCDF measurements in all Modes – Transmit On|Off Power measurement in 5GNR Mode – Power vs. Time and Transmit Power measurement in GSM/EDGE Mode – Burst Power measurement in Spectrum Analyzer Mode The SCPI-only "soft" electronic attenuation for the single-attenuator configuration is not available in all measurements; in particular, it is not available in the Swept SA measurement
Couplings	Enabling and disabling the Electronic Attenuator affects the setting of the Mechanical Attenuator (in Dual-Attenuator configurations). This is described in more detail below and in "Mechanical Attenuator Transition Rules" on page 1755
Preset	0 dB `OFF` (Disabled) for Swept SA measurement `ON` (Enabled) for all other measurements that support the electronic attenuator
State Saved	Saved in instrument state
Min	0 dB
Max	Dual-Attenuator configuration: 24 dB

	Single-Attenuator configuration: the total of ATT and EATT cannot exceed 50 dB. So, if the EATT is set to 24 dB first, the main attenuation cannot be greater than 26 dB and will be reduced accordingly; if the main attenuator is set to 40 dB first, EATT cannot be greater than 10 dB
Annotation	See Annotation under the **Mech Atten** control description

More Information

The electronic attenuator offers finer steps than the mechanical attenuator, has no acoustical noise, is faster, and is less subject to wear. These advantages primarily aid in remote operation and are negligible for front panel use. See "Using the Electronic Attenuator: Pros and Cons" on page 1756 for a detailed discussion of the pros and cons of using the electronic attenuator.

For the Single-Attenuator configuration, for SCPI backwards compatibility, the “soft” attenuation feature replaces the Dual-Attenuator configuration’s electronic attenuator. All the same couplings and limitations apply. See "Attenuator Configurations and Auto/Man" on page 1937

Mechanical Attenuator Transition Rules

When the Electronic Attenuator is enabled, the Mechanical Attenuator transitions to a state that has no Auto function. Below are the rules for transitioning the Mechanical Attenuator. Note that the information below *only* applies to the Dual-Attenuator configurations, and *only* when the Electronic Attenuator is installed:

When the Electronic Attenuation is enabled from a disabled state:

- The Mechanical Attenuator is initialized to 10 dB (this is its optimal performance setting). You can then set it as desired with SCPI, numeric keypad, step keys, or knob, and it behaves as it normally would in manual mode
- The Auto/Man state of (Mech) Atten is saved
- The Auto/Man toggle on the (Mech) Atten control disappears, and the auto rules are disabled
- The Electronic Attenuator is set to 10 dB less than the previous value of the Mechanical Attenuator, within the limitation that it must stay within the range of 0 to 24 dB of attenuation

Examples in the Dual-Attenuator configuration:

- Mech Atten at 20 dB. Elec Atten enabled, Mech Atten set to 10 dB, and Elec Atten set to 10 dB. New total attenuation equals the value before Elec Atten enabled
- Mech Atten at 0 dB. Elec Atten enabled, Mech Atten set to 10 dB, and Elec Atten set to 0 dB. New total attenuation does not equal the value before Elec Atten

enabled

– Mech Atten at 40 dB. Elec Atten enabled, Mech Atten set to 10 dB, and Elec Atten set to 24 dB. New total attenuation does not equal the value before Elec Atten enabled

When the Electronic Attenuation is disabled from an enabled state:

– The Elec Atten control is grayed out

– The Auto/Man state of (Mech) Atten is restored

– If now in Auto, (Mech) Atten recouples

– If now in Man, (Mech) Atten is set to the value of total attenuation that existed before the Elec Atten was disabled. The resulting value is rounded up to the smallest value possible given the (Mech) Atten Step setting - (That is, 57 dB changes to 58 dB when (Mech) Atten Step is 2 dB)

Using the Electronic Attenuator: Pros and Cons

The electronic attenuator offers finer steps than the mechanical attenuator, has no acoustical noise, is faster, and is less subject to wear.

The “finer steps” advantage of the electronic attenuator is beneficial in optimizing the alignment of the instrument dynamic range to the signal power in the front panel as well as remote use. Thus, you can achieve improved relative signal measurement accuracy. Compared to a mechanical attenuator with 2 dB steps, the 1 dB resolution of the electronic attenuator only gives better resolution when the odd-decibel steps are used. Those odd-decibel steps are less accurately calibrated than the even-decibel steps, so one tradeoff for this superior relative accuracy is reduced absolute amplitude accuracy.

Another disadvantage of the electronic attenuator is that the spectrum analyzer loses its “Auto” setting, making operation less convenient.

Also, the relationship between the dynamic range specifications (TOI, SHI, compression, and noise) and instrument performance are less well-known with the electrical attenuator. With the mechanical attenuator, TOI, SHI, and compression threshold levels increase dB-for-dB with increasing attenuation, and the noise floor does as well. With the electronic attenuator, there is an excess attenuation of about 1 to 3 dB between 0 and 3.6 GHz, making the effective TOI, SHI, and so forth, less well known. Excess attenuation is the actual attenuation relative to stated attenuation. Excess attenuation is accounted for in the instrument calibration.

Adjust Atten for Min Clipping

Sets the combination of mechanical and electronic attenuation and gain based on the current measured signal level so that clipping will be at a minimum.

This is an immediate action function, that is, it executes once, when the control is pressed.

The algorithms that are used for the adjustment are documented under "Pre-Adjust for Min Clipping" on page 1942.

Remote Command	`[:SENSe]:POWer[:RF]:RANGe:OPTimize IMMediate`
Example	`:POW:RANG:OPT IMM`
Notes	Executing **Adjust Atten for Min Clipping** initiates the measurement
Dependencies	Does not appear in the Swept SA, RTSA, Monitor Spectrum and Complex Spectrum measurements Appears in the Waveform measurement in 5G NR Mode only

Adjust Atten

Allows you to select;

– Electric attenuator only

– Combination of Electric attenuator and Mechanical attenuator

when `[:SENSe]:POWer[:RF]:RANGe:OPTimize IMMediate` is executed.

Remote Command	`[:SENSe]:POWer[:RF]:RANGe:OPTimize:TYPE EONLy | COMBined` `[:SENSe]:POWer[:RF]:RANGe:OPTimize:TYPE?`
Example	`:POW:RANG:OPT:TYPE EONL` `:POW:RANG:OPT:TYPE?`
Dependencies	Does not appear in the Swept SA, RTSA, Monitor Spectrum and Complex Spectrum measurements Appears in the Waveform measurement in 5G NR Mode only
Preset	`COMBined`
State Saved	Saved in instrument state

Pre-Adjust for Min Clipping

If this function is `ON`, it applies the adjustment described under "Adjust Atten for Min Clipping" on page 1941 each time a measurement restarts. Therefore, in Continuous measurement mode, it only executes before the first measurement.

In Dual-Attenuator models, you can set **Elec+Mech Atten**, in which case both attenuators participate in the autoranging, or **Elec Atten Only**, in which case the mechanical attenuator does not participate in the autoranging. This latter case results in less wear on the mechanical attenuator and is usually faster.

See "Adjustment Algorithm" on page 1759

Selection	SCPI	Note
Off	`OFF`	This is the default setting
On	`ON`	Available in Single-Attenuator instruments. For compatibility with models that do not have an input attenuator, the `ON` parameter is supported and mapped to `COMBined`
Elec Atten Only	`ELECtrical`	Selects only the electric attenuator to participate in auto ranging. This offers less wear on the mechanical attenuator and is usually faster
Elec+Mech Atten	`COMBined`	In Dual-Attenuator models, this selects both attenuators to participate in the autoranging

Remote Command	`[:SENSe]:POWer[:RF]:RANGe:OPTimize:ATTenuation OFF | ON | ELECtrical | COMBined` `[:SENSe]:POWer[:RF]:RANGe:OPTimize:ATTenuation?`
Example	`:POW:RANG:OPT:ATT OFF` `:POW:RANG:OPT:ATT?`
Notes	The parameter option `ELECtrical` sets this function to `ON` in Single-Attenuator models The parameter option `COMBined` is mapped to `ELECtrical` in Single-Attenuator models. If you send `COMBined`, it sets the function to `ON` and returns `ELEC` to a query For SCPI compatibility with models that do not have an input attenuator, the `ON` parameter is honored and mapped to `COMBined`
Dependencies	Only appears in Dual-Attenuator models with an Electronic Attenuator installed In instruments with Dual-Attenuator model, when "Elec Atten" on page 1937 is `OFF` or grayed-out, "Pre-Adjust for Min Clipping" on page 1757 is grayed-out Does not appear in the Swept SA, RTSA, Monitor Spectrum and Complex Spectrum measurements For the Waveform measurement, available only in 5G NR Mode
Preset	`OFF` when Elec Atten is Disabled at preset, otherwise `ELEC`
State Saved	Saved in instrument state
Range	Dual-Attenuator models: Off | Elec Atten Only | Mech + Elec Atten Single-Attenuator models: Off | On

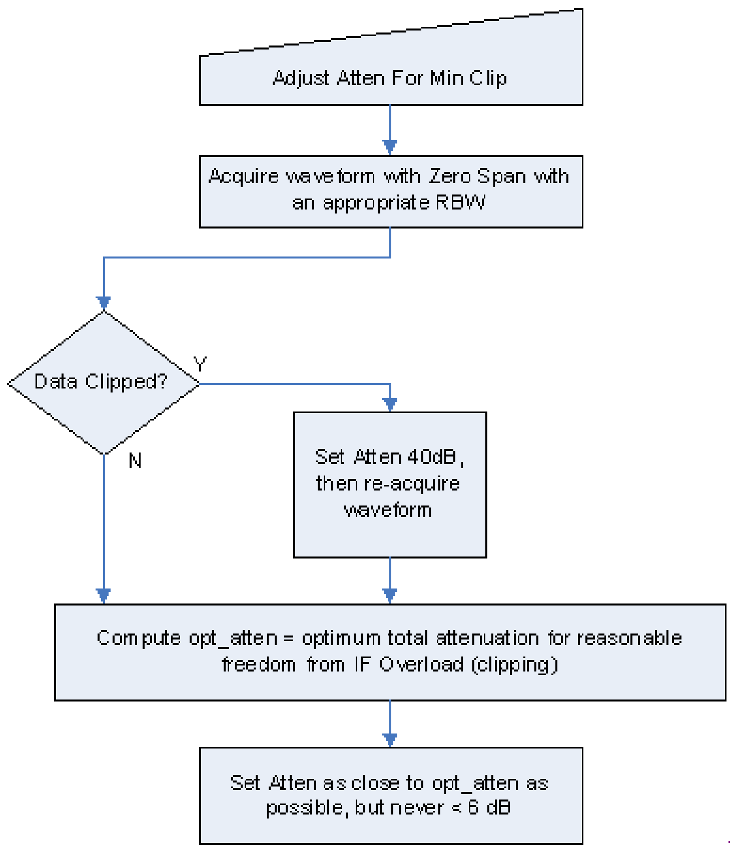
Notes	`ON` aliases to "Elec Atten Only" (`:POW:RANG:OPT:ATT ELEC`) `OFF` aliases to "Off" (`:POW:RANG:OPT:ATT OFF`) `:POW:RANG:AUTO?` returns true if `:POW:RANG:OPT:ATT` is not `OFF`

Backwards Compatibility SCPI	[:SENSe]:POWer[:RF]:RANGe:AUTO ON | OFF | 1 | 0 [:SENSe]:POWer[:RF]:RANGe:AUTO?

Adjustment Algorithm

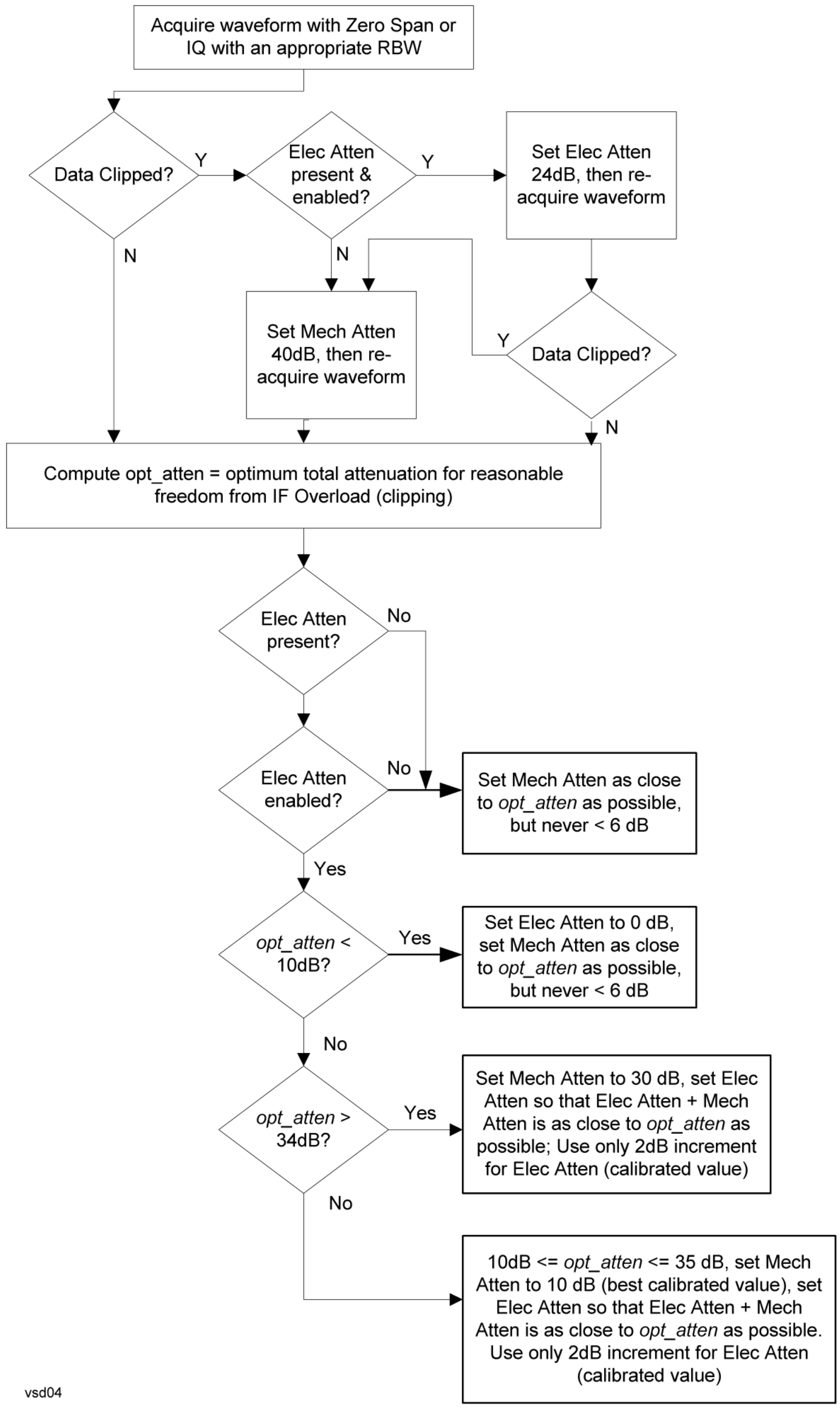
The algorithms for the adjustment are documented below:

Single-Attenuator Models



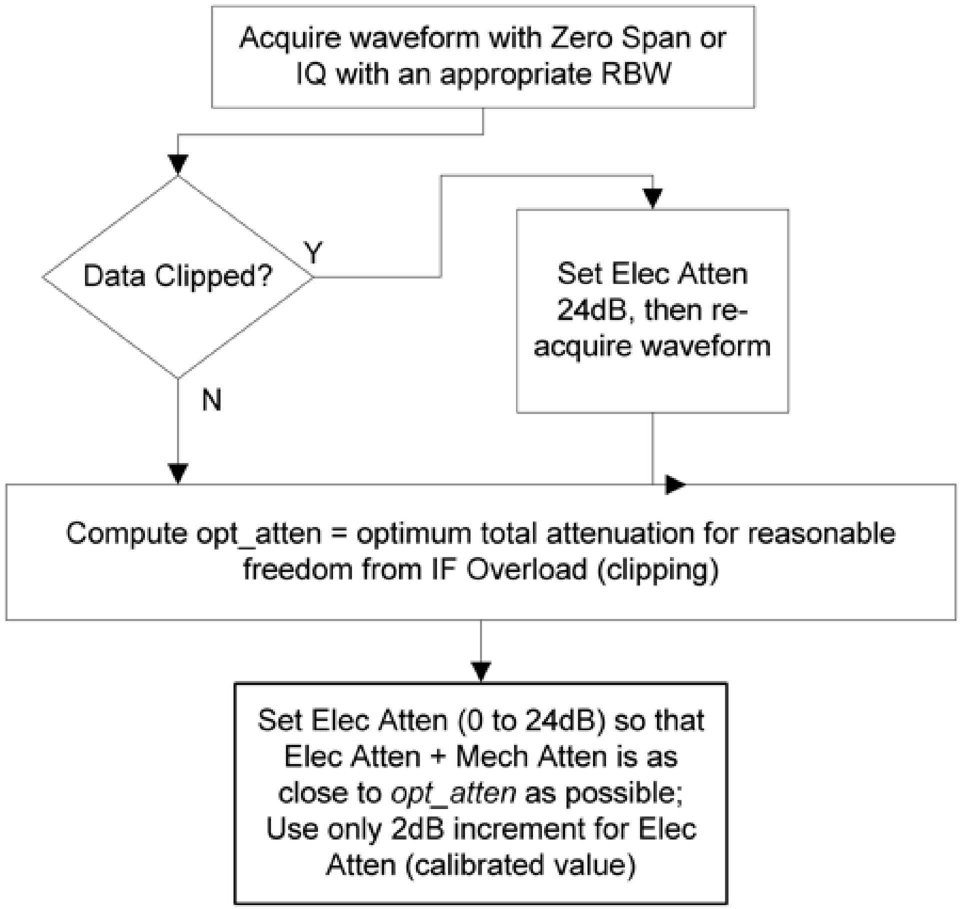
Dual-Attenuator models

"Adjust Atten for Min Clipping" on page 1941 or "Pre-Adjust for Min Clipping" on page 1757 selection is Mech + Elec Atten:


Acquire waveform with Zero Span or IQ with an appropriate RBW
Data Clipped?
Y
Elec Atten present & enabled?
Y
Set Elec Atten 24dB, then re-acquire waveform
N
N
Set Mech Atten 40dB, then re-acquire waveform
Y
Data Clipped?
N
Compute opt_atten = optimum total attenuation for reasonable freedom from IF Overload (clipping)
Elec Atten present?
No
Elec Atten enabled?
No
Set Mech Atten as close to opt_atten as possible, but never < 6 dB
Yes
opt_atten < 10dB?
Yes
Set Elec Atten to 0 dB, set Mech Atten as close to opt_atten as possible, but never < 6 dB
No
opt_atten > 34dB?
Yes
Set Mech Atten to 30 dB, set Elec Atten so that Elec Atten + Mech Atten is as close to opt_atten as possible; Use only 2dB increment for Elec Atten (calibrated value)
No
10dB <= opt_atten <= 35 dB, set Mech Atten to 10 dB (best calibrated value), set Elec Atten so that Elec Atten + Mech Atten is as close to opt_atten as possible. Use only 2dB increment for Elec Atten (calibrated value)
vsd04

"Pre-Adjust for Min Clipping" on page 1757 selection is Elec Only.

Note that the **Mech Atten** value is not adjusted, and the value previously set is used. Therefore, there is a case that IF Overload is still observed depending on the input signal level and the Mech Atten setting.



Mech Atten Step

Controls the step size used when making adjustments to the input attenuation.

Labeled **Mech Atten Step** in Dual-Attenuator models and **Atten Step** in Single-Attenuator models. In the Dual-Attenuator configuration, only affects the step size of the mechanical attenuator.

Remote Command	`[:SENSe]:POWer[:RF]:ATTenuation:STEP[:INCRement] 10 dB | 2 dB`

	`[:SENSe]:POWer[:RF]:ATTenuation:STEP[:INCRement]?`
Example	`:POW:ATT:STEP 2` `:POW:ATT:STEP?`
Notes	Has a toggle control on the front panel, but takes a specific value (in dB) when used remotely. The only valid values are 2 and 10
Dependencies	Blanked in EXA, CXA and CXA-m if option FSA (2 dB steps) is not present. If blanked, attempts to set it via SCPI yield an error
Couplings	When the attenuation step size changes, the current mechanical attenuation value is adjusted (if necessary) to be quantized to the new step size. That is, if step is set to 10 dB, mech atten is increased if necessary so it is a multiple of 10 dB
Preset	EXA, CXA and CXA-m: 10 dB (2 dB with option FSA) All other models: 2 dB
State Saved	Saved in instrument state

3.10.3.3 Range (Non-attenuator models)

Only available for Keysight's modular signal analyzers and certain other Keysight products, such as VXT

State Saved	No

Range

Represents the amplitude of the largest sinusoidal signal that could be present within the IF without being clipped by the ADC. For signals with high peak-to-average ratios, the range may need to exceed the rms signal power by a significant amount to avoid clipping.

This is a measurement global setting.

Remote Command	`[:SENSe]:POWer[:RF]:RANGe <real>` `[:SENSe]:POWer[:RF]:RANGe?`
Example	`:POW:RANG 10 dBm` `:POW:RANG?`
Notes	The MIN and MAX values are affected by the External Gain parameters, and by the **Center Frequency** The hardware compensates for frequency response and alters the Range setting
Preset	0 dBm
State Saved	Yes
Min	-100
Max	100
Annotation	Meas Bar

Adjust Range for Min Clipping

Sets the combination of attenuation and gain based on the current measured signal level so that clipping will be at a minimum.

This is an "immediate action" function, that is, it executes once, when the key is pressed.

This key does not appear in measurements that do not support this functionality.

Remote Command	`[:SENSe]:POWer[:RF]:RANGe:OPTimize IMMediate`
Notes	Executing Adjust Range for Min Clipping initiates the measurement
Dependencies	Does not appear in the Swept SA and Monitor Spectrum measurements

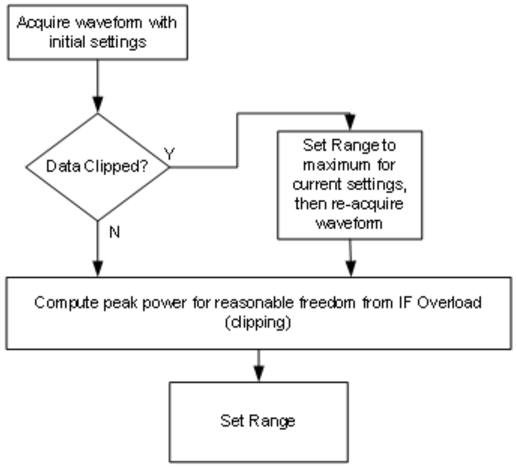
Pre-Adjust for Min Clipping

If this function is ON, it applies the adjustment described under Adjust Range For Min Clipping each time a measurement restarts. Therefore, in Continuous measurement mode, it only executes before the first measurement.

Remote Command	`[:SENSe]:POWer[:RF]:RANGe:OPTimize:ATTenuation OFF | ON | ELECtrical | COMBined` `[:SENSe]:POWer[:RF]:RANGe:OPTimize:ATTenuation?`
Notes	Because there is no attenuator control available in these models, the control displays only ON and OFF choices. However, for SCPI compatibility with other platforms, all three parameters (`ELECtrical`, `COMBined`, and ON) are honored and all are mapped to `ELECtrical`, so if any of these three parameters is sent, a subsequent query will return `ELEC`
Dependencies	Does not appear in the Swept SA and Monitor Spectrum measurements
Preset	OFF for Swept SA measurement; ON for all other measurements that support **Pre-Adjust for Min Clipping**
State Saved	Saved in instrument state

Adjustment Algorithm

The algorithm for the adjustment is documented below:



Peak-to-Average Ratio

Used with "Range (Non-attenuator models)" on page 1953 to optimize the level control in the instrument. The value is the ratio, in dB, of the peak power to the average power of the signal to be measured. A ratio of 0 should be used for sinusoidal signals; for 802.11g OFDM signals use 9 dB.

All Modes show the current value of Peak-to-Average ratio on the control. However, some Modes do not permit changing the value. In these situations, the control is grayed-out.

Remote Command	`[:SENSe]:POWer[:RF]:RANGe:PARatio <real>` `[:SENSe]:POWer[:RF]:RANGe:PARatio?`
Example	`:POW:RANG:PAR 12 dB`
Notes	In some Modes, this parameter is read-only; meaning the value will appear on the control and query via SCPI, but is not changeable. In such applications the control is grayed-out. Attempting to change the value via SCPI will be ignored but no error message will be generated
Dependencies	Does not appear in Spectrum Analyzer Mode
Preset	10 dB VXT Models M9410A/11A: 0 dB
State Saved	Saved in instrument state
Min	0 dB
Max	20 dB VXT Models M9410A/11A: 50 dB

Mixer Lvl Offset

This is an advanced setting to adjust target Range at the input mixer, which in turn affects the signal level in the instrument's IF. This setting can be used when additional optimization is needed after setting "Peak-to-Average Ratio" on page 1955. Positive values of offset optimize noise performance over distortion, negative values optimize distortion performance over noise.

Remote Command	`[:SENSe]:POWer[:RF]:RANGe:MIXer:OFFSet <real>` `[:SENSe]:POWer[:RF]:RANGe:MIXer:OFFSet?`
Example	`:POW:RANG:MIX:OFFS -5 dB`
Preset	0 dB
State Saved	Saved in instrument state
Min	-35 dB VXT Models M9410A/11A: -34 dB
Max	30 dB

3.10.3.4 Signal Path

Contains controls that pertain to the routing of the signal through the frontend of the instrument.

In general, only appears in instruments whose hardware supports this signal routing. For example, this tab does not appear in many of the modular instrument products, including VXT Model M9421A, or UXM.

This tab *does* appear in VXT Models M9410A/11A, because "Software Preselection" on page 1971 is under this tab, and VXT Models M9410A/11A implement a version of Software Preselection.

Presel Center

Adjusts the centering of the preselector filter to optimize the amplitude accuracy at the frequency of the selected marker. If the selected marker is not on when **Presel Center** is pressed, the instrument turns on the selected marker, performs a peak search, and then performs centering on the marker's center frequency. If the selected marker is already on and between the start and stop frequencies of the instrument, the instrument performs the preselector calibration on that marker's frequency. If the selected marker is already on, but outside the frequency range between **Start Freq** and **Stop Freq**, the instrument first performs a peak search, and then performs centering on the marker's center frequency.

The value displayed on "Preselector Adjust" on page 1958 changes to reflect the new preselector tuning.

Certain considerations should be observed to ensure proper operation, as detailed in "Proper Preselector Operation" on page 1766.

Remote Command	`[:SENSe]:POWer[:RF]:PCENter`
Example	`:POW:PCEN`
Notes	The rules outlined above under the control description apply for the remote command as well as the key. The result of the command depends on marker position, etc. Any message generated by the control press is also generated in response to the remote command
Dependencies	Does not appear in CXA-m, nor in VXT Models M9410A/11A Grayed-out if the microwave preselector is off – If the selected marker's frequency is below Band 1, an advisory message is generated "Preselector not used in this frequency range" and no action is taken – Grayed-out if entirely in Band 0, that is, if **Stop Freq** is below about 3.6 GHz Grayed-out if entirely above 50 GHz, that is, if **Start Freq** is above 50 GHz – Blanked in models that do not include a preselector, such as Option 503. If the remote command is sent in these instruments, accepted without error, and the query always returns 0 – Grayed-out in the Spectrogram View
Couplings	The active marker position determines where the centering will be attempted If the instrument is in a measurement such as averaging when centering is initiated, the act of centering the preselector restarts averaging, but the first average trace will not be taken until the centering is completed The offset applied to do the centering appears in "Preselector Adjust" on page 1958
Status Bits/OPC dependencies	When centering the preselector, `*OPC` does not return true until the process is complete and a subsequent measurement has completed, nor are results returned in response to `:READ` or `:MEASure` queries The `Measuring` bit remains set (true) while this command is operating, and does not go false until the subsequent sweep/measurement has completed

Proper Preselector Operation

Certain considerations should be observed to ensure proper operation:

1. If the selected marker is **Off**, the instrument turns on a marker, performs a peak search, and adjusts the preselector using the selected marker's frequency. It uses the "highest peak" peak search method unqualified by threshold or excursion, so that there is no chance of a 'no peak found' error. It continues with that peak, even if it is the peak of just noise. Therefore, for this operation to work properly, there should be a signal on-screen in a preselected range for the peak search to find

2. If the selected marker is already **On**, the instrument attempts the centering at that marker's frequency. There is no preselector for signals below about 3.6 GHz, so if the marker is on a signal below 3.6 GHz, no centering is attempted, and an advisory message is generated

3. In some models, the preselector can be bypassed. If it is bypassed, no centering is attempted in that range and a message is generated

Preselector Adjust

Lets you manually adjust the preselector filter frequency to optimize its response to the signal of interest. Only available when "Presel Center" on page 1956 is available.

For general purpose signal analysis, using **Presel Center** is recommended. Centering the filter minimizes the impact of long-term preselector drift. **Preselector Adjust** can be used instead to manually optimize the preselector. One application of manual optimization would be to peak the preselector response, which both optimizes the signal-to-noise ratio and minimizes amplitude variations due to small (short-term) preselector drifting.

When **Presel Center** is performed, the offset applied to do the centering becomes the new value of **Preselector Adjust**.

Remote Command	`[:SENSe]:POWer[:RF]:PADJust <freq>` `[:SENSe]:POWer[:RF]:PADJust?`
Example	`:POW:PADJ 100KHz` `:POW:PADJ?`
Notes	The value on the control is displayed to 0.1 MHz resolution
Dependencies	– Does not appear in CXA-m – Does not appear in VXT Models M9410A/11A – Grayed-out if microwave preselector is off – Grayed-out if entirely in Band 0, that is, if Stop Freq is lower than about 3.6 GHz – Grayed-out if entirely above 50 GHz, that is, if Start Freq is higher than 50 GHz – Blank in models that do not include a preselector, such as Option 503. If the command is sent in these instruments, it is accepted without error, and the query always returns 0 – Grayed-out in the Spectrogram View
Preset	0 MHz
State Saved	The **Preselector Adjust** value set by "Presel Center" on page 1956, or by manually adjusting **Preselector Adjust** Not saved in instrument state, and does not survive a Preset or power cycle

Min	-500 MHz
Max	500 MHz
Backwards Compatibility SCPI	[:SENSe]:POWer[:RF]:MW:PADJust [:SENSe]:POWer[:RF]:MMW:PADJust

Notes	The command has no effect, and the query always returns MWAVe
Backwards Compatibility SCPI	[:SENSe]:POWer[:RF]:PADJust:PRESelector MWAVe | MMWave | EXTernal [:SENSe]:POWer[:RF]:PADJust:PRESelector?

Internal Preamp

Accesses a menu of controls for the internal preamps. Turning on the preamp gives a better noise figure, but a poorer inter-modulation distortion (TOI) to noise floor dynamic range. You can optimize this setting for your measurement.

The instrument takes the preamp gain into account as it sweeps. If you sweep outside of the range of the preamp, the instrument will also account for that. The displayed result always reflects the correct gain.

For some measurements, when the preamp is on and any part of the displayed frequency range is below the lowest frequency for which the preamp has specifications, a warning condition message appears in the status line. For example, for a preamp with a 9 kHz lowest specified frequency: "Preamp: Accy unspec'd below 9 kHz".

Selection	Example	Note
Off	:POW:GAIN OFF	
Low Band	:POW:GAIN ON :POW:GAIN:BAND LOW	Sets the internal preamp to use only the low band. The frequency range of the installed (optional) low-band preamp is displayed in square brackets on the Low Band selection in the dropdown
Full Range	:POW:GAIN ON :POW:GAIN:BAND FULL	Sets the internal preamp to use its full range. The low band (0-3.6 GHz, 0-3.4 GHz, 0-3 GHz, depending on the model) is supplied by the low band preamp and the frequencies above low band are supplied by the high band preamp The frequency range of the installed (optional) low-band preamp is displayed in square brackets on the Full Range selection in the dropdown. If the high band option is not installed the Full Range selection does not appear

NOTE The maximum **Center Frequency** for Low Band, displayed in square brackets, can change based on the selected IFBW for measurements that support IFBW (for example, Waveform measurement across all Modes that support it). In certain models (such as N9042B & N9032B), IFBW values <= 40 MHz have a maximum Low Band frequency of 3.6 GHz, while 40 MHz < IFBW <= 1 GHz have a maximum of 3.3 GHz, and 1 GHz < IFBW <= 1.5 GHz have a maximum of 3.5 GHz. IFBW values > 1.5 GHz do not support a **Center Frequency** that can reach the Low Band maximum frequency. In these cases, **N/A** is displayed in the square brackets for Low Band.

Remote Command	`[:SENSe]:POWer[:RF]:GAIN:BAND LOW | FULL`
	`[:SENSe]:POWer[:RF]:GAIN:BAND?`
	`[:SENSe]:POWer[:RF]:GAIN[:STATe] OFF | ON | 0 | 1`
	`[:SENSe]:POWer[:RF]:GAIN[:STATe]?`

Example	`:POW:GAIN:BAND LOW`
	`:POW:GAIN:BAND?`
	`:POW:GAIN OFF`
	`:POW:GAIN?`

Dependencies	Not available on all hardware platforms. If the preamp is not present or is unlicensed, this control is not shown Does not appear in VXT Models M9410A/11A/15A/16A If `:POW:GAIN:BAND FULL` is sent when a low band preamp is available, the preamp band parameter is set to `LOW` instead of `FULL`, and an "Option not installed" message is generated Not available when the electronic/soft attenuator is enabled
Preset	`LOW` `OFF`
State Saved	Saved in instrument state
Annotation	When the USB Preamp is not connected to USB, the Preamp annotation in the Meas Bar says “Off” if the preamp is off and displays the frequency range of the low band or full range preamp depending on the setting. For example, if the Preamp is set to Low Band and the Low Band is 3.6 GHz the annotation says “3.6 GHz”. If it is a 13.6 GHz preamp and it is set to Full Range the annotation says “13.6 GHz” When the USB Preamp is connected to USB, the Preamp annotation says “Preamp: USB” if the internal preamp is off or “Preamp: USB, Int” if the internal preamp is on (only for measurements that support the USB preamp)

LNA

Lets you turn the Low Noise Amplifier (LNA) on or off.

LNA is an additional preamplifier that provides superior DANL and frequency range compared to "Internal Preamp" on page 1959. LNA provides lower system noise

figure, especially at frequencies above 100 MHz, and can be operated up to the full range of 50 GHz instruments.

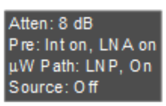
For best possible sensitivity, **LNA** can be turned on *together* with "Internal Preamp" on page 1959, although if you operate both preamps together, note that the TOI (distortion) specifications are impacted. The sensitivity improvement of this combination is substantial when operating in high band (frequencies above 3.6 GHz).

For more details about annotation, see "More Information" on page 1770

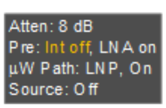
Remote Command	`[:SENSe]:POWer[:RF]:GAIN:LNA[:STATe] OFF | ON | 0 | 1` `[:SENSe]:POWer[:RF]:GAIN:LNA[:STATe]?`
Example	`:POW:GAIN:LNA ON`
Dependencies	Requires Option LNA, except for VXT models M9415A/16A Does not appear in VXT models M9421A/10A/11A May not appear in some measurements **LNA** is not available when the electronic/soft attenuator is enabled
Preset	`OFF`
State Saved	Saved in State

More Information

When **LNA** is installed, the preamp annotation changes to show the state of both **LNA** and **Internal Preamp**. Below is an example:



Note that when operating entirely in the low band (below about 3.6 GHz), if **LNA** is on, **Internal Preamp** is switched off (even if you have its switch set to `ON`). This is because the noise performance is actually degraded in low band if both preamps are on. In this case, the annotation reflects the actual state of the two preamps, but the **Internal Preamp** annotation displays in amber, to warn you that the actual state of **Internal Preamp** does not match its switch control display:



µW Path Control

Options for this control include **µW Preselector Bypass** (Option MPB), **Low Noise Path** (Option LNP) and **Full Bypass Enable** in the High Band path circuits.

When the µW Preselector is bypassed, flatness is improved, but will be subject to spurs from out of band interfering signals. When **Low Noise Path Enable** is selected, the instrument automatically bypasses certain circuitry in the high frequency bands that can contribute to noise, when it is appropriate based on other instrument settings.

For most applications, the preset state is **Standard Path**, which provides the best remote-control throughput, minimizes acoustic noise from switching and minimizes the risk of wear in the hardware switches, particularly in remote test scenarios where both low band and high band setups will follow in rapid succession. In this path, the bypass of the low band/high band switch and microwave preamp is never activated, which can cause some noise degradation but preserves the life of the bypass switch.

For applications that utilize the wideband IF paths, the preset state is **µW Preselector Bypas**s, if option MPB is present. This is because, when using a wideband IF such as the 140 MHz IF, the µW Preselector's bandwidth can be narrower than the available IF bandwidth, causing degraded amplitude flatness and phase linearity, so it is desirable to bypass the preselector in the default case.

You may choose **Low Noise Path Enable** for a lower noise floor, especially in the 21-26.5 GHz region, though without improving many measures of dynamic range, and without giving the best possible noise floor. The preamp, if purchased and used, gives better noise floor than does **Low Noise Path Enable**, but the preamp's compression threshold and third-order intercept are much poorer than that of **Low Noise Path Enable**.

A fourth choice is **Full Bypass Enable**, which combines **µW Preselector Bypass** and **Low Noise Path Enable**. Because this can bypass most of the circuitry between the input and the first mixer, care should be taken when using this setting to avoid damaging the mixer. **Full Bypass Enable** is only available if both options LNP and MPB are present, as well as option FBP.

Path	Example	Note
Standard Path	`:POW:MW:PATH STD`	Normal setting for most measurements. µW Preselector in circuit, Low Noise Path disabled
Low Noise Path Enable	`:POW:MW:PATH LNP`	See "Low Noise Path Enable" on page 1775
µW Preselector Bypass	`:POW:MW:PATH MPB`	See "µW Preselector Bypass" on page 1777
Full Bypass Enable	`:POW:MW:PATH FULL`	See "Full Bypass Enable" on page 1778

Remote Command	`[:SENSe]:POWer[:RF]:MW:PATH STD | LNPath | MPBypass | FULL` `[:SENSe]:POWer[:RF]:MW:PATH?`
Example	`:POW:MW:PATH LNP` Enables the Low Noise path

	`:POW:MW:PATH?`
Notes	If "Presel Center" on page 1956 is performed, the instrument will momentarily switch to the Standard Path, regardless of the setting of **µW Path Control** The DC Block will always be switched in when the low noise path is switched in, to protect succeeding circuitry from DC. Note that this does not mean "when the low noise path is enabled" but when, based on the Low Noise Path rules, the path is actually switched in. This can happen when the selection is **Low Noise Path Enable** or **Full Bypass Enable**. In the case where the DC Block is switched in the instrument is now AC coupled. However, if you selected DC coupling, the UI would still behave as though it were DC coupled, including all annunciation, warnings, status bits, and responses to SCPI queries. This is because, based on other settings, the instrument could switch out the low noise path at any time and hence go back to being DC coupled Alignment switching ignores the settings in this menu, and restores them when finished
Dependencies	Does not appear in CXA-m, VXT Models M9410A/11A, nor in BBIQ and External Mixing – The **Low Noise Path Enable** selection does not appear unless Option LNP is present and licensed – The **µW Preselector Bypass** selection does not appear unless Option MPB is present and licensed – The **Full Bypass Enable** selection does not appear unless options LNP and MPB are both present as well as option FBP In any of these cases, if the required options are not present and the SCPI command is sent, error -241, "Hardware missing; Option not installed" is generated **Low Noise Path Enable** and **Full Bypass Enable** are grayed-out if the current measurement does not support them **Low Noise Path Enable** and **Full Bypass Enable** are not supported in Avionics and MMR Modes (non-modulation measurements). In any of these cases (that is, the feature is not supported in either measurement or Mode), if the SCPI command is sent, the following error is generated: -221, "Setting Conflict; Feature not supported for this measurement"
Preset	**Mode** / **Value** IQ Analyzer, Pulse, Avionics: MPB option present and licensed: `MPB`; MPB option not present and licensed: `STD` All other Modes: `STD`
State Saved	Save in instrument state
Range	Standard Path | Low Noise Path Enable | µW Presel Bypass | Full Bypass Enable
Annotation	In the Meas Bar, if the Standard path is chosen: µW Path: Standard If Low Noise Path is enabled but the LNP switch is not thrown: µW Path: LNP,Off If the Low Noise Path is enabled and the LNP switch *is* thrown: µW Path: LNP,On If the preselector is bypassed:

µW Path: Bypass

If Full Bypass Enable is selected but the LNP switch is not thrown:

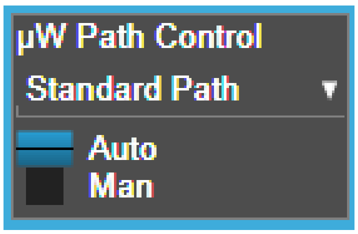
µW Path: FByp,Off

If Full Bypass Enable is selected and the LNP switch *is* thrown:

µW Path: FByp,On

µW Path Control Auto

In VMA, WLAN, 5G NR, CQM Modes, an **Auto/Man** switch is added to **µW Path Control**:



This allows the function to automatically switch based on certain Auto Rules as shown below:

VMA Mode

Measurement	When µW Path Control is in Auto
Digital Demod	Use Standard Path unless tuned frequency > 3.6 GHz and IFBW > 15 MHz, in which case choose Preselector Bypass
Monitor Spectrum	Always Presel Bypass
IQ Waveform	Use Standard Path unless tuned frequency > 3.6 GHz and IFBW > 15 MHz, in which case choose Preselector Bypass
Custom OFDM	Use Standard Path unless tuned frequency > 3.6 GHz and IFBW > 15 MHz, in which case choose Preselector Bypass
Channel Power	Always Presel Bypass
Occupied BW	Always Presel Bypass
CCDF	Use Standard Path unless tuned frequency > 3.6 GHz and IFBW > 15 MHz, in which case choose Preselector Bypass
ACP	Always Presel Bypass
SEM	Always Presel Bypass
Spurious Emissions	Always Standard Path

WLAN Mode

Measurement	When µW Path Control is in Auto
Modulation	Always Presel Bypass

Measurement	When µW Path Control is in Auto
Analysis	
Spectral Flatness	Always Presel Bypasss
Power vs Time	Always Presel Bypass
Monitor Spectrum	Always Presel Bypass
IQ Waveform	Always Presel Bypass
Channel Power	Always Presel Bypass
Occupied BW	Always Presel Bypass
CCDF	Always Presel Bypass
SEM	For 11be 320M, when 'Enabled Wideband IF for FFT' is OFF or 'Sweep Type Rule' is Best Dynamic Range, auto µW path is standard For other cases, auto µW path is presel bypass if presel bypass is enabled, auto µW path is standard if presel bypass is not enabled
Spurious Emissions	Always Standard Path

5G NR Mode

Measurement	When µW Path Control is in Auto
Modulation Analysis	Use Standard Path unless tuned frequency > 3.6 GHz and IFBW > 15 MHz, in which case choose Full Bypass if conditions warrant(FBP Option is available and "Allow Full Bypass in Auto" is On), otherwise choose Preselector Bypass
Monitor Spectrum	Always Standard Path
IQ Waveform	Use Standard Path unless tuned frequency > 3.6 GHz and IFBW > 15 MHz, in which case choose Full Bypass if conditions warrant(FBP Option is available and "Allow Full Bypass in Auto" is On), otherwise choose Preselector Bypass
Channel Power	Always Standard Path
Occupied BW	Always Standard Path
CCDF	Use Standard Path unless tuned frequency > 3.6 GHz and IFBW > 15 MHz, in which case choose Preselector Bypass
ACP	Always Standard Path
SEM	Always Standard Path
Spurious Emissions	Always Standard Path
Transmit On|Off Power	Use Standard Path unless tuned frequency > 3.6 GHz and Info BW > 15 MHz, in which case choose Preselector Bypass

Channel Quality Mode

Measurement	When µW Path Control is in Auto
Group Delay	Use Standard Path unless tuned frequency > 3.6 GHz and IFBW > 15 MHz, in which case choose Full Bypass if conditions warrant(FBP Option is available and

Measurement	When µW Path Control is in Auto
	"Allow Full Bypass in Auto" is On), otherwise choose Preselector Bypass
Monitor Spectrum	Always Standard Path
IQ Waveform	Use Standard Path unless tuned frequency > 3.6 GHz and IFBW > 15 MHz, in which case choose Preselector Bypass
CCDF	Use Standard Path unless tuned frequency > 3.6 GHz and IFBW > 15 MHz, in which case choose Preselector Bypass

Remote Command	`[:SENSe]:POWer[:RF]:MW:PATH:AUTO ON | OFF | 1 | 0` `[:SENSe]:POWer[:RF]:MW:PATH:AUTO?`
Example	`:POW:MW:PATH:AUTO ON` `:POW:MW:PATH:AUTO?`
Dependencies	Only appears in VMA, WLAN, 5G NR and CQM Modes
Couplings	See the tables above
Preset	`ON`
Range	`ON|OFF`

Low Noise Path Enable

Low Noise Path Enable provides a lower noise floor under some circumstances, particularly when operating in the 21–26.5 GHz region. With the Low Noise Path enabled, the low band/high band switch and microwave preamp are bypassed whenever *all* the following are true:

- The instrument is not in the Low Band, meaning:
- the start frequency is above 3.5 GHz and
- the stop frequency is above 3.6 GHz
- The internal preamp is not installed, or if installed, is set to **Off** or **Low Band**

Note that this means that, when any part of a sweep is done in Low Band, the Low Noise Path is not used, whether or not the **Low Noise Path Enable** is selected in the user interface. Also, if the preamp is turned on, the Low Noise Path is not used, whether or not the **Low Noise Path Enable** is selected in the user interface. The only time the Low Noise Path is used is when **Low Noise Path Enable** is selected, the sweep is completely in High Band (> 3.6 GHz) and no preamp is in use.

For measurements that use IQ acquisition, the low noise path is used when **Center Frequency** is in High Band (> 3.6 GHz) and no preamp is in use. In other words, the rules above are modified to use only the center frequency to qualify which path to switch in. This is not the case for FFTs in the Swept SA measurement; they use the same rules as swept measurements.

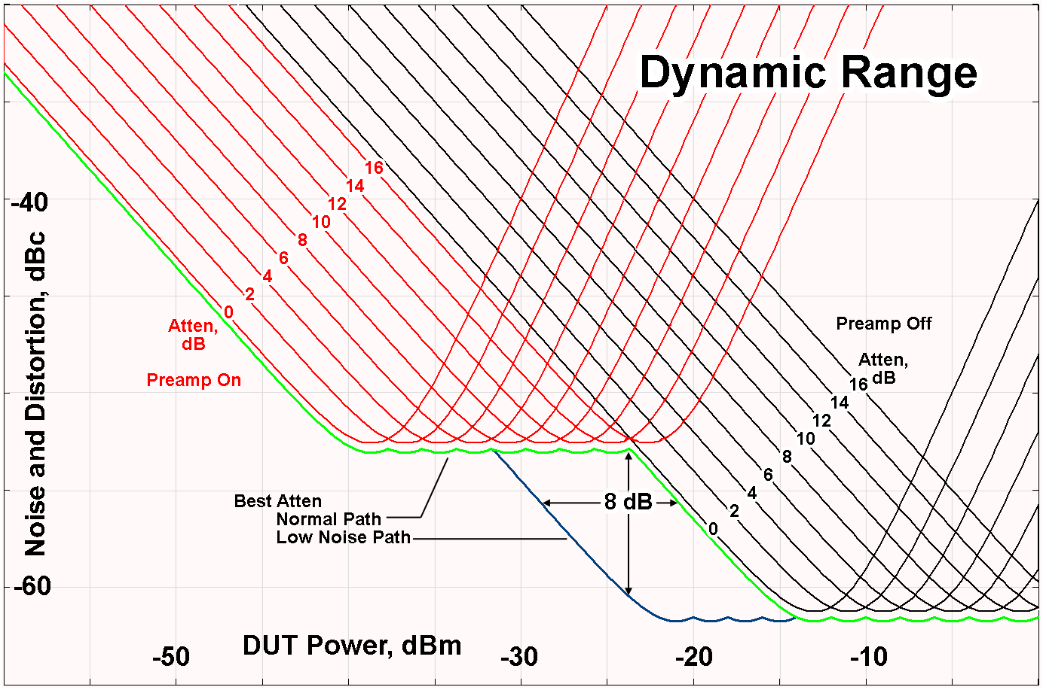
Note that the Low Noise Path, while giving improved DANL, has the disadvantage of decreased TOI performance and decreased gain compression performance relative to the standard path.

Note also that the bypass switch is a mechanical switch and has finite life, so if the **Low Noise Path Enable** is selected, it is possible to cause frequent cycling of this switch by frequently changing instrument settings such that the above conditions hold true only some of the time. A user making tests of this nature should consider opting for the **Standard Path**, which will never throw the bypass switch, at the expense of some degraded noise performance.

The low noise path is useful for situations where the signal level is so low that the instrument performance is dominated by noise even with 0 dB attenuation, but still high enough that the preamp option would have excessive third-order intermodulation or compression. The preamp, if purchased and used, gives better noise floor than does the “Low Noise Path.” However, its compression threshold and third-order intercept are much poorer than that of the non-preamp path.

There are some applications, typically for signals around –30 dBm, for which the third-order dynamic range of the standard path is good enough, but the noise floor is not low enough even with 0 dB input attenuation. When the third-order dynamic range of the preamp path is too little and the noise floor of the standard path is too high, the Low Noise Path can provide the best dynamic range

The graph below illustrates the concept. It shows, in red, the performance of an instrument at different attenuation settings, both with the preamp on and off, in a measurement that is affected by both instrument noise and instrument TOI. The green shows the best available dynamic range, offset by 0.5 dB for clarity. The blue shows how the best available dynamic range improves for moderate signal levels with the low noise path switched in. In this illustration, the preamp improves the noise floor by 15 dB while degrading the third-order intercept by 30 dB, and the low noise path reduces loss by 8 dB. The attenuator step size is 2 dB.



There are other times where selecting the low noise path improves performance, too. Compression-limited measurements such as finding the nulls in a pulsed-RF spectrum can profit from the low noise path in a way similar to the TOI-limited measurement illustrated. Accuracy can be improved when the low noise path allows the optimum attenuation to increase from a small amount like 0, 2 or 4 dB to a larger amount, giving better return loss at the instrument input. Harmonic measurements, such as second and third harmonic levels, are much improved using the low noise path because of the superiority of that path for harmonic (though not intermodulation) distortion performance.

µW Preselector Bypass

Toggles the preselector bypass switch for band 1 and higher. When the microwave presel is on, the signal path is preselected. When the microwave preselector is off, the signal path is not preselected. The preselected path is the normal path for the instrument.

The preselector is a tunable bandpass filter which prevents signals away from the frequency of interest from combining in the mixer to generate in-band spurious signals (images). The consequences of using a preselector filter are its limited bandwidth, the amplitude and phase ripple in its passband, and any amplitude and phase instability due to center frequency drift.

Option MPB or pre-selector bypass provides an unpreselected input mixer path for certain X-Series signal analyzers with frequency ranges above 3.6 GHz. This signal path allows a wider bandwidth and less amplitude variability, which is an advantage when doing modulation analysis and broadband signal analysis. The disadvantage is that, without the preselector, image signals will be displayed. Another disadvantage of bypassing the preselector is increased LO emission levels at the front panel input port.

Image responses are separated from the real signal by twice the 1st IF. For IF Paths of 10 MHz and 25 MHz, the 1st IF is 322.5 MHz, so the image response and the real signal will be separated by 645 MHz. The 1st IF will be different for other IF Path settings. When viewing a real signal and its corresponding image response in internal mixing, the image response will be to the left of the real signal.

Also, the image response and the real signal typically have the same amplitude and exhibit the same shape factor.

However, if Option FS1 (Fast Sweep Capability) is enabled, the image response in the Swept SA measurement appears lower in amplitude and has a much wider shape factor compared to the real signal.

Full Bypass Enable

With **Full Bypass Enable** selected, the microwave preselector is bypassed. In addition, the low band/high band switch and microwave preamp are bypassed whenever *all* the following are true:

- The instrument is not in the Low Band, meaning:
- the start frequency is above 3.5 GHz and
- the stop frequency is above 3.6 GHz.
- the internal preamp is not installed or if installed, is set to **Off** or **Low Band**

Note that this means that, when any part of a sweep is done in Low Band, the Low Noise Path is not used, whether or not the **Full Bypass Enable** is selected in the user interface. Also, if the preamp is turned on, the Low Noise Path is not used, whether or not the **Full Bypass Enable** is selected in the user interface. The only time the Low Noise Path is used is when **Full Bypass Enable** is selected, the sweep is completely in High Band (> 3.6 GHz) and no preamp is in use.

CAUTION

When Full Bypass Enable is selected, and "Y Scale" on page 1929 is set to 0 dB, there will be a direct AC connection between the input and the first converter when the Low Noise Path switches in (when Start Freq >3.6 GHz and the Preamp is either not licensed, set to Low Band, or Off). This puts the first converter at considerable risk to be damaged by high AC power. Consequently,

whenever **Full Bypass Enable** is selected, a warning message appears in the status bar:

"Full Bypass Enabled, maximum safe input power reduced"

Microwave Preselector Bypass Backwards Compatibility

Example	`:POW:MW:PRES OFF` Bypasses the microwave preselector
Notes	Included for Microwave Preselector Bypass backwards compatibility The `ON` parameter sets the `STD` path (`:POW:MW:PATH STD`) The `OFF` parameter sets path `MPB` (`:POW:MW:PATH MPB`)
Preset	`ON`
Backwards Compatibility SCPI	`[:SENSe]:POWer[:RF]:MW:PRESelector[:STATe] ON | OFF | 0 | 1` `[:SENSe]:POWer[:RF]:MW:PRESelector[:STATe]?`

Frequency Extender Preselection Bypass

Only applies to the high frequency path of the Frequency Extender, and only if the Frequency Extender allows it. For example, the V3050A high frequency path is 50 – 110 GHz and *does* allow control of the preselector bypass.

When the Frequency Extender's preselection is bypassed, flatness is improved, but will be subject to spurs from out-of-band interfering signals. For bandwidths greater than 2.5 [GHz], it is recommended that the signal bypass the Frequency Extender Preselector since the max bandwidth of the Preselector can be as narrow as 2.5 [GHz].

For most applications, the preset state is `OFF`, which gives the best remote-control throughput, minimizes acoustic noise from switching, minimizes out of band spurs, and minimizes the risk of wear in the hardware switches.

Preselector and Bandwidth Conflict

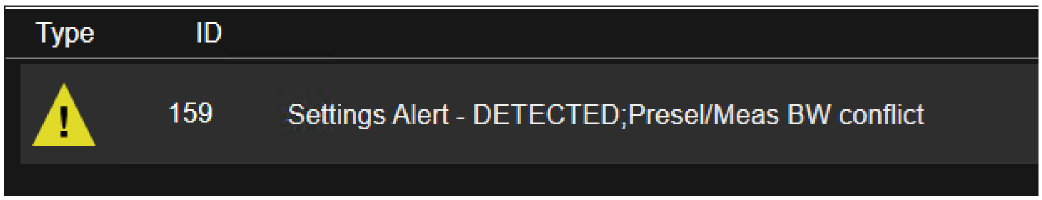
When the Frequency Extender Preselector is applied and the signal bandwidth is greater than 2.5 [GHz], then a settings alert message will show to warn the user that the signal may be distorted due to the limitation of the Frequency Extender Preselector bandwidth.

An example of the settings alert message is shown below.

Settings Alert message in the Status Bar at the bottom of the display.

Settings Alert message in the error queue

.



Software Preselection

Provided in some instruments, either to compensate for issues with provided hardware preselection or to provide the preselection function when there is no hardware preselector.

N9041B

Software Preselection compensates for the frequency range limit of the microwave preselector. Since the microwave preselector only goes up to 50 GHz, software preselection must be used to suppress and separate images above 50 GHz. The specific algorithm used for software preselection is specified by the SW Preselection Type selection – Normal or Advanced.

In N9041B, Software Preselection only applies for frequencies above 50 GHz, therefore it is only used for RF Input 2. Even if turned on, it is not used for other inputs, and never for frequencies below 50 GHz. This is why the label of this control contains the parenthetical note “(>~50 GHz)”.

Note that in N9041B, in Swept SA measurement, Software Preselection works even if the measurement is using an FFT Sweep Type. In measurements other than Swept SA, Software Preselection is not used if the measurement is using an FFT sweep type.

N9042B+V3050A

Software Preselection compensates for the frequency range limit of the microwave preselector. Since the microwave preselector only goes up to 50 GHz, software preselection must be used to suppress and separate images above 50 GHz. The specific algorithm used for software preselection is specified by the SW Preselection Type selection – Normal or Advanced.

For N9042B+V3050A, Software Preselection only applies for frequencies above 50 GHz, therefore it is only used for External RF. Even if it is turned on, it will not be used for other inputs and never for frequencies below 50 GHz. This is why the label of this control contains the parenthetical note "(>~50 GHz)".

Note that for N9042B+V3050A, in the Swept SA measurement, Software Preselection works even if the measurement is using an FFT Sweep Type. In measurements other than Swept SA, Software Preselection is not used if the measurement is using an FFT Sweep Type.

VXT models M9410A/11A

Software Preselection is used to provide the preselection function, as there is no hardware preselector in these models. Two background traces are taken and compared point by point, and the point with the lowest amplitude from the two traces is used. This provides a method to reduce spurs that are internally generated within the VXT, but you should note the following when using Software Preselection:

- There is some speed cost due to the need to take multiple captures
- Taking the point with the lowest amplitude in each trace will make the average noise level lower at all points that do not have a spur. This can reduce the accuracy of the measurement of noise and noise-like signals

Because of the difficulty in identifying spurs manually, you are recommended to leave Software Preselection ON at all times in VXT models M9410A/11A. If you turn it off in order to speed up your measurement or improve noise accuracy, be aware of unwanted onscreen spurs.

Remote Command	`[:SENSe]:POWer[:RF]:SWPResel:STATe 0 | 1 | ON | OFF` `[:SENSe]:POWer[:RF]:SWPresel:STAT?`
Example	`:POW:SWPR:STAT 1` `:POW:SWPR:STAT?`
Dependencies	Only appears in N9041B, N9042B+V2050A, and VXT models M9410A/11A. Does not appear in all measurements
Couplings	Affects **Sweep Time** **Auto Tune** supports **Software Preselection**, so **Auto Tune** should be performed after setting the **Software Preselection** state
Preset	N9041B: OFF N9042B+V3050A: ON M9410A/11A: ON
State Saved	Saved in instrument state

SW Preselection Type

Specifies the algorithm used for software preselection.

Two hidden sweeps occur in succession. The second sweep is offset in LO frequency by 2 * IF / N. For each point in each trace, the smaller amplitude from the two traces is taken and placed in that point in the selected trace. The Peak detector is auto-selected to improve the image suppression effectiveness. Responses of each trace that lie on top of one another will remain and are valid signals. Other signals are images, which are suppressed. The action of taking the smaller of the two traces will make the average noise level lower in all points that do not have an image, thus reducing the accuracy of the measurement of noise and noise-like signals.

- `NORMal` - mathematically removes all image and multiple responses of signals present at the input
- `ADVanced` - any trace processing (such as "max hold" or trace averaging) is performed on the points of both candidate traces before the "select minimum" operation occurs. This form of processing works better for non-stationary signals, such as pulsed-RF signals

Remote Command	`[:SENSe]:POWer[:RF]:SWPResel NORMal | ADVanced` `[:SENSe]:POWer[:RF]:SWPResel?`
Example	`:POW:SWPR NORM` `:POW:SWPR?`
Dependencies	Only appears in N9041B and N9042B+V3050A. Only appears in measurements that use the Swept method Grayed-out when "Software Preselection" on page 1971 is `OFF`. The grayout message is "Unavailable unless SW Presel enabled"
Preset	N9041B: `ADVanced` N9042B+V3050A: `NORMal`
State Saved	Saved in instrument state

SW Preselection BW

Specifies the effective bandwidth to be used for Software Preselection.

The options are:

- `NORMal` – when making Swept measurements, a software preselection algorithm is used which takes up to 4 background acquisitions, then post-processes the result. This algorithm can remove images from signals with an occupied

bandwidth up to around 3 GHz. (Default/Preset setting). When making FFT measurements, this algorithm is not used, instead the same algorithm is used as for NARRow (below)

– NARRow– a software preselection algorithm is used which takes two background acquisitions, then post-processes the result to detect and remove images from wideband signals with occupied bandwidths up to 2 GHz. This increases the risk of images failing to be rejected, but improves the measurement speed

Remote Command	`[:SENSe]:POWer[:RF]:SWPResel:BW NORMal | NARRow` `[:SENSe]:POWer[:RF]:SWPResel:BW?`
Example	`:POW:SWPR:BW NARR`
Dependencies	Only appears in N9041B and N9042B+V3050A. Only appears in measurements that use the Swept method Grayed-out when "Software Preselection" on page 1971 is OFF. The grayout message is "Unavailable unless SW Presel enabled" For N9042B+V3050A, the parameter is SCPI-only, and always set to NARRow when **Software Preselection** is enabled
Preset	N9041B: NORMal N9042B+V3050A: NARRow
State Saved	Saved in instrument state

High Freq Prefilter

Lets you set the state of Prefilter for center frequencies above 1310 MHz.

In VXT Models M9410A/11A, the Receiver RF path has a bank of filters that come after the RF Attenuator in the signal path. Since this bank of filters precedes the mixer they are known as the "Prefilter" bank. Their purpose is to eliminate unwanted in-band mixing products by filtering out all but the desired frequencies before the signals get to the mixer. There are 13 prefilter bands to cover the frequencies between 9 kHz and 6000 MHz. The Prefilter provides the necessary rejection of the unwanted signal.

Remote Command	`[:SENSe]:<measurement>:PFILter[:STATe] ON | OFF | 1 | 0` `[:SENSe]:<measurement>:PFILter[:STATe]?`

Example	Enable High Freq Prefilter for the Complex Spectrum Measurement in BASIC Mode:
	`:SPEC:PFIL ON`
	Enable High Freq Prefilter for the IQ Waveform Measurement, in multiple Modes:
	`:WAV:PFIL ON`
	Enable High Freq Prefilter for the Swept SA Measurement in SA Mode:

	`:SAN:PFIL ON`
Dependencies	Only appears in VXT models M9410A/11A with center frequency above 1310 MHz
Preset	See "Prefilter Presets" on page 1784 below
State Saved	Saved in instrument state

Prefilter Presets

Meas	Mode	Preset
SPEC	BASIC	OFF
WAV	BASIC, WCDMA, WLAN, LTEAFDD, LTEATDD, 5GNR, VMA	OFF
MON	WCDMA, WLAN, LTEAFDD, LTEATDD, 5GNR, VMA	OFF
RHO	WCDMA	OFF
CDP	WCDMA	OFF
PCON	WCDMA	OFF
EVMQ	WCDMA	OFF
CHP	WCDMA, WLAN, LTEAFDD, LTEATDD, 5GNR, VMA, SA	OFF
OBW	WCDMA, WLAN, LTEAFDD, LTEATDD, 5GNR, VMA, SA	OFF
ACP	WCDMA, LTEAFDD, LTEATDD, 5GNR, VMA, SA	OFF
SEM	WCDMA, WLAN, LTEAFDD, LTEATDD, 5GNR, VMA, SA	OFF
PST	WCDMA, WLAN, LTEAFDD, LTEATDD, 5GNR, VMA, SA	OFF
PVT	WLAN, LTEAFDD, LTEATDD, 5GNR	OFF
EVM	WLAN, LTEAFDD, LTEATDD, 5GNR	OFF
FLAT	WLAN	OFF
EVMM	WLAN	OFF
CEVM	LTEAFDD, LTEATDD	OFF
PAVT	5GNR, VMA	OFF
DDEM	VMA	OFF
OFDM	VMA	OFF
SAN	SA	ON
HARM	SA	ON

3.10.4 BW

Opens the bandwidth (BW) menu, which contains controls for the Resolution Bandwidth and Video Bandwidth functions of the instrument.

The Resolution BW functions control filter bandwidth and filter type. There are two filter types, Gaussian and Flattop. The Gaussian filters have a response curve that is parabolic on a log scale. The Flattop filter shape is a close approximation of a rectangular filter.

3.10.4.1 Settings

Contains the basic bandwidth functions. In this measurement, it is the only tab under **BW**.

Res BW

Activates the resolution bandwidth active function, which allows you to manually set the resolution bandwidth (RBW) of the instrument.

Normally, **Res BW** (Auto) selects automatic coupling of the Res BW to Span using the ratio set by the Span:3 dB RBW control (some measurements do not have a Span:3 dB RBW control, in which case the measurement chooses the optimal ratio). To decouple the resolution bandwidth, press the **Auto/Man** toggle on the **Res BW** control, or simply enter a different value for **Res BW**.

When the **Res BW** is manually selected, it may be returned to the coupled state by pressing the **Auto/Man** toggle on the **Res BW** control. This may also be done by pressing Auto Couple or by performing a **Preset**.

Only certain discrete resolution bandwidths are available. The available bandwidths are dependent on the **EMC Standard**. If an unavailable bandwidth is entered with the numeric keypad, the closest available bandwidth is selected.

Remote Command	`[:SENSe]:TOI:BANDwidth|BWIDth[:RESolution] <freq>` `[:SENSe]:TOI:BANDwidth|BWIDth[:RESolution]?`
Example	`:TOI:BWID 10 kHz` `:TOI:BWID?`
Notes	For numeric entries, all RBW Types choose the nearest (arithmetically, on a linear scale, rounding up) available RBW to the value entered The setting and querying of values depends on the current bandwidth type
Couplings	"Sweep Time" on page 1815 is coupled to RBW. As RBW changes, **Sweep Time** (if set to Auto) changes to maintain amplitude calibration "Video BW" on page 1786 is coupled to RBW. As the resolution bandwidth changes, the **Video BW** (if set to Auto) changes to maintain the ratio of VBW/RBW (10:1) When **Res BW** is set to Auto, the resolution bandwidth is auto-coupled to **Span**. The ratio of **Span/Res BW** is approximately 106:1 when auto coupled. When **Res BW** is set to **Man**, and the bandwidths are entered manually, these bandwidths are used regardless of other instrument settings For this measurement, **Res BW** can be auto-coupled to **Span** via "Span:3dB RBW" on page 1788. This auto-coupled RBW will not exceed 3 MHz
Preset	Auto (unless noted in the table below)
State Saved	Saved in instrument state
Min	1 Hz

Max	8 MHz is the max equivalent –3 dB RBW, which means that the named RBW (the one shown on the control etc.) can actually exceed 8 MHz if using a filter other than –3 dB Gaussian
Annotation	A "#" mark appears before "RBW" in the annotation when it is switched from Auto to Manual coupling
Backwards Compatibility Notes	For backwards compatibility this command supports both `BANDwidth` and `BWIDth` forms

Auto Function

Remote Command	`[:SENSe]:TOI:BANDwidth|BWIDth[:RESolution]:AUTO ON | OFF | 1 | 0` `[:SENSe]:TOI:BANDwidth|BWIDth[:RESolution]:AUTO?`
Example	`:TOI:BAND:AUTO ON` `:TOI:BAND:AUTO?`

Video BW

Lets you change the instrument post-detection filter (**VBW** or "video bandwidth") from 1 Hz to 8 MHz in approximately 10% steps. In addition, a wide-open video filter bandwidth may be chosen by selecting 50 MHz. The VBW is annotated at the bottom of the display, in the center.

Normally, **Video BW (Auto)** selects automatic coupling of the Video BW to RBW using the ratio set by the VBW:3 dB RBW control. To decouple the resolution bandwidth, press the **Auto/Man** toggle on the **Video BW** control, or simply enter a different value for **Video BW**.

When the **Video BW** is manually selected, it may be returned to the coupled state by pressing the **Auto/Man** toggle on the **Video BW** control. This may also be done by pressing "Auto Couple" on page 1995 or by performing a **Preset**.

Remote Command	`[:SENSe]:TOI:BANDwidth|BWIDth:VIDeo <freq>` `[:SENSe]:TOI:BANDwidth|BWIDth:VIDeo?`
Example	`:TOI:BAND:VID 1 KHZ` `:TOI:BAND:VID?`
Notes	For numeric entries, the instrument chooses the nearest (arithmetically, on a linear scale, rounding up) available **VBW** to the value entered. The 50 MHz VBW is defined to mean "wide open" The values shown in this table reflect the conditions after a **Mode Preset**
Couplings	Normally coupled to **RBW**. If **VBW** is set to Auto, then **VBW** changes as **RBW** changes, to maintain the ratio set by "VBW:3dB RBW" on page 1787 (usually 10:1 for measurements that do not have a **VBW:3 dB RBW** control)
Preset	Auto
State Saved	Saved in instrument state
Min	1 Hz

Max	50 MHz
Annunciation	A "#" mark appears before "VBW" in the annotation when it is not coupled
Annotation	In the bottom center of the screen, "VBW <value> <units>" indicates the current video bandwidth value. Note that for some detectors this is not the value actually used for VBW (see above)
Backwards Compatibility Notes	For backwards compatibility this command supports both `BANDwidth` and `BWIDth` forms

Auto Function

Remote Command	`[:SENSe]:TOI:BANDwidth:VIDeo:AUTO OFF | ON | 0 | 1` `[:SENSe]:TOI:BANDwidth:VIDeo:AUTO?`
Example	`:TOI:BAND:VID:AUTO OFF` `:TOI:BAND:VID:AUTO?`
Preset	`ON`

VBW:3dB RBW

Selects the ratio between the video bandwidth and the equivalent 3 dB resolution bandwidth to be used for setting **VBW** when **VBW** is in **Auto**.

VBW:3dB RBW (Auto) selects automatic coupling of the VBW:3 dB RBW ratio to the optimal value based on other instrument settings. To decouple the ratio, press the **Auto/Man** toggle on **VBW:3 dB RBW**, or simply enter a different value for **VBW:3 dB RBW**.

When **VBW:3dB RBW** is manually selected, it may be returned to the coupled state by setting the toggle on **VBW:3 dB RBW** back to **Auto**. This may also be done by pressing "Auto Couple" on page 1995 or by performing a **Preset**.

Remote Command	`[:SENSe]:TOI:BANDwidth:VIDeo:RATio <real>` `[:SENSe]:TOI:BANDwidth:VIDeo:RATio?`
Example	`:TOI:BAND:VID:RAT 2` `:TOI:BAND:VID:RAT?`
Preset	1
State Saved	Saved in instrument state
Min	0.00001
Max	3000000
Backwards Compatibility Notes	For backwards compatibility this command supports both `BANDwidth` and `BWIDth` forms

Auto Function

Remote Command	`[:SENSe]:TOI:BANDwidth:VIDeo:RATio:AUTO OFF | ON | 0 | 1` `[:SENSe]:TOI:BANDwidth:VIDeo:RATio:AUTO?`
Example	`:TOI:BAND:VID:RAT:AUTO 0` `:TOI:BAND:VID:RAT:AUTO?`
Preset	ON
Backwards Compatibility SCPI	`[:SENSe]:SFRequency:BWIDth:VIDeo:RATio:AUTO`

Span:3dB RBW

Selects the ratio between span and resolution bandwidth.

Normally, **Span:3dB RBW** (**Auto**) selects a Span:3 dB RBW ratio of 106:1. If you manually enter the ratio, the toggle on **Span:3dB RBW** changes to **Man.** This enables you to manually select ratios more suitable for certain measurements.

When **Span:3dB RBW** is manually selected, it may be returned to the coupled state by setting the toggle on **RBW:3 dB RBW** back to **Auto**. This may also be done by pressing "Auto Couple" on page 1995 or by performing a **Preset**.

Remote Command	`[:SENSe]:TOI:FREQuency:SPAN:BANDwidth[:RESolution]:RATio <integer>` `[:SENSe]:TOI:FREQuency:SPAN:BANDwidth[:RESolution]:RATio?`
Example	`:TOI:FREQ:SPAN:BAND:RAT 106`
Notes	The values shown in this table reflect the conditions after a **Mode Preset**
Preset	106
State Saved	Saved in instrument state
Min	2
Max	10000

Auto Function

Remote Command	`[:SENSe]:TOI:FREQuency:SPAN:BANDwidth[:RESolution]:RATio:AUTO OFF | ON | 0 | 1` `[:SENSe]:TOI:FREQuency:SPAN:BANDwidth[:RESolution]:RATio:AUTO?`
Example	`:TOI:FREQ:SPAN:BAND:RAT:AUTO 0`
Backwards Compatibility SCPI	`[:SENSe]:TOI:FREQuency:SPAN:BWIDth[:RESolution]:RATio`

3.10.5 Display

Opens the **Display** Menu, which lets you configure display items for the current Mode, Measurement View or Window.

3.10.5.1 Annotation

Contains controls for setting up the annotation for the current Mode or Measurement.

Graticule

Turns the display graticule On or Off for all windows with graticules in all measurements in the current Mode. Also turns the graticule Y-Axis annotation on and off.

Remote Command	`:DISPlay:GRATicule[:STATe] OFF | ON | 0 | 1` `:DISPlay:GRATicule[:STATe]?`
Example	`:DISP:GRAT OFF`
Notes	The graticule is the set of horizontal and vertical lines that make up the grid/divisions for the X-Axis and Y-Axis
Preset	`ON`
State Saved	Saved in instrument state

Backwards Compatibility SCPI	`:DISPlay:WINDow[1]:TRACe:GRATicule:GRID[:STATe] OFF | ON | 0 | 1`
	`:DISPlay:WINDow[1]:TRACe:GRATicule:GRID[:STATe]?`
	This command is accepted for backwards compatibility with older instruments, but the `WINDow`, `TRACe` and `GRID` parameters are ignored

Screen Annotation

Controls the display of the annunciation and annotation around the graticule, including any annotation on lines (such as the display line, the threshold line, etc.) and the Y-Axis annotation, for all windows with screen annotation in all measurements in the current Mode.

This does *not* include marker annotation (or the N dB result). When `OFF`, the graticule expands to fill the entire graticule area, leaving only the 1.5% gap above the graticule, as described in the **Trace** section.

Remote Command	`:DISPlay:ANNotation:SCReen[:STATe] OFF | ON | 0 | 1` `:DISPlay:ANNotation:SCReen[:STATe]?`

Example	`:DISP:ANN:SCR OFF`
Dependencies	Grayed-out and forced to `OFF` when **System Display Settings**, **Annotation** is `OFF`
Preset	`ON` This remains `OFF` through a Preset when **System Display Settings**, **Annotation** is set to `OFF`
State Saved	Saved in instrument state

Trace Annotation

Turns on and off the labels on the traces, showing their detector (or their Math Mode) as described in the **Trace** section, for all windows in all measurements in the current Mode for which Trace Annotation on/off is supported.

If Trace Math is being performed on a trace, then the Trace Math annotation replaces the detector annotation.

For measurements that support limit lines, this key also turns on and off the labels on the Limit Lines. The label is the Limit number annotation and Limit Comment displayed on the graph. If the length of the comment is greater than 20 characters, the first 8 characters and the last 8 characters are displayed, joined with ....

Remote Command	`:DISPlay:ANNotation:TRACe[:STATe] ON | OFF | 1 | 0` `:DISPlay:ANNotation:TRACe[:STATe]?`
Example	`:DISP:ANN:TRAC OFF`
Preset	`OFF`
State Saved	Saved in instrument state

Control Annotation

Turns on and off the display of values on the Active Function controls for all measurements in the current Mode. This is a security feature.

Remote Command	`:DISPlay:ACTivefunc[:STATe] ON | OFF | 1 | 0` `:DISPlay:ACTivefunc[:STATe]?`
Example	`:DISP:ACT OFF`
Dependencies	Grayed out and forced to `OFF` when **System Display Settings**, **Annotation** is `OFF`
Preset	`ON` This remains `OFF` through a Preset when **System Display Settings**, **Annotation** is set to `OFF`
State Saved	Saved in instrument state

Frequency Annotation

Turns on and off the absolute frequency annotation in the main display for all windows in all measurements in the current Mode for which Frequency Annotation on/off is supported.

The affected annotations include Center Frequency, Start/Stop Frequency, Frequency Offset, Marker Frequency. Any relative frequency annotation such as Span and Marker Delta are not affected.

The frequency annotations in any other associated display, such as in Active Function, Softkey label, Limit Editor, Amp Corr Editor and Marker Table are not changed.

Frequency annotations that are not associated with the spectrum, such as RBW, IBW, Sweep Time, are excluded and they are shown regardless of this selection.

Remote Command	`:DISPlay:ANNotation:FREQuency[:STATe] ON | OFF | 1 | 0` `:DISPlay:ANNotation:FREQuency[:STATe]?`
Example	`:DISP:ANN:FREQ OFF`
Dependencies	Only appears in the Swept SA measurement in Spectrum Analyzer Mode
Preset	`ON`

Meas Bar

Turns the Measurement Bar at the top of the screen on and off for all measurements in the current Mode. When `OFF`, the graticule area expands to fill the area formerly occupied by the Measurement Bar.

Remote Command	`:DISPlay:ANNotation:MBAR[:STATe] OFF | ON | 0 | 1` `:DISPlay:ANNotation:MBAR[:STATe]?`
Example	`:DISP:ANN:MBAR OFF`
Dependencies	Grayed out and forced to `OFF` when **System Display Settings**, **Annotation** is `OFF`
Preset	`ON` This remains `OFF` through a Preset when **System Display Settings**, **Annotation** is set to `OFF`
State Saved	Saved in instrument state

Display Enable (Remote Command Only)

Turns the display on/off, including the display drive circuitry. The backlight stays lit to confirm that the instrument is on. The display enable setting is mode global. Theare three reasons for turning the display off:

1. To increase speed as much as possible by freeing the instrument from having to update the display
2. To reduce emissions from the display, drive circuitry
3. For security purposes

If you have turned off the display:

– and you are in local operation, the display can be turned back on by pressing any key or by sending `:SYSTem:DEFaults MISC` or `:DISPlay:ENABle ON` (neither `*RST` nor :SYSTem:PRESet enable the display)

– and you are in remote operation, the display can be turned back on by pressing the **Local** or **Esc** keys, or by sending `:SYSTem:DEFaults MISC` or `:DISPlay:ENABle ON` (neither `*RST` nor `:SYSTem:PRESet` enable the display)

– and you are using either the `:SYSTem:KLOCk` command or GPIB local lockout, then *no* front-panel key press will turn the display back on. You must turn it back on remotely.

If the display is `OFF`, many SCPI commands related to User Views and Multiscreen functionality do not work, and return the error messages “-221, Settings conflict; Screen SCPI cannot be used when Display is disabled” or “221, Settings conflict; View SCPI cannot be used while Display is disabled”. These commands include:

Name	Command
Select User View	`:DISPlay:VIEW:ADVanced:SELect`
Rename User View	`:DISPlay:VIEW:ADVanced:REName`
Delete User View	`:DISPlay:VIEW:ADVanced:DELete`
Create User View	`:DISPlay:VIEW:ADVanced:NAME`
Select Screen	`:INSTrument:SCReen:SELect`
Delete Screen	`:INSTrument:SCReen:DELete`
Delete All But This Screen	`:INSTrument:SCReen:DELete:ALL`
Add Screen	`:INSTrument:SCReen:CREate`
Rename Screen	`:INSTrument:SCReen:REName`
Sequencer On/Off	`:SYSTem:SEQuencer`

Remote Command	`:DISPlay:ENABle OFF | ON | 0 | 1` `:DISPlay:ENABle?`
Example	`:DISP:ENAB OFF`
Couplings	`:DISP:ENAB OFF` turns Backlight `OFF` and `:DISP:ENAB ON` turns Backlight `ON`, but changing Backlight settings does *not* change the state of `:DISP:ENAB`

Preset	ON Set by :SYST:DEF MISC, but not affected by *RST or :SYSTem:PRESet
State Saved	Not saved in instrument state
Backwards Compatibility Notes	:SYST:PRES no longer turns on :DISPlay:ENABle as it did in legacy analyzers

3.10.5.2 View

Contains controls for selecting the current **View**, and for editing User Views.

View

See "Views" on page 1738

User View

Lets you choose a View from the saved User Views for the current measurement. This panel only appears if a User View exists for the current measurement.

Remote Command	:DISPlay:VIEW:ADVanced:SELect <alphanumeric> :DISPlay:VIEW:ADVanced:SELect?
Example	Select Baseband as the current View :DISP:VIEW:ADV:SEL “Baseband”
Notes	You must be in the measurement whose View you are trying to set to send the command. You can only set Views for the current measurement using this command For predefined views, the parameter is derived from the view name that is shown in the View list in the user interface. For example, if you are trying to select the Trace Zoom view in the Swept SA measurement, you send: :DISP:VIEW:ADV:SEL "Trace Zoom" because “Trace Zoom” is the name of the View as seen in the Mode/Meas dialog or in the Display, View menu You *cannot* use the legacy View parameter (which in this case would be TZOom) with :DISP:VIEW:ADV:SEL <alphanumeric> is case insensitive; you can specify mixed case, however the name will be evaluated on a single case. Thus, both of the following forms work: :DISP:VIEW:ADV:SEL "Trace Zoom" :DISP:VIEW:ADV:SEL "TRACE ZOOM" If the specified view is not a valid View, the query returns the error message “-224, Illegal parameter value; View with the name <alphanumeric> does not exist” If the display is disabled (via :DISP:ENAB OFF) then the error message “-221, Settings conflict;

	View SCPI cannot be used while Display is disabled" is generated
Backwards Compatibility SCPI	The legacy node `:DISPlay:VIEW[:SELect]` is retained for backwards compatibility, but it only supports predefined views

Restore Layout to Default

Restores the Layout to the default for Basic.

Modified Views are very temporary; if you exit the current measurement they are discarded, and they are not saved in State. To retain this View for later use, and to be able to return easily to your original Basic View, you can save your edited View as a "User View".

Save Layout as New View

Saves your new View as a User View. An alpha keyboard appears, which lets you name your new View; the default is the old View name plus a number.

Remote Command	`:DISPlay:VIEW:ADVanced:NAME <alphanumeric>`
Example	`:DISP:VIEW:ADV:NAME "Baseband"` Creates a new View named `Baseband` from the current View, and selects it as the current View
Notes	`<alphanumeric>` is case insensitive; you can specify mixed case, however the name will be evaluated on a single case If `<alphanumeric>` name already exists as a View, the error message "-224, Illegal parameter value; View <alphanumeric> already exists" is generated If the display is disabled (via `:DISP:ENAB OFF`) then the error message "-221, Settings conflict; User View SCPI cannot be used while Display is disabled" is generated

Re-Save User View

You can re-edit a User View; if you make changes, then an asterisk will appear next to the User View's name. You can then tap **Re-Save User View** to save it back to its existing name, or **Save Layout as New View** to add another, new User View.

This is a front panel function only, there is no remote command available to perform this function. To do this remotely, you must first perform **Save Layout as New View**, then delete the old User View and rename the new one with the name of the View you just deleted.

Rename User View

You can rename the current View by giving it a new unique name. Only User Views can be renamed, if the current View is a Predefined View, an error occurs.

Remote Command	`:DISPlay:VIEW:ADVanced:REName <alphanumeric>`
Example	`:DISP:VIEW:ADV:REN “Baseband”`
Notes	`<alphanumeric>` is case insensitive; you can specify mixed case, however the name will be evaluated on a single case If the `<alphanumeric>` specifying the new name is already present in the list of View names, the error message “-224, Illegal parameter value; View <alphanumeric> already exists” is generated If the current View is a Predefined View, the error message “-224, Illegal parameter value; Cannot rename a Predefined View” is generated If the display is disabled (via `:DISP:ENAB OFF`) then the error message “-221, Settings conflict; View SCPI cannot be used while Display is disabled” is generated

Delete User View

You can delete the current View if it is a User View. The default view becomes the current view for the Measurement.

Remote Command	`:DISPlay:VIEW:ADVanced:DELete`
Example	`:DISP:VIEW:ADV:DEL`
Notes	`<alphanumeric>` is case insensitive; you can specify mixed case, however the name will be evaluated on a single case If the `<alphanumeric>` is not present in the list of View names, the error message “-224, Illegal parameter value; View <alphanumeric> does not exist” is generated If the current View is a Predefined View, the error message “-224, Illegal parameter value; Cannot delete a Predefined View” is generated If the display is disabled (via `:DISP:ENAB OFF`) then the error message “-221, Settings conflict; View SCPI cannot be used while Display is disabled” is generated

Delete All User Views

Deletes all previously saved User Views. The default view becomes the current view for the Measurement if a User View was the current view when this command was executed.

Remote Command	`:DISPlay:VIEW:ADVanced:DELete:ALL`

Example	`:DISP:VIEW:ADV:DEL:ALL`
Notes	Disabled if there are no User Views

View Editor Remote Commands

The following remote commands help you manage Views and User Views. Note that the SCPI node for User Views handles both Predefined and User Views. The legacy nodes, `:DISPlay:VIEW[:SELect]` and `:DISPlay:VIEW:NSEL`, are retained for backwards compatibility, but they only support predefined views.

View Listing Query

Returns a string containing a comma-separated list of names for *all* the Views, including User Views, available for the current Measurement.

Remote Command	`:DISPlay:VIEW:ADVanced:CATalog?`
Example	`:DISP:VIEW:ADV:CAT?`
Notes	Returns a quoted string of the available Views for the current measurement, separated by commas. The list includes names for *all* the Views, including User Views, available for the current Measurement Example: `"Normal,Trace Zoom,Spectrogram,Baseband,myView1,yourView1"` No distinction is made between Predefined and User Views If you switch measurements with the display disabled (via `:DISP:ENAB OFF`), then query the list of available Views, the result is undefined

User View Listing Query

Returns a string containing a comma-separated list of names for *only* the User Views available for the current Measurement.

Remote Command	`:DISPlay:VIEW:ADVanced:USER:CATalog?`
Example	`:DISP:VIEW:ADV:USER:CAT?`
Notes	Returns a quoted string of the available User Views for the current measurement, separated by commas. Example: `"Baseband,myView1,yourView1"` If you switch measurements with the display disabled (see "Display Enable (Remote Command Only)" on page 1983), then query the list of available Views, the result is undefined

3.10.6 Frequency

Opens the **Frequency** menu, which contains controls that allow you to control the frequency and channel parameters of the instrument.

Some features in the **Frequency** menu are the same for all measurements in the current Mode – they do not change as you change measurements. Settings like these are called “Meas Global” and are unaffected by **Meas Preset**. For example, the **Center Frequency** setting is the same for all measurements – it does not change as you change measurements.

3.10.6.1 Settings

Contains the basic **Frequency** functions.

Center Frequency

Sets the frequency that corresponds to the horizontal center of the graticule. While adjusting **Center Frequency**, **Span** is held constant.

The **Center Frequency** setting is the same for all measurements within a Mode, that is, it is Meas Global. Some Modes are also able to share a Mode Global center frequency value. If this is the case, the Mode has a **Global** tab in its **Meas Setup** menu.

The **Center Frequency** function sets (and queries) the center frequency for the currently selected input. If your instrument has multiple inputs, and you select another input, **Center Frequency** changes to the value for that input. SCPI commands are available to directly set the value for a specific input.

Center Frequency is remembered as you go from input to input. Thus, you can set a **Center Frequency** of 10 GHz with the RF Input selected, change to BBIQ and set a **Center Frequency** of 20 MHz, then switch to External Mixing and set a **Center Frequency** of 60 GHz. When you return to the RF Input; **Center Frequency** reverts to 10 GHz; back to BBIQ and it is 20 MHz; back to External Mixing and it is 60 GHz.

See "Center Frequency Presets" on page 1798

Remote Command	`[:SENSe]:FREQuency:CENTer <freq>` `[:SENSe]:FREQuency:CENTer?`

Example	Set **Center Frequency** to 50 MHz:
	`:FREQ:CENT 50 MHz`
	Increment **Center Frequency** by the value of "CF Step" on page 1804
	`:FREQ:CENT UP`

	Return the current value of **Center Frequency**: `:FREQ:CENT?`
Notes	Sets the RF, External Mixing or I/Q Center Frequency depending on the selected input: – For RF input it is equivalent to `:FREQ:RF:CENT` – For I/Q input it is equivalent to `:FREQ:IQ:CENT` – For External Mixer it is equivalent to `:FREQ:EMIX:CENT` Preset and Max values depend on Hardware Options If no terminator (for example, MHz) is sent, the terminator Hz is used. If a terminator with unit other than frequency is used, an invalid suffix error message is generated
Dependencies	Limited if **Span** is such that the range of the instrument is exceeded
Preset	Depends on instrument maximum frequency, mode, measurement, and selected input See "Center Frequency Presets" on page 1798
State Saved	Saved in instrument state
Min/Max	Depends on instrument maximum frequency, mode, measurement, and selected input See "Center Frequency Presets" on page 1798
Annotation	Center <value> appears in the lower left corner of the display
Status Bits/OPC dependencies	Non-overlapped

Center Frequency Presets

The following table provides the Center Frequency Presets for the Spectrum Analyzer mode, and the Max Freq, for the various frequency options:

Freq Option	CF after Mode Preset	Stop Freq after Mode Preset	Max Freq (can't tune above)
503 (all but CXA)	1.805 GHz	3.6 GHz	3.7 GHz
503 (CXA)	1.505 GHz	3.0 GHz	3.08 GHz
507 (all but CXA)	3.505 GHz	7.0 GHz	7.1 GHz
507 (CXA)	3.755 GHz	7.5 GHz	7.58 GHz
508 (all but MXE)	1.805 GHz	3.6 GHz	8.5 GHz
508 (MXE)	4.205 GHz	8.4 GHz	8.5 GHz
513	6.805 GHz	13.6 GHz	13.8 GHz
526 (except CXA and MXE)	13.255 GHz	26.5 GHz	27.0 GHz*
526 (CXA)	13.255 GHz	26.5 GHz	26.55 GHz
526 (MXE)	1.805 GHz	3.6 GHz	27.0 GHz

Freq Option	CF after Mode Preset	Stop Freq after Mode Preset	Max Freq (can't tune above)
532	16.005 GHz	32.0 GHz	32.5 GHz
540	20.005 GHz	40.0 GHz	40.5 GHz
543	21.505 GHz	43.0 GHz	43.0 GHz
544	22.005 GHz	44.0 GHz	45.0 GHz
550	25.005 GHz	50.0 GHz	52 GHz
F03 (CXA-m)	1.505 GHz	3.0 GHz	3.08 GHz
F07 (CXA-m)	3.755 GHz	7.5 GHz	7.575 GHz
F13 (CXA-m)	6.805 GHz	13.6 GHz	13.8 GHz
F26 (CXA-m)	13.255 GHz	26.5 GHz	26.55 GHz
504 (M9421A, M8920A)	2.145 GHz	3.88GHz	3.88 GHz
506 (M9421A, M8920A)	3.245 GHz	6.08GHz	6.08 GHz
F06 (M9410A/11A)	1.0 GHz	6.08 GHz	6.08 GHz
F06 (M9415A)	1 GHz	1.08 GHz	6.6 GHz
F08 (M9415A)	1 GHz	1.08 GHz	8.6 GHz
F12 (M9415A)	1 GHz	1.08 GHz	12.9 GHz

*For option 526, the Max CF in RTSA is 26.999999995 GHz.

N9041B Center Freq Presets

Input	CF after Mode Preset	Stop Freq after Mode Preset	Max Freq (can't tune above)
Input 1, all models	25.005 GHz	50.0 GHz	52 GHz
Input 2, opt 585	42.505 GHz	85.0 GHz	86 GHz
Input 2, opt 590	45.005 GHz	90.0 GHz	92 GHz
Input 2, opt 5CX	55.005 GHz	110.0 GHz	110 GHz

Input 2, CXA and MXE

Model	CF after Mode Preset	Stop Freq after Mode Preset	Max Freq (can't tune above)
CXA opt C75	0.7505 GHz	1.5 GHz	1.58 GHz
MXE	505 MHz	1 GHz	1.000025 GHz

Tracking Generator Frequency Limits (CXA only)

Tracking Generator Option	Min Freq (clips to this freq when turn TG on and can't tune below while TG on)	If above this Freq, Stop Freq clipped to this Freq when TG turned on	Max Freq (can't tune above) while TG on
T03	9 kHz	3.0 GHz	3.08 GHz
T06	9 kHz	6.0 GHz	6.05 GHz

Tracking Generator Frequency Limits(CXA-m only)

Tracking Generator Option	Min Freq (clips to this freq when turn TG on and can't tune below while TG on)	If above this Freq, Stop Freq clipped to this Freq when TG turned on	Max Freq (can't tune above) while TG on
T03	2 MHz	3.08 GHz	3.08 GHz
T07	2 MHz	7.575 GHz	7.575 GHz
T13	2 MHz	13.8 GHz	13.8 GHz
T26	2 MHz	26.55 GHz	26.55 GHz

Span

Changes the displayed frequency range symmetrically about the center frequency. While adjusting **Span**, **Center Frequency** is held constant, which means that both Start Frequency and Stop Frequency will change.

If **Span** is set to a value greater than the maximum allowable span of the instrument, an error message is generated indicating the data is out of range and was clipped to upper limit.

Remote Command	`[:SENSe]:TOI:FREQuency:SPAN <freq>` `[:SENSe]:TOI:FREQuency:SPAN?`
Example	`:TOI:FREQ:SPAN 26.490000 GHz` `:TOI:FREQ:SPAN?`
Dependencies	If the electrical attenuator is enabled, any attempt to set **Span** such that the stop frequency would be >3.6 GHz results in an error In instruments with an RF Preselector, such as MXE, you cannot sweep across the band break at 3.6 GHz while the RF Preselector is on in **Continuous** sweep, as there is a mechanical switch that bypasses the RF Preselector above 3.6 GHz
Couplings	Affects RBW, sweeptime, FFT & Sweep choice (including FFT Width, Phase Noise Optimization and ADC Dither auto couplings) Any value of **Center Frequency** or **Span** that is within the frequency range of the instrument is allowed *when* the value is being set through the front panel numeric keypad or the SCPI command. The other parameter is forced to a different value if needed When using the knob or the step up/down keys or the `UP` | `DOWN` keywords in SCPI, the value that is

	being changed, that is, **Center Frequency** or **Span**, is limited so that the other parameter is not forced to a new value
Preset	Depends on instrument maximum frequency, mode, measurement, and selected input
State Saved	Saved in instrument state
Min	10 Hz
Max	Depends on instrument maximum frequency, mode, measurement, and selected input Note that, if **Source Mode** is set to **Tracking**, the effective instrument maximum **Span** may be limited by the source maximum frequency
Annotation	Span <value> appears on the first line of the annotation in the lower right corner of display
Backwards Compatibility SCPI	`[:SENSe]:TOIntercept:FREQuency:SPAN`

Span Presets

The following table provides the Span Presets for the Spectrum Analyzer mode, and the Max Span, for the various frequency options:

Freq Option	Span after Mode Preset	Max Span (can't set higher than this)
503 (all but CXA)	3.59 GHz	3.7 GHz
503 (CXA), F03 (CXA-m)	2.99 GHz	3.08 GHz
507 (all but CXA)	6.99 GHz	7.1 GHz
507 (CXA), F07 (CXA-m)	7.49 GHz	7.575 GHz
508 (all but MXE)	8.39 GHz	8.5 GHz
508 (MXE)	3.59 GHz	8.5 GHz
513, F13	13.59 GHz	13.8 GHz
526 (all but CXA and MXE)	26.49 GHz	27.0 GHz
526 (MXE)	3.59 GHz	27.0 GHz
526 (CXA), F26 (CXA-m)	26.49 GHz	26.55 GHz
543	42.99 GHz	
544	43.99 GHz	44.5 GHz
550	49.99 GHz	52 GHz

Input 2:

Model	Span after Mode Preset	Max Span (can't set higher than this)
CXA opt C75	1.499 GHz	1.58 GHz
MXE	1 GHz	1.000025 GHz

Note that if you are in External Mixing, the maximum **Span** is Maximum Stop Frequency – Minimum Start Frequency for the currently selected mixer.

Auto Tune

This is an immediate action control. When it is pressed, it causes the instrument to change "Center Frequency" on page 1797 to the strongest signal in the tunable span of the instrument, excluding the LO. It is designed to quickly get you to the most likely signal(s) of interest, with no signal analysis knowledge required. As such, there are no configurable parameters for this feature. There are only preselected values that work in most real-world situations.

NOTE **Auto Tune** performs a Preset as part of its function, so it always returns you to the `Normal` View and a preset state, although it leaves the AC/DC coupling and **Single/Cont** state unaffected.

NOTE You will see an hourglass, and you may see a slight pause, until the signal of interest is presented at midscreen.

Remote Command	`[:SENSe]:TOI:FREQuency:TUNE:IMMediate`
Example	`:TOI:FREQ:TUNE:IMM`

There are several phases of operation for **AutoTune**, which happen in sequential order. Each is described below.

Step	Phase	Notes
1	Initial setup	We record the initial state of ‘single/continuous’ and ‘AC/DC’. The instrument is then preset, and placed in single sweep mode with 10000 sweep points. The recorded state of ‘AC/DC’ is then restored. If the instrument is set to DC coupling, we set the start frequency to 100 kHz to potentially capture the low frequency signals of interest
2	Search for two peaks	We set the peak detector and single sweep, then look for peaks with a threshold of -40 dBm and a peak excursion of 20 dBm. Look for a second peak within 2 GHz and 10 dB from the first peak If no such peaks are found, issue a “peak not found” message and terminate the auto tune algorithm If one such peak is found, narrow the span to equal the RBW, set the center frequency to the largest peak location, and remeasure. Repeat up to four times until two peaks are found. If no second peak is found in 4 zooms, issue a “peak not found” message and terminate the auto tune algorithm Note that there is a coupling between the number of zooms required and the resolution bandwidth; 1/100th assumes the preset condition of RBW = Span /106
3	Position the two peaks	Set the span to 4 times the difference between the two peaks, and the center frequency to the midpoint between the two peaks Adjust the reference level to 3 dB higher than the highest peak, rounded to the nearest 5 dB

Step	Phase	Notes
		Remeasure, and once again set the span to 4 times the difference between the two peaks, and the center frequency to the midpoint between the two peaks
4	Final Presentation	If the instrument had been in **Continuous** sweep prior to executing the auto tune, we restore that state now. Set the number of sweep points back to preset condition

Lower Tone

Sets the lower of the two base frequencies for TOI measurement.

Normally, the lower base frequency is set by choosing the lower in frequency of the two highest peaks on the trace. When in **Manual** mode, the measurement frequency is fixed.

When zero-span measurement is turned on, a frequency count is required to accurately calculate the needed intermodulation frequencies. Thus, the measurement will be slightly faster if you switch the lower base frequency to manual.

Remote Command	`[:SENSe]:TOI:FREQuency:BASE:LOWer <freq>` `[:SENSe]:TOI:FREQuency:BASE:LOWer?`
Example	`:TOI:FREQ:BASE:LOW 13.2500000 GHz`
Notes	Forces measurement restart
Couplings	In **Auto** mode, after each sweep the lower frequency base is set to the lower in frequency of the two highest peaks within the span. If there is no peak or only one peak within the span, the lower frequency base is set to `NaN` If you set Lower Frequency Tone >= Upper Frequency Tone, the Upper Frequency Tone changes to 1 Hz greater than Lower Frequency Tone If in **Auto** when Zero-Span measurement is on, a frequency count is run at the lower frequency base so that we can more accurately calculate the intermod frequency. This is necessary since the Resolution Bandwidth of the intermod measurement will likely be significantly lower than the main sweep RBW Affected by "Freq Offset" on page 1805 When the lower frequency tone auto is changed, the upper frequency tone auto is set to the same value
Preset	Determined by trace data
Min	10 Hz
Max	The maximum value for this parameter is the maximum frequency of the instrument minus 1 kHz

Auto Function

Remote Command	`[:SENSe]:TOI:FREQuency:BASE:LOWer:AUTO OFF | ON | 0 | 1` `[:SENSe]:TOI:FREQuency:BASE:LOWer:AUTO?`
Example	`:TOI:FREQ:BASE:LOW:AUTO ON`
Preset	`ON`

Upper Tone

Sets the upper of the two base frequencies for TOI measurement.

Normally, the upper base frequency is set by choosing the higher in frequency of the two highest peaks on the trace. When in **Manual** mode, the measurement frequency is fixed.

When zero-span measurement is turned on, a frequency count is required to accurately calculate the needed intermodulation frequencies. Thus, the measurement will be slightly faster if you switch the lower base frequency to manual.

Remote Command	`[:SENSe]:TOI:FREQuency:BASE:UPPer <frequency>` `[:SENSe]:TOI:FREQuency:BASE:UPPer?`
Example	`:TOI:FREQ:BASE:UPP 13.2600000 GHz`
Notes	Forces measurement restart
Couplings	If you set Upper Frequency Tone <= Lower Frequency Tone, the Lower Frequency Tone will change to 1 Hz less than Upper Frequency Tone In **Auto**, after each sweep the upper frequency base is set to the upper in frequency of the two highest peaks within the span. If there is no peak or only one peak within the span, the lower frequency base is set to `NaN` If in **Auto** when Zero-Span measurement is on, a frequency count is run at the upper frequency base so that we can more accurately calculate the intermod frequency. This is needed since the Resolution Bandwidth of the intermod measurement will likely be significantly lower than the main sweep RBW Affected by "Freq Offset" on page 1805 When the upper frequency tone auto is changed, the lower frequency tone auto is set to the same value
Preset	13.2600000 GHz
Min	11 Hz
Max	The maximum frequency of the instrument

Auto Function

Remote Command	`[:SENSe]:TOI:FREQuency:BASE:UPPer:AUTO OFF | ON | 0 | 1` `[:SENSe]:TOI:FREQuency:BASE:UPPer:AUTO?`
Example	`:TOI:FREQ:BASE:UPP:AUTO ON`
Preset	`ON`

CF Step

Changes the step size for "Center Frequency" on page 1797, and start and stop frequency functions. Once a step size has been selected and the **Center Frequency** function is active, the step keys (and the `UP|DOWN` parameters from remote commands) change **Center Frequency** by the step-size value. The step size function is useful for finding harmonics and sidebands beyond the current frequency span of the instrument.

Remote Command	`[:SENSe]:FREQuency:CENTer:STEP[:INCRement] <freq>` `[:SENSe]:FREQuency:CENTer:STEP[:INCRement]?`

Example	`:FREQ:CENT:STEP 500 MHz`
	`:FREQ:CENT UP`
	increases the current **Center Frequency** value by 500 MHz

Notes	Preset and Max values depend on Hardware Options
Dependencies	If the electronic/soft attenuator is enabled, any attempt to change the value of **Center Frequency** >3.6 GHz by pressing the **Up**-arrow key fails and results in an advisory message. If the equivalent SCPI command is sent, this same message is generated as part of a "-221, Settings conflict" warning
Couplings	When auto-coupled, **CF Step** size is set to 10% of the span
Preset	Auto
State Saved	Saved in instrument state
Min/Max	– /+(the maximum frequency of the instrument). That is, 27 GHz max freq instrument has a CF step range of +/- 27 GHz. Note that this is the maximum frequency given the current settings of the instrument, so in External Mixing, for example, it is the maximum frequency of the current mixer band
Status Bits/OPC dependencies	non-overlapped

Auto Function

Remote Command	`[:SENSe]:FREQuency:CENTer:STEP:AUTO OFF | ON | 0 | 1` `[:SENSe]:FREQuency:CENTer:STEP:AUTO?`
Example	`:FREQ:CENT:STEP:AUTO ON` `:FREQ:CENT:STEP:AUTO?`
Preset	`ON`

Freq Offset

Lets you set a frequency offset value to account for frequency conversions outside of the instrument. This value is added to the display readout of the marker frequency, center frequency, start frequency, stop frequency, and all other absolute frequency settings in the instrument including frequency count. When a frequency offset is entered, the value appears below the center of the graticule. To eliminate an offset, perform a **Mode Preset** or set the frequency offset to 0 Hz.

See "More Information" on page 1806.

Remote Command	`[:SENSe]:FREQuency:OFFSet <freq>` `[:SENSe]:FREQuency:OFFSet?`

Example	`:FREQ:OFFS 10 MHz` `:FREQ:OFFS?`
Notes	Preset and Max values depend on Hardware Options
Dependencies	Not available in External Mixing. In this case, the **Freq Offset** control is grayed out and shows a value of zero. However, the value of CF Offset that was set for the RF Input is retained and restored when you switch back to the RF Input
Preset	See "Center Frequency Presets" on page 1798
State Saved	Saved in instrument state
Min	-500 GHz
Max	500 GHz
Annotation	If Frequency Offset is not zero, "Freq Offset <value>" appears on the upper line of the annotation, below the graticule, in the center
Status Bits/OPC dependencies	Non-overlapped
Backwards Compatibility SCPI	`:DISPlay:WINDow[1]:TRACe:X[:SCALe]:OFFSet` The `DISPlay` version of the command is supported for compatibility across platforms, but is not recommended for new developments
Backwards Compatibility Notes	In pre-X-Series instruments, **Freq Offset** could not be adjusted by the knob or step keys. That is no longer the case

More Information

This command does not affect any bandwidths, nor the settings of relative frequency parameters such as delta markers or span. It does not affect the current hardware settings of the instrument, but only the displayed frequency values. Entering an offset does not affect the trace position or display, just the value of the start and stop frequency and the values represented by the trace data. The frequency values of exported trace data, queried trace data, markers, trace data used in calculations such as N dB points, trace math, etc., are all affected by **Freq Offset**. Changing the offset, even on a trace that is not updating, immediately changes all the above, without taking new data

3.10.7 Marker

There is no **Marker** functionality in this measurement.

3.10.8 Meas Setup

Accesses a menu panel that allows averaging control, and enables zero-span measurements for increased accuracy.

3.10.8.1 Settings

Contains frequently used **Meas Setup** functions to which you will want the fastest access.

Avg/Hold Num

When **Average/Hold** is turned on, at each frequency a specified number of sweeps is taken, and the data in those sweeps averaged for the purposes of establishing the measurement.

Remote Command	`[:SENSe]:TOI:AVERage:COUNt <integer>` `[:SENSe]:TOI:AVERage:COUNt?`
Example	`:TOI:AVER:COUN 20`
Preset	10
Min	1
Max	10000
Annotation	In the Meas Bar
Backwards Compatibility SCPI	`[:SENSe]:TOINtercept:AVERage:COUNt`

Auto Function

Remote Command	`[:SENSe]:TOI:AVERage[:STATe] ON | OFF | 1 | 0` `[:SENSe]:TOI:AVERage[:STATe]?`
Preset	`OFF`
Backwards Compatibility SCPI	`[:SENSe]:TOINtercept:AVERage[:STATe]`

Averaging On/Off

Turns Averaging on or off.

NOTE In this measurement, the **Average Type** is preset to the `Log-Pwr Avg (Video)` method. Other averaging methods are not available.

Remote Command	`[:SENSe]:TOI:AVERage[:STATe] OFF | ON | 0 | 1` `[:SENSe]:TOI:AVERage[:STATe]?`
Example	`:TOI:AVER OFF` `:TOI:AVER?`

Preset	ON
State Saved	Yes
Range	OFF|ON

Average Mode

Selects the termination control used for the averaging function when averaging the trace. This determines the action after the specified number of measurements (**Avg/Hold Num**) is reached.

EXPonential	Each successive data acquisition after the average count is reached is exponentially weighted and combined with the existing average. Exponential averaging weights new data more than old data, which facilitates tracking of slow-changing signals. The average is displayed at the end of each sweep
REPeat	After reaching the "Avg/Hold Num" on page 1807, all previous result data is cleared, and the average count set back to 1

Remote Command	[:SENSe]:TOI:AVERage:TCONtrol EXPonential | REPeat [:SENSe]:TOI:AVERage:TCONtrol?
Example	:TOI:AVER:TCON EXP
Preset	EXP
Range	EXPonential | REPeat
Backwards Compatibility SCPI	[:SENSe]:TOINtercept:AVERage:TCONtrol

Meas Setup Summary Table

Lets you view and access many **Meas Setup** parameters on one screen.

Auto Couple

Immediately puts all **Auto/Man** functions into **Auto**. **Auto Couple** is confined to the current measurement only. It does not affect other measurements in the Mode.

In the **Auto** state, **Auto/Man** functions are said to be “coupled”, meaning their values change as you make changes to other values in the measurement. This helps ensure accurate measurements and optimum dynamic range. **Auto Couple** is an immediate action function, and when it is executed, all the **Auto/Man** controls for the current measurement are set to **Auto**, and all measurement settings coupled to the **Auto/Man** parameters are automatically set to their optimal values.

For further details of measurement-specific settings (if any), see "Measurement-Specific Details" on page 1809 below.

Remote Command	`:COUPle ALL`
Example	`:COUP ALL`
Backwards Compatibility SCPI	`:COUPLE ALL | NONE`
Backwards Compatibility Notes	`:COUP:NONE` puts all Auto/Man parameters in manual mode, decoupling all the coupled instrument parameters. It is retained for backwards compatibility and is *not* recommended for making measurements or new designs

All **Auto/Man** parameter couplings in the measurement are set to **Auto**. This includes couplings that may be unavailable or grayed-out due to the current state. For example, in the Swept SA measurement, there is no **Auto/Man** coupling for **RBW** while in Zero Span. Nonetheless, if **Auto Couple** were executed while in Zero Span, it would set **RBW** to Auto "behind the scenes" so that, on exit from Zero Span, it would be in **Auto**.

Any **Auto/Man** selection specific (local) to the other measurements in the current Mode are not affected by **Auto Couple**. Any functions that are *not* coupled with other instrument parameters, such as ranging or leveling variables, such as **AutoRange** or **AutoScale**, are not affected.

Executing **Auto Couple** generates the informational message, "All Auto/Man functions have been set to Auto".

Each parameter, upon being set to **Auto**, selects and sets the appropriate auto-coupled value based on that parameter's coupling rules. The Dependency Resolver orchestrates the couplings for parameters that depend on one or more other parameters. The coupling and dependency rules for each parameter are defined in the section describing that parameter.

Executing **Auto Couple***does not* affect markers, marker functions, trace or display attributes, or any other instrument setting other than those specifically mentioned above.

Measurement-Specific Details

TOI (SA Mode only)

Parameters affected by **Auto Couple** are:

- Center Frequency Step
- Resolution Bandwidth
- Span/RBW Ratio

- Sweep Time
- Video BANDwidth VBW/RBW ratio
- Upper and Lower Tone (set to Sense)
- Zero span measurement Resolution Bandwidth
- Zero span measurement Dwell Time

Harmonics (SA Mode only)

Parameters affected by **Auto Couple** are:

- Resolution Bandwidth
- Fundamental Frequency
- Dwell Time
- Range Table Resolution Bandwidths
- Range Table Dwell Times

Meas Preset

Initiates the first sweep. Returns Meas Local variables in the current measurement to their preset values (many of which are determined from the results of the first sweep).

Remote Command	`:CONFigure:TOI`

3.10.8.2 Zero Span

Contains **Meas Setup** functions that enable you to control Zero-Span measurement parameters.

Zero-Span Measurement

Zero-Span Measurement uses two additional zero-span sweeps – one at each intermodulation product – to significantly increase the accuracy and the dynamic range of the TOI measurement. Zero-span measurement cannot be used on signals that vary rapidly in frequency.

Remote Command	`[:SENSe]:TOI:ZSPan:STATe ON	OFF	1	0`

	[:SENSe]:TOI:ZSPan:STATe?
Example	:TOI:ZSP:STAT OFF
Notes	Forces a measurement restart
Preset	OFF
Range	ON|OFF

Zero-Span RBW

Zero-Span RBW is the resolution bandwidth used when making the zero-span intermod measurements when "Zero-Span Measurement" on page 1810 is ON. The **Zero-Span RBW** is typically smaller than the main resolution bandwidth, although it must still be large enough to accommodate three times the width of the intermodulation products.

The required frequency accuracy of the lower and upper base frequencies increases when **Zero-Span RBW** decreases. For this reason, frequency counting is used when the lower and upper base frequencies are in auto mode. For optimum measurement speed, set the lower and upper base frequencies explicitly.

Remote Command	[:SENSe]:TOI:ZSPan:BANDwidth|BWIDth <frequency> [:SENSe]:TOI:ZSPan:BANDwidth|BWIDth?
Example	:TOI:ZSP:BAND 300 kHz
Notes	Forces a measurement restart
Couplings	When **Auto** is on, **Zero-Span RBW** is one step down from the measurement RBW
Preset	3 MHz
Min	1 Hz
Max	8 MHz

Auto Function

Remote Command	[:SENSe]:TOI:ZSPan:BANDwidth|BWIDth:AUTO OFF | ON | 0 | 1 [:SENSe]:TOI:ZSPan:BANDwidth|BWIDth:AUTO?
Example	:TOI:ZSP:BAND:AUTO ON
Preset	ON

Dwell Time

This is the sweep time used when making the zero-span intermod measurements when "Zero-Span Measurement" on page 1810 is ON. Additional sweep time gives better noise performance.

Remote Command	`[:SENSe]:TOI:ZSPan:SWEep:TIME <time>` `[:SENSe]:TOI:ZSPan:SWEep:TIME?`
Example	`:TOI:ZSP:SWE:TIME 66.24 ms`
Couplings	If **ZS Sweep Time Auto** is ON, **Dwell Time** is the same as the measurement sweep time
Preset	Depends upon the maximum span of the instrument; see "Sweep Time" on page 1815 for more information
Min	100 us
Max	4000 s

Auto Function

Remote Command	`[:SENSe]:TOI:ZSPan:SWEep:TIME:AUTO OFF | ON | 0 | 1` `[:SENSe]:TOI:ZSPan:SWEep:TIME:AUTO?`
Example	`:TOI:ZSP:SWE:TIME:AUTO ON`
Preset	ON

3.10.8.3 Global

The controls in this menu apply to all Modes in the instrument.

Some controls (for example, "Global Center Freq" on page 2013) allow you to switch certain Meas Global parameters to a Mode Global state. These switches apply to all Modes that support global settings. For example, no matter what Mode you are in when you set **Global Center Freq** to ON, it applies to all Modes that support Global settings.

Other controls (for example, **Extend Low Band**) are actually set in this menu, but apply to all Modes.

Global Center Freq

The software maintains a Mode Global value called **Global Center Freq**.

When **Global Center Freq** is switched ON, the current Mode's center frequency is copied into the **Global Center Frequency**, and from then on all Modes that support global settings use the **Global Center Frequency**, so you can switch between any of these Modes and the **Center Frequency** remains unchanged.

Adjusting the **Center Frequency** of any Mode that supports Global Settings, while **Global Center Freq** is ON, modifies the **Global Center Freq**.

When **Global Center Freq** is switched OFF, the **Center Frequency** of the current Mode is unchanged, but now the **Center Frequency** of each Mode is once again independent.

When **Mode Preset** is pressed while **Global Center Freq** is ON, the **Global Center Freq** is preset to the preset **Center Frequency** of the current Mode.

This function resets to OFF when "Restore Defaults" on page 2016 is pressed, or when **System**, **Restore Defaults**, **All Modes** is pressed.

Remote Command	`:INSTrument:COUPle:FREQuency:CENTer ALL | NONE` `:INSTrument:COUPle:FREQuency:CENTer?`
Example	`:INST:COUP:FREQ:CENT ALL` `:INST:COUP:FREQ:CENT?`
Preset	Set to OFF on **Global** Settings, **Restore Defaults** and **System, Restore Defaults, All Modes**
Range	ALL|NONE

Preset	OFF
Backwards Compatibility SCPI	`:GLOBal:FREQuency:CENTer[:STATe] 1 | 0 | ON | OFF` `:GLOBal:FREQuency:CENTer[:STATe]?`

Global EMC Std

When this control is switched ON, the current Mode's EMC Std is copied into the **Global EMC Std**, and from then on all Modes that support global settings use the **Global EMC Std**, so you can switch between any of these Modes and the EMC Std remains unchanged.

Adjusting the EMC Std of any Mode that supports Global settings, while **Global EMC Std** is ON modifies the **Global EMC Std**.

When **Global EMC Std** is switched OFF, the EMC Std of the current Mode remains unchanged, but now the EMC Std of each Mode is once again independent. When **Mode Preset** is pressed while **Global EMC Std** is ON, **Global EMC Std** is preset to the preset EMC Std of the current Mode.

This function resets to OFF when "Restore Defaults" on page 2016 is pressed, or when **System, Restore Defaults, All Modes** is pressed.

Remote Command	`:INSTrument:COUPle:EMC:STANdard ALL | NONE` `:INSTrument:COUPle:EMC:STANdard?`
Example	`:INST:COUP:EMC:STAN ALL` `:INST:COUP:EMC:STAN?`
Dependencies	Only available if Option EMC is installed
Preset	Set to OFF on **Global** Settings, **Restore Defaults** and **System, Restore Defaults, All Modes**
Range	ALL | NONE

Global Limit Lines (Freq and Amptd)

When this control is set to ALL, the current Mode's Limit Line is copied into the **Global Limit Lines**, and from there to all Modes that support Global settings and use **Global Limit Lines**, so you can switch between any of these Modes and the Limit Lines remain unchanged.

Adjusting the Limit Lines of any Mode that supports **Global** Settings, while **Global Limit Lines** is ALL, modifies the **Global Limit Lines**.

When **Global Limit Lines** is set to NONE, the Limit Lines of the current Mode are unchanged, but now the Limit Lines of each Mode are once again independent. When **Mode Preset** is pressed while **Global Limit Lines** is ALL, **Global Limit Lines** is preset to the preset Limit Lines of the current Mode.

This function is reset to NONE when "Restore Defaults" on page 2016 is pressed, or when **System**, **Restore Defaults**, **All Modes** is pressed.

Remote Command	`:INSTrument:COUPle:LLINe ALL | NONE` `:INSTrument:COUPle:LLINe?`
Example	`:INST:COUP:LLIN ALL | NONE` `:INST:COUP:LLIN?`
Preset	Set to OFF on **Global** Settings, **Restore Defaults** and **System, Restore Defaults, All Modes**
Range	ALL | NONE

Extend Low Band

The software maintains a Mode Global value called **Extend Low Band**.

Under the current sweep configuration crossing over two bands, when **Extend Low Band** is turned ON, the instrument checks whether one band can cover the whole sweep frequency range or not. If it can, then the instrument locks the band; otherwise, it does nothing (the band crossover occurs).

This function does *not* work when **Band Lock** under **System** > **Service** > **Lock Functions** is not -1 (no Band Lock). In that case, **Band Lock** takes priority over **Extend Low Band**.

This function resets to OFF when "Restore Defaults" on page 2016 is pressed, or when **System**, **Restore Defaults**, **All Modes** is pressed.

Remote Command	`:INSTrument:COUPle:FREQuency:BAND:EXTend 0 | 1 | ON | OFF` `:INSTrument:COUPle:FREQuency:BAND:EXTend?`
Example	`:INST:COUP:FREQ:BAND:EXT 1` `:INST:COUP:FREQ:BAND:EXT?`

Preset	Set to OFF by Global Settings > Restore Defaults and System > Restore Defaults > All Modes
Range	ON|OFF

Restore Defaults

Resets all functions in the Global settings menu to OFF. Pressing System, Restore Defaults, All Modes has the same effect.

Remote Command	:INSTrument:COUPle:DEFault
Example	:INST:COUP:DEF
Backwards Compatibility SCPI	:GLOBal:DEFault

3.10.9 Sweep

Accesses controls to configure and control the acquisition of data, and the X-axis parameters of the instrument.

Depending on the selected mode and measurement, these controls might include: Sweep Time, Continuous/Single, Pause/Resume, X Scale and Number of Points.

3.10.9.1 Sweep/Control

Accesses controls that let you operate the sweep and control functions of the instrument, such as Sweep Time and Continuous/Single.

Sweep Time

Controls the time the instrument takes to sweep the current frequency span in swept measurements, displays the sweep time in swept measurements, and displays the equivalent Sweep Time in FFT measurements.

NOTE **In instruments without sweeping hardware this control may be labeled Acquisition Time**

When Sweep Time is in Auto, the instrument computes a time that will give accurate measurements based on other settings of the instrument, such as RBW and VBW.

You can select a shorter sweep time to improve the measurement throughput (with some potential unspecified accuracy reduction), but the Meas Uncal indicator will come on if the Sweep Time you set is less than the calculated Auto Sweep time.

You can also select a longer sweep time, which can be useful (for example) for obtaining accurate insertion loss measurements on very narrowband filters.

NOTE Significantly faster sweep times are available with Option FS1.

NOTE The **Meas Uncal** (measurement uncalibrated) warning appears in the Status Bar at the bottom of the screen if the manual **Sweep Time** entered is faster than the time computed by the instrument's Sweep time equations, that is, the Auto Sweep Time. The instrument's computed **Sweep Time** provides accurate measurements; if you sweep faster than this your measurements may be inaccurate. A **Meas Uncal** condition may be corrected by returning **Sweep Time** to **Auto**; by entering a longer **Sweep Time**; or by choosing a wider **RBW** and/or **VBW**.

Remote Command	`[:SENSe]:TOI:SWEep:TIME <time>` `[:SENSe]:TOI:SWEep:TIME?`
Example	Set **Sweep Time** to 1ms: `:TOI:SWE:TIME 1ms`
Dependencies	In certain instruments without sweeping hardware, such as VXT, this control is grayed-out, and the **Auto/Man** toggle disappears
Couplings	Coupled to **RBW** when **Sweep Time** is set to **Auto**; in this case the sweep time is changed as **RBW** changes, to maintain amplitude calibration Also coupled to "Video BW" on page 1786. As **VBW** changes, **Sweep Time** (when set to **Auto**) changes to maintain amplitude calibration. This occurs because of common hardware between the two circuits
Preset	Depends on the maximum span of the instrument
State Saved	Saved in instrument state
Min	1 ms
Max	4000 s
Annotation	The sweep time is displayed in the lower-right corner of the screen. The number of points is displayed parenthetically, as Sweep 13.3 ms (1001 points) A "#" mark appears before "Sweep" in the annotation when it is switched from Auto to Manual coupling
Status Bits/OPC dependencies	Meas Uncal is Bit 0 in the `STATus:QUEStionable:INTegrity:UNCalibrated` register

Auto Function

Remote Command	`[:SENSe]:TOI:SWEep:TIME:AUTO OFF | ON | 0 | 1` `[:SENSe]:TOI:SWEep:TIME:AUTO?`
Example	`:TOI:SWE:TIME:AUTO OFF` `:TOI:SWE:TIME:AUTO?`

Preset	ON

Sweep/Measure

Lets you toggle between **Continuous** and **Single** sweep or measurement operation. The single/continuous state is Meas Global, so the setting affects all measurements.

The front-panel key **Single/Cont** performs exactly the same function

See "More Information" on page 1817

Remote Command	`:INITiate:CONTinuous OFF | ON | 0 | 1` `:INITiate:CONTinuous?`

Example	Put instrument into **Single** measurement operation:
	`:INIT:CONT 0`
	`:INIT:CONT OFF`
	Put instrument into **Continuous** measurement operation:
	`:INIT:CONT 1`
	`:INIT:CONT ON`

Preset	ON Note that `:SYST:PRES` sets `:INIT:CONT` to `ON`, but `*RST` sets `:INIT:CONT` to `OFF`
State Saved	Saved in instrument state
Annunciation	The **Single/Continuous** icon in the Meas Bar changes depending on the setting: – A line with an arrow is **Single** – A loop with an arrow is **Continuous**
Backwards Compatibility Notes	X-Series A-models had **Single** and **Cont** hardkeys in place of the **SweepSingleCont** softkey. In the X-Series A-models, if in single measurement, the **Cont** hardkey (and `INIT:CONT ON`) switched to continuous measurement, but never restarted a measurement and never reset a sweep X-Series B-models have a **Cont/Single** toggle control instead of **Single** and **Cont** hardkeys, but it is still true that, if in single measurement, the **Cont/Single** toggle control never restarts a measurement and never resets a sweep

More Information

Continuous Mode	The instrument takes repetitive sweeps, averages, measurements, etc., when in continuous mode. If in average or Max/Min Hold, and the average/hold count reaches the **Average/Hold Num**, the count stops incrementing, but the instrument keeps sweeping See the **Trace** key description under **Trace Average** for the averaging formula used both before and after the **Average/Hold Num** is reached. The trigger condition must be met prior to each sweep The type of trace processing for multiple sweeps is set under the **Trace** key, with

	choices of **Trace Average**, **Max Hold**, or **Min Hold**
Single Mode	The instrument takes a single sweep when in **Single** mode, or if in average or Max/Min Hold, or if there is a **Waterfall** window displayed, it takes multiple sweeps until the average/hold count reaches the **Average/Hold Num**, then the count stops incrementing, and the instrument stops sweeping See the **Trace** key description under **Trace Average** for the averaging formula used. The trigger condition must be met prior to the sweep The type of trace processing for multiple sweeps is set under the **Trace** key, with choices of **Trace Average**, **Max Hold**, or **Min Hold**

If the instrument is in **Single** measurement mode, pressing the **Cont/Single** toggle control does not zero the count and does not cause the sweep to be reset; the only action is to put the instrument into Continuous measurement operation.

If the instrument is already in **Continuous** sweep:

– `:INIT:CONT 1` has no effect

– `:INIT:CONT 0` places the instrument in Single Sweep but has no effect on the current sequence until k = N, at which point the current sequence will stop and the instrument will go to the idle state

See "Restart" on page 2018 for details of `:INIT:IMMediate`.

If the instrument is already in **Single** sweep, `:INIT:CONT OFF` has no effect.

If the instrument is already in **Single** sweep, then pressing **Cont/Single** in the middle of a sweep does not restart the sweep or sequence. Similarly, pressing **Cont/Single** does not restart the sweep or sequence if the sweep is not in the idle state (for example, if you are taking a very slow sweep, or the instrument is waiting for a trigger). Even though pressing **Cont/Single** in the middle of a sweep does not restart the sweep, sending `:INIT:IMM` *does* reset it.

If the instrument is in **Single** sweep, and *not* Averaging/Holding, and you want to take one more sweep, press **Restart**.

If the instrument is in **Single** sweep, *and* Averaging/Holding, and you want to take one more sweep without resetting the Average trace or count, go to **Meas Setup** and increment the average count by 1 by pressing the **Step-Up** key while **Average/Hold Num** is the active function. You can also do this by sending `:CALC:AVER:TCON UP`.

Restart

Restarts the current sweep, or measurement, or set of averaged/held sweeps or measurements. If you are Paused, pressing **Restart** performs a Resume.

The front-panel key **Restart** performs exactly the same function.

The **Restart** function is accessed in several ways:

- Pressing the **Restart** key
- Sending :INIT:IMM
- Sending :INIT:REST

See "More Information" on page 1819

Remote Command	:INITiate[:IMMediate] :INITiate:RESTart
Example	:INIT:IMM :INIT:REST
Notes	:INIT:REST and :INIT:IMM perform exactly the same function
Couplings	Resets average/hold count k. For the first sweep overwrites all active (update = on) traces with new current data. For application modes, it resets other parameters as required by the measurement
Status Bits/OPC dependencies	This is an Overlapped command The STATus:OPERation register bits 0 through 8 are cleared , *except* bit 6 (Waiting for Periodic Sync). Initiating a measurement and Waiting for Periodic Sync could be asynchronous The STATus:QUEStionable register bit 9 (INTegrity sum) is cleared The SWEEPING bit is set The MEASURING bit is set
Backwards Compatibility Notes	For Spectrum Analysis Mode in ESA and PSA, the **Restart** hardkey and the :INIT:REST command restarted trace averages (displayed average count reset to 1) for a trace in **Clear Write**, but did not restart **Max Hold** and **Min Hold** In X-Series, the **Restart** hardkey and the :INIT:REST command restart not only **Trace Average**, but **MaxHold** and **MinHold** traces as well

More Information

The **Restart** function first aborts the current sweep or measurement as quickly as possible. It then resets the sweep and trigger systems, sets up the measurement and initiates a new data measurement sequence with a new data acquisition (sweep) taken once the trigger condition is met.

If the instrument is in the process of aligning when a **Restart** is executed, the alignment finishes before the restart function is performed.

Even when set for **Single** operation, multiple sweeps may be taken when **Restart** is pressed (for example, when averaging/holding is on). Thus, when we say that **Restart** "restarts a measurement", depending on the current settings, we may mean that it:

- Restarts the current sweep
- Restarts the current measurement
- Restarts the current set of sweeps if any trace is in Trace Average, Max Hold or Min Hold
- Restarts the current set of measurements if Averaging, or Max Hold, or Min Hold is on for the measurement

If there is no Average or Max/Min Hold function (no trace in Trace Average or Hold, or **Average/Hold Num** set to 1), and no **Waterfall** window is being displayed, a single sweep is equivalent to a single measurement. A single sweep is taken after the trigger condition is met; and the instrument stops sweeping once that sweep has completed. However, with **Average/Hold Num** >1, and at least one trace set to Trace Average, Max Hold, or Min Hold, or a **Waterfall** window being displayed, multiple sweeps/data acquisitions are taken for a single measurement. The trigger condition must be met prior to each sweep. The sweep is stopped when the average count k equals the number N set for **Average/Hold Num**.

Once the full set of sweeps has been taken, the instrument goes to the idle state. To take one more sweep without resetting the average count, increment the average count by 1, by pressing the **Step-Up** key while **Average/Hold Number** is the active function, or by sending the remote command `:CALC:AVER:TCON UP`.

Trace Update

The numeric results are not blanked at any time during the restart cycle.

For slow sweeps (see **Trace Update** section in **Trace/Detector**), the traces are updated real-time during the sweep. There may be a special circumstance in application mode measurements where an exception is made and the traces and/or results need to be blanked before displaying the new results.

To summarize, the following list shows what happens to the trace data on various events:

Event	Trace Effect
Clear/Write pressed (even if already in Clear/Write)	Set to mintracevalue
Max Hold pressed (even if already in Max Hold)	Set to mintracevalue
Min Hold pressed (even if already in Min Hold)	Set to maxtracevalue
Trace Average pressed (even if already in Trace Average)	Trace data unaffected but start new sweep/avg/hold
Restart pressed	Trace data unaffected but start new sweep/avg/hold
Parameter requiring restart changed (e.g., RBW)	Trace data unaffected but start new sweep/avg/hold

Sweep and Trigger Reset

Resetting the sweep system resets the average/hold count k to 0. It also resets the set point counter to 0. Resetting the trigger system resets the internal auto trig timer to the value set by the **Auto Trig** control.

Averaging

The weighting factor used for averaging is k. This k is also the average/hold count for how many valid sweeps (data acquisitions) have been done. This k is used for comparisons with N, as those comparisons always needs to be based on valid completed sweeps.

The displayed average/hold, K, shows the count for the sweep (data acquisition) in progress. K = k + 1, with a limit of N. The displayed value K changes from its previous value to 1 as soon as the trigger condition for the first data acquisition (sweep) is met.

Pause/Resume

Pauses a measurement after the current data acquisition is complete.

When paused, the label on the control changes to **Resume**. Pressing **Resume** un-pauses the measurement. When paused, pressing **Restart** performs a Resume.

Remote Command	`:INITiate:PAUSe` `:INITiate:RESume`
Example	`:INIT:PAUS` `:INIT:RES`
Dependencies	Not displayed in Modes that do not support pausing
Annotation	Only on control

Abort (Remote Command Only)

Stops the current measurement. Aborts the current measurement as quickly as possible, resets the sweep and trigger systems, and puts the measurement into an "idle" state. If the instrument is in the process of aligning when `:ABORt` is sent, the alignment finishes *before* the abort function is performed, so `:ABORt` does not abort an alignment.

If the instrument is set for **Continuous** measurement, it sets up the measurement and initiates a new data measurement sequence with a new data acquisition (sweep) taken once the trigger condition is met.

If the instrument is set for **Single** measurement, it remains in the "idle" state until an `:INIT:IMM` command is received.

Remote Command	`:ABORt`
Example	`:ABOR`
Notes	If `:INIT:CONT` is `ON`, then a new continuous measurement will start immediately, with sweep (data acquisition) occurring once the trigger condition has been met If `:INIT:CONT` is `OFF`, then `:INIT:IMM` is used to start a single measurement, with sweep (data acquisition) occurring once the trigger condition has been met
Dependencies	For continuous measurement, `:ABORt` is equivalent to the **Restart** key Not all measurements support this command
Status Bits/OPC dependencies	The `STATus:OPERation` register bits 0 through 8 are cleared , *except* bit 6 (Waiting for Periodic Sync). Initiating a measurement and Waiting for Periodic Sync could be asynchronous The `STATus:QUEStionable` register bit 9 (`INTegrity` sum) is cleared Since all the bits that feed into OPC are cleared by `:ABORt`, the Abort command will cause the `*OPC` query to return true

3.10.9.2 Sweep Config

Accesses controls that enable you to configure the Sweep and Control functions of the instrument, such as **Sweep Rules**.

Points

Sets the number of points taken per sweep, and displayed in the traces. The current value of points is displayed parenthetically, next to the sweep time in the lower-right corner of the display. Using more points provides greater resolution. Using fewer points compacts the data and decreases the time required to access a trace over the remote interface.

Increasing the number of points does not increase the sweep time. However, it can slightly impact the trace processing time and therefore the overall measurement speed. Decreasing the number of points does not decrease the sweep time, but it may speed up the measurement, depending on the other sweep settings (for example, in FFT sweeps). Fewer points will always speed up the I/O.

Due to minimum sweep rate limitations of the hardware, the minimum sweep time available to the user will increase above its normal value of 1 ms as the number of sweep points increases above 15001.

Changing the number of sweep points has several effects on the instrument.Since markers are read at the point location, the marker reading may change.The sweep time resolution will change. Trace data for all the traces will be cleared and, if **Sweep** is in **Cont**, a new trace taken. If any trace is in average or hold, the averaging starts over.

Because of sweep time quantization issues, the knob and up/down keys *cannot* be used to adjust the number of points.

When in a split screen display each window may have its own value for points.

When sweep points is changed, an informational message is displayed, "Sweep points changed, all traces cleared."

Remote Command	`[:SENSe]:TOI:SWEep:POINts <integer>` `[:SENSe]:TOI:SWEep:POINts?`
Example	`:TOI:SWE:POIN 1001` `:TOI:SWE:POIN?`
Dependencies	Not available when **Signal ID** is ON in External Mixing Neither the knob nor the step keys can be used to change this value. If it is attempted, a warning is given Grayed-out in measurements that do not support swept
Couplings	Whenever the number of sweep points change: – All trace data is erased – Any traces with **Update Off** will also switch to **Display Off** – **Sweep Time** is re-quantized – Any limit lines that are on will be updated – If "Averaging On/Off" on page 1807 is ON, averaging/hold starts over The resolution of setting the sweep time depends on the number of points selected
Preset	1001
State Saved	Saved in instrument state
Min	1
Max	100,001
Annotation	On second line of annotations, in lower right corner in parenthesis behind the sweep annotation

IF Dithering

Lets you turn IF Dithering on or off. This is a technique used in unpreselected instruments (such as Keysight’s modular instruments) to enhance the rejection of images and internally-generated spurious signals.

Remote Command	`[:SENSe]:SWEep:IF:DITHer OFF | ON | 0 | 1` `[:SENSe]:SWEep:IF:DITHer?`
Dependencies	Only appears in Spectrum Analyzer Mode in VXT models
Preset	`OFF`
State Saved	Saved in instrument state

Image Protection

Lets you turn IF Protection on or off. This is a technique used in unpreselected instruments (such as Keysight's modular instruments) to detect and suppress images and spurs that may be present in non-preselected hardware.

IF Protection takes two sweeps and by correlating the data between them, provides a single, correct power-versus-frequency trace.

Remote Command	`[:SENSe]:SWEep:IMAGeprot OFF | ON | 0 | 1` `[:SENSe]:SWEep:IMAGeprot?`
Dependencies	Only appears in Spectrum Analyzer Mode in VXT models
Preset	`ON`
State Saved	Saved in instrument state

3.10.10 Trace

The controls in this menu let you control the acquisition, display, storage, detection and manipulation of trace data for the available traces. The "Trace Control" on page 1904 tab contains radio-button selections for the trace type (**Clear/Write, Trace Average, Max Hold, Min Hold**) and **View/Blank** setting for the selected trace.

3.10.10.1 Trace Control

The controls on this tab allow you to set the "Trace Type" on page 1905 and its update mode.

There are four Trace Types:

- Clear/Write
- Trace Average
- Max Hold
- Min Hold

Each type handles data in a different way.

Each trace also has two values that determine whether it is being written or not, and whether it is being displayed or not. These values, **Update** and **Display,** are described fully in the "View/Blank" on page 1721 control description. Essentially, when **Update** is `ON`, a trace is updating, and when **Update** is `OFF` it is not. When **Display** is `ON`, it is visible and when **Display** is `OFF` it is not. These terms are used throughout the descriptions in this section.

Trace Type

Selects trace max hold characteristics.

There are two trace Types: **Clear/Write** and **Max Hold**, as described below. You may select one of these types for each trace. Re-selecting the current **Trace Type** initiates the same action that selecting it the first time did, even though it is already selected. For example, selecting **Clear/Write** while **Clear/Write** is already selected nonetheless clears the trace and begins rewriting it.

Value	SCPI	Notes
"Clear/Write" on page 1825	`WRITe`	Each trace update replaces the old data in the trace with new data Selecting **Clear/Write** clears the trace and initiates a new sweep
"Max Hold" on page 1826	`MAXHold`	The instrument maintains and displays a max hold trace, which represents the maximum data value on a point-by-point basis of the new trace data and previous trace data Selecting **Max Hold** clears the trace, initiates a new sweep, and restarts the hold sequence

Remote Command	`:TRACe:TOI:TYPE WRITe | MAXHold`

Example	Set **Trace Type** to **Clear/Write**:
	`:TRAC:TOI:TYPE WRIT`
	Set **Trace Type** to **Max Hold**:
	`:TRAC:TOI:TYPE MAXHold`

Preset	Clear Write

Trace Writing Type Details

Clear/Write

Each trace update replaces the old data in the trace with new data. Pressing **Clear/Write**, or sending `:TRAC:TYPE WRIT`, sets the trace type to **Clear/Write** and causes the trace to be cleared, even if you are already in **Clear/Write**. Then a new sweep is initiated. Trigger conditions must be met before the sweep actually starts, and if in **Single**, the sweep does not start until **Restart** is pressed.

When in **Clear/Write**, if a measurement-related instrument setting is changed when the instrument is sweeping, a new sweep is initiated but the trace is not cleared. While the sweep always uses the peak detector, in zero-span measurement the average detector is used, and the metrics are calculated using the average of the zero-span data.

Max Hold

The instrument maintains and displays a max hold trace, which represents the maximum data value on a point-by-point basis of the new trace data and previous trace data. Details of the count limiting behavior may be found under "Avg/Hold Num" on page 1807 in **Meas Setup**.

Pressing **Max Hold**, or sending `:TRAC:TYPE MAXH`, sets the trace type to **Max Hold**, causes the trace to be cleared, and causes the **Max Hold** sequence to be (re)started, even if you are already in **Max Hold**. The max hold trace uses peak detection; in zero-span measurement the metrics are calculated using the peak value of the zero-span data.

Restarting the **Max Hold** sequence means:

– The average/hold count k is set to 1, so that the next time the max hold trace is displayed it simply represents one trace of new data

– A new sweep is initiated

Clear and Write | Restart Averaging | Restart Max/Min Hold

Starts the trace writing, as though the "Trace Type" on page 1905 had just been selected. The effect is exactly the same as reselecting the current **Trace Type** again – the control is provided because it may not be obvious that reselecting the same selection from a radio button menu will take any action.

This control displays different labels, depending on the selected Trace Type:

– **Clear/Write**: Clear and Write

– **Trace Average**: Restart Averaging

– **Max Hold**: Restart Max Hold

– **Min Hold**: Restart Min Hold

3.11 Harmonics Measurement

IMPORTANT **This measurement is not supported in VXT models M9410A/11A/15A/16A.**

The Harmonics measurement allows a simple (one-button) measurement of the harmonics of a specified carrier frequency.

At each cycle, the instrument will do a zero-span measurement at the fundamental and at each harmonic frequency. With that information, it will calculate and report each harmonic in dBc, and will also calculate and report the total harmonic distortion.

In most use cases, this approach is sufficient. In cases where a specialized harmonic measurement is required, such as measuring the harmonics of a baseband amplifier when looking at the carrier signal, the user may separately specify the parameters of each harmonic measurement.

For measurement results and views, see "Views" on page 1829.

Harmonics Measurement Commands

These commands are used to initialize the measurement, and to retrieve results.

The general functionality of "CONFigure" on page 2732, "INITiate" on page 2733, "FETCh" on page 2733, "MEASure" on page 2735, and "READ" on page 2734 are described in the section **SCPI Operation and Results Query** in the topic **Programming the Instrument**.

`:INITiate:HARMonics`	Initiates a trigger cycle for the measurement, but does not return any data Does not change any measurement settings
`:CONFigure:HARMonics`	Selects the measurement with **Meas Setup** settings in their preset states. This is the same as "Meas Preset" on page 1895
`:CONFigure:HARMonics:NDEFault`	Selects the HARM measurement *without* affecting settings
`:CONFigure?`	Returns the name of the measurement: HARM

The queries listed below retrieve each harmonic measurement, and the Total Harmonic Distortion calculated from the measurement. Returned amplitudes are in fixed units, and do not honor the Y Axis Unit setting. Returned absolute amplitudes are affected by "Ref Level Offset" on page 1837, and returned absolute frequencies are affected by "Freq Offset" on page 1886.

Command	Return Value

`:FETCh:HARMonics:AMPLitude:ALL?`
`:MEASure:HARMonics:AMPLitude:ALL?`
`:READ:HARMonics:AMPLitude:ALL?`
	Returns the amplitude values of the first 10 harmonics
	The first value (for the fundamental) is measured in dBm. The remaining harmonics are measured in dBc (relative to the fundamental). If fewer

Command	Return Value
	than 10 harmonics are measured, zero is returned for any harmonic not measured
:FETCh:HARMonics:DISTortion? :MEASure:HARMonics:DISTortion? :READ:HARMonics:DISTortion?	Returns the computed total harmonic distortion as a percentage
:FETCh:HARMonics:FREQuency:ALL? :MEASure:HARMonics:FREQuency:ALL? :READ:HARMonics:FREQuency:ALL?	Returns the frequency values of the first 10 harmonics in Hz The first value returned is the fundamental. If fewer than 10 harmonics are measured, zero is returned for any harmonic not measured
:FETCh:HARMonics:FUNDamental? :MEASure:HARMonics:FUNDamental? :READ:HARMonics:FUNDamental?	Returns the frequency of the fundamental in Hz

Some results queries support a numeric suffix, n, as below:

Command	n	Return Value
:FETCh:HARMonics:AMPLitude[n]? :MEASure:HARMonics:AMPLitude[n]? :READ:HARMonics:AMPLitude[n]?	1 – 10	Returns the amplitude values of the specified harmonic If n = 1 is specified, the return value is in dBm. Otherwise, the returned value is in dBc (relative to the fundamental)
:FETCh:HARMonics:FREQuency[n]? :MEASure:HARMonics:FREQuency[n]? :READ:HARMonics:FREQuency[n]?	1 – 10	Returns the frequency of the specified harmonic in Hz If n = 1 is specified, the fundamental frequency is returned
:FETCh:HARMonics[n]? :MEASure:HARMonics[n]? :READ:HARMonics[n]?	1 – 2	For n = 1, or n not specified, returns the computed total harmonic distortion as a percentage For n = 2, returns the computed total harmonic distortion in dBc

Harmonic Measurement Details

First Sweep

The first sweep of the harmonics measurement is used to find the fundamental frequency and bandwidth.

First Sweep Initiation

The first sweep is not used when the range table is turned on, or when all parameters are in “Manual” mode. It is only used when at least one of the following parameters is in “Sense” mode:

1. Fundamental frequency
2. Resolution Bandwidth

If one of the above parameters is in “Sense”, the first sweep occurs when any of the following happen:

1. We first enter the measurement
2. After a preset
3. When a parameter change causes a measurement restart in continuous sweep mode
4. When the user initiates a sweep.

First Sweep Action

If Fundamental Frequency is set to “Sense”, the first sweep sets the fundamental frequency to the largest amplitude signal between 10 MHz and half the bandwidth of the spectrum analyzer. We should span zoom (or frequency count) to give us a good measurement of the fundamental frequency.

If Resolution Bandwidth is set to “Sense”, the first sweep sets the resolution bandwidth to the lowest available Resolution Bandwidth greater than the 3.5 times the 99% occupied bandwidth of the signal, to a minimum of 30 Hz. By default, the video bandwidth and sweep time are coupled to those parameters, and all harmonic parameters are coupled to the fundamental parameters.

Note that, even though the automatic RBW is limited to a minimum of 30 Hz, the actual value measured should be retained. When multiplying the RBW for the 2nd and subsequent harmonics, use the maximum of the calculated value and 30 Hz.

For example, assume that the occupied bandwidth calculation results in desired RBW of 12 Hz. The fundamental RBW will use 30 Hz, the second harmonic RBW will use 30 Hz. The calculated RBW for the third and subsequent harmonics exceeds 30 Hz, so we should use the calculated value when measuring those harmonics.

3.11.1 Views

There is only one predefined view for this measurement (**Normal**), which displays zero-span traces corresponding to the fundamental and the measured harmonics. **Normal** is a multiple-window View. When in a multiple-window View, you select a window by touching it. The menu controls may sometimes change depending on which window is selected.

Whenever the View changes, the default menu is **Frequency**, unless otherwise specified in the view description.

The table below shows the View and Windows used for this Measurement:

View	Result Windows
Normal	Graph
	Metrics

When a measurement restart requires an auto tune, this view is displayed without table data or traces, and the fundamental frequency is displayed as “---”. As the data is collected, the data is displayed appropriately.

Example	`:DISP:VIEW NORM`

3.11.2 Windows

The following windows are available in this measurement.

3.11.2.1 Graph

This is the fundamental window in the **Normal** view.

The fundamental and each harmonic is measured at zero span, and the measured trace is displayed in the appropriate column within the graticule (thus, the graticule shows the most recent measurement of each harmonic).

The Graph window appears as follows:

View	Size	Position
Normal	Full height, two thirds width	Right

3.11.2.2 Metrics

The frequency and measured power at each harmonic are displayed in a result table, along with the Total Harmonic Distortion (THD).

The Metrics window appears as follows:

View	Size	Position
Normal	Full height, One third width	Left

3.11.3 Amplitude

Activates the **Amplitude** menu and selects **Reference Level** or **Reference Value** as the active function, depending on the measurement.

Some features in this menu apply to multiple measurements. Some other features apply only to specific measurements and their controls are blanked or grayed-out in measurements that do not support the feature.

3.11.3.1 Y Scale

Contains controls that pertain to the Y axis parameters of the measurement. These parameters control how data on the vertical (Y) axis is displayed and control instrument settings that affect the vertical axis.

Ref Value

Sets the value for the absolute power reference. The reference line is at the top, center, or bottom of the graticule, depending on the value of the Ref Position function.

Remote Command	`:DISPlay:HARMonics:VIEW:WINDow:TRACe:Y[:SCALe]:RLEVel <amplitude>` `:DISPlay:HARMonics:VIEW:WINDow:TRACe:Y[:SCALe]:RLEVel?`
Example	`:DISP:HARM:VIEW:WIND:TRAC:Y:RLEV -10 dBm` `:DISP:HARM:VIEW:WIND:TRAC:Y:RLEV?`
Preset	0.00 dBm
State Saved	Saved in instrument state
Min/Max	-250.00 dBm / 250.00 dBm
Annotation	Ref <value> top left of graph

Scale/Div

For measurements that support a logarithmic Y-Axis, **Scale/Div** sets the height of one division of the graticule in the current "Y Axis Unit" on page 1832.

Scale/Div also determines the displayed amplitude range in the log plot graph. Since there are usually 10 vertical graticule divisions on the display, the total amplitude range of the graph is typically 10x this amount. For example, if **Scale/Div** is 10 dB, then the total range of the graph is 100 dB.

This function is only available when a logarithmic **Y Axis Unit** is selected and the vertical scale is power. When a linear **Y Axis Unit** is selected, **Scale/Div** is grayed out.

For this measurement, the displayed **Scale/Div** is identical for all harmonics displayed.

Remote Command	`:DISPlay:HARMonics:VIEW:WINDow:TRACe:Y[:SCALe]:PDIVision <relative amplitude>` `:DISPlay:HARMonics:VIEW:WINDow:TRACe:Y[:SCALe]:PDIVision?`

Example	`:DISP:HARM:VIEW:WIND:TRAC:Y:PDIV 5`
Preset	10.00 dB / Div
State Saved	Saved in instrument state
Min	0.10 dB
Max	20 dB
Annotation	<value> dB/ left upper of graph ! all measurements unless noted

Y Axis Unit

Displays a dropdown menu that enables you to change the vertical (Y) axis amplitude unit. This setting affects how the data is read over the remote interface. When using the remote interface, only numerical values are returned, so you must know what the Y Axis Unit is to interpret the results. This is described in more detail in "Amplitude Data Query and Y Axis Unit" on page 1835 below.

For measurements that support both Log and Lin scales, the instrument retains the entered Y Axis Unit separately for both Log and Lin amplitude Display Scales. For example, if Display Scale has been set to Log, and you set Y Axis Unit to dBm, pressing **Display Scale (Log)** sets the Y Axis Unit to dBm. If Display Scale has been set to Lin and you set Y Axis Unit to V, pressing **Display Scale (Lin)** sets the Y Axis Unit to V. Pressing **Display Scale (Log)** again sets the Y Axis Unit back to dBm.

If an Amplitude Correction is being applied that has an associated Transducer Unit, all selections but **Xducer Unit** are grayed-out. For more information, see "Transducer Unit" on page 1835 below.

Remote Command	`:UNIT:POWer DBM | DBMV | DBMA | V | W | A | DBUV | DBUA | DBPW | DBUVM | DBUAM | DBPT | DBG` `:UNIT:POWer?`

Example	`:UNIT:POW dBmV`
	`:UNIT:POW?`
	See also "Remote Interface Examples" on page 1833 below

Notes	The Y axis unit has either logarithmic or linear characteristics. The set of units that is logarithmic consists of dBm, dBmV, dBmA, dBmV, dBmA, dBmV/m, dBmA/m, dBpT, and dBG. The set of units that are linear consists of V, W, and A. The chosen unit will determine how the reference level and all the amplitude-related outputs like trace data, marker data, etc., read out
Dependencies	Appears only in Spectrum Analyzer Mode If an amplitude correction with a Transducer Unit other than None is applied and enabled: – The Transducer Unit selection is forced, and is the only Y Axis Unit available. The specific Transducer Unit is shown in square brackets in the dropdown, and all other Y Axis Unit choices are grayed-out – If you turn off that correction or set Apply Corrections to NO, the Y Axis Unit that existed before

	the Transducer Unit was applied is restored When Normalize is ON (in the **Trace**, **Normalize** menu), Y Axis Unit is grayed-out, and forced to dBm
Couplings	The instrument retains the entered Y Axis Unit separately for both Log and Lin amplitude Display Scales
Preset	dBm for log scale, V for linear. The true 'preset' value is dBm, since at preset the Y Display Scale is set to logarithmic
State Saved	Saved in instrument state
Annotation	The Y Axis Unit is shown after Ref Level value at the top of the graticule

Unit	Example	Notes
dBm	`:UNIT:POW DBM`	Y Axis Unit is set to dBm
dBmV	`:UNIT:POW DBMV`	Y Axis Unit is set to dBmV
dBmA	`:UNIT:POW DBMA`	Y Axis Unit is set to dBmA
W	`:UNIT:POW W`	Y Axis Unit is set to W
V	`:UNIT:POW V`	Y Axis Unit is set to V
A	`:UNIT:POW A`	Y Axis Unit is set to A
dBmV	`:UNIT:POW DBUV`	Y Axis Unit is set to dBmV
dBmA	`:UNIT:POW DBUA`	Y Axis Unit is dBmA. The unit dBuA can also appear as a Transducer Unit
dBpW	`:UNIT:POW DBPW`	Y Axis Unit is set to dBpW

Remote Interface Examples

Command examples and details appear in the table below. Note that each of the commands below sets the amplitude unit only for the *selected* amplitude scale (Log or Lin), the other scale is unaffected.

Unit	Example	Notes
dBm	`:UNIT:POW DBM`	dB relative to one milliwatt
dBmV	`:UNIT:POW DBMV`	dB relative to one millivolt
dBmA	`:UNIT:POW DBMA`	dB relative to one milliamp
W	`:UNIT:POW W`	Watts
V	`:UNIT:POW V`	Volts
A	`:UNIT:POW A`	Amperes
dBmV	`:UNIT:POW DBUV`	dB relative to one microvolt

Unit	Example	Notes
dBmA	:UNIT:POW DBUA	dB relative to one microamp The unit dBuA can also appear as a "Transducer Unit" on page 1835 When querying the Y-Axis unit, you can query the Transducer Unit to distinguish between regular dBuA and the dBuA transducer unit. If :CORR:CSET:ANT? returns NOC (for No Conversion), you are using a normal Y Axis dBuA. If it returns UA, you are using a Transducer Unit dBuA
dBpW	:UNIT:POW DBPW	dB relative to one picowatt
dBmV/m (Transducer Unit)	:UNIT:POW DBUVM	Sets the amplitude unit for the selected amplitude scale (log/lin) to dBmV/meter. This selection is only available if a Correction is turned on, and the Transducer Unit for that Correction is not None See "Transducer Unit" on page 1835
dBmA/m (Transducer Unit)	:UNIT:POW DBUAM	Sets the amplitude unit for the selected amplitude scale (log/lin) to dBmA/meter. This selection is only available if a Correction is turned on, and the Transducer Unit for that Correction is not None See "Transducer Unit" on page 1835
dBpT (Transducer Unit)	:UNIT:POW DBPT	Sets the amplitude unit for the selected amplitude scale (log/lin) to dBpT (dB relative to one picotesla). This selection is only available if a Correction is turned on, and the Transducer Unit for that Correction is not None See "Transducer Unit" on page 1835
dBG (Transducer Unit)	:UNIT:POW DBG	Sets the amplitude unit for the selected amplitude scale (log/lin) to dBG (dB relative to one Gauss). This selection is only available if a Correction is turned on, and the Transducer Unit for that Correction is not None See "Transducer Unit" on page 1835
dBmA (Transducer Unit)	:UNIT:POW DBUA	Sets the amplitude unit for the selected amplitude scale (log/lin) to dBmA. This selection is only available as a Transducer Unit if a Correction is turned on, and the Transducer Unit for that Correction is not None See "Transducer Unit" on page 1835 The unit dBuA can also appear as a normal Y Axis Unit (see above) dBuA as a Transducer Unit is used when using current probes, because current probes are often supplied with conversion tables that provide the transducer factors. When dBuA is used as a Transducer Unit, the normal conversion from power to amps for dBuA (based on the instrument input impedance) is not done, but instead the conversion is based solely on the Correction that contains the transducer factors. This is what distinguishes dBuA as a normal unit from dBuA as a transducer unit When querying the Y-Axis unit, you can query the Transducer Unit to distinguish between regular dBuA and the dBuA Transducer Unit. If :CORR:CSET:ANT? returns NOC (for No Conversion), you are using a normal Y-Axis dBuA. If it returns UA, you are using a Transducer Unit dBuA

Amplitude Data Query and Y Axis Unit

The settings of Y-Axis Unit and Display Scale affect how the data is returned over the remote interface in response to a query. When using the remote interface, no unit is returned, so you must know what the Y-Axis unit is to interpret the results:

Example 1

Set the following:

- Display Scale (Log)
- Y Axis Unit, dBm
- Scale/Div, 1 dB
- Ref Level, 10 dBm

This sets the top line to 10 dBm with each vertical division representing 1 dB. Thus, if a point on trace 1 is on the fifth graticule line from the top, it represents 5 dBm and will read out remotely as 5.

Example 2

Set the following:

- Display Scale (Lin)
- Y Axis Unit, Volts
- Ref Level, 100 mV (10 mV/div)

This sets the top line to 100 mV and the bottom line to 0 V, so each vertical division represents 10 mV. Thus, if a point on trace 1 is on the fifth graticule line from the top, it represents 50 mV and will read out remotely as 50.

NOTE **The units of current (A, dBmA, dBuA) are calculated based on 50 Ω input impedance.**

Transducer Unit

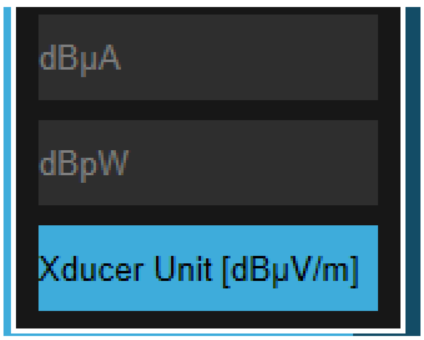
Transducer Units (formerly called Antenna Units) are units of field strength rather than amplitude, and are used when correcting the response of device such as antennas whose amplitude characteristics are measured in units of field strength. All five of the Transducer Units (dBmA/m, dBmV/m, dBG, dBpT, dBmA) are treated by the instrument exactly as though they were dBmV, when uncorrected. You must load an appropriate correction factor using Input/Output, Corrections for accurate and meaningful results.

If a remote command is sent to the instrument that uses one of the Transducer Units as a terminator, the instrument treats it as though DBUV had been sent as the terminator.

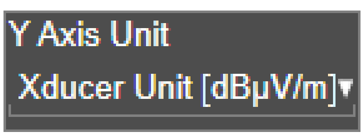
When a Correction is turned on that uses a Transducer Unit, the Y Axis Unit changes to that Transducer Unit. All of the selections in the **Y-Axis Unit** dropdown are then grayed-out, except the Transducer Unit selection. The unit being used is shown on this selection in square brackets, and appears on the control in square brackets preceded by **Xducer Unit**.

Example:

If the Transducer Unit in the Correction is dBmV/m, then the selection in the dropdown looks like this:



And on the control it looks like this:



NOTE

If a Transducer Unit is set, it is displayed as **Xducer Unit** in the **Y Axis Unit** dropdown. However, you can only *change* the Transducer Unit via the **Edit Correction** dialog in the **Input/Output**, **Corrections** menu. In that dialog, tap **Settings** then **Transducer Unit**. You can also turn off Transducer Unit from the same menu, by selecting **None**.

If a Transducer Unit is set, it is displayed as **Xducer Unit** in the **Y Axis Unit** dropdown. However, you can only *change* the Transducer Unit via the **Edit Correction** dialog in the **Input/Output**, **Corrections** menu. In that dialog, tap **Settings** then **Transducer Unit**. You can also turn off Transducer Unit from the same menu, by selecting **None**.

The Transducer Units are:

Units	Example
dBmV/m	`:UNIT:POW DBUVM`
dBmA/m	`:UNIT:POW DBUAM`
dBpT	`:UNIT:POW DBPT`
dBG	`:UNIT:POW DBG`
dBmA	`:UNIT:POW DBUA`
None	n/a

Ref Level Offset

Adds an offset value to the displayed reference level. The reference level is the absolute amplitude represented by the top graticule line on the display.

The **On/Off** switch turns **Ref Level Offset** on or off. Setting a specific value turns **Ref Level Offset**ON.

Remote Command	`:DISPlay:WINDow[1]:TRACe:Y[:SCALe]:RLEVel:OFFSet <rel_ampl>` `:DISPlay:WINDow[1]:TRACe:Y[:SCALe]:RLEVel:OFFSet?`

Example	`:DISP:WIND:TRAC:Y:RLEV:OFFS 12.7`
	`:DISP:WIND:TRAC:Y:RLEV:OFFS?`
	Sets the Ref Level Offset to 12.7 dB. The only valid suffix is dB. If no suffix is sent, dB will be assumed

Preset	0 dBm
State Saved	Saved in instrument state
Min	The range is variable. It is limited to values that keep the reference level within the range –327.6 dB to 327.6 dB
Max	327.6 dB
Annotation	The offset is displayed as “Ref Offset <value>” to the right of the reference level annotation if nonzero. When the offset is zero, no annotation is shown

Auto Function

Remote Command	`:DISPlay:WINDow[1]:TRACe:Y[:SCALe]:RLEVel:OFFSet:STATe OFF | ON | 0 | 1` `:DISPlay:WINDow[1]:TRACe:Y[:SCALe]:RLEVel:OFFSet:STATe?`
Example	`:DISP:WIND:TRAC:Y:RLEV:OFFS:STAT ON` Turns the Ref Level Offset On
Preset	`OFF`

Ref Position

Positions the reference level at the top, center, or bottom of the Y Scale display. Changing the reference position does not change the reference level value.

Remote Command	`:DISPlay:HARMonics:VIEW:WINDow:TRACe:Y[:SCALe]:RPOSition TOP | CENTer | BOTTom` `:DISPlay:HARMonics:VIEW:WINDow:TRACe:Y[:SCALe]:RPOSition?`
Example	`:DISP:HARM:VIEW:WIND:TRAC:Y:RPOS BOTT`
Preset	`TOP`
State Saved	Saved in instrument state
Range	`TOP|CENTer|BOTTom`
Annotation	The greater than (>) and less than (<) symbols are displayed on both sides of the graph to indicate the **Ref Position**

3.11.3.2 Attenuation

Controls the attenuator functions and interactions between the attenuation system components.

There are two attenuator configurations in the X-Series. One is a Dual-Attenuator configuration consisting of a mechanical attenuator and an optional electronic attenuator. The other configuration uses a single attenuator with combined mechanical and electronic sections that controls all the attenuation functions. Different models in the X-Series come with different configurations.

– See "Dual-Attenuator Configurations" on page 1839

– See "Single-Attenuator Configuration" on page 1839

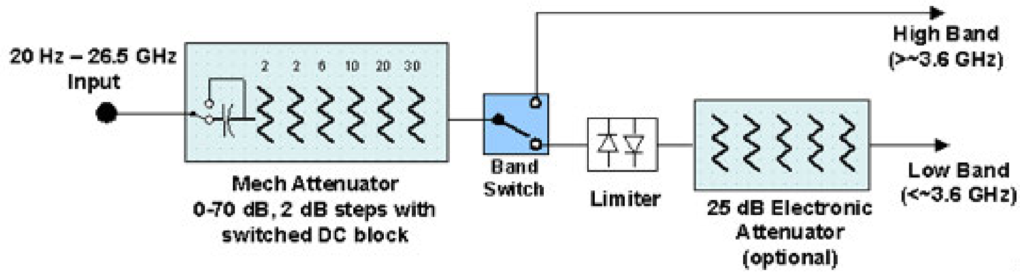
Most attenuation settings are the same for all measurements – they do not change as you change measurements. Settings like these are called “Meas Global” and are unaffected by **Meas Preset**.

Only available when the hardware set includes an input attenuator, which is typically only the case for Keysight’s benchtop instruments. For example, this tab does *not* appear in VXT models M9421A/10A/11A, nor in UXM. In UXM, all **Attenuation** and **Range** settings are disabled, as the expected input power level is handled by the Call Processing App that drives the DUT power control.

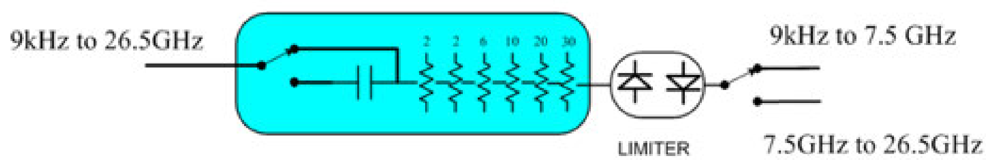
Dependencies	In measurements that support the I/Q inputs, unavailable when I/Q is the selected input. Replaced by the **Range** tab in that case

Dual-Attenuator Configurations

Configuration 1: Mechanical attenuator + optional electronic attenuator

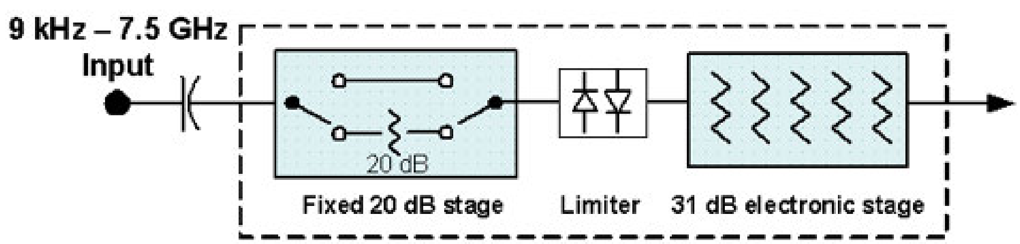


Configuration 2: Mechanical attenuator, no optional electronic attenuator

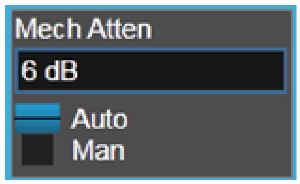


Note that Configuration 2 is not strictly speaking a dual-section attenuator, since there is no electronic section available. However, it behaves exactly like Configuration 1 without the Electronic Attenuator Option EA3, therefore for the sake of this document it is grouped into the “Dual-Attenuator” configuration.

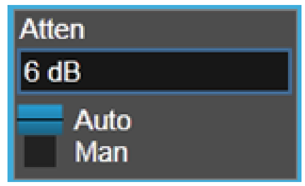
Single-Attenuator Configuration



You can tell which attenuator configuration you have by pressing the Attenuation tab, which (in most Modes) opens the Attenuation menu. If the first control in the Attenuation menu says **Mech Atten** you have the Dual-Attenuator configuration. If the first control says **Atten** you have the Single-Attenuator configuration.



Dual Attenuator



Single Attenuator

(Note that depending on the measurement, there may be no Auto/Man functionality on the Mech Atten control.)

In the Single-Attenuator configuration, you control the attenuation with a single control, as the fixed stage has only two states. In the Dual-Attenuator configuration, both stages have significant range, so you are given separate control of the mechanical and electronic attenuator stages.

When you have the Dual-Attenuator configuration, you may still have only a Single-Attenuator, because unless Option EA3 (the Electronic Attenuator option) is available, and you purchase it, you will have only the mechanical attenuator.

Full Range Atten

This control and **Attenuator Summary** only appear in N9041B, when the RF input is selected, the RF Input Port is set to RF Input 2, and the Full Range Attenuator is installed. The Full Range Attenuator adds a second input attenuator in front of RF Input 2, which enhances the protection and optimizes the performance of the extra internal mixers used by RF Input 2.

Remote Command	[:SENSe]:POWer[:RF]:FRATten <rel_ampl> [:SENSe]:POWer[:RF]:FRATten?
Example	:POW:FRAT 14 :POW:FRAT?
Notes	When you enter an amplitude value that falls between valid values, the value will be incremented to the next smallest valid value
Dependencies	Only appears if input RF is selected, RF Input Port 2 is selected, and the Full Range Attenuator exists
Couplings	This value is never changed by any coupling, but other couplings use this value. See **Reference Level** and "Mech Atten" on page 1935 command descriptions
Preset	20 dB
State Saved	Saved in instrument state
Min	0 dB
Max	Only valid values are 0, 6, 14, 20 dB
Annotation	When the **Input** is **RF**, and the **Input Port** is **RF Input 2**, and the Full Range Attenuator is installed:

On the Meas Bar, the field “Atten” displays as follows:

- If the sweep is entirely < 50 GHz, the value shown after “Atten:” is equal to Mech Atten + Elec Atten + Full Range Atten
- If the sweep is entirely > 50 GHz, the value shown after “Atten:” is equal to Full Range Atten
- If the sweep straddles 50 GHz, the value shown after “Atten:” is preceded by the symbol “>=” and is equal to Full Range Atten

In the **Amplitude**, "Y Scale" on page 1929 menu, and the Atten **Meas Bar** dropdown menu panel, a summary is displayed as follows:

“Total Atten below 50 GHz” followed by the value of Full Range Atten + Mech Atten + Elec Atten

“Total Atten above 50 GHz” followed by the value of Full Range Atten

For example, if Mech Atten = 6 dB, Elec Atten = 4 dB, and Full Range Atten = 20 dB, the summary below is shown:

- Attenuator summary:
- Total Atten below 50 GHz: 30 dB
- Total Atten above 50 GHz: 20 dB

Mech Atten

Labeled **Mech Atten** in Dual-Attenuator models and **Atten** in Single-Attenuator models. In the Dual-Attenuator configuration, this control only affects the mechanical attenuator.

Lets you modify the attenuation applied to the RF input signal path. This value is normally auto-coupled to the Ref Level, the Internal Preamp Gain, any External Gain that is entered, and the Max Mixer Level, as described in the table below.

See "Attenuator Configurations and Auto/Man" on page 1843

Remote Command	`[:SENSe]:POWer[:RF]:ATTenuation <rel_ampl>`
	`[:SENSe]:POWer[:RF]:ATTenuation?`
	`[:SENSe]:POWer[:RF]:ATTenuation:AUTO OFF | ON | 0 | 1`
	`[:SENSe]:POWer[:RF]:ATTenuation:AUTO?`

Example	`:POW:ATT 20`
	Dual-Attenuator configuration: sets the mechanical attenuator to 20 dB
	Single-Attenuator mode: sets the main attenuation to 20 dB (see below for definition of “main” attenuation)
	In either case, if the attenuator was in Auto, it is set to Manual
	`:POW:ATT:AUTO ON`
	Turn Auto Mech Atten ON

Dependencies	Some measurements do not support Auto setting of "Mech Atten" on page 1841. In these measurements, the **Auto/Man** selection is not available, and the Auto/Man toggle function is not available In Dual-Attenuator configurations, when the electronic attenuator is enabled, the mechanical attenuator has no auto setting, and the Auto/Man toggle function is not available. The state of Auto/Man is remembered and restored when the electronic attenuator is once again disabled. This is described in more detail in "Elec Atten" on page 1937 See "Attenuator Configurations and Auto/Man" on page 1843 for more information on the Auto/Man functionality `:POW:ATT:AUTO` is only available in measurements that support Mech Atten Auto, such as Swept SA
Couplings	If the RF Input Port is the RF Input: – If the USB Preamp is connected to USB, use 0 dB for Mech Atten – Otherwise compute the auto-selected value of Mech Atten based on **Reference Level**, Int Preamp, External Gain, Ref Level Offset, Max Mixer Level, µW Path Control and IF Gain settings. Limit this value to be no less than 6 dB (total attenuation below 6 dB can never be chosen by Auto) – In the N9041B, if the RF Input Port is RF Input 2, use the formula above and subtract the Full Range Atten value from the result to determine the Mech Atten. Limit the value so that it is never lower than 0 dB and so that total attenuation, including Full Range Atten, is never less than 6 dB (total attenuation, including Full Range Atten below 6 dB, can never be chosen by Auto) In External Mixing and BBIQ, where the Attenuator is not in the signal path, the Attenuator setting changes as described above when "Mech Atten" on page 1841 is in Auto, but no changes are made to the actual attenuator hardware setting until the input is changed back to the RF Input For CXA-m with option FSA (Fine-Step Attenuator or 2 dB steps), the FSA-like behavior is only available when the frequency setting is <= 7.5 GHz. So, when the frequency is changed from below 7.5 GHz to above 7.5 GHz, the attenuation setting will be changed to a multiple of 10 dB which will be no smaller than the previous setting. For example, 4 dB attenuation will be changed to 10 dB
Preset	The preset for Mech Attenuation is "Auto" The Auto value of attenuation is 10 dB `ON`
State Saved	Saved in instrument state
Min	0 dB The attenuation set by this control cannot be decreased below 6 dB with the knob or step keys. Values below 6 dB must be directly entered from the keypad or via SCPI. This protects against setting a dangerously small attenuation value, which can put the instrument at risk of damage to input circuitry. If the current mechanical attenuation is below 6 dB, it can be increased with the knob and step keys, but not decreased
Max	CXA Option 503 or 507: 50 dB EXA: 60 dB All other models: 70 dB Note that in the Single-Attenuator configuration, the total of ATT and EATT cannot exceed 50 dB. So, if the EATT is set to 24 dB first, the main attenuation cannot be greater than 26 dB and will be reduced

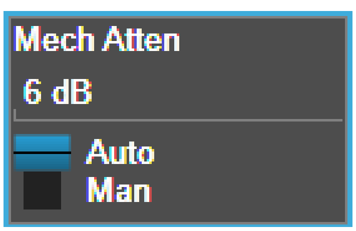
	accordingly; if the main attenuator is set to 40 dB first, EATT cannot be greater than 10 dB
Annotation	The current value for Total Atten is displayed in the Measurement Bar at the top of the display. A value appears for Electronic Attenuation only if the Electronic Attenuator is enabled. The annotation appears as Atten: <total> dB (e<elec>) The e letter is in amber in Single-Attenuator configurations For example: Dual-Attenuator configuration: Atten: 24 dB (e14) Indicating the total attenuation is at 24 dB and the electronic attenuation is at 14 dB Single-Attenuator configuration: A: 24 dB (e14) Indicating the total attenuation is at 24 dB and the “soft” attenuation is at 14 dB (see below for definition of “soft” attenuation) When in Manual, a # sign appears in front of Atten in the annotation

Attenuator Configurations and Auto/Man

As described under "Y Scale" on page 1929, there are two distinct attenuator configurations available in the X-Series, the single attenuator and Dual-Attenuator configurations. In Dual-Attenuator configurations, we have the mechanical attenuation and the electronic attenuation, and the current total attenuation is the sum of the electronic + mechanical attenuation. In Single-Attenuator configurations, we refer to the attenuation set using "Mech Atten" on page 1841 (or `:POW:ATT`) as the “main” attenuation; and the attenuation that is set by `:POW:EATT` as the “soft” attenuation (`:POW:EATT` is honored even in the Single-Attenuator configuration, for compatibility purposes). Then the current total attenuation is the sum of the main + soft attenuation.

See "Elec Atten" on page 1937 for more about “soft” attenuation.

NOTE In some measurements, the **Mech Atten** control has an Auto/Man function. In these measurements, an Auto/Man switch is shown on the **Mech Atten** control:



Note that in configurations that include an Electronic Attenuator, this switch is only shown when the Electronic Attenuator is disabled.

In other measurements, **Mech Atten** has no Auto/Man function. In these measurements, no switch is shown on the **Mech Atten** control:

Mech Atten also appears with no switch, as above, in configurations that include an Electronic Attenuator but when the Electronic Attenuator is enabled.

Elec Atten

Controls the Electronic Attenuator in Dual-Attenuator configurations. Does not appear in Single-Attenuator configurations, because the control of both the mechanical and electronic stages of the Single-Attenuator is integrated into the single **Atten** control.

This control includes an **Enable/Disable** toggle switch; it is only possible to enter a value for the Electronic Attenuator when this switch is in the **Enable** position.

For more details about the Electronic Attenuator, see "More Information" on page 1845

Remote Command	`[:SENSe]:POWer[:RF]:EATTenuation <rel_ampl>`
	`[:SENSe]:POWer[:RF]:EATTenuation?`
	`[:SENSe]:POWer[:RF]:EATTenuation:STATe OFF | ON | 0 | 1`
	`[:SENSe]:POWer[:RF]:EATTenuation:STATe?`

Example	`:POW:EATT 10`
	`:POW:EATT?`
	`:POW:EATT:STAT ON`
	`:POW:EATT:STAT?`

Notes	Electronic Attenuation's specification is defined only when Mechanical Attenuation is 6 dB
Dependencies	Only appears in Dual-Attenuator models with an Electronic Attenuator installed and licensed. Does not appear in models with the Single-Attenuator configuration, because in the Single-Attenuator configuration there is no "electronic attenuator"; there is only a single integrated attenuator (which has both a mechanical and electronic stage). However, in the Single-Attenuator configuration, EATT SCPI commands are accepted for compatibility with other X-series instruments, and set a "soft" attenuation. The "soft" attenuation is treated as an addition to the "main" attenuation value set by the **Attenuation** control or `:POW:ATT`, and affects the total attenuation displayed on the **Attenuation** control and the Meas Bar The electronic attenuator, and the "soft" attenuation function provided in Single-Attenuator configurations, are unavailable above the low band (0-3.6 GHz, 0-3.4 GHz, 0-3 GHz, depending on the

	model). If the low band range is from 0-3.6 GHz, and Stop Frequency of the instrument is > 3.6 GHz, then the **Enabled/Disabled** section of the **Elec Atten** control will be OFF and grayed-out If "Internal Preamp" on page 1959 is ON (that is, set to Low Band or Full), the electronic attenuator (and the "soft" attenuation function provided in Single-Attenuator configurations) is unavailable. In this case the **Enabled/Disabled** section of the **Elec Atten** control will be OFF and grayed-out If either of the above is true, and the SCPI command is sent, an error indicating that the electronic attenuator is unavailable is returned If both the above are true, pressing the control generates error message -221, in other words, the frequency range lockout takes precedence If the electronic/soft Attenuator is enabled, then the **Stop Freq** of the instrument is limited to 3.6 GHz and **Internal Preamp** is unavailable If "LNA" on page 1960 is ON, the electronic attenuator (and the "soft" attenuation function provided in Single-Attenuator configurations) is unavailable. In this case the **Enabled/Disabled** section of the **Elec Atten** control will be OFF and grayed-out. This coupling works in the following modes/measurements: – Channel Power, Occupied BW, ACP, SEM, Spurious Emissions, Power Stat CCDF measurements in all Modes – Transmit On|Off Power measurement in 5GNR Mode – Power vs. Time and Transmit Power measurement in GSM/EDGE Mode – Burst Power measurement in Spectrum Analyzer Mode The SCPI-only "soft" electronic attenuation for the single-attenuator configuration is not available in all measurements; in particular, it is not available in the Swept SA measurement
Couplings	Enabling and disabling the Electronic Attenuator affects the setting of the Mechanical Attenuator (in Dual-Attenuator configurations). This is described in more detail below and in "Mechanical Attenuator Transition Rules" on page 1846
Preset	0 dB OFF (Disabled) for Swept SA measurement ON (Enabled) for all other measurements that support the electronic attenuator
State Saved	Saved in instrument state
Min	0 dB
Max	Dual-Attenuator configuration: 24 dB Single-Attenuator configuration: the total of ATT and EATT cannot exceed 50 dB. So, if the EATT is set to 24 dB first, the main attenuation cannot be greater than 26 dB and will be reduced accordingly; if the main attenuator is set to 40 dB first, EATT cannot be greater than 10 dB
Annotation	See Annotation under the **Mech Atten** control description

More Information

The electronic attenuator offers finer steps than the mechanical attenuator, has no acoustical noise, is faster, and is less subject to wear. These advantages primarily aid in remote operation and are negligible for front panel use. See "Using the Electronic Attenuator: Pros and Cons" on page 1847 for a detailed discussion of the pros and cons of using the electronic attenuator.

For the Single-Attenuator configuration, for SCPI backwards compatibility, the “soft” attenuation feature replaces the Dual-Attenuator configuration’s electronic attenuator. All the same couplings and limitations apply. See "Attenuator Configurations and Auto/Man" on page 1937

Mechanical Attenuator Transition Rules

When the Electronic Attenuator is enabled, the Mechanical Attenuator transitions to a state that has no Auto function. Below are the rules for transitioning the Mechanical Attenuator. Note that the information below *only* applies to the Dual-Attenuator configurations, and *only* when the Electronic Attenuator is installed:

When the Electronic Attenuation is enabled from a disabled state:

- The Mechanical Attenuator is initialized to 10 dB (this is its optimal performance setting). You can then set it as desired with SCPI, numeric keypad, step keys, or knob, and it behaves as it normally would in manual mode
- The Auto/Man state of (Mech) Atten is saved
- The Auto/Man toggle on the (Mech) Atten control disappears, and the auto rules are disabled
- The Electronic Attenuator is set to 10 dB less than the previous value of the Mechanical Attenuator, within the limitation that it must stay within the range of 0 to 24 dB of attenuation

Examples in the Dual-Attenuator configuration:

- Mech Atten at 20 dB. Elec Atten enabled, Mech Atten set to 10 dB, and Elec Atten set to 10 dB. New total attenuation equals the value before Elec Atten enabled
- Mech Atten at 0 dB. Elec Atten enabled, Mech Atten set to 10 dB, and Elec Atten set to 0 dB. New total attenuation does not equal the value before Elec Atten enabled
- Mech Atten at 40 dB. Elec Atten enabled, Mech Atten set to 10 dB, and Elec Atten set to 24 dB. New total attenuation does not equal the value before Elec Atten enabled

When the Electronic Attenuation is disabled from an enabled state:

- The Elec Atten control is grayed out
- The Auto/Man state of (Mech) Atten is restored

– If now in Auto, (Mech) Atten recouples

– If now in Man, (Mech) Atten is set to the value of total attenuation that existed before the Elec Atten was disabled. The resulting value is rounded up to the smallest value possible given the (Mech) Atten Step setting - (That is, 57 dB changes to 58 dB when (Mech) Atten Step is 2 dB)

Using the Electronic Attenuator: Pros and Cons

The electronic attenuator offers finer steps than the mechanical attenuator, has no acoustical noise, is faster, and is less subject to wear.

The “finer steps” advantage of the electronic attenuator is beneficial in optimizing the alignment of the instrument dynamic range to the signal power in the front panel as well as remote use. Thus, you can achieve improved relative signal measurement accuracy. Compared to a mechanical attenuator with 2 dB steps, the 1 dB resolution of the electronic attenuator only gives better resolution when the odd-decibel steps are used. Those odd-decibel steps are less accurately calibrated than the even-decibel steps, so one tradeoff for this superior relative accuracy is reduced absolute amplitude accuracy.

Another disadvantage of the electronic attenuator is that the spectrum analyzer loses its “Auto” setting, making operation less convenient.

Also, the relationship between the dynamic range specifications (TOI, SHI, compression, and noise) and instrument performance are less well-known with the electrical attenuator. With the mechanical attenuator, TOI, SHI, and compression threshold levels increase dB-for-dB with increasing attenuation, and the noise floor does as well. With the electronic attenuator, there is an excess attenuation of about 1 to 3 dB between 0 and 3.6 GHz, making the effective TOI, SHI, and so forth, less well known. Excess attenuation is the actual attenuation relative to stated attenuation. Excess attenuation is accounted for in the instrument calibration.

Adjust Atten for Min Clipping

Sets the combination of mechanical and electronic attenuation and gain based on the current measured signal level so that clipping will be at a minimum.

This is an immediate action function, that is, it executes once, when the control is pressed.

The algorithms that are used for the adjustment are documented under "Pre-Adjust for Min Clipping" on page 1942.

Remote Command	`[:SENSe]:POWer[:RF]:RANGe:OPTimize IMMediate`
Example	`:POW:RANG:OPT IMM`
Notes	Executing **Adjust Atten for Min Clipping** initiates the measurement

Dependencies	Does not appear in the Swept SA, RTSA, Monitor Spectrum and Complex Spectrum measurements Appears in the Waveform measurement in 5G NR Mode only

Adjust Atten

Allows you to select;

- Electric attenuator only
- Combination of Electric attenuator and Mechanical attenuator

when `[:SENSe]:POWer[:RF]:RANGe:OPTimize IMMediate` is executed.

Remote Command	`[:SENSe]:POWer[:RF]:RANGe:OPTimize:TYPE EONLy | COMBined` `[:SENSe]:POWer[:RF]:RANGe:OPTimize:TYPE?`
Example	`:POW:RANG:OPT:TYPE EONL` `:POW:RANG:OPT:TYPE?`
Dependencies	Does not appear in the Swept SA, RTSA, Monitor Spectrum and Complex Spectrum measurements Appears in the Waveform measurement in 5G NR Mode only
Preset	`COMBined`
State Saved	Saved in instrument state

Pre-Adjust for Min Clipping

If this function is `ON`, it applies the adjustment described under "Adjust Atten for Min Clipping" on page 1941 each time a measurement restarts. Therefore, in Continuous measurement mode, it only executes before the first measurement.

In Dual-Attenuator models, you can set **Elec+Mech Atten**, in which case both attenuators participate in the autoranging, or **Elec Atten Only**, in which case the mechanical attenuator does not participate in the autoranging. This latter case results in less wear on the mechanical attenuator and is usually faster.

See "Adjustment Algorithm" on page 1849

Selection	SCPI	Note
Off	`OFF`	This is the default setting
On	`ON`	Available in Single-Attenuator instruments. For compatibility with models that do not have an input attenuator, the `ON` parameter is supported and mapped to `COMBined`
Elec Atten Only	`ELECtrical`	Selects only the electric attenuator to participate in auto ranging. This offers less wear on the mechanical attenuator and is usually faster

Selection	SCPI	Note
Elec+Mech Atten	COMBined	In Dual-Attenuator models, this selects both attenuators to participate in the autoranging

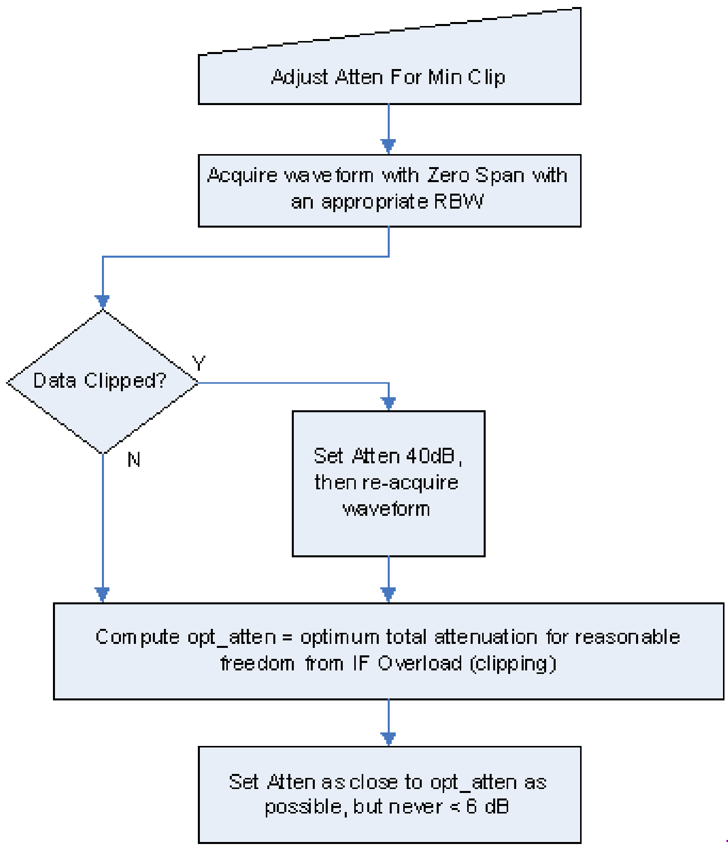
Remote Command	[:SENSe]:POWer[:RF]:RANGe:OPTimize:ATTenuation OFF | ON | ELECtrical | COMBined [:SENSe]:POWer[:RF]:RANGe:OPTimize:ATTenuation?
Example	:POW:RANG:OPT:ATT OFF :POW:RANG:OPT:ATT?
Notes	The parameter option ELECtrical sets this function to ON in Single-Attenuator models The parameter option COMBined is mapped to ELECtrical in Single-Attenuator models. If you send COMBined, it sets the function to ON and returns ELEC to a query For SCPI compatibility with models that do not have an input attenuator, the ON parameter is honored and mapped to COMBined
Dependencies	Only appears in Dual-Attenuator models with an Electronic Attenuator installed In instruments with Dual-Attenuator model, when "Elec Atten" on page 1937 is OFF or grayed-out, "Pre-Adjust for Min Clipping" on page 1848 is grayed-out Does not appear in the Swept SA, RTSA, Monitor Spectrum and Complex Spectrum measurements For the Waveform measurement, available only in 5G NR Mode
Preset	OFF when Elec Atten is Disabled at preset, otherwise ELEC
State Saved	Saved in instrument state
Range	Dual-Attenuator models: Off | Elec Atten Only | Mech + Elec Atten Single-Attenuator models: Off | On

Notes	ON aliases to "Elec Atten Only" (:POW:RANG:OPT:ATT ELEC) OFF aliases to "Off" (:POW:RANG:OPT:ATT OFF) :POW:RANG:AUTO? returns true if :POW:RANG:OPT:ATT is not OFF
Backwards Compatibility SCPI	[:SENSe]:POWer[:RF]:RANGe:AUTO ON | OFF | 1 | 0 [:SENSe]:POWer[:RF]:RANGe:AUTO?

Adjustment Algorithm

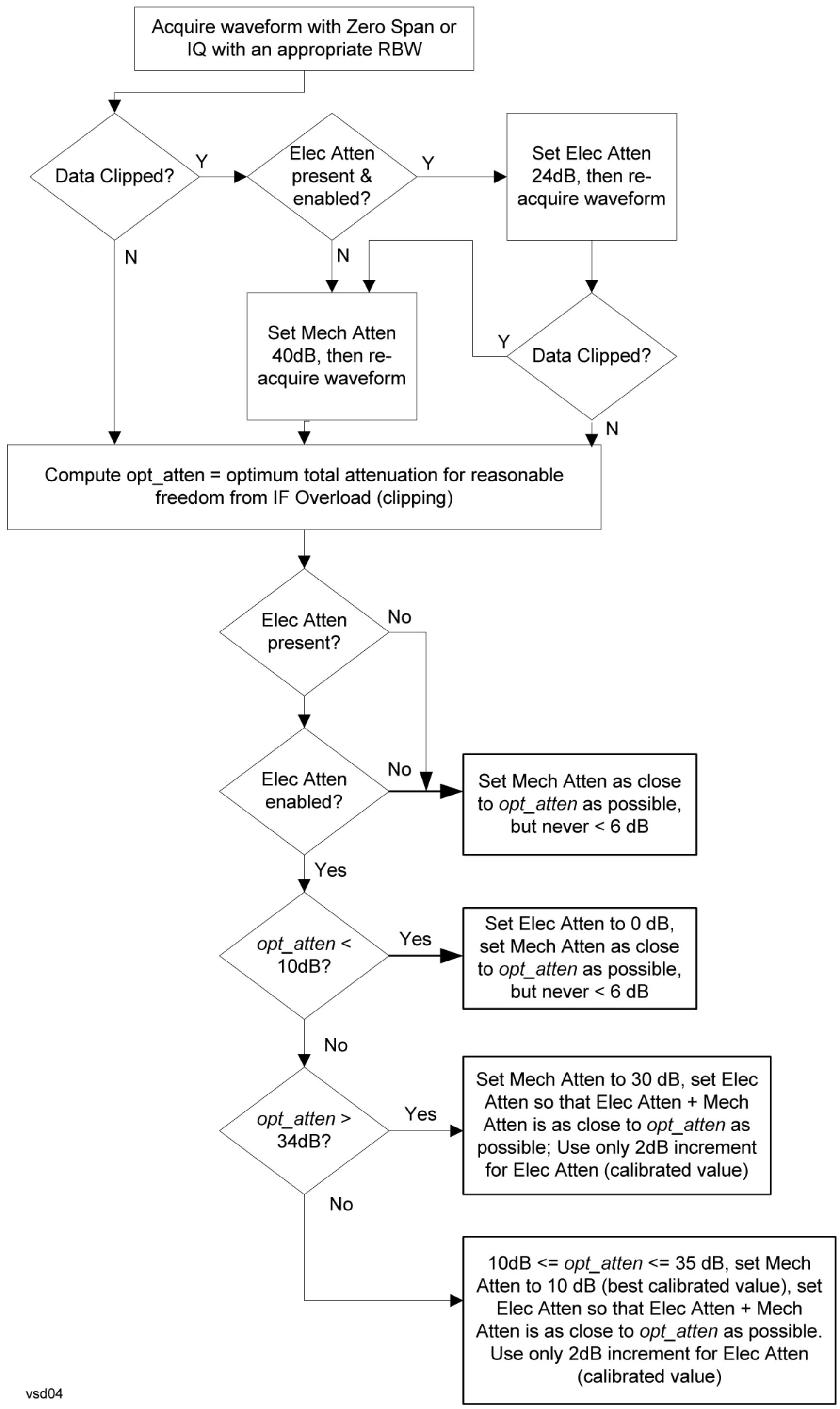
The algorithms for the adjustment are documented below:

Single-Attenuator Models



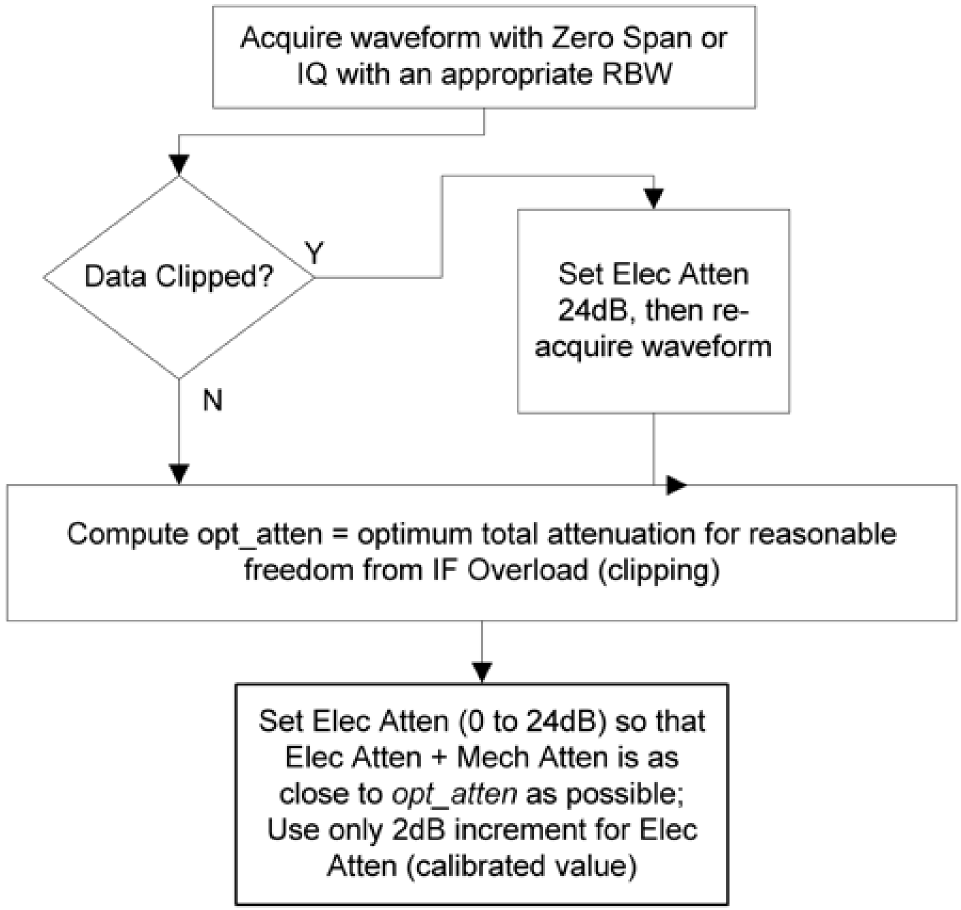
Dual-Attenuator models

"Adjust Atten for Min Clipping" on page 1941 or "Pre-Adjust for Min Clipping" on page 1848 selection is Mech + Elec Atten:


Acquire waveform with Zero Span or IQ with an appropriate RBW
Data Clipped?
Y
N
Elec Atten present & enabled?
Y
N
Set Elec Atten 24dB, then re-acquire waveform
Set Mech Atten 40dB, then re-acquire waveform
Data Clipped?
Y
N
Compute opt_atten = optimum total attenuation for reasonable freedom from IF Overload (clipping)
Elec Atten present?
No
Elec Atten enabled?
No
Yes
Set Mech Atten as close to opt_atten as possible, but never < 6 dB
opt_atten < 10dB?
Yes
No
Set Elec Atten to 0 dB, set Mech Atten as close to opt_atten as possible, but never < 6 dB
opt_atten > 34dB?
Yes
No
Set Mech Atten to 30 dB, set Elec Atten so that Elec Atten + Mech Atten is as close to opt_atten as possible; Use only 2dB increment for Elec Atten (calibrated value)
10dB <= opt_atten <= 35 dB, set Mech Atten to 10 dB (best calibrated value), set Elec Atten so that Elec Atten + Mech Atten is as close to opt_atten as possible. Use only 2dB increment for Elec Atten (calibrated value)
vsd04

"Pre-Adjust for Min Clipping" on page 1848 selection is Elec Only.

Note that the **Mech Atten** value is not adjusted, and the value previously set is used. Therefore, there is a case that IF Overload is still observed depending on the input signal level and the Mech Atten setting.



Mech Atten Step

Controls the step size used when making adjustments to the input attenuation.

Labeled **Mech Atten Step** in Dual-Attenuator models and **Atten Step** in Single-Attenuator models. In the Dual-Attenuator configuration, only affects the step size of the mechanical attenuator.

Remote Command	`[:SENSe]:POWer[:RF]:ATTenuation:STEP[:INCRement] 10 dB | 2 dB`

	`[:SENSe]:POWer[:RF]:ATTenuation:STEP[:INCRement]?`
Example	`:POW:ATT:STEP 2` `:POW:ATT:STEP?`
Notes	Has a toggle control on the front panel, but takes a specific value (in dB) when used remotely. The only valid values are 2 and 10
Dependencies	Blanked in EXA, CXA and CXA-m if option FSA (2 dB steps) is not present. If blanked, attempts to set it via SCPI yield an error
Couplings	When the attenuation step size changes, the current mechanical attenuation value is adjusted (if necessary) to be quantized to the new step size. That is, if step is set to 10 dB, mech atten is increased if necessary so it is a multiple of 10 dB
Preset	EXA, CXA and CXA-m: 10 dB (2 dB with option FSA) All other models: 2 dB
State Saved	Saved in instrument state

3.11.3.3 Range (Non-attenuator models)

Only available for Keysight's modular signal analyzers and certain other Keysight products, such as VXT

State Saved	No

Range

Represents the amplitude of the largest sinusoidal signal that could be present within the IF without being clipped by the ADC. For signals with high peak-to-average ratios, the range may need to exceed the rms signal power by a significant amount to avoid clipping.

This is a measurement global setting.

Remote Command	`[:SENSe]:POWer[:RF]:RANGe <real>` `[:SENSe]:POWer[:RF]:RANGe?`
Example	`:POW:RANG 10 dBm` `:POW:RANG?`
Notes	The MIN and MAX values are affected by the External Gain parameters, and by the **Center Frequency** The hardware compensates for frequency response and alters the Range setting
Preset	0 dBm
State Saved	Yes
Min	-100
Max	100
Annotation	Meas Bar

Adjust Range for Min Clipping

Sets the combination of attenuation and gain based on the current measured signal level so that clipping will be at a minimum.

This is an "immediate action" function, that is, it executes once, when the key is pressed.

This key does not appear in measurements that do not support this functionality.

Remote Command	`[:SENSe]:POWer[:RF]:RANGe:OPTimize IMMediate`
Notes	Executing Adjust Range for Min Clipping initiates the measurement
Dependencies	Does not appear in the Swept SA and Monitor Spectrum measurements

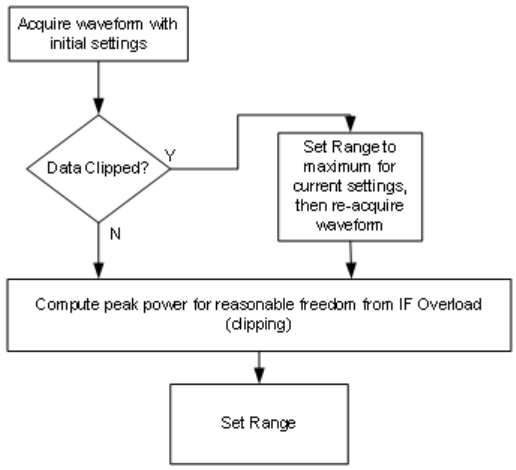
Pre-Adjust for Min Clipping

If this function is ON, it applies the adjustment described under Adjust Range For Min Clipping each time a measurement restarts. Therefore, in Continuous measurement mode, it only executes before the first measurement.

Remote Command	`[:SENSe]:POWer[:RF]:RANGe:OPTimize:ATTenuation OFF | ON | ELECtrical | COMBined` `[:SENSe]:POWer[:RF]:RANGe:OPTimize:ATTenuation?`
Notes	Because there is no attenuator control available in these models, the control displays only ON and OFF choices. However, for SCPI compatibility with other platforms, all three parameters (`ELECtrical`, `COMBined`, and ON) are honored and all are mapped to `ELECtrical`, so if any of these three parameters is sent, a subsequent query will return ELEC
Dependencies	Does not appear in the Swept SA and Monitor Spectrum measurements
Preset	OFF for Swept SA measurement; ON for all other measurements that support **Pre-Adjust for Min Clipping**
State Saved	Saved in instrument state

Adjustment Algorithm

The algorithm for the adjustment is documented below:



Peak-to-Average Ratio

Used with "Range (Non-attenuator models)" on page 1953 to optimize the level control in the instrument. The value is the ratio, in dB, of the peak power to the average power of the signal to be measured. A ratio of 0 should be used for sinusoidal signals; for 802.11g OFDM signals use 9 dB.

All Modes show the current value of Peak-to-Average ratio on the control. However, some Modes do not permit changing the value. In these situations, the control is grayed-out.

Remote Command	`[:SENSe]:POWer[:RF]:RANGe:PARatio <real>` `[:SENSe]:POWer[:RF]:RANGe:PARatio?`
Example	`:POW:RANG:PAR 12 dB`
Notes	In some Modes, this parameter is read-only; meaning the value will appear on the control and query via SCPI, but is not changeable. In such applications the control is grayed-out. Attempting to change the value via SCPI will be ignored but no error message will be generated
Dependencies	Does not appear in Spectrum Analyzer Mode
Preset	10 dB VXT Models M9410A/11A: 0 dB
State Saved	Saved in instrument state
Min	0 dB
Max	20 dB VXT Models M9410A/11A: 50 dB

Mixer Lvl Offset

This is an advanced setting to adjust target Range at the input mixer, which in turn affects the signal level in the instrument's IF. This setting can be used when additional optimization is needed after setting "Peak-to-Average Ratio" on page 1955. Positive values of offset optimize noise performance over distortion, negative values optimize distortion performance over noise.

Remote Command	`[:SENSe]:POWer[:RF]:RANGe:MIXer:OFFSet <real>` `[:SENSe]:POWer[:RF]:RANGe:MIXer:OFFSet?`
Example	`:POW:RANG:MIX:OFFS -5 dB`
Preset	0 dB
State Saved	Saved in instrument state
Min	-35 dB VXT Models M9410A/11A: -34 dB
Max	30 dB

3.11.3.4 Signal Path

Contains controls that pertain to the routing of the signal through the frontend of the instrument.

In general, only appears in instruments whose hardware supports this signal routing. For example, this tab does not appear in many of the modular instrument products, including VXT Model M9421A, or UXM.

This tab *does* appear in VXT Models M9410A/11A, because "Software Preselection" on page 1971 is under this tab, and VXT Models M9410A/11A implement a version of Software Preselection.

Presel Center

Adjusts the centering of the preselector filter to optimize the amplitude accuracy at the frequency of the selected marker. If the selected marker is not on when **Presel Center** is pressed, the instrument turns on the selected marker, performs a peak search, and then performs centering on the marker's center frequency. If the selected marker is already on and between the start and stop frequencies of the instrument, the instrument performs the preselector calibration on that marker's frequency. If the selected marker is already on, but outside the frequency range between **Start Freq** and **Stop Freq**, the instrument first performs a peak search, and then performs centering on the marker's center frequency.

The value displayed on "Preselector Adjust" on page 1958 changes to reflect the new preselector tuning.

Certain considerations should be observed to ensure proper operation, as detailed in "Proper Preselector Operation" on page 1857.

Remote Command	`[:SENSe]:POWer[:RF]:PCENter`
Example	`:POW:PCEN`
Notes	The rules outlined above under the control description apply for the remote command as well as the key. The result of the command depends on marker position, etc. Any message generated by the control press is also generated in response to the remote command
Dependencies	Does not appear in CXA-m, nor in VXT Models M9410A/11A Grayed-out if the microwave preselector is off – If the selected marker's frequency is below Band 1, an advisory message is generated "Preselector not used in this frequency range" and no action is taken – Grayed-out if entirely in Band 0, that is, if **Stop Freq** is below about 3.6 GHz Grayed-out if entirely above 50 GHz, that is, if **Start Freq** is above 50 GHz – Blanked in models that do not include a preselector, such as Option 503. If the remote command is sent in these instruments, accepted without error, and the query always returns 0 – Grayed-out in the Spectrogram View
Couplings	The active marker position determines where the centering will be attempted If the instrument is in a measurement such as averaging when centering is initiated, the act of centering the preselector restarts averaging, but the first average trace will not be taken until the centering is completed The offset applied to do the centering appears in "Preselector Adjust" on page 1958
Status Bits/OPC dependencies	When centering the preselector, `*OPC` does not return true until the process is complete and a subsequent measurement has completed, nor are results returned in response to `:READ` or `:MEASure` queries The `Measuring` bit remains set (true) while this command is operating, and does not go false until the subsequent sweep/measurement has completed

Proper Preselector Operation

Certain considerations should be observed to ensure proper operation:

1. If the selected marker is **Off**, the instrument turns on a marker, performs a peak search, and adjusts the preselector using the selected marker's frequency. It uses the "highest peak" peak search method unqualified by threshold or excursion, so that there is no chance of a 'no peak found' error. It continues with that peak, even if it is the peak of just noise. Therefore, for this operation to work properly, there should be a signal on-screen in a preselected range for the peak search to find

2. If the selected marker is already **On**, the instrument attempts the centering at that marker's frequency. There is no preselector for signals below about 3.6 GHz, so if the marker is on a signal below 3.6 GHz, no centering is attempted, and an advisory message is generated
3. In some models, the preselector can be bypassed. If it is bypassed, no centering is attempted in that range and a message is generated

Preselector Adjust

Lets you manually adjust the preselector filter frequency to optimize its response to the signal of interest. Only available when "Presel Center" on page 1956 is available.

For general purpose signal analysis, using **Presel Center** is recommended. Centering the filter minimizes the impact of long-term preselector drift. **Preselector Adjust** can be used instead to manually optimize the preselector. One application of manual optimization would be to peak the preselector response, which both optimizes the signal-to-noise ratio and minimizes amplitude variations due to small (short-term) preselector drifting.

When **Presel Center** is performed, the offset applied to do the centering becomes the new value of **Preselector Adjust**.

Remote Command	`[:SENSe]:POWer[:RF]:PADJust <freq>` `[:SENSe]:POWer[:RF]:PADJust?`
Example	`:POW:PADJ 100KHz` `:POW:PADJ?`
Notes	The value on the control is displayed to 0.1 MHz resolution
Dependencies	– Does not appear in CXA-m – Does not appear in VXT Models M9410A/11A – Grayed-out if microwave preselector is off – Grayed-out if entirely in Band 0, that is, if Stop Freq is lower than about 3.6 GHz – Grayed-out if entirely above 50 GHz, that is, if Start Freq is higher than 50 GHz – Blank in models that do not include a preselector, such as Option 503. If the command is sent in these instruments, it is accepted without error, and the query always returns 0 – Grayed-out in the Spectrogram View
Preset	0 MHz
State Saved	The **Preselector Adjust** value set by "Presel Center" on page 1956, or by manually adjusting **Preselector Adjust** Not saved in instrument state, and does not survive a Preset or power cycle

Min	-500 MHz
Max	500 MHz
Backwards Compatibility SCPI	`[:SENSe]:POWer[:RF]:MW:PADJust` `[:SENSe]:POWer[:RF]:MMW:PADJust`

Notes	The command has no effect, and the query always returns `MWAVe`
Backwards Compatibility SCPI	`[:SENSe]:POWer[:RF]:PADJust:PRESelector MWAVe | MMWave | EXTernal` `[:SENSe]:POWer[:RF]:PADJust:PRESelector?`

Internal Preamp

Accesses a menu of controls for the internal preamps. Turning on the preamp gives a better noise figure, but a poorer inter-modulation distortion (TOI) to noise floor dynamic range. You can optimize this setting for your measurement.

The instrument takes the preamp gain into account as it sweeps. If you sweep outside of the range of the preamp, the instrument will also account for that. The displayed result always reflects the correct gain.

For some measurements, when the preamp is on and any part of the displayed frequency range is below the lowest frequency for which the preamp has specifications, a warning condition message appears in the status line. For example, for a preamp with a 9 kHz lowest specified frequency: "Preamp: Accy unspec'd below 9 kHz".

Selection	Example	Note
Off	`:POW:GAIN OFF`	
Low Band	`:POW:GAIN ON` `:POW:GAIN:BAND LOW`	Sets the internal preamp to use only the low band. The frequency range of the installed (optional) low-band preamp is displayed in square brackets on the Low Band selection in the dropdown
Full Range	`:POW:GAIN ON` `:POW:GAIN:BAND FULL`	Sets the internal preamp to use its full range. The low band (0-3.6 GHz, 0-3.4 GHz, 0-3 GHz, depending on the model) is supplied by the low band preamp and the frequencies above low band are supplied by the high band preamp The frequency range of the installed (optional) low-band preamp is displayed in square brackets on the Full Range selection in the dropdown. If the high band option is not installed the Full Range selection does not appear

NOTE: The maximum **Center Frequency** for Low Band, displayed in square brackets, can change based on the selected IFBW for measurements that support IFBW (for example, Waveform measurement across all Modes that support it). In certain models (such as N9042B & N9032B), IFBW values <= 40 MHz have a maximum Low Band frequency of 3.6 GHz, while 40 MHz < IFBW <= 1 GHz have a maximum of 3.3 GHz, and 1 GHz < IFBW <= 1.5 GHz have a maximum of 3.5 GHz. IFBW values > 1.5 GHz do not support a **Center Frequency** that can reach the Low Band maximum frequency. In these cases, **N/A** is displayed in the square brackets for Low Band.

Remote Command	`[:SENSe]:POWer[:RF]:GAIN:BAND LOW | FULL`
	`[:SENSe]:POWer[:RF]:GAIN:BAND?`
	`[:SENSe]:POWer[:RF]:GAIN[:STATe] OFF | ON | 0 | 1`
	`[:SENSe]:POWer[:RF]:GAIN[:STATe]?`

Example	`:POW:GAIN:BAND LOW`
	`:POW:GAIN:BAND?`
	`:POW:GAIN OFF`
	`:POW:GAIN?`

Dependencies	Not available on all hardware platforms. If the preamp is not present or is unlicensed, this control is not shown Does not appear in VXT Models M9410A/11A/15A/16A If `:POW:GAIN:BAND FULL` is sent when a low band preamp is available, the preamp band parameter is set to `LOW` instead of `FULL`, and an "Option not installed" message is generated Not available when the electronic/soft attenuator is enabled
Preset	`LOW` `OFF`
State Saved	Saved in instrument state
Annotation	When the USB Preamp is not connected to USB, the Preamp annotation in the Meas Bar says “Off” if the preamp is off and displays the frequency range of the low band or full range preamp depending on the setting. For example, if the Preamp is set to Low Band and the Low Band is 3.6 GHz the annotation says “3.6 GHz”. If it is a 13.6 GHz preamp and it is set to Full Range the annotation says “13.6 GHz” When the USB Preamp is connected to USB, the Preamp annotation says “Preamp: USB” if the internal preamp is off or “Preamp: USB, Int” if the internal preamp is on (only for measurements that support the USB preamp)

LNA

Lets you turn the Low Noise Amplifier (LNA) on or off.

LNA is an additional preamplifier that provides superior DANL and frequency range compared to "Internal Preamp" on page 1959. LNA provides lower system noise

figure, especially at frequencies above 100 MHz, and can be operated up to the full range of 50 GHz instruments.

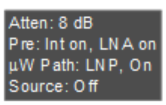
For best possible sensitivity, **LNA** can be turned on *together* with "Internal Preamp" on page 1959, although if you operate both preamps together, note that the TOI (distortion) specifications are impacted. The sensitivity improvement of this combination is substantial when operating in high band (frequencies above 3.6 GHz).

For more details about annotation, see "More Information" on page 1861

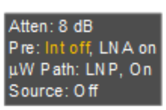
Remote Command	`[:SENSe]:POWer[:RF]:GAIN:LNA[:STATe] OFF | ON | 0 | 1` `[:SENSe]:POWer[:RF]:GAIN:LNA[:STATe]?`
Example	`:POW:GAIN:LNA ON`
Dependencies	Requires Option LNA, except for VXT models M9415A/16A Does not appear in VXT models M9421A/10A/11A May not appear in some measurements **LNA** is not available when the electronic/soft attenuator is enabled
Preset	`OFF`
State Saved	Saved in State

More Information

When **LNA** is installed, the preamp annotation changes to show the state of both **LNA** and **Internal Preamp**. Below is an example:



Note that when operating entirely in the low band (below about 3.6 GHz), if **LNA** is on, **Internal Preamp** is switched off (even if you have its switch set to ON). This is because the noise performance is actually degraded in low band if both preamps are on. In this case, the annotation reflects the actual state of the two preamps, but the **Internal Preamp** annotation displays in amber, to warn you that the actual state of **Internal Preamp** does not match its switch control display:



µW Path Control

Options for this control include **µW Preselector Bypass** (Option MPB), **Low Noise Path** (Option LNP) and **Full Bypass Enable** in the High Band path circuits.

When the µW Preselector is bypassed, flatness is improved, but will be subject to spurs from out of band interfering signals. When **Low Noise Path Enable** is selected, the instrument automatically bypasses certain circuitry in the high frequency bands that can contribute to noise, when it is appropriate based on other instrument settings.

For most applications, the preset state is **Standard Path**, which provides the best remote-control throughput, minimizes acoustic noise from switching and minimizes the risk of wear in the hardware switches, particularly in remote test scenarios where both low band and high band setups will follow in rapid succession. In this path, the bypass of the low band/high band switch and microwave preamp is never activated, which can cause some noise degradation but preserves the life of the bypass switch.

For applications that utilize the wideband IF paths, the preset state is **µW Preselector Bypas**s, if option MPB is present. This is because, when using a wideband IF such as the 140 MHz IF, the µW Preselector's bandwidth can be narrower than the available IF bandwidth, causing degraded amplitude flatness and phase linearity, so it is desirable to bypass the preselector in the default case.

You may choose **Low Noise Path Enable** for a lower noise floor, especially in the 21-26.5 GHz region, though without improving many measures of dynamic range, and without giving the best possible noise floor. The preamp, if purchased and used, gives better noise floor than does **Low Noise Path Enable**, but the preamp's compression threshold and third-order intercept are much poorer than that of **Low Noise Path Enable**.

A fourth choice is **Full Bypass Enable**, which combines **µW Preselector Bypass** and **Low Noise Path Enable**. Because this can bypass most of the circuitry between the input and the first mixer, care should be taken when using this setting to avoid damaging the mixer. **Full Bypass Enable** is only available if both options LNP and MPB are present, as well as option FBP.

Path	Example	Note
Standard Path	`:POW:MW:PATH STD`	Normal setting for most measurements. µW Preselector in circuit, Low Noise Path disabled
Low Noise Path Enable	`:POW:MW:PATH LNP`	See "Low Noise Path Enable" on page 1866
µW Preselector Bypass	`:POW:MW:PATH MPB`	See "µW Preselector Bypass" on page 1868
Full Bypass Enable	`:POW:MW:PATH FULL`	See "Full Bypass Enable" on page 1869

Remote Command	`[:SENSe]:POWer[:RF]:MW:PATH STD | LNPath | MPBypass | FULL` `[:SENSe]:POWer[:RF]:MW:PATH?`

Example	`:POW:MW:PATH LNP`
	Enables the Low Noise path
	`:POW:MW:PATH?`

Notes	If "Presel Center" on page 1956 is performed, the instrument will momentarily switch to the Standard Path, regardless of the setting of **µW Path Control** The DC Block will always be switched in when the low noise path is switched in, to protect succeeding circuitry from DC. Note that this does not mean “when the low noise path is enabled” but when, based on the Low Noise Path rules, the path is actually switched in. This can happen when the selection is **Low Noise Path Enable** or **Full Bypass Enable**. In the case where the DC Block is switched in the instrument is now AC coupled. However, if you selected DC coupling, the UI would still behave as though it were DC coupled, including all annunciation, warnings, status bits, and responses to SCPI queries. This is because, based on other settings, the instrument could switch out the low noise path at any time and hence go back to being DC coupled Alignment switching ignores the settings in this menu, and restores them when finished
Dependencies	Does not appear in CXA-m, VXT Models M9410A/11A, nor in BBIQ and External Mixing – The **Low Noise Path Enable** selection does not appear unless Option LNP is present and licensed – The **µW Preselector Bypass** selection does not appear unless Option MPB is present and licensed – The **Full Bypass Enable** selection does not appear unless options LNP and MPB are both present as well as option FBP In any of these cases, if the required options are not present and the SCPI command is sent, error -241, "Hardware missing; Option not installed" is generated **Low Noise Path Enable** and **Full Bypass Enable** are grayed-out if the current measurement does not support them **Low Noise Path Enable** and **Full Bypass Enable** are not supported in Avionics and MMR Modes (non-modulation measurements). In any of these cases (that is, the feature is not supported in either measurement or Mode), if the SCPI command is sent, the following error is generated: -221, “Setting Conflict; Feature not supported for this measurement”
Preset	**Mode** / **Value** IQ Analyzer, Pulse, Avionics: MPB option present and licensed: `MPB`; MPB option not present and licensed: `STD` All other Modes: `STD`
State Saved	Save in instrument state
Range	Standard Path | Low Noise Path Enable | µW Presel Bypass | Full Bypass Enable
Annotation	In the Meas Bar, if the Standard path is chosen: µW Path: Standard If Low Noise Path is enabled but the LNP switch is not thrown: µW Path: LNP,Off If the Low Noise Path is enabled and the LNP switch *is* thrown: µW Path: LNP,On If the preselector is bypassed: µW Path: Bypass

If Full Bypass Enable is selected but the LNP switch is not thrown:

µW Path: FByp,Off

If Full Bypass Enable is selected and the LNP switch *is* thrown:

µW Path: FByp,On

µW Path Control Auto

In VMA, WLAN, 5G NR, CQM Modes, an **Auto/Man** switch is added to **µW Path Control**:

This allows the function to automatically switch based on certain Auto Rules as shown below:

VMA Mode

Measurement	When µW Path Control is in Auto
Digital Demod	Use Standard Path unless tuned frequency > 3.6 GHz and IFBW > 15 MHz, in which case choose Preselector Bypass
Monitor Spectrum	Always Presel Bypass
IQ Waveform	Use Standard Path unless tuned frequency > 3.6 GHz and IFBW > 15 MHz, in which case choose Preselector Bypass
Custom OFDM	Use Standard Path unless tuned frequency > 3.6 GHz and IFBW > 15 MHz, in which case choose Preselector Bypass
Channel Power	Always Presel Bypass
Occupied BW	Always Presel Bypass
CCDF	Use Standard Path unless tuned frequency > 3.6 GHz and IFBW > 15 MHz, in which case choose Preselector Bypass
ACP	Always Presel Bypass
SEM	Always Presel Bypass
Spurious Emissions	Always Standard Path

WLAN Mode

Measurement	When µW Path Control is in Auto
Modulation Analysis	Always Presel Bypass

Measurement	When µW Path Control is in Auto
Spectral Flatness	Always Presel Bypasss
Power vs Time	Always Presel Bypass
Monitor Spectrum	Always Presel Bypass
IQ Waveform	Always Presel Bypass
Channel Power	Always Presel Bypass
Occupied BW	Always Presel Bypass
CCDF	Always Presel Bypass
SEM	For 11be 320M, when ‘Enabled Wideband IF for FFT’ is OFF or ‘Sweep Type Rule’ is Best Dynamic Range, auto µW path is standard For other cases, auto µW path is presel bypass if presel bypass is enabled, auto µW path is standard if presel bypass is not enabled
Spurious Emissions	Always Standard Path

5G NR Mode

Measurement	When µW Path Control is in Auto
Modulation Analysis	Use Standard Path unless tuned frequency > 3.6 GHz and IFBW > 15 MHz, in which case choose Full Bypass if conditions warrant(FBP Option is available and “Allow Full Bypass in Auto” is On), otherwise choose Preselector Bypass
Monitor Spectrum	Always Standard Path
IQ Waveform	Use Standard Path unless tuned frequency > 3.6 GHz and IFBW > 15 MHz, in which case choose Full Bypass if conditions warrant(FBP Option is available and “Allow Full Bypass in Auto” is On), otherwise choose Preselector Bypass
Channel Power	Always Standard Path
Occupied BW	Always Standard Path
CCDF	Use Standard Path unless tuned frequency > 3.6 GHz and IFBW > 15 MHz, in which case choose Preselector Bypass
ACP	Always Standard Path
SEM	Always Standard Path
Spurious Emissions	Always Standard Path
Transmit On|Off Power	Use Standard Path unless tuned frequency > 3.6 GHz and Info BW > 15 MHz, in which case choose Preselector Bypass

Channel Quality Mode

Measurement	When µW Path Control is in Auto
Group Delay	Use Standard Path unless tuned frequency > 3.6 GHz and IFBW > 15 MHz, in which case choose Full Bypass if conditions warrant(FBP Option is available and “Allow Full Bypass in Auto” is On), otherwise choose Preselector Bypass

Measurement	When µW Path Control is in Auto
Monitor Spectrum	Always Standard Path
IQ Waveform	Use Standard Path unless tuned frequency > 3.6 GHz and IFBW > 15 MHz, in which case choose Preselector Bypass
CCDF	Use Standard Path unless tuned frequency > 3.6 GHz and IFBW > 15 MHz, in which case choose Preselector Bypass

Remote Command	`[:SENSe]:POWer[:RF]:MW:PATH:AUTO ON | OFF | 1 | 0` `[:SENSe]:POWer[:RF]:MW:PATH:AUTO?`
Example	`:POW:MW:PATH:AUTO ON` `:POW:MW:PATH:AUTO?`
Dependencies	Only appears in VMA, WLAN, 5G NR and CQM Modes
Couplings	See the tables above
Preset	ON
Range	ON|OFF

Low Noise Path Enable

Low Noise Path Enable provides a lower noise floor under some circumstances, particularly when operating in the 21–26.5 GHz region. With the Low Noise Path enabled, the low band/high band switch and microwave preamp are bypassed whenever *all* the following are true:

- The instrument is not in the Low Band, meaning:
- the start frequency is above 3.5 GHz and
- the stop frequency is above 3.6 GHz
- The internal preamp is not installed, or if installed, is set to **Off** or **Low Band**

Note that this means that, when any part of a sweep is done in Low Band, the Low Noise Path is not used, whether or not the **Low Noise Path Enable** is selected in the user interface. Also, if the preamp is turned on, the Low Noise Path is not used, whether or not the **Low Noise Path Enable** is selected in the user interface. The only time the Low Noise Path is used is when **Low Noise Path Enable** is selected, the sweep is completely in High Band (> 3.6 GHz) and no preamp is in use.

For measurements that use IQ acquisition, the low noise path is used when **Center Frequency** is in High Band (> 3.6 GHz) and no preamp is in use. In other words, the rules above are modified to use only the center frequency to qualify which path to switch in. This is not the case for FFTs in the Swept SA measurement; they use the same rules as swept measurements.

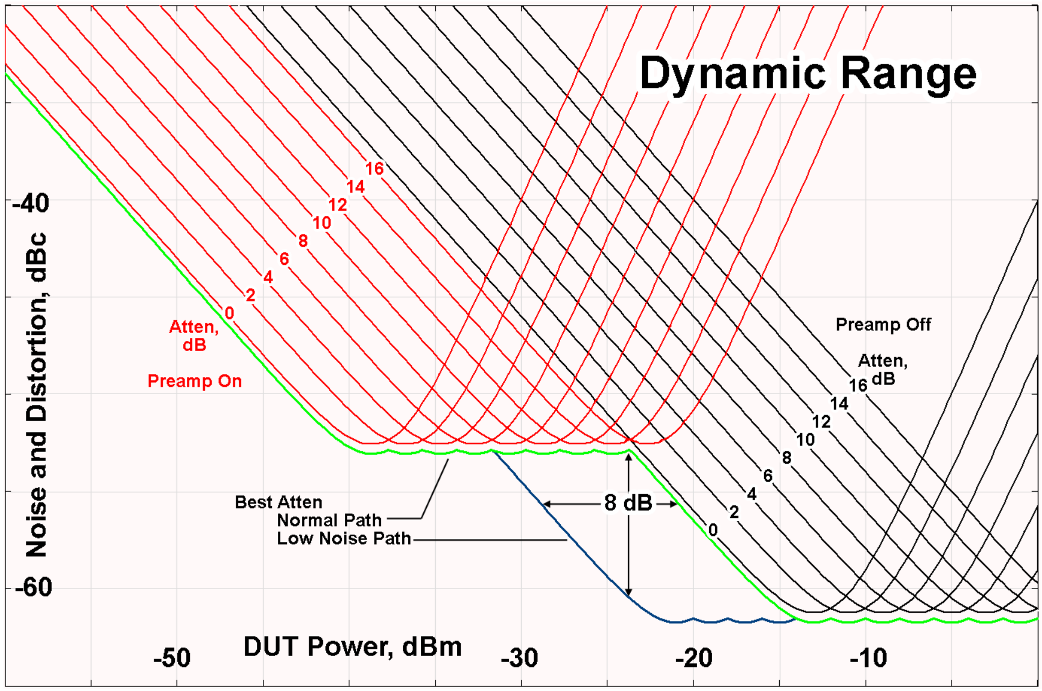
Note that the Low Noise Path, while giving improved DANL, has the disadvantage of decreased TOI performance and decreased gain compression performance relative to the standard path.

Note also that the bypass switch is a mechanical switch and has finite life, so if the **Low Noise Path Enable** is selected, it is possible to cause frequent cycling of this switch by frequently changing instrument settings such that the above conditions hold true only some of the time. A user making tests of this nature should consider opting for the **Standard Path**, which will never throw the bypass switch, at the expense of some degraded noise performance.

The low noise path is useful for situations where the signal level is so low that the instrument performance is dominated by noise even with 0 dB attenuation, but still high enough that the preamp option would have excessive third-order intermodulation or compression. The preamp, if purchased and used, gives better noise floor than does the “Low Noise Path.” However, its compression threshold and third-order intercept are much poorer than that of the non-preamp path.

There are some applications, typically for signals around –30 dBm, for which the third-order dynamic range of the standard path is good enough, but the noise floor is not low enough even with 0 dB input attenuation. When the third-order dynamic range of the preamp path is too little and the noise floor of the standard path is too high, the Low Noise Path can provide the best dynamic range

The graph below illustrates the concept. It shows, in red, the performance of an instrument at different attenuation settings, both with the preamp on and off, in a measurement that is affected by both instrument noise and instrument TOI. The green shows the best available dynamic range, offset by 0.5 dB for clarity. The blue shows how the best available dynamic range improves for moderate signal levels with the low noise path switched in. In this illustration, the preamp improves the noise floor by 15 dB while degrading the third-order intercept by 30 dB, and the low noise path reduces loss by 8 dB. The attenuator step size is 2 dB.



There are other times where selecting the low noise path improves performance, too. Compression-limited measurements such as finding the nulls in a pulsed-RF spectrum can profit from the low noise path in a way similar to the TOI-limited measurement illustrated. Accuracy can be improved when the low noise path allows the optimum attenuation to increase from a small amount like 0, 2 or 4 dB to a larger amount, giving better return loss at the instrument input. Harmonic measurements, such as second and third harmonic levels, are much improved using the low noise path because of the superiority of that path for harmonic (though not intermodulation) distortion performance.

µW Preselector Bypass

Toggles the preselector bypass switch for band 1 and higher. When the microwave presel is on, the signal path is preselected. When the microwave preselector is off, the signal path is not preselected. The preselected path is the normal path for the instrument.

The preselector is a tunable bandpass filter which prevents signals away from the frequency of interest from combining in the mixer to generate in-band spurious signals (images). The consequences of using a preselector filter are its limited bandwidth, the amplitude and phase ripple in its passband, and any amplitude and phase instability due to center frequency drift.

Option MPB or pre-selector bypass provides an unpreselected input mixer path for certain X-Series signal analyzers with frequency ranges above 3.6 GHz. This signal path allows a wider bandwidth and less amplitude variability, which is an advantage when doing modulation analysis and broadband signal analysis. The disadvantage is that, without the preselector, image signals will be displayed. Another disadvantage of bypassing the preselector is increased LO emission levels at the front panel input port.

Image responses are separated from the real signal by twice the 1st IF. For IF Paths of 10 MHz and 25 MHz, the 1st IF is 322.5 MHz, so the image response and the real signal will be separated by 645 MHz. The 1st IF will be different for other IF Path settings. When viewing a real signal and its corresponding image response in internal mixing, the image response will be to the left of the real signal.

Also, the image response and the real signal typically have the same amplitude and exhibit the same shape factor.

However, if Option FS1 (Fast Sweep Capability) is enabled, the image response in the Swept SA measurement appears lower in amplitude and has a much wider shape factor compared to the real signal.

Full Bypass Enable

With **Full Bypass Enable** selected, the microwave preselector is bypassed. In addition, the low band/high band switch and microwave preamp are bypassed whenever *all* the following are true:

- The instrument is not in the Low Band, meaning:
- the start frequency is above 3.5 GHz and
- the stop frequency is above 3.6 GHz.
- the internal preamp is not installed or if installed, is set to **Off** or **Low Band**

Note that this means that, when any part of a sweep is done in Low Band, the Low Noise Path is not used, whether or not the **Full Bypass Enable** is selected in the user interface. Also, if the preamp is turned on, the Low Noise Path is not used, whether or not the **Full Bypass Enable** is selected in the user interface. The only time the Low Noise Path is used is when **Full Bypass Enable** is selected, the sweep is completely in High Band (> 3.6 GHz) and no preamp is in use.

CAUTION **When Full Bypass Enable is selected, and "Y Scale" on page 1929 is set to 0 dB, there will be a direct AC connection between the input and the first converter when the Low Noise Path switches in (when Start Freq >3.6 GHz and the Preamp is either not licensed, set to Low Band, or Off). This puts the first converter at considerable risk to be damaged by high AC power. Consequently,**

whenever **Full Bypass Enable** is selected, a warning message appears in the status bar:

"Full Bypass Enabled, maximum safe input power reduced"

Microwave Preselector Bypass Backwards Compatibility

Example	`:POW:MW:PRES OFF` Bypasses the microwave preselector
Notes	Included for Microwave Preselector Bypass backwards compatibility The `ON` parameter sets the `STD` path (`:POW:MW:PATH STD`) The `OFF` parameter sets path `MPB` (`:POW:MW:PATH MPB`)
Preset	`ON`
Backwards Compatibility SCPI	`[:SENSe]:POWer[:RF]:MW:PRESelector[:STATe] ON | OFF | 0 | 1` `[:SENSe]:POWer[:RF]:MW:PRESelector[:STATe]?`

Frequency Extender Preselection Bypass

Only applies to the high frequency path of the Frequency Extender, and only if the Frequency Extender allows it. For example, the V3050A high frequency path is 50 – 110 GHz and *does* allow control of the preselector bypass.

When the Frequency Extender's preselection is bypassed, flatness is improved, but will be subject to spurs from out-of-band interfering signals. For bandwidths greater than 2.5 [GHz], it is recommended that the signal bypass the Frequency Extender Preselector since the max bandwidth of the Preselector can be as narrow as 2.5 [GHz].

For most applications, the preset state is `OFF`, which gives the best remote-control throughput, minimizes acoustic noise from switching, minimizes out of band spurs, and minimizes the risk of wear in the hardware switches.

Preselector and Bandwidth Conflict

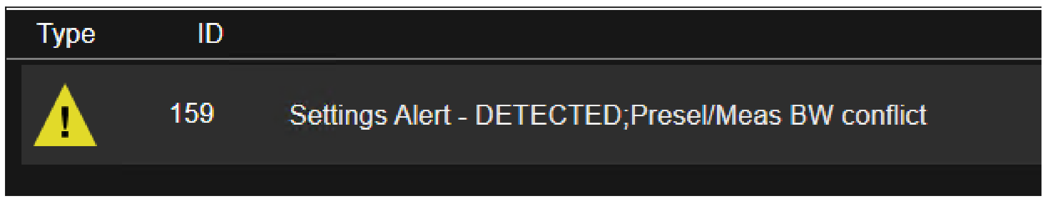
When the Frequency Extender Preselector is applied and the signal bandwidth is greater than 2.5 [GHz], then a settings alert message will show to warn the user that the signal may be distorted due to the limitation of the Frequency Extender Preselector bandwidth.

An example of the settings alert message is shown below.

Settings Alert message in the Status Bar at the bottom of the display.

Settings Alert message in the error queue

.



Software Preselection

Provided in some instruments, either to compensate for issues with provided hardware preselection or to provide the preselection function when there is no hardware preselector.

N9041B

Software Preselection compensates for the frequency range limit of the microwave preselector. Since the microwave preselector only goes up to 50 GHz, software preselection must be used to suppress and separate images above 50 GHz. The specific algorithm used for software preselection is specified by the SW Preselection Type selection – Normal or Advanced.

In N9041B, **Software Preselection** only applies for frequencies above 50 GHz, therefore it is only used for RF Input 2. Even if turned on, it is not used for other inputs, and never for frequencies below 50 GHz. This is why the label of this control contains the parenthetical note "(>~50 GHz)".

Note that in N9041B, in Swept SA measurement, **Software Preselection** works even if the measurement is using an FFT Sweep Type. In measurements other than Swept SA, Software Preselection is not used if the measurement is using an FFT sweep type.

N9042B+V3050A

Software Preselection compensates for the frequency range limit of the microwave preselector. Since the microwave preselector only goes up to 50 GHz, software preselection must be used to suppress and separate images above 50 GHz. The specific algorithm used for software preselection is specified by the SW Preselection Type selection – Normal or Advanced.

For N9042B+V3050A, Software Preselection only applies for frequencies above 50 GHz, therefore it is only used for External RF. Even if it is turned on, it will not be used for other inputs and never for frequencies below 50 GHz. This is why the label of this control contains the parenthetical note “(>~50 GHz)”.

Note that for N9042B+V3050A, in the Swept SA measurement, Software Preselection works even if the measurement is using an FFT Sweep Type. In measurements other than Swept SA, Software Preselection is not used if the measurement is using an FFT Sweep Type.

VXT models M9410A/11A

Software Preselection is used to provide the preselection function, as there is no hardware preselector in these models. Two background traces are taken and compared point by point, and the point with the lowest amplitude from the two traces is used. This provides a method to reduce spurs that are internally generated within the VXT, but you should note the following when using Software Preselection:

- There is some speed cost due to the need to take multiple captures
- Taking the point with the lowest amplitude in each trace will make the average noise level lower at all points that do not have a spur. This can reduce the accuracy of the measurement of noise and noise-like signals

Because of the difficulty in identifying spurs manually, you are recommended to leave Software Preselection ON at all times in VXT models M9410A/11A. If you turn it off in order to speed up your measurement or improve noise accuracy, be aware of unwanted onscreen spurs.

Remote Command	`[:SENSe]:POWer[:RF]:SWPResel:STATe 0 | 1 | ON | OFF` `[:SENSe]:POWer[:RF]:SWPresel:STAT?`
Example	`:POW:SWPR:STAT 1` `:POW:SWPR:STAT?`
Dependencies	Only appears in N9041B, N9042B+V2050A, and VXT models M9410A/11A. Does not appear in all measurements
Couplings	Affects **Sweep Time** **Auto Tune** supports **Software Preselection**, so **Auto Tune** should be performed after setting the **Software Preselection** state
Preset	N9041B: OFF N9042B+V3050A: ON M9410A/11A: ON
State Saved	Saved in instrument state

SW Preselection Type

Specifies the algorithm used for software preselection.

Two hidden sweeps occur in succession. The second sweep is offset in LO frequency by 2 * IF / N. For each point in each trace, the smaller amplitude from the two traces is taken and placed in that point in the selected trace. The Peak detector is auto-selected to improve the image suppression effectiveness. Responses of each trace that lie on top of one another will remain and are valid signals. Other signals are images, which are suppressed. The action of taking the smaller of the two traces will make the average noise level lower in all points that do not have an image, thus reducing the accuracy of the measurement of noise and noise-like signals.

– `NORMal` - mathematically removes all image and multiple responses of signals present at the input

– `ADVanced` - any trace processing (such as “max hold” or trace averaging) is performed on the points of both candidate traces before the “select minimum” operation occurs. This form of processing works better for non-stationary signals, such as pulsed-RF signals

Remote Command	`[:SENSe]:POWer[:RF]:SWPResel NORMal | ADVanced` `[:SENSe]:POWer[:RF]:SWPResel?`
Example	`:POW:SWPR NORM` `:POW:SWPR?`
Dependencies	Only appears in N9041B and N9042B+V3050A. Only appears in measurements that use the Swept method Grayed-out when "Software Preselection" on page 1971 is `OFF`. The grayout message is “Unavailable unless SW Presel enabled”
Preset	N9041B: `ADVanced` N9042B+V3050A: `NORMal`
State Saved	Saved in instrument state

SW Preselection BW

Specifies the effective bandwidth to be used for Software Preselection.

The options are:

– `NORMal` – when making Swept measurements, a software preselection algorithm is used which takes up to 4 background acquisitions, then post-processes the result. This algorithm can remove images from signals with an occupied

bandwidth up to around 3 GHz. (Default/Preset setting). When making FFT measurements, this algorithm is not used, instead the same algorithm is used as for NARRow (below)

– NARRow– a software preselection algorithm is used which takes two background acquisitions, then post-processes the result to detect and remove images from wideband signals with occupied bandwidths up to 2 GHz. This increases the risk of images failing to be rejected, but improves the measurement speed

Remote Command	`[:SENSe]:POWer[:RF]:SWPResel:BW NORMal | NARRow` `[:SENSe]:POWer[:RF]:SWPResel:BW?`
Example	`:POW:SWPR:BW NARR`
Dependencies	Only appears in N9041B and N9042B+V3050A. Only appears in measurements that use the Swept method Grayed-out when "Software Preselection" on page 1971 is OFF. The grayout message is "Unavailable unless SW Presel enabled" For N9042B+V3050A, the parameter is SCPI-only, and always set to NARRow when **Software Preselection** is enabled
Preset	N9041B: NORMal N9042B+V3050A: NARRow
State Saved	Saved in instrument state

High Freq Prefilter

Lets you set the state of Prefilter for center frequencies above 1310 MHz.

In VXT Models M9410A/11A, the Receiver RF path has a bank of filters that come after the RF Attenuator in the signal path. Since this bank of filters precedes the mixer they are known as the "Prefilter" bank. Their purpose is to eliminate unwanted in-band mixing products by filtering out all but the desired frequencies before the signals get to the mixer. There are 13 prefilter bands to cover the frequencies between 9 kHz and 6000 MHz. The Prefilter provides the necessary rejection of the unwanted signal.

Remote Command	`[:SENSe]:<measurement>:PFILter[:STATe] ON | OFF | 1 | 0` `[:SENSe]:<measurement>:PFILter[:STATe]?`

Example	Enable High Freq Prefilter for the Complex Spectrum Measurement in BASIC Mode:
	`:SPEC:PFIL ON`
	Enable High Freq Prefilter for the IQ Waveform Measurement, in multiple Modes:
	`:WAV:PFIL ON`
	Enable High Freq Prefilter for the Swept SA Measurement in SA Mode:

	:SAN:PFIL ON
Dependencies	Only appears in VXT models M9410A/11A with center frequency above 1310 MHz
Preset	See "Prefilter Presets" on page 1875 below
State Saved	Saved in instrument state

Prefilter Presets

Meas	Mode	Preset
SPEC	BASIC	OFF
WAV	BASIC, WCDMA, WLAN, LTEAFDD, LTEATDD, 5GNR, VMA	OFF
MON	WCDMA, WLAN, LTEAFDD, LTEATDD, 5GNR, VMA	OFF
RHO	WCDMA	OFF
CDP	WCDMA	OFF
PCON	WCDMA	OFF
EVMQ	WCDMA	OFF
CHP	WCDMA, WLAN, LTEAFDD, LTEATDD, 5GNR, VMA, SA	OFF
OBW	WCDMA, WLAN, LTEAFDD, LTEATDD, 5GNR, VMA, SA	OFF
ACP	WCDMA, LTEAFDD, LTEATDD, 5GNR, VMA, SA	OFF
SEM	WCDMA, WLAN, LTEAFDD, LTEATDD, 5GNR, VMA, SA	OFF
PST	WCDMA, WLAN, LTEAFDD, LTEATDD, 5GNR, VMA, SA	OFF
PVT	WLAN, LTEAFDD, LTEATDD, 5GNR	OFF
EVM	WLAN, LTEAFDD, LTEATDD, 5GNR	OFF
FLAT	WLAN	OFF
EVMM	WLAN	OFF
CEVM	LTEAFDD, LTEATDD	OFF
PAVT	5GNR, VMA	OFF
DDEM	VMA	OFF
OFDM	VMA	OFF
SAN	SA	ON
HARM	SA	ON

3.11.4 BW

Opens the Bandwidth (BW) menu, which contains controls for the Resolution Bandwidth and Video Bandwidth functions of the instrument.

The Resolution BW functions control filter bandwidth and filter type. There are two filter types: Gaussian and Flattop. The Gaussian filters have a response curve that is parabolic on a log scale. The Flattop filter shape is a close approximation to a rectangular filter.

3.11.4.1 Settings

Contains the basic bandwidth functions. In most measurements it is the only tab under BW.

Res BW

Sets the Resolution Bandwidth (RBW) used in measuring the fundamental signal. Second and subsequent harmonics by default use a multiple of the resolution bandwidth proportional to their frequency multiplier. Only Gaussian RBW filters are enabled and the list of allowable RBW values matches those of the Spectrum Analyzer measurement.

In this measurement, the resolution bandwidth is *not* autocoupled to span. If Auto is on, the resolution bandwidth is automatically determined from the first sweep when the measurement is restarted.

Only Gaussian RBW filters are enabled.

Remote Command	`[:SENSe]:HARMonics:BANDwidth|BWIDth[:RESolution] <freq>` `[:SENSe]:HARMonics:BANDwidth|BWIDth[:RESolution]?`
Example	`:HARM:BWID 10 kHz` `:HARM:BWID?`
Notes	Forces measurement restart
Preset	The bandwidth found by the first sweep. The resulting value will vary, depending upon the input signal
Min	1 Hz
Max	8 MHz

Auto Function

Remote Command	`[:SENSe]:HARMonics:BANDwidth|BWIDth[:RESolution]:AUTO OFF | ON | 0 | 1` `[:SENSe]:HARMonics:BANDwidth|BWIDth[:RESolution]:AUTO?`
Preset	ON (Sense)

Video BW (Remote Command only)

For backwards compatibility, the instrument accepts but ignores this command. There is no setting of the video bandwidth, since we are using single-point averaging of a zero-span measurement. When the average detector is selected, the video bandwidth is not used. When the peak detector is selected, the video bandwidth is be set to instrument maximum.

Preset	50 MHz
Min	50 MHz
Max	50 MHz
Backwards Compatibility SCPI	[:SENSe]:HARMonics:BANDwidth|BWIDth:VIDeo <frequency> [:SENSe]:HARMonics:BANDwidth|BWIDth:VIDeo?

Auto Function

Preset	ON
Backwards Compatibility SCPI	[:SENSe]:HARMonics:BANDwidth|BWIDth:VIDeo:AUTO OFF | ON | 0 | 1 [:SENSe]:HARMonics:BANDwidth|BWIDth:VIDeo:AUTO?

3.11.5 Display

Lets you configure display items for the current Mode, Measurement View or Window.

3.11.5.1 Annotation

Contains controls for setting up the annotation for the current Mode or Measurement.

Graticule

Turns the display graticule On or Off for all windows with graticules in all measurements in the current Mode. Also turns the graticule Y-Axis annotation on and off.

Remote Command	:DISPlay:GRATicule[:STATe] OFF | ON | 0 | 1 :DISPlay:GRATicule[:STATe]?
Example	:DISP:GRAT OFF
Notes	The graticule is the set of horizontal and vertical lines that make up the grid/divisions for the X-Axis and Y-Axis
Preset	ON
State Saved	Saved in instrument state
Backwards Compatibility SCPI	:DISPlay:WINDow[1]:TRACe:GRATicule:GRID[:STATe] OFF | ON | 0 | 1 :DISPlay:WINDow[1]:TRACe:GRATicule:GRID[:STATe]? This command is accepted for backwards compatibility with older instruments, but the WINDow, TRACe and GRID parameters are ignored

Screen Annotation

Controls the display of the annunciation and annotation around the graticule, including any annotation on lines (such as the display line, the threshold line, etc.) and the Y-Axis annotation, for all windows with screen annotation in all measurements in the current Mode.

This does *not* include marker annotation (or the N dB result). When `OFF`, the graticule expands to fill the entire graticule area, leaving only the 1.5% gap above the graticule, as described in the **Trace** section.

Remote Command	`:DISPlay:ANNotation:SCReen[:STATe] OFF | ON | 0 | 1` `:DISPlay:ANNotation:SCReen[:STATe]?`
Example	`:DISP:ANN:SCR OFF`
Dependencies	Grayed-out and forced to `OFF` when **System Display Settings**, **Annotation** is `OFF`
Preset	`ON` This remains `OFF` through a Preset when **System Display Settings**, **Annotation** is set to `OFF`
State Saved	Saved in instrument state

Trace Annotation

Turns on and off the labels on the traces, showing their detector (or their Math Mode) as described in the **Trace** section, for all windows in all measurements in the current Mode for which Trace Annotation on/off is supported.

If Trace Math is being performed on a trace, then the Trace Math annotation replaces the detector annotation.

For measurements that support limit lines, this key also turns on and off the labels on the Limit Lines. The label is the Limit number annotation and Limit Comment displayed on the graph. If the length of the comment is greater than 20 characters, the first 8 characters and the last 8 characters are displayed, joined with **…**.

Remote Command	`:DISPlay:ANNotation:TRACe[:STATe] ON | OFF | 1 | 0` `:DISPlay:ANNotation:TRACe[:STATe]?`
Example	`:DISP:ANN:TRAC OFF`
Preset	`OFF`
State Saved	Saved in instrument state

Control Annotation

Turns on and off the display of values on the Active Function controls for all measurements in the current Mode. This is a security feature.

Remote Command	`:DISPlay:ACTivefunc[:STATe] ON | OFF | 1 | 0` `:DISPlay:ACTivefunc[:STATe]?`
Example	`:DISP:ACT OFF`
Dependencies	Grayed out and forced to `OFF` when **System Display Settings**, **Annotation** is `OFF`
Preset	`ON` This remains `OFF` through a Preset when **System Display Settings**, **Annotation** is set to `OFF`
State Saved	Saved in instrument state

Frequency Annotation

Turns on and off the absolute frequency annotation in the main display for all windows in all measurements in the current Mode for which Frequency Annotation on/off is supported.

The affected annotations include Center Frequency, Start/Stop Frequency, Frequency Offset, Marker Frequency. Any relative frequency annotation such as Span and Marker Delta are not affected.

The frequency annotations in any other associated display, such as in Active Function, Softkey label, Limit Editor, Amp Corr Editor and Marker Table are not changed.

Frequency annotations that are not associated with the spectrum, such as RBW, IBW, Sweep Time, are excluded and they are shown regardless of this selection.

Remote Command	`:DISPlay:ANNotation:FREQuency[:STATe] ON | OFF | 1 | 0` `:DISPlay:ANNotation:FREQuency[:STATe]?`
Example	`:DISP:ANN:FREQ OFF`
Dependencies	Only appears in the Swept SA measurement in Spectrum Analyzer Mode
Preset	`ON`

Meas Bar

Turns the Measurement Bar at the top of the screen on and off for all measurements in the current Mode. When `OFF`, the graticule area expands to fill the area formerly occupied by the Measurement Bar.

Remote Command	`:DISPlay:ANNotation:MBAR[:STATe] OFF | ON | 0 | 1` `:DISPlay:ANNotation:MBAR[:STATe]?`
Example	`:DISP:ANN:MBAR OFF`
Dependencies	Grayed out and forced to `OFF` when **System Display Settings**, **Annotation** is `OFF`
Preset	`ON` This remains `OFF` through a Preset when **System Display Settings**, **Annotation** is set to `OFF`
State Saved	Saved in instrument state

Display Enable (Remote Command Only)

Turns the display on/off, including the display drive circuitry. The backlight stays lit to confirm that the instrument is on. The display enable setting is mode global. Theare three reasons for turning the display off:

1. To increase speed as much as possible by freeing the instrument from having to update the display
2. To reduce emissions from the display, drive circuitry
3. For security purposes

If you have turned off the display:

– and you are in local operation, the display can be turned back on by pressing any key or by sending `:SYSTem:DEFaults MISC` or `:DISPlay:ENABle ON` (neither `*RST` nor :SYSTem:PRESet enable the display)

– and you are in remote operation, the display can be turned back on by pressing the **Local** or **Esc** keys, or by sending `:SYSTem:DEFaults MISC` or `:DISPlay:ENABle ON` (neither `*RST` nor `:SYSTem:PRESet` enable the display)

– and you are using either the `:SYSTem:KLOCk` command or GPIB local lockout, then *no* front-panel key press will turn the display back on. You must turn it back on remotely.

If the display is `OFF`, many SCPI commands related to User Views and Multiscreen functionality do not work, and return the error messages “-221, Settings conflict; Screen SCPI cannot be used when Display is disabled” or “221, Settings conflict; View SCPI cannot be used while Display is disabled”. These commands include:

Name	Command
Select User View	`:DISPlay:VIEW:ADVanced:SELect`
Rename User View	`:DISPlay:VIEW:ADVanced:REName`
Delete User View	`:DISPlay:VIEW:ADVanced:DELete`
Create User View	`:DISPlay:VIEW:ADVanced:NAME`

Name	Command
Select Screen	:INSTrument:SCReen:SELect
Delete Screen	:INSTrument:SCReen:DELete
Delete All But This Screen	:INSTrument:SCReen:DELete:ALL
Add Screen	:INSTrument:SCReen:CREate
Rename Screen	:INSTrument:SCReen:REName
Sequencer On/Off	:SYSTem:SEQuencer

Remote Command	:DISPlay:ENABle OFF | ON | 0 | 1 :DISPlay:ENABle?
Example	:DISP:ENAB OFF
Couplings	:DISP:ENAB OFF turns Backlight OFF and :DISP:ENAB ON turns Backlight ON, but changing Backlight settings does *not* change the state of :DISP:ENAB
Preset	ON Set by :SYST:DEF MISC, but not affected by *RST or :SYSTem:PRESet
State Saved	Not saved in instrument state
Backwards Compatibility Notes	:SYST:PRES no longer turns on :DISPlay:ENABle as it did in legacy analyzers

3.11.5.2 View

Contains controls for selecting the current **View**, and for editing User Views.

View

See "Views" on page 1829.

User View

Lets you choose a View from the saved User Views for the current measurement. This panel only appears if a User View exists for the current measurement.

Remote Command	:DISPlay:VIEW:ADVanced:SELect <alphanumeric> :DISPlay:VIEW:ADVanced:SELect?
Example	Select Baseband as the current View :DISP:VIEW:ADV:SEL “Baseband”
Notes	You must be in the measurement whose View you are trying to set to send the command. You can only

	set Views for the current measurement using this command
	For predefined views, the parameter is derived from the view name that is shown in the View list in the user interface. For example, if you are trying to select the Trace Zoom view in the Swept SA measurement, you send:
	`:DISP:VIEW:ADV:SEL "Trace Zoom"`
	because “Trace Zoom” is the name of the View as seen in the Mode/Meas dialog or in the Display, View menu
	You *cannot* use the legacy View parameter (which in this case would be `TZOom`) with `:DISP:VIEW:ADV:SEL`
	`<alphanumeric>` is case insensitive; you can specify mixed case, however the name will be evaluated on a single case. Thus, both of the following forms work:
	`:DISP:VIEW:ADV:SEL "Trace Zoom"`
	`:DISP:VIEW:ADV:SEL "TRACE ZOOM"`
	If the specified view is not a valid View, the query returns the error message “-224, Illegal parameter value; View with the name <alphanumeric> does not exist”
	If the display is disabled (via `:DISP:ENAB OFF`) then the error message “-221, Settings conflict; View SCPI cannot be used while Display is disabled” is generated

Backwards Compatibility SCPI	The legacy node `:DISPlay:VIEW[:SELect]` is retained for backwards compatibility, but it only supports predefined views

Restore Layout to Default

Restores the Layout to the default for Basic.

Modified Views are very temporary; if you exit the current measurement they are discarded, and they are not saved in State. To retain this View for later use, and to be able to return easily to your original Basic View, you can save your edited View as a “User View”.

Save Layout as New View

Saves your new View as a User View. An alpha keyboard appears, which lets you name your new View; the default is the old View name plus a number.

Remote Command	`:DISPlay:VIEW:ADVanced:NAME <alphanumeric>`
Example	`:DISP:VIEW:ADV:NAME “Baseband”` Creates a new View named `Baseband` from the current View, and selects it as the current View
Notes	`<alphanumeric>` is case insensitive; you can specify mixed case, however the name will be evaluated on a single case If `<alphanumeric>` name already exists as a View, the error message “-224, Illegal parameter value;

	View <alphanumeric> already exists" is generated If the display is disabled (via `:DISP:ENAB OFF`) then the error message "-221, Settings conflict; User View SCPI cannot be used while Display is disabled" is generated

Re-Save User View

You can re-edit a User View; if you make changes, then an asterisk will appear next to the User View's name. You can then tap **Re-Save User View** to save it back to its existing name, or **Save Layout as New View** to add another, new User View.

This is a front panel function only, there is no remote command available to perform this function. To do this remotely, you must first perform **Save Layout as New View**, then delete the old User View and rename the new one with the name of the View you just deleted.

Rename User View

You can rename the current View by giving it a new unique name. Only User Views can be renamed, if the current View is a Predefined View, an error occurs.

Remote Command	`:DISPlay:VIEW:ADVanced:REName <alphanumeric>`
Example	`:DISP:VIEW:ADV:REN "Baseband"`
Notes	`<alphanumeric>` is case insensitive; you can specify mixed case, however the name will be evaluated on a single case If the `<alphanumeric>` specifying the new name is already present in the list of View names, the error message "-224, Illegal parameter value; View <alphanumeric> already exists" is generated If the current View is a Predefined View, the error message "-224, Illegal parameter value; Cannot rename a Predefined View" is generated If the display is disabled (via `:DISP:ENAB OFF`) then the error message "-221, Settings conflict; View SCPI cannot be used while Display is disabled" is generated

Delete User View

You can delete the current View if it is a User View. The default view becomes the current view for the Measurement.

Remote Command	`:DISPlay:VIEW:ADVanced:DELete`
Example	`:DISP:VIEW:ADV:DEL`
Notes	`<alphanumeric>` is case insensitive; you can specify mixed case, however the name will be evaluated on a single case If the `<alphanumeric>` is not present in the list of View names, the error message "-224, Illegal

parameter value; View <alphanumeric> does not exist" is generated

If the current View is a Predefined View, the error message "-224, Illegal parameter value; Cannot delete a Predefined View" is generated

If the display is disabled (via `:DISP:ENAB OFF`) then the error message "-221, Settings conflict; View SCPI cannot be used while Display is disabled" is generated

Delete All User Views

Deletes all previously saved User Views. The default view becomes the current view for the Measurement if a User View was the current view when this command was executed.

Remote Command	`:DISPlay:VIEW:ADVanced:DELete:ALL`
Example	`:DISP:VIEW:ADV:DEL:ALL`
Notes	Disabled if there are no User Views

View Editor Remote Commands

The following remote commands help you manage Views and User Views. Note that the SCPI node for User Views handles both Predefined and User Views. The legacy nodes, `:DISPlay:VIEW[:SELect]` and `:DISPlay:VIEW:NSEL`, are retained for backwards compatibility, but they only support predefined views.

View Listing Query

Returns a string containing a comma-separated list of names for *all* the Views, including User Views, available for the current Measurement.

Remote Command	`:DISPlay:VIEW:ADVanced:CATalog?`
Example	`:DISP:VIEW:ADV:CAT?`
Notes	Returns a quoted string of the available Views for the current measurement, separated by commas. The list includes names for *all* the Views, including User Views, available for the current Measurement Example: `"Normal,Trace Zoom,Spectrogram,Baseband,myView1,yourView1"` No distinction is made between Predefined and User Views If you switch measurements with the display disabled (via `:DISP:ENAB OFF`), then query the list of available Views, the result is undefined

User View Listing Query

Returns a string containing a comma-separated list of names for *only* the User Views available for the current Measurement.

Remote Command	`:DISPlay:VIEW:ADVanced:USER:CATalog?`
Example	`:DISP:VIEW:ADV:USER:CAT?`
Notes	Returns a quoted string of the available User Views for the current measurement, separated by commas. Example: `"Baseband,myView1,yourView1"` If you switch measurements with the display disabled (see "Display Enable (Remote Command Only)" on page 1983), then query the list of available Views, the result is undefined

3.11.6 Frequency

Contains controls that allow you to control the frequency and channel parameters of the instrument.

Some features in the **Frequency** menu are the same for all measurements in the current Mode – they do not change as you change measurements. Settings like these are called “Meas Global” and are unaffected by "Meas Preset" on page 1895. For example, **Center Frequency** is the same for all measurements — it does not change as you change measurements.

3.11.6.1 Settings

Contains the basic **Frequency** functions.

Fundamental

Sets the frequency of the fundamental measured signal. By default, other harmonic measurements will be measured at multiples of the specified fundamental frequency.

If **Auto** is on, the fundamental is determined from the first sweep ("Harmonic Measurement Details" on page 1828) whenever the measurement is restarted. If **Manual**, the first sweep is still taken to determine the resolution bandwidth.

Remote Command	`[:SENSe]:HARMonics:FREQuency:FUNDamental <freq>` `[:SENSe]:HARMonics:FREQuency:FUNDamental?`

Example	`:HARM:FREQ:FUND 1 GHZ` `:HARM:FREQ:FUND?`
Notes	Forces measurement restart
Dependencies	Sense is not available for VXT
Couplings	Affected by "Freq Offset" on page 1886
Preset	The frequency found when initiating an Auto Tune from the current measurement condition
Min	1 Hz
Max	Half the maximum available instrument frequency

Auto Function

Remote Command	`[:SENSe]:HARMonics:FREQuency:FUNDamental:AUTO OFF | ON | 0 | 1` `[:SENSe]:HARMonics:FREQuency:FUNDamental:AUTO?`
Preset	ON

Freq Step

Lets you change the step size for the fundamental frequency. Once a step size has been selected and the fundamental frequency function is active, the step keys (and the UP|DOWN parameters for **Fundamental Frequency** from remote commands) change frequency by the step-size value.

Remote Command	`[:SENSe]:HARMonics:FREQuency:STEP[:INCRement] <freq>` `[:SENSe]:HARMonics:FREQuency:STEP[:INCRement]?`
Example	`:HARM:FREQ:STEP 1 MHZ` `:HARM:FREQ:STEP?`
Preset	1 GHz
Min	1 Hz
Max	Set by the instrument maximum frequency

Freq Offset

Enables you to set a frequency offset value to account for frequency conversions outside of the instrument. This value is added to the display readout of the marker frequency, center frequency, start frequency, stop frequency, and all other absolute frequency settings in the instrument including frequency count. When a frequency offset is entered, the value appears below the center of the graticule. To eliminate an offset, perform a Mode Preset or set the frequency offset to 0 Hz.

Remote Command	`[:SENSe]:FREQuency:OFFSet <freq>` `[:SENSe]:FREQuency:OFFSet?`

Example	`:FREQ:OFFS 10 MHz` `:FREQ:OFFS?`
Notes	Preset and Max values are dependent on Hardware Options
Dependencies	Freq Offset is not available in External Mixing. In this case the Freq Offset control is grayed-out and shows a value of zero. However, the value of **CF Offset** that was set for the RF Input is retained and restored when you switch back to the RF Input
Preset	0 Hz
State Saved	Saved in instrument state
Min/Max	–/+500 GHz
Annotation	If Freq Offset is not zero, "Freq Offset <value>" appears on the upper line of the annotation, below the graticule, in the center
Status Bits/OPC dependencies	Non-overlapped
Backwards Compatibility SCPI	`:DISPlay:WINDow[1]:TRACe:X[:SCALe]:OFFSet` The `DISPlay` version of the command is supported for compatibility across platforms. It is not recommended for new development
Backwards Compatibility Notes	In pre-X-Series instruments, **Freq Offset** could not be adjusted by the knob or step keys. That is no longer the case Some previous spectrum analyzers did not adjust frequency counter results for **Freq Offset**. X-Series does adjust the frequency counter for the offset

3.11.7 Marker

There is no **Marker** functionality in this measurement.

3.11.8 Meas Setup

Accesses a menu panel for averaging control and customization of measurements.

3.11.8.1 Settings

Contains basic functions.

Avg/Hold Num

When **Average/Hold** is `ON`, the average/hold number of sweeps are taken at each frequency. The traces themselves are not averaged; the data resulting from each sweep is averaged when calculating the measurement result.

The Average Type is *always*`Log-Pwr Avg (Video)` (RMS).

Remote Command	[:SENSe]:HARMonics:AVERage:COUNt <integer> [:SENSe]:HARMonics:AVERage:COUNt?
Example	:HARM:AVER:COUN 20
Preset	10
Min	1
Max	9999
Annotation	In the Meas Bar

Auto Function

Remote Command	[:SENSe]:HARMonics:AVERage[:STATe] ON | OFF | 1 | 0 [:SENSe]:HARMonics:AVERage[:STATe]?
Preset	OFF

Averaging On/Off

Turns averaging on or off.

NOTE In this measurement, **Average Type** is preset to the Log-Pwr Avg (Video) method. Other averaging methods are not available.

Remote Command	[:SENSe]:HARMonics:AVERage[:STATe] OFF | ON | 0 | 1 [:SENSe]:HARMonics:AVERage[:STATe]?
Example	:HARM:AVER OFF :HARM:AVER?
Preset	ON
State Saved	Yes
Range	OFF|ON

Average Mode

Selects the termination control used for the averaging function. This determines the action after the specified number of measurements (**Avg/Hold Num**) is reached.

- EXPonential – Each successive data acquisition after the average count is reached is exponentially weighted and combined with the existing average. **Exponential** averaging weights new data more than old data, which facilitates tracking of slow-changing signals. The average is displayed at the end of each sweep

- REPeat – After reaching the "Avg/Hold Num" on page 1897, all previous result data is cleared, and the average count set back to 1

Remote Command	[:SENSe]:HARMonics:AVERage:TCONtrol EXPonential | REPeat [:SENSe]:HARMonics:AVERage:TCONtrol?
Example	:HARM:AVER:TCON EXP
Preset	REPeat
Range	EXPonential|REPeat

Meas Setup Summary Table

Lets you view and access many of the parameters in the **Meas Setup** menus on one screen.

Harmonics

Sets the number of harmonics that are measured, including the fundamental, thus, setting this to 3 measures up through the third harmonic. All measured harmonics are included in the calculation of Total Harmonic Distortion (THD).

Harmonics outside of the frequency range of the instrument are not measured. Harmonics that require a resolution bandwidth greater than the instrument's range are measured using the widest available resolution bandwidth.

Remote Command	[:SENSe]:HARMonics:NUMBer <integer> [:SENSe]:HARMonics:NUMBer?
Example	:HARM:NUMB 5
Preset	10
Min	2
Max	10

Range Table (On/Off)

Enables override of the default harmonic measurement parameters. Allows you to set frequency, bandwidth, sweep time, etc. for each harmonic independently.

When **Range Tabl**e is OFF, the data in the range table is cleared.

Remote Command	[:SENSe]:HARMonics:RTABle:STATe OFF | ON | 0 | 1 [:SENSe]:HARMonics:RTABle:STATe?
Example	:HARM:RTAB:STAT 1

Preset	OFF
Range	OFF|ON

Range Table

Accesses a dialog that allows editing of the **Range Table** to control the measurement parameters for each individual measurement.

Measure Tone

Sets whether the selected harmonic is measured (checked) or not measured (unchecked). Harmonics that are not measured do not affect Total Harmonic Distortion (THD).

When sending the Backwards Compatibility SCPI command below, send a *complete* list of 10 states. Each harmonic will be made active or inactive depending on the position. Thus, `:HARM:RANG:STAT 1,0,1,0,1,0,0,0,0,0` turns on the third and fifth harmonics. The Backwards Compatibility query returns 10 states.

Remote Command	`[:SENSe]:HARMonics:TONE[1]|2|…|10:STATe OFF	ON	0	1` `[:SENSe]:HARMonics:TONE[1]|2|…|10:STATe OFF	ON	0	1`
Example	Turn on the second tone (by default the second harmonic): `:HARM:TONE2:STAT ON`
Preset	ON
Range	OFF|ON

Backwards Compatibility Command

Example	`:HARM:RANG:STAT 1,0,1,0,1,0,0,0,0,0`
Preset	ON, ON, ON, ON, ON, ON, ON, ON, ON, ON
Backwards Compatibility SCPI	`[:SENSe]:HARMonics:RANGe[:LIST]:STATe OFF	ON	0	1, …` `[:SENSe]:HARMonics:RANGe[:LIST]:STATe`

Frequency

Sets the frequency of the selected harmonic. This overrides the normal frequency calculation and allows non-integral harmonics to be measured.

When sending the Backwards Compatibility SCPI command below, send a complete list of 10 frequencies. Each harmonic will have its frequency set appropriately. The Backwards Compatibility query returns 10 frequencies.

Remote Command	`[:SENSe]:HARMonics:TONE[1]|2|…|10:FREQuency <frequency>` `[:SENSe]:HARMonics:TONE[1]|2|…|10:FREQuency?`
Example	`:HARM:TONE2:FREQ 2 GHz`
Couplings	Tone frequencies are affected by "Freq Offset" on page 1886
Preset	1 GHz
Min	Instrument minimum frequency
Max	Instrument maximum frequency

Backwards Compatibility Command

Preset	1 GHz
Backwards Compatibility SCPI	`[:SENSe]:HARMonics:RANGe[:LIST]:FREQuency <frequency>, <frequency>, <frequency>, <frequency>, <frequency>, <frequency>, <frequency>, <frequency>, <frequency>, <frequency>` `[:SENSe]:HARMonics:RANGe[:LIST]:FREQuency?`

Res BW

Sets the pre-detection filter (RBW) bandwidth of the selected harmonic measurement. The bandwidth of a harmonic signal is greater than the bandwidth of the fundamental; the auto rules multiply the fundamental bandwidth by the harmonic number. Thus, third harmonic measurement should typically use a resolution bandwidth 3 times as wide as the fundamental resolution bandwidth.

When using a measurement without a range table, or when auto is selected, this calculation is performed automatically. If the requested resolution bandwidth is higher than the maximum available resolution bandwidth, a "*" is shown next to the result in the measurement table.

Remote Command	`[:SENSe]:HARMonics:TONE[1]|2|…|10:BANDwidth|BWIDth[:RESolution] <frequency>` `[:SENSe]:HARMonics:TONE[1]|2|…|10:BANDwidth|BWIDth[:RESolution]?`
Example	`:HARM:TONE3:BAND 100 kHz` Set the resolution bandwidth for the 3rd harmonic to 100 kHz
Couplings	In **Auto** mode, the tone RBW is set to the minimum available RBW that is at least as high as the fundamental RBW times the tone frequency divided by the fundamental frequency
Preset	The value used after a preset is dependent upon the input signal, as the RBW defaults to Sense
Min	1 Hz
Max	8 MHz

Auto Function

Remote Command	`[:SENSe]:HARMonics:TONE[1]|2|…|10:BANDwidth|BWIDth[:RESolution]:AUTO ON | OFF | 1 | 0`

	[:SENSe]:HARMonics:TONE[1]|2|…|10:BANDwidth|BWIDth[:RESolution]:AUTO?
Preset	ON

Dwell Time

Sets the **Dwell Time** for the specified harmonic. In zero-span, the **Auto** mode strikes a balance between measurement speed and accuracy; increasing the dwell time will reduce measurement speed while increasing accuracy.

Remote Command	[:SENSe]:HARMonics:TONE[1]|2|…|10:SWEep:TIME <time> [:SENSe]:HARMonics:TONE[1]|2|…|10:SWEep:TIME?
Example	:HARM:TONE:SWE:TIME 100 us Set the sweep time for this harmonic to 100 us
Couplings	If the **Sweep Time** is set to **Auto**, the sweep time will be 200 divided by the resolution bandwidth, to a minimum of 10 ms
Preset	The actual preset value depends upon an input signal, since **Dwell Time** defaults to Sense
Min	100 us
Max	4000 s

Auto Function

Remote Command	[:SENSe]:HARMonics:TONE[1]|2|…|10:SWEep:TIME:AUTO OFF | ON | 0 | 1 [:SENSe]:HARMonics:TONE[1]|2|…|10:SWEep:TIME:AUTO?
Preset	ON

Backwards Compatibility Command

Backwards Compatibility SCPI	[:SENSe]:HARMonics:RANGe[:LIST]:SWEeptime <time>, … [:SENSe]:HARMonics:RANGe[:LIST]:SWEeptime?

Backwards Compatibility Auto Function

Preset	ON, ON, ON, ON, ON, ON, ON, ON, ON, ON

Auto-Fill

Sets up the "Range Table" on page 1890, based on the first entry in the range table. When selected, each of the entries after range 1 are set appropriately.

Remote Command	[:SENSe]:HARMonics:RTABle:FILL
Example	:HARM:RTAB:FILL fills the range table based on current fundamental measurement settings

Couplings	Changes all settings in the range table The frequency for each range is set to the integer multiples of the first entry in the range table The RBW for each range is set to integer multiples of the first RBW The **Dwell Time** for each range is set to integer divisors of the first dwell time

Meas Setup Summary Table

Lets you view and access many of the parameters in the **Meas Setup** menus on one screen.

Auto Couple

Immediately puts all **Auto/Man** functions into **Auto**. **Auto Couple** is confined to the current measurement only. It does not affect other measurements in the Mode.

In the **Auto** state, **Auto/Man** functions are said to be “coupled”, meaning their values change as you make changes to other values in the measurement. This helps ensure accurate measurements and optimum dynamic range. **Auto Couple** is an immediate action function, and when it is executed, all the **Auto/Man** controls for the current measurement are set to **Auto**, and all measurement settings coupled to the **Auto/Man** parameters are automatically set to their optimal values.

For further details of measurement-specific settings (if any), see "Measurement-Specific Details" on page 1894 below.

Remote Command	`:COUPle ALL`
Example	`:COUP ALL`
Backwards Compatibility SCPI	`:COUPLE ALL | NONE`
Backwards Compatibility Notes	`:COUP:NONE` puts all Auto/Man parameters in manual mode, decoupling all the coupled instrument parameters. It is retained for backwards compatibility and is *not* recommended for making measurements or new designs

All **Auto/Man** parameter couplings in the measurement are set to **Auto**. This includes couplings that may be unavailable or grayed-out due to the current state. For example, in the Swept SA measurement, there is no **Auto/Man** coupling for **RBW** while in Zero Span. Nonetheless, if **Auto Couple** were executed while in Zero Span, it would set **RBW** to Auto "behind the scenes" so that, on exit from Zero Span, it would be in **Auto**.

Any **Auto/Man** selection specific (local) to the other measurements in the current Mode are not affected by **Auto Couple**. Any functions that are *not* coupled with other instrument parameters, such as ranging or leveling variables, such as **AutoRange** or **AutoScale**, are not affected.

Executing **Auto Couple** generates the informational message, "All Auto/Man functions have been set to Auto".

Each parameter, upon being set to **Auto**, selects and sets the appropriate auto-coupled value based on that parameter's coupling rules. The Dependency Resolver orchestrates the couplings for parameters that depend on one or more other parameters. The coupling and dependency rules for each parameter are defined in the section describing that parameter.

Executing **Auto Couple***does not* affect markers, marker functions, trace or display attributes, or any other instrument setting other than those specifically mentioned above.

Measurement-Specific Details

TOI (SA Mode only)

Parameters affected by **Auto Couple** are:

– Center Frequency Step

– Resolution Bandwidth

– Span/RBW Ratio

– Sweep Time

– Video BANDwidth VBW/RBW ratio

– Upper and Lower Tone (set to Sense)

– Zero span measurement Resolution Bandwidth

– Zero span measurement Dwell Time

Harmonics (SA Mode only)

Parameters affected by **Auto Couple** are:

– Resolution Bandwidth

– Fundamental Frequency

– Dwell Time

- Range Table Resolution Bandwidths
- Range Table Dwell Times

Meas Preset

Initiates the first sweep ("Harmonic Measurement Details" on page 1828). Returns Meas Local variables in the current measurement to their preset values (many of which are determined from the results of the first sweep).

Remote Command	`:CONFigure:HARMonics`

3.11.8.2 Global

The controls in this menu apply to all Modes in the instrument.

Some controls (for example, "Global Center Freq" on page 2013) allow you to switch certain Meas Global parameters to a Mode Global state. These switches apply to all Modes that support global settings. For example, no matter what Mode you are in when you set **Global Center Freq** to `ON`, it applies to all Modes that support Global settings.

Other controls (for example, **Extend Low Band**) are actually set in this menu, but apply to all Modes.

Global Center Freq

The software maintains a Mode Global value called **Global Center Freq**.

When **Global Center Freq** is switched `ON`, the current Mode's center frequency is copied into the **Global Center Frequency**, and from then on all Modes that support global settings use the **Global Center Frequency**, so you can switch between any of these Modes and the **Center Frequency** remains unchanged.

Adjusting the **Center Frequency** of any Mode that supports Global Settings, while **Global Center Freq** is `ON`, modifies the **Global Center Freq**.

When **Global Center Freq** is switched `OFF`, the **Center Frequency** of the current Mode is unchanged, but now the **Center Frequency** of each Mode is once again independent.

When **Mode Preset** is pressed while **Global Center Freq** is `ON`, the **Global Center Freq** is preset to the preset **Center Frequency** of the current Mode.

This function resets to `OFF` when "Restore Defaults" on page 2016 is pressed, or when **System**, **Restore Defaults**, **All Modes** is pressed.

Remote Command	`:INSTrument:COUPle:FREQuency:CENTer ALL | NONE` `:INSTrument:COUPle:FREQuency:CENTer?`
Example	`:INST:COUP:FREQ:CENT ALL` `:INST:COUP:FREQ:CENT?`
Preset	Set to `OFF` on **Global** Settings, **Restore Defaults** and **System, Restore Defaults, All Modes**
Range	`ALL|NONE`

Preset	`OFF`
Backwards Compatibility SCPI	`:GLOBal:FREQuency:CENTer[:STATe] 1 | 0 | ON | OFF` `:GLOBal:FREQuency:CENTer[:STATe]?`

Global EMC Std

When this control is switched `ON`, the current Mode's EMC Std is copied into the **Global EMC Std**, and from then on all Modes that support global settings use the **Global EMC Std**, so you can switch between any of these Modes and the EMC Std remains unchanged.

Adjusting the EMC Std of any Mode that supports Global settings, while **Global EMC Std** is `ON` modifies the **Global EMC Std**.

When **Global EMC Std** is switched `OFF`, the EMC Std of the current Mode remains unchanged, but now the EMC Std of each Mode is once again independent. When **Mode Preset** is pressed while **Global EMC Std** is `ON`, **Global EMC Std** is preset to the preset EMC Std of the current Mode.

This function resets to `OFF` when "Restore Defaults" on page 2016 is pressed, or when **System, Restore Defaults, All Modes** is pressed.

Remote Command	`:INSTrument:COUPle:EMC:STANdard ALL | NONE` `:INSTrument:COUPle:EMC:STANdard?`
Example	`:INST:COUP:EMC:STAN ALL` `:INST:COUP:EMC:STAN?`
Dependencies	Only available if Option EMC is installed
Preset	Set to `OFF` on **Global** Settings, **Restore Defaults** and **System, Restore Defaults, All Modes**
Range	`ALL | NONE`

Extend Low Band

The software maintains a Mode Global value called **Extend Low Band**.

Under the current sweep configuration crossing over two bands, when **Extend Low Band** is turned `ON`, the instrument checks whether one band can cover the whole sweep frequency range or not. If it can, then the instrument locks the band; otherwise, it does nothing (the band crossover occurs).

This function does *not* work when **Band Lock** under **System** > **Service** > **Lock Functions** is not -1 (no Band Lock). In that case, **Band Lock** takes priority over **Extend Low Band**.

This function resets to `OFF` when "Restore Defaults" on page 2016 is pressed, or when **System**, **Restore Defaults**, **All Modes** is pressed.

Remote Command	`:INSTrument:COUPle:FREQuency:BAND:EXTend 0 | 1 | ON | OFF` `:INSTrument:COUPle:FREQuency:BAND:EXTend?`
Example	`:INST:COUP:FREQ:BAND:EXT 1` `:INST:COUP:FREQ:BAND:EXT?`
Preset	Set to `OFF` by **Global** Settings > **Restore Defaults** and **System** > **Restore Defaults** > **All Modes**
Range	`ON|OFF`

Restore Defaults

Resets all functions in the **Global** settings menu to `OFF`. Pressing **System**, **Restore Defaults**, **All Modes** has the same effect.

Remote Command	`:INSTrument:COUPle:DEFault`
Example	`:INST:COUP:DEF`
Backwards Compatibility SCPI	`:GLOBal:DEFault`

Avg/Hold Num

When **Average/Hold** is `ON`, the average/hold number of sweeps are taken at each frequency. The traces themselves are not averaged; the data resulting from each sweep is averaged when calculating the measurement result.

The Average Type is *always*`Log-Pwr Avg (Video)` (RMS).

Remote Command	`[:SENSe]:HARMonics:AVERage:COUNt <integer>` `[:SENSe]:HARMonics:AVERage:COUNt?`
Example	`:HARM:AVER:COUN 20`
Preset	10
Min	1
Max	9999
Annotation	In the Meas Bar

Auto Function

Remote Command	`[:SENSe]:HARMonics:AVERage[:STATe] ON | OFF | 1 | 0` `[:SENSe]:HARMonics:AVERage[:STATe]?`
Preset	`OFF`

3.11.9 Sweep

Accesses controls to configure and control the acquisition of data, and the X-axis parameters of the instrument.

Depending on the selected mode and measurement, these controls might include: **Sweep Time**, **Continuous/Single**, **Pause/Resume**, **X Scale** and **Number of Points**.

3.11.9.1 Sweep/Control

Accesses controls that let you operate the sweep and control functions of the instrument, such as **Sweep Time** and **Continuous/Single**.

Dwell Time

Selects the length of time for which the instrument sweeps when measuring the fundamental. Additional overhead time is required by the instrument that impacts the sweep rate, but is not calculated as part of **Dwell Time**.

Reducing the sweep time increases the rate of sweeps.

Dwell Time normally changes with the resolution bandwidth, so by default the dwell time varies with each harmonic. If **Dwell Time Auto** is `OFF`, the harmonics will have the same dwell time unless "Range Table" on page 1890 is used.

Remote Command	`[:SENSe]:HARMonics:SWEeptime <time>` `[:SENSe]:HARMonics:SWEeptime?`
Example	Set **Dwell Time** for the fundamental to 100 µs: `:HARM:SWE 100 us`
Couplings	If **Dwell Time** is **Auto**, the dwell time will be 200 divided by the resolution bandwidth, to a minimum of 10 ms. If **Range Table** is active, the time for each harmonic is determined by that harmonic's individual dwell time setting (which includes an auto toggle)
Preset	The actual preset dwell time depends upon the results of the first sweep operation, since the sweep time is **Auto**, and the auto rule depends upon the detected optimal RBW
Min	100 us
Max	4000 s

Auto Function

Remote Command	[:SENSe]:HARMonics:SWEeptime:AUTO OFF | ON | 0 | 1 [:SENSe]:HARMonics:SWEeptime:AUTO? [:SENSe]:HARMonics:SWEeptime:STATe OFF | ON | 0 | 1 [:SENSe]:HARMonics:SWEeptime:STATe?
Preset	ON

Sweep/Measure

Lets you toggle between **Continuous** and **Single** sweep or measurement operation. The single/continuous state is Meas Global, so the setting affects all measurements.

The front-panel key **Single/Cont** performs exactly the same function

See "More Information" on page 1899

Remote Command	:INITiate:CONTinuous OFF | ON | 0 | 1 :INITiate:CONTinuous?
Example	Put instrument into **Single** measurement operation: :INIT:CONT 0 :INIT:CONT OFF Put instrument into **Continuous** measurement operation: :INIT:CONT 1 :INIT:CONT ON
Preset	ON Note that :SYST:PRES sets :INIT:CONT to ON, but *RST sets :INIT:CONT to OFF
State Saved	Saved in instrument state
Annunciation	The **Single/Continuous** icon in the Meas Bar changes depending on the setting: – A line with an arrow is **Single** – A loop with an arrow is **Continuous**
Backwards Compatibility Notes	X-Series A-models had **Single** and **Cont** hardkeys in place of the **SweepSingleCont** softkey. In the X-Series A-models, if in single measurement, the **Cont** hardkey (and INIT:CONT ON) switched to continuous measurement, but never restarted a measurement and never reset a sweep X-Series B-models have a **Cont/Single** toggle control instead of **Single** and **Cont** hardkeys, but it is still true that, if in single measurement, the **Cont/Single** toggle control never restarts a measurement and never resets a sweep

More Information

Continuous Mode	The instrument takes repetitive sweeps, averages, measurements, etc., when in continuous mode. If in average or Max/Min Hold, and the average/hold count reaches the **Average/Hold Num**, the count stops incrementing, but the instrument

	keeps sweeping See the **Trace** key description under **Trace Average** for the averaging formula used both before and after the **Average/Hold Num** is reached. The trigger condition must be met prior to each sweep The type of trace processing for multiple sweeps is set under the **Trace** key, with choices of **Trace Average**, **Max Hold**, or **Min Hold**
Single Mode	The instrument takes a single sweep when in **Single** mode, or if in average or Max/Min Hold, or if there is a **Waterfall** window displayed, it takes multiple sweeps until the average/hold count reaches the **Average/Hold Num**, then the count stops incrementing, and the instrument stops sweeping See the **Trace** key description under **Trace Average** for the averaging formula used. The trigger condition must be met prior to the sweep The type of trace processing for multiple sweeps is set under the **Trace** key, with choices of **Trace Average**, **Max Hold**, or **Min Hold**

If the instrument is in **Single** measurement mode, pressing the **Cont/Single** toggle control does not zero the count and does not cause the sweep to be reset; the only action is to put the instrument into Continuous measurement operation.

If the instrument is already in **Continuous** sweep:

- `:INIT:CONT 1` has no effect
- `:INIT:CONT 0` places the instrument in Single Sweep but has no effect on the current sequence until k = N, at which point the current sequence will stop and the instrument will go to the idle state

See "Restart" on page 2018 for details of `:INIT:IMMediate`.

If the instrument is already in **Single** sweep, `:INIT:CONT OFF` has no effect.

If the instrument is already in **Single** sweep, then pressing **Cont/Single** in the middle of a sweep does not restart the sweep or sequence. Similarly, pressing **Cont/Single** does not restart the sweep or sequence if the sweep is not in the idle state (for example, if you are taking a very slow sweep, or the instrument is waiting for a trigger). Even though pressing **Cont/Single** in the middle of a sweep does not restart the sweep, sending `:INIT:IMM` *does* reset it.

If the instrument is in **Single** sweep, and *not* Averaging/Holding, and you want to take one more sweep, press **Restart**.

If the instrument is in **Single** sweep, *and* Averaging/Holding, and you want to take one more sweep without resetting the Average trace or count, go to **Meas Setup** and increment the average count by 1 by pressing the **Step-Up** key while **Average/Hold Num** is the active function. You can also do this by sending `:CALC:AVER:TCON UP`.

Restart

Restarts the current sweep, or measurement, or set of averaged/held sweeps or measurements. If you are Paused, pressing **Restart** performs a Resume.

The front-panel key **Restart** performs exactly the same function.

The **Restart** function is accessed in several ways:

- Pressing the **Restart** key
- Sending `:INIT:IMM`
- Sending `:INIT:REST`

See "More Information" on page 1901

Remote Command	`:INITiate[:IMMediate]` `:INITiate:RESTart`
Example	`:INIT:IMM` `:INIT:REST`
Notes	`:INIT:REST` and `:INIT:IMM` perform exactly the same function
Couplings	Resets average/hold count k. For the first sweep overwrites all active (update = on) traces with new current data. For application modes, it resets other parameters as required by the measurement
Status Bits/OPC dependencies	This is an Overlapped command The `STATus:OPERation` register bits 0 through 8 are cleared , *except* bit 6 (Waiting for Periodic Sync). Initiating a measurement and Waiting for Periodic Sync could be asynchronous The `STATus:QUEStionable` register bit 9 (`INTegrity` sum) is cleared The `SWEEPING` bit is set The `MEASURING` bit is set
Backwards Compatibility Notes	For Spectrum Analysis Mode in ESA and PSA, the **Restart** hardkey and the `:INIT:REST` command restarted trace averages (displayed average count reset to 1) for a trace in **Clear Write**, but did not restart **Max Hold** and **Min Hold** In X-Series, the **Restart** hardkey and the `:INIT:REST` command restart not only **Trace Average**, but **MaxHold** and **MinHold** traces as well

More Information

The **Restart** function first aborts the current sweep or measurement as quickly as possible. It then resets the sweep and trigger systems, sets up the measurement and initiates a new data measurement sequence with a new data acquisition (sweep) taken once the trigger condition is met.

If the instrument is in the process of aligning when a **Restart** is executed, the alignment finishes before the restart function is performed.

Even when set for **Single** operation, multiple sweeps may be taken when **Restart** is pressed (for example, when averaging/holding is on). Thus, when we say that **Restart** "restarts a measurement", depending on the current settings, we may mean that it:

- Restarts the current sweep
- Restarts the current measurement
- Restarts the current set of sweeps if any trace is in Trace Average, Max Hold or Min Hold
- Restarts the current set of measurements if Averaging, or Max Hold, or Min Hold is on for the measurement

If there is no Average or Max/Min Hold function (no trace in Trace Average or Hold, or **Average/Hold Num** set to 1), and no **Waterfall** window is being displayed, a single sweep is equivalent to a single measurement. A single sweep is taken after the trigger condition is met; and the instrument stops sweeping once that sweep has completed. However, with **Average/Hold Num** >1, and at least one trace set to Trace Average, Max Hold, or Min Hold, or a **Waterfall** window being displayed, multiple sweeps/data acquisitions are taken for a single measurement. The trigger condition must be met prior to each sweep. The sweep is stopped when the average count k equals the number N set for **Average/Hold Num**.

Once the full set of sweeps has been taken, the instrument goes to the idle state. To take one more sweep without resetting the average count, increment the average count by 1, by pressing the **Step-Up** key while **Average/Hold Number** is the active function, or by sending the remote command `:CALC:AVER:TCON UP`.

Trace Update

The numeric results are not blanked at any time during the restart cycle.

For slow sweeps (see **Trace Update** section in **Trace/Detector**), the traces are updated real-time during the sweep. There may be a special circumstance in application mode measurements where an exception is made and the traces and/or results need to be blanked before displaying the new results.

To summarize, the following list shows what happens to the trace data on various events:

Event	Trace Effect
Clear/Write pressed (even if already in Clear/Write)	Set to mintracevalue
Max Hold pressed (even if already in Max Hold)	Set to mintracevalue

Event	Trace Effect
Min Hold pressed (even if already in Min Hold)	Set to maxtracevalue
Trace Average pressed (even if already in Trace Average)	Trace data unaffected but start new sweep/avg/hold
Restart pressed	Trace data unaffected but start new sweep/avg/hold
Parameter requiring restart changed (e.g., RBW)	Trace data unaffected but start new sweep/avg/hold

Sweep and Trigger Reset

Resetting the sweep system resets the average/hold count k to 0. It also resets the set point counter to 0. Resetting the trigger system resets the internal auto trig timer to the value set by the **Auto Trig** control.

Averaging

The weighting factor used for averaging is k. This k is also the average/hold count for how many valid sweeps (data acquisitions) have been done. This k is used for comparisons with N, as those comparisons always needs to be based on valid completed sweeps.

The displayed average/hold, K, shows the count for the sweep (data acquisition) in progress. K = k + 1, with a limit of N. The displayed value K changes from its previous value to 1 as soon as the trigger condition for the first data acquisition (sweep) is met.

3.11.9.2 Sweep Config

Lets you configure the Sweep and Control functions of the instrument , such as **Sweep Rules**.

Only appears in VXT.

IF Dithering

Lets you turn IF Dithering on or off. This is a technique used in unpreselected instruments (such as Keysight's modular instruments) to enhance the rejection of images and internally-generated spurious signals.

Remote Command	`[:SENSe]:SWEep:IF:DITHer OFF | ON | 0 | 1` `[:SENSe]:SWEep:IF:DITHer?`

Dependencies	Only appears in Spectrum Analyzer Mode in VXT models
Preset	`OFF`
State Saved	Saved in instrument state

Image Protection

Lets you turn IF Protection on or off. This is a technique used in unpreselected instruments (such as Keysight's modular instruments) to detect and suppress images and spurs that may be present in non-preselected hardware.

IF Protection takes two sweeps and by correlating the data between them, provides a single, correct power-versus-frequency trace.

Remote Command	`[:SENSe]:SWEep:IMAGeprot OFF | ON | 0 | 1` `[:SENSe]:SWEep:IMAGeprot?`
Dependencies	Only appears in Spectrum Analyzer Mode in VXT models
Preset	`ON`
State Saved	Saved in instrument state

3.11.10 Trace

Lets you control the acquisition, display, storage, detection and manipulation of trace data for the available traces. The "Trace Control" on page 1904 tab in this menu contains radio-button selections for the trace type (**Clear/Write, Max Hold**).

3.11.10.1 Trace Control

The controls on this tab allow you to set the "Trace Type" on page 1905 and its update mode.

There are four Trace Types:

- **Clear/Write**
- **Trace Average**
- **Max Hold**
- **Min Hold**

Each type handles data in a different way.

Each trace also has two values that determine whether it is being written or not, and whether it is being displayed or not. These values, **Update** and **Display,** are described fully in the "View/Blank" on page 1721 control description. Essentially, when **Update** is ON, a trace is updating, and when **Update** is OFF it is not. When **Display** is ON, it is visible and when **Display** is OFF it is not. These terms are used throughout the descriptions in this section.

Trace Type

There are four trace Types:

Option	Parameter	SCPI Example	Details
Clear/Write	WRITe	:TRAC2:TYPE WRIT	See: "Clear/Write" on page 1908
Trace Average	AVERage	:TRAC2:TYPE AVER	See: "Trace Average" on page 1908
Maximum Hold	MAXHold	:TRAC3:TYPE MAXH	See: "Max Hold" on page 1909
Minimum Hold	MINHold	:TRAC5:TYPE MINH	See: "Min Hold" on page 1909

Full descriptions of each type are provided below. You may select one of these types for each trace. Re-selecting the current **Trace Type** initiates the same action that selecting it the first time did, even though it is already selected. For example, selecting **Clear/Write** while **Clear/Write** is already selected will nonetheless clear the trace and begin rewriting it.

Besides the **Trace Type**, the "View/Blank" on page 1721 state must be set to **Active** (**Update**: ON, **Display**: ON) for a trace to be updating and visible. Selecting any **Trace Type** automatically makes the trace **Active**.

See also: "Trace Mode Backwards Compatibility Commands" on page 1906

Remote Command	For Swept SA Measurement (in SA Mode): `:TRACe[1]|2|…|6:TYPE WRITe	AVERage	MAXHold	MINHold` `:TRACe[1]|2|…|6:TYPE?` For all other measurements: `:TRACe[1]|2|3:<meas>:TYPE WRITe	AVERage	MAXHold	MINHold` `:TRACe[1]|2|3:<meas>:TYPE?` where `<meas>` is the identifier for the current measurement
Example	`:TRAC:TYPE WRIT` `:TRAC:TYPE?`
Couplings	Selecting a **Trace Type** (by pressing any of the Trace Type selections or sending `:TRAC:TYPE`) sets the Trace to **Active** (**Update**: ON, **Display**: OFF), even if the same trace type was already selected When Detector setting is "Auto" (`[:SENSe]:<meas>:DETector:AUTO?`), Detector (`[:SENSe]:<meas>:DETector[:FUNCtion]?`) switches aligning with the switch of this parameter: "NORMal" with WRITe (Clear Write), "AVERage" with AVERage, "POSitive (peak)" with MAXHold, and "NEGative (peak)" with MINHold
Preset	Swept SA and Monitor Spectrum: WRITe All other measurements: AVERage

	Following **Preset**, all traces are cleared (all trace points set to mintracevalue)
State Saved	The type of each trace is saved in instrument state
Annunciation	The type for each trace is indicated in the Trace annunciator panel on the Measurement Bar

Trace Mode Backwards Compatibility Commands

In earlier instruments, the "Trace Modes" were: Clear/Write, Max Hold, Min Hold, View and Blank. Averaging was global to all traces and was controlled under the **BW/Avg** menu.

In X-Series, trace averaging can be done on a per-trace basis. The Trace Modes (now called Trace Types) are Clear/Write, Trace Average, Max Hold and Min Hold. View and Blank are set separately under "View/Blank" on page 1721.

While this provides more flexibility, it also gives rise to potential backwards compatibility problems. To mitigate these, the old Trace Mode command has been retained and a new Trace Type command has been added. The `:TRACe:MODE` command is retained for backwards compatibility, and the `:TRACe:TYPE`, `:TRACe:UPDate` and `:TRACe:DISPlay` commands introduced for ongoing use. The old Trace Modes are selected using `:TRAC:MODE`, whose parameters are mapped into calls to `:TRACe:TYPE`, `:TRACe:UPDate` and `:TRACe:DISPlay`, and the old global Averaging command `[:SENSe]:AVERage[:STATe]` is provided for backwards compatibility. See the individual command descriptions for details.

When **Average/Hold** in the **Meas Setup**, **Legacy Compatibility** menu is `ON`, the following is true for traces in Max Hold and Min Hold:

- They ignore the **Average/Hold** number; **Single** for Max Hold causes one sweep only, so switching to **Single** stops after the current sweep, and switching to **Cont** starts again without clearing the accumulated result
- Max Hold is not cleared on a **Restart**, **Single** or `:INIT:IMM`, but changing a measurement parameter, like frequency or bandwidth etc., still restarts the Max Hold

Preset	`WRITe`
State Saved	The trace mode is an alias only
Backwards Compatibility SCPI	`:TRACe[1]|2|…|6:MODE WRITe | MAXHold | MINHold | VIEW | BLANk` `:TRACe[1]|2|…|6:MODE?`
Backwards Compatibility Notes	The legacy `:TRACe:MODE` command is retained for backwards compatibility. In conjunction with the legacy `:AVERage` command, it works as follows: – `:AVERage ON|OFF` sets/clears a variable that we will call average for the sake of this discussion. This variable is maintained by the instrument solely for backwards compatibility. See the `[:SENSe]:AVERage[:STATe]` command description below – `:TRACe:MODE WRITe` sets `:TRACe:TYPE WRITe` (Clear/Write) unless average is true, in

which case it sets it to :TRACe:TYPE AVErage. It also sets :TRACe:UPDate ON, :TRACe:DISPlay ON, for the selected trace

– :TRACe:MODE MAXHold sets :TRACe:TYPE MAXHold (Max Hold). It also sets :TRACe:UPDate ON, :TRACe:DISPlay ON, for the selected trace

– :TRACe:MODE MINHold sets :TRACe:TYPE MINHold (Min Hold). It also sets :TRACe:UPDate ON, :TRACe:DISPlay ON, for the selected trace

– :TRACe:MODE VIEW sets :TRACe:UPDate OFF, :TRACe:DISPlay ON, for the selected trace

– :TRACe:MODE BLANK sets :TRACe:UPDate OFF, :TRACe:DISPlay OFF, for the selected trace

The query returns the same value as :TRACe:TYPE?, meaning that if you set :TRACe:MODE:VIEW or :TRACe:MODE:BLANK, the query response will not be what you sent

:TRACe[n]:MODE was formerly used to set the type or "writing mode" of the trace. At that time, View and Blank were writing modes. The new :TRACe:TYPE command should be used in the future, but :TRACe:MODE is retained to provide backwards compatibility

In X-Series, unlike earlier instruments, Max Hold and Min Hold now obey the Average Number and counts up to a terminal value as Average always has

As the **Average/Hold Number** now affects **Min Hold** and **Max Hold**, the operations that restart Averaging (for example, the **Restart** key) now also restart **Min Hold** and **Max Hold**

As a result of these changes, legacy code that restarts averaging while retaining a running Max Hold will need to be rewritten, because the Max Hold will now restart when the Average does

Also, previous to X-Series:

– Pressing **Max Hold** while already in **Max Hold** (or doing so remotely) had no effect. Now it will clear the trace and restart the sweep and the Max Hold sequence

– Changing the vertical scale (Log/Lin or dB/div) of the display restarted **Max Hold** and **Min Hold**. This is no longer the case

Preset	OFF
State Saved	The state of Average is saved in Instrument State for ghosting purposes
Backwards Compatibility SCPI	[:SENSe]:AVERage[:STATe] ON | OFF | 1 | 0 [:SENSe]:AVERage[:STATe]?
Backwards Compatibility Notes	Previous to X-Series, Averaging (also sometimes known as trace averaging) was global to all traces, that is, it was either on or off for all active traces. The legacy command [:SENSe]:AVERage[:STATe] ON|OFF|1|0 was used to turn Averaging on or off In X-Series, Averaging is turned on or off on a per-trace basis, so it can be on for one trace and off for another For backwards compatibility, the old global Average State variable is retained solely as a legacy variable, turned on and off and queried by the legacy command [:SENSe]:AVERage[:STATe] OFF|ON|0|1. When Average is turned on, any trace in Clear/Write will get put into Average. While Average is on, any trace put into Clear/Write by the old :TRAC:MODE command will instead get put

into Average. When Average is turned off, any trace in Average will get put into Clear/Write

Trace Type Details

Clear/Write

Each trace update replaces the old data in the trace with new data.

Pressing **Clear/Write** for the selected trace, or sending `:TRAC:TYPE WRIT` for the specified trace, sets the trace type to **Clear/Write** and clears the trace, even if you are already in **Clear/Write**. Then a new sweep is initiated. Trigger conditions must be met before the sweep actually starts, and if in **Single** the sweep won't start until **Restart** is pressed.

Pressing **Clear/Write** stops the current sweep and initiates a new one, so **Trace Average, Max Hold** and **Min Hold** data may be interrupted in mid-sweep when **Clear/Write** is pressed, and therefore may not accurately reflect the displayed count. Therefore, when **Clear/Write** is pressed for one trace, **Trace Average, Max Hold** and **Min Hold** must restart for all traces.

When in **Clear/Write**, if a measurement-related instrument setting is changed (that is, one which requires new data to be taken, like **Center Frequency** or **Attenuation**), a new sweep is initiated but the trace is not cleared.

Trace Average

The instrument maintains and displays an average trace, which represents the cumulative average on a point-by-point basis of the new trace data and previous averaged trace data.

Pressing **Trace Average** (for the selected trace), or sending `:TRAC:TYPE AVER` (for the specified trace), sets the trace type to **Trace Average**, clears the trace, initiates a new sweep, and restarts the Average sequence.

Details of the count limiting behavior and the averaging calculations may be found under **Avg|Hold Number** and **Average Type** under **Meas Setup.**

When in **Trace Average**, if a measurement-related instrument setting is changed (that is, one which requires new data to be taken, like Center Frequency or Attenuation), the average restarts and a new sweep is initiated but the trace is not cleared.

Restarting the average means:

- The average/hold count k is set to 1, so that the next time the average trace is displayed it simply represents one trace of new data

– A new sweep is initiated

– Once the new sweep starts, the trace is overwritten with current trace data as the first trace of the new average

Remember that restarting averaging also restarts **Max Hold** and **Min Hold**, as there is only one count for Trace Average and Hold.

Max Hold

The instrument maintains and displays a max hold trace, which represents the maximum data value on a point-by-point basis of the new trace data and previous trace data. Details of the count limiting behavior may be found under **Avg|Hold Number** under **Meas Setup.**

Pressing **Max Hold** for the selected trace, or sending `:TRAC:TYPE MAXH` for the specified trace, sets the Trace Type to **Max Hold,** clears the trace , initiates a new sweep, and restarts the hold sequence, even if you are already in **Max Hold**.

When in **Max Hold**, if a measurement-related instrument setting is changed(that is, one which requires new data to be taken, like **Center Frequency** or **Attenuation**), the **Max Hold** sequence restarts and a new sweep is initiated but the trace is not cleared.

Restarting the **Max Hold** sequence means:

– The average/hold count k is set to 1, so that the next time the max hold trace is displayed it simply represents one trace of new data

– A new sweep is initiated.

Remember that restarting **Max Hold** also restarts averaging and **Min Hold**, as there is only one count for Trace Average and Hold.

Min Hold

The instrument maintains and displays a min hold trace, which represents the minimum data value on a point-point basis of the new trace data and previous trace data. Details of the count limiting behavior may be found under **Avg|Hold Number** under the **Meas Setup** functions.

Pressing **Min Hold** for the selected trace, or sending `:TRAC:TYPE MINH` for the specified trace, sets the Trace Type to **Min Hold,** clears the trace, initiates a new sweep, and restarts the hold sequence, even if you are already in **Min Hold**.

When in **Min Hold**, if a measurement-related instrument setting is changed(that is, one which requires new data to be taken, like **Center Frequency** or **Attenuation**), the **Min Hold** sequence restarts and a new sweep is initiated but the trace is not cleared.

Restarting the **Min Hold** sequence means:

– The average/hold count k is set to 1, so that the next time the min hold trace is displayed it simply represents one trace of new data

– A new sweep is initiated

Remember that restarting **Min Hold** also restarts **Max Hold** and averaging, because there is only one count for Trace Average and Hold.

Clear and Write | Restart Averaging | Restart Max/Min Hold

Starts the trace writing, as though the "Trace Type" on page 1905 had just been selected. The effect is exactly the same as reselecting the current **Trace Type** again – the control is provided because it may not be obvious that reselecting the same selection from a radio button menu will take any action.

This control displays different labels, depending on the selected Trace Type:

– **Clear/Write**: Clear and Write

– **Trace Average**: Restart Averaging

– **Max Hold**: Restart Max Hold

– **Min Hold**: Restart Min Hold

3.12 List Sweep Measurement (Remote Only)

List Sweep can be selected using the front panel key or the remote command. Measurement setup control is only available remotely. While in the List Sweep measurement, the screen is blanked, with a message “Executing List Sweep measurement from Remote Control port”.

To exit List Sweep you can select another measurement (press **Mode/Meas** for the Mode/Meas/View dialog) or press the **Mode Preset** key, which will return you to the Swept SA measurement.

Since List Sweep is a Remote only measurement, you may want to lock out the front panel keys to avoid having key presses interfere with the measurement. There are two ways to lock out the front panel keys. Accessing the instrument over GPIB (IEEE-488) puts it in remote operation, or you can send the `:SYSTem:KLOCk ON` command.

List Sweep Measurement Commands

Command	Action	Return Value
`:INITiate:LIST`	Restart the measurement (see also "Trigger Source" on page 1920 for BUS trigger info)	n/a
`:CONFigure?`	Query the current measurement	Name of current measurement: “LIST”
`:CONFigure:LIST`	Switch to the List Sweep measurement and preset List Sweep parameters. See "List Parameters " on page 1913 for preset values.	n/a
`:FETCh:LIST?`	Query measurement data	List of measurement data (see below)
`:READ:LIST?`	Measure and query measurement data	List of measurement data (see below)

Example	Assume that only one detector is used for each point and the list length is 4:
	`READ:LIST?`
	`-12.3, 34.5, 56.7,23.4`
	Note that all returned values are in the internal unit of dBm

Remote Command Notes	The range of the list length is [0,10000], inclusive, unless otherwise specified, so the list can contain a maximum of 10,001 points.

	If remote commands are sent containing inconsistent list lengths, an error is returned. See also "List Lengths of One or Zero" on page 1912
Status Bits/OPC Dependencies	The Status Operation Register bit “Waiting for Trigger” is set at the same time when a new list point measurement is initiated. It is cleared when the trigger actually occurs (i.e. after the trigger event occurs and all the applicable trigger criteria have been met). While the Trigger bit is set/unset along with each triggering condition at each point, the Measurement bit is set once when the first point measurement is initiated. It is cleared only after all points measurement in the list are complete and results are available

3.12.1 Views and Windows

While in the List Sweep measurement, the screen is blanked, with a message “List Sweep measurement in progress. System under remote control”.

View	Result
(none)	(none)

3.12.2 General Information

The List Sweep measurement is entirely based on lists of parameters sent by remote commands described in the section "Remote Commands" on page 1914. This section includes some general information about the List Sweep measurement.

3.12.2.1 List Lengths of One or Zero

List Length of One

SCPI standards call for all lists to be the same length except for lists of length one. When a list is of length 1, the particular list is treated as though it were a list of length equal to the other lists, with all values being the same.

List Length of Zero

A list of length zero is defined as being a parameter that is not modified from its current value in executing a list, that is, the value it was et to in the Swept SA measurement. This provides the programmer the flexibility to execute the measurement at a number of different Center Frequencies, for example, by setting the Center Frequency before entering the List Sweep measurement and then providing a Frequency list of length zero.

The measurement presets to lists of length zero, which is the only way to set a list of length zero. Once you have sent a command to set a particular list, the only way to set it back to zero is with a preset.

NOTE **If you query the the list values when the length is zero, the analyzer will return 9.91 E+37 for any numerical parameter, which means "not a number" and is the value usually returned for an undefined quantity. For an enumerated value, such as Trigger Source, the analyzer will return "NONE". The user should understand that either means "List Sweep is using the current value from the Swept SA measurement"**

3.12.2.2 Differences with other measurements

The following are the major differences of the "List sweep" feature from other measurements:

- "List sweep" does not support front panel data display in order to meet optimum high throughput.
- The following remote commands are not supported for the List Sweep Measurement, even though they are common SCPI commands for other measurements. They are accepted without error, but do nothing when the List Sweep Measurement is running:
  - INITiate:RESTart
  - INITiate:PAUSe
  - INITiate:RESume
- The command MEASure:LIST? generates NaN.
- The command SENSe:FEED EMIXer is accepted, but all elements of an existing Frequency List will have the values clipped to the default value for the External Mixer band that is selected. The Frequency List will not be retained when changing inputs. When switching back to RF from External Mixing all elements of an existing Freq List will be clipped to the RF default frequency.

3.12.2.3 List Parameters

Non-List SCPI commands are not allowed while in List Sweep Measurement and should not be sent while in the List Sweep measurement. In general, parameters in List Sweep inherit the values they were set to in Swept SA, with a few exceptions:

- Phase noise optimization is set to Fast Tune. See "Phase Noise Optimization" on page 1918

– Detector type is set to LAVG. See "Detector List" on page 1919

– Trigger source is set to Free Run, see "Trigger Source" on page 1920

In addition, sweep mode is set to Single (INIT:CONT OFF) regardless of its value in Swept SA. "List sweep" only allows single measurement mode (see details in the command section.) INITiate:CONTinuous ON is not supported and should not be sent.

Additionally, the list parameter settings do not affect other application or measurement settings.

Note that list parameters will hold their values on entry as long as no list command has been sent defining them, which means as long as they have a list length of zero. See "List Lengths of One or Zero" on page 1912.

3.12.2.4 Output data

The results are output as a list in the order of the entered list points. The number of the output data per each list point depends on the number of the detector settings. The measurement results are output in a list of float point values separated by commas. The unit of the results is dBm, the fundamental amplitude unit.

3.12.3 Remote Commands

There is no front panel user interface for List Sweep. The following remote commands are used to build your list. Once you have constructed the list, you can start the measurement using the INITiate or READ commands described in "List Sweep Measurement Commands" on page 1911

3.12.3.1 Frequency List

The command defines a list of analyzer center frequencies at which the measurements are made.

The query form queries the analyzer for the values in the frequency list.

Remote Command	`[:SENSe]:LIST:FREQuency <freq>[, <freq>]` `[:SENSe]:LIST:FREQuency?`
Example	`LIST:FREQ 1GHz,1.5GHz,2GHz,2.5GHz` Sets a list of 4 frequencies.
Preset	Current center frequency value from Swept SA measurement
State Saved	Saved in instrument state
Range	Same as center frequency range.

Remote Command	`[:SENSe]:LIST:FREQuency:POINts?`
Example	`LIST:FREQ:POIN?`

3.12.3.2 Mechanical Attenuator List

This command defines a list of analyzer mechanical attenuator settings at which the measurements are made.

NOTE **Changing the mechanical attenuator within the list should be avoided if possible, because it slows down the measurement and wears out the attenuator.**

The query form queries the analyzer for the values in the mechanical attenuation list.

Remote Command	`[:SENSe]:LIST:ATTenuation <power>[, <power>]` `[:SENSe]:LIST:ATTenuation?`
Example	`LIST:ATT 10DB`
Dependencies	If the requested setting is not valid, it is ignored and the previous setting is retained.
Preset	Current mechanical attenuation value from Swept SA measurement
State Saved	Saved in State
Range	Same as the mechanical attenuator range.

Remote Command	`[:SENSe]:LIST:ATTenuation:POINts?`
Example	`LIST:ATT:POIN?`

3.12.3.3 Electronic Attenuation List

This command defines a list of analyzer electronic attenuator settings at which the measurements are made.

The query form queries the analyzer for the values in the electronic attenuation list.

Remote Command	`[:SENSe]:LIST:EATTenuation <power>[, <power>]` `[:SENSe]:LIST:EATTenuation?`
Example	`LIST:EATT 10DB`
Dependencies	If the required hardware option is not present, an error message would be issued. However, the error message does not prevent list sweep from execution if all other list settings are set properly.

Preset	Current electronic attenuation value from Swept SA measurement
State Saved	Saved in instrument state
Range	Same as the electronic attenuator range.

Remote Command	`[:SENSe]:LIST:EATTenuation:POINts?`
Example	`LIST:EATT:POIN?`

3.12.3.4 RBW Type List

This command defines a list of analyzer RBW Type settings used for the measurements.

The query form queries the analyzer for the values in the RBW Type list.

Remote Command	`[:SENSe]:LIST:BANDwidth|BWIDth:RESolution:TYPE <type>[, <type>]` `[:SENSe]:LIST:BANDwidth|BWIDth:RESolution:TYPE?`
Example	`LIST:BAND:RES:TYPE GAUS` For this example, Types from Swept SA measurement include: GAUSsian|FLATtop|EMI
Preset	Current RBW Type setting from Swept SA measurement
State Saved	Saved in instrument state
Range	Same as the RBW Types available in Swept SA measurement.

Remote Command	`[:SENSe]:LIST:BANDwidth|BWIDth:RESolution:TYPE:POINts?`
Example	`LIST:BAND:RES:TYPE:POIN?`

3.12.3.5 RBW List

This command defines a list of analyzer RBW settings at which the measurements are made.

The query form queries the analyzer for the values in the RBW list.

Remote Command	`[:SENSe]:LIST:BANDwidth|BWIDth:RESolution <freq>[, <freq>]` `[:SENSe]:LIST:BANDwidth|BWIDth:RESolution?`
Example	`LIST:BAND:RES 100KHZ`
Preset	Current RBW value from Swept SA measurement

State Saved	Saved in instrument state
Range	Same as the RBW values available in the Swept SA measurement

Remote Command	`[:SENSe]:LIST:BANDwidth|BWIDth:RESolution:POINts?`
Example	`LIST:BAND:RES:POIN?`

3.12.3.6 VBW List

This command defines a list of analyzer VBW settings at which the measurements are made.

The query form queries the analyzer for the values in the VBW list.

Remote Command	`[:SENSe]:LIST:BANDwidth|BWIDth:VIDeo <freq>[, <freq>]` `[:SENSe]:LIST:BANDwidth|BWIDth:VIDeo?`
Example	`LIST:BAND:VID 10KHZ`
Preset	Current Video BW value from Swept SA measurement
State Saved	Saved in instrument state
Range	Same as the Video BW values available in the Swept SA measurement.

Remote Command	`[:SENSe]:LIST:BANDwidth|BWIDth:VIDeo:POINts?`
Example	`LIST:BAND:VID:POIN?`

3.12.3.7 Sweep Time List

This command defines a list of analyzer sweep times at which the measurements are made. In zero span measurements, this is the time required to measure a single point given the current setting for the number of points in the sweep.

The query form queries the analyzer for the values in the sweep time list.

Remote Command	`[:SENSe]:LIST:SWEep:TIME <time>[, <time>]` `[:SENSe]:LIST:SWEep:TIME?`
Preset	Current Sweep Time value from Swept SA measurement
State Saved	Saved in instrument state
Range	Same as the Sweep Time range available in the Swept SA measurement.

Remote Command	`[:SENSe]:LIST:SWEep:TIME:POINts?`
Example	`LIST:SWE:TIME:POIN?`

3.12.3.8 Trigger Delay List

This command defines a list of analyzer trigger delay time used when making the measurements.

The query form queries the analyzer for the values in the trigger delay list.

Remote Command	`[:SENSe]:LIST:TRIGger:DELay <time>[, <time>]` `[:SENSe]:LIST:TRIGger:DELay?`
Example	`LIST:TRIG:DEL 0.01S`
Preset	0 seconds
State Saved	Saved in instrument state
Range	Same as the Trigger Delay range for EXTernal1 trigger.

Remote Command	`[:SENSe]:LIST:TRIGger:DELay:POINts?`
Example	`LIST:TRIG:DEL:POIN?`

3.12.3.9 Phase Noise Optimization

This command defines a list of analyzer phase noise optimization settings at which the measurements are made.

Upon switching to List Sweep from another measurement, phase noise optimization is set to “Fast Tune”. The user may select whatever phase noise optimization one desires via the phase noise optimization list parameter afterwards.

Remote Command	`[:SENSe]:LIST:FREQuency:SYNThesis 1 | 2 | 3`
	`[:SENSe]:LIST:FREQuency:SYNThesis?`
	`[:SENSe]:LIST:FREQuency:SYNThesis:AUTO OFF | ON | 0 | 1`
	`[:SENSe]:LIST:FREQuency:SYNThesis:AUTO?`

Example	`LIST:FREQ:SYNT 2`
	`LIST:FREQ:SYNT:AUTO OFF`
	`LIST:FREQ:SYNT 2`

Preset	Fast Tuning

State Saved	Saved in instrument state
Range	Fast Tuning (3) Best Phase Noise for offsets <20kHz (2) Best Phase Noise for offsets >30kHz (1)
Min	1
Max	3

3.12.3.10 Detector List

This command defines a list of analyzer detector settings at which the measurements are made. The choice of detectors is different from the choice in other measurements.

The query form queries the analyzer for the values in the detector list.

Remote Command	`[:SENSe]:LIST:DETector <type>[, <type>]` `[:SENSe]:LIST:DETector?`
Example	`LIST:DET POS`
Remote Command Notes	LAVG : average detector. Average detected on the log scale. VAVG : average detector. Average detected on the voltage scale. RMS: average detector. Average detected on the power (rms) scale. NEGative: negative peak detector. POSitive: positive peak detector. SAMPle: sample detector. PKAV: Peak-AVER detector, a newly defined term, would allow the simultaneous measurement and two-point reporting of the results of the positive peak and the average detector (voltage scale). PRMS: Peak-RMS detector, a newly defined term, would allow the simultaneous measurement and two-point reporting of the results of the positive peak and the average detector (rms scale). DAVG: DualAvg detector is similarly a newly defined term that allows two-point reporting of simultaneously made measurements. With this detector, one result (the former) is average detected on the power (rms) scale, and one is average detected on the voltage scale.
Preset	LAVG
State Saved	Saved in instrument state
Range	LAVG | VAVG | RMS | NEGative | POSitive | SAMPle | PKAV | PRMS | DAVG

Remote Command	`[:SENSe]:LIST:DETector:POINts?`
Example	`LIST:DET:POIN?`

3.12.3.11 Trigger Source

This command sets the source for the trigger that controls the start of each new measurement point in the list. The other trigger command :TRIGger:SOURce, is used to start the list .

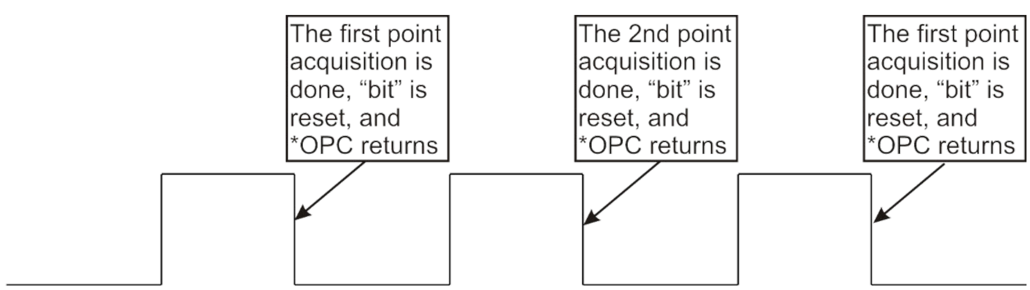
The query form queries the analyzer for the values in the trigger source of the list sweep.

When list trigger is set to BUS, the first measurement is taken immediately when the INIT command is sent, and subsequent measurements are taken when the *TRG command is sent. The measuring bit is set at the time when a new list point measurement is initiated via *TRG and cleared when the measurement result of that point is received. In other words, the measurement bit is set/reset at each point. An example is shown as following:

1. TRIG:SOUR IMM // this sets the first point trigger setting in the list sweep
2. CONF:LIST // set to list sweep measurement
3. LIST:FREQ 800e6, 810e6, 820e6 //set three point list frequency measurement
4. LIST:TRIG:SOUR BUS // set list trigger to BUS
5. INIT:IMM; *OPC? // Initiate one measurement and obtain the first point acquisition as the first point is free run (in step (2))
6. *TRG; *OPC? // trigger and obtain the 2nd point acquisition
7. *TRG; *OPC? // trigger and obtain the 3rd point acquisition
8. FETCH:LIST? // it should return the 3-point list of result

In the example above, the measuring "bit" is set at the starting of (5),(6) and (7) and cleared when *OPC returns. The diagram below illustrates the measuring "bit" status change vs. time:

Measuring "bit" status time line:



Remote Command	`[:SENSe]:LIST:TRIGger:SOURce EXTernal1 | EXTernal2 | IMMediate | BUS` `[:SENSe]:LIST:TRIGger:SOURce?`
Example	`LIST:TRIG:SOUR EXT2`
Remote Command Notes	EXTernal1|2: external sources IMMediate: free run BUS: software controlled trigger The BUS trigger is only in “List Sweep”. It specifies a common trigger source which allows a source and a receiver (analyzer) to coordinate triggering without requiring the connection of the trigger in and trigger out ports on the rear panels of the instruments.
Dependencies	If the list trigger source is set to BUS for all points, you need a trigger for each list item after the first. For example, if there are three points in the list, you get the first point on the INIT and then have to send *TRG two times to execute the complete List Sweep measurement. If the list trigger source is not set to BUS, use *TRG or TRIG:IMM to start the list measurement.
Preset	IMMediate
State Saved	Saved in instrument state
Status Bits/OPC Dependencies	The trigger bit is set and cleared at each measurement point. The Status Operation Register bit “Waiting for Trigger” is set at the time when a new list point measurement is initiated. It is cleared when the trigger actually occurs (i.e. after the trigger event occurs and all the applicable trigger criteria have been met). While the Trigger bit is set/unset along with each triggering condition at each point, the Measurement bit is set once when the first point measurement is initiated. It is cleared only after all points measurement in the list are complete. The only exception is when list trigger setting is BUS, see details above

Remote Command	`[:SENSe]:LIST:TRIGger:SOURce:POINts?`
Example	`LIST:TRIG:SOUR:POIN?`
Remote Command Notes	Only one trigger source selection is allowed.

3.12.3.12 Trigger Holdoff

Sets the holdoff time between triggers. When the trigger condition is satisfied, the trigger occurs, the delay begins, and the holdoff time begins. New trigger conditions are ignored until the holdoff time expires. For a free-running trigger, the holdoff value is the minimum time between triggers.

Remote Command	`[:SENSe]:LIST:TRIGger:HOLDoff <time>` `[:SENSe]:LIST:TRIGger:HOLDoff?`
Example	`LIST:TRIG:HOLD 100MS`

Preset	0.0 s
State Saved	Saved in State
Min	0 s
Max	100 s

Remote Command	`[:SENSe]:LIST:TRIGger:HOLDoff:POINts?`
Example	`LIST:TRIG:HOLD:POIN?`
Remote Command Notes	Only one trigger holdoff selection is allowed.

3.12.3.13 Trigger Level

Sets the value at which the selected trigger input will trigger a new sweep.

Remote Command	`[:SENSe]:LIST:TRIGger:LEVel <ampl>` `[:SENSe]:LIST:TRIGger:LEVel?`
Example	`LIST:TRIG:LEV 0.4V`
Preset	1.2 V
State Saved	Saved in instrument state
Min	-5 V
Max	5 V

Remote Command	`[:SENSe]:LIST:TRIGger:LEVel:POINts?`
Example	`LIST:TRIG:LEV:POIN?`
Remote Command Notes	Only one trigger level selection is allowed.

3.12.3.14 Trigger Slope

Controls the trigger polarity. It is set positive to trigger on a rising edge and negative to trigger on a falling edge.

Remote Command	`[:SENSe]:LIST:TRIGger:SLOPe POSitive | NEGative` `[:SENSe]:LIST:TRIGger:SLOPe?`
Example	`LIST:TRIG:SLOP NEG`
Preset	POSitive

State Saved	Saved in instrument state
Range	Same as the Sweep Time range available in the Swept SA measurement.

Remote Command	`[:SENSe]:LIST:TRIGger:SLOPe:POINts?`
Example	`LIST:TRIG:SLOP:POIN?`
Remote Command Notes	Only one trigger slope selection is allowed.

3.12.3.15 Sequencing

Defines a sequence for stepping through the list. You must use LIST:SEQ or LIST:SEQ:AUTO before performing a measurement using the READ command. When lists are not of the same length (except lengths of 0 and 1) an error "Invalid List length" would be generated at sequencing time.

Remote Command	`[:SENSe]:LIST:SEQuence <value>[,<value>]`
	`[:SENSe]:LIST:SEQuence?`
	`[:SENSe]:LIST:SEQuence:AUTO ON1`
	`[:SENSe]:LIST:SEQuence:AUTO?`

Example	`LIST:SEQ 1,2,4,3`
Remote Command Notes	LIST:SEQ: defines a sequence for stepping through the list. LIST:SEQ:AUTO: when on, the sequence is set to 1 through N, where N is the longest list.
Preset	Ascending order: 1 through N
Range	Depends on the number of frequency points in your list.

Remote Command	`[:SENSe]:LIST:SEQuence:POINts?`
Example	`LIST:SEQ:POIN?`

3.12.3.16 Preselector Center State

This command defines a list of Preselector Center request states. When the state is set to 1 (true), a preselector center will initiate at the frequency setting before the measurement. If set to 0 (false), no preselector center will occur. A preselector center state that is set to true will override a preselector adjust offset frequency.

Remote Command	`[:SENSe]:LIST:PCENter <state>[, <state>]` `[:SENSe]:LIST:PCENter?`
Example	`LIST:PCEN 0,1,1,1`

	Sets a list of 4 preselector center states
Preset	Sets preselector center state to off
State Saved	Saved in instrument state

Remote Command	`[:SENSe]:LIST:PCENter:POINts?`
Example	`[:SENSe]:LIST:PCEN:POIN?`

3.12.3.17 Preselector Adjust

This command defines a list of Preselector Adjust offset frequencies. A preselector center state that is set to true will override a preselector adjust offset frequency.

Remote Command	`[:SENSe]:LIST:PADJust <freq>[, <freq>]` `[:SENSe]:LIST:PADJust?`
Example	`LIST:PCEN 1.0 MHz, 2.0 MHz, 3.5 MHz, 2.0 MHz` Sets a list of 4 preselector adjust offset frequencies
Preset	Sets the preselector center offset frequency to zero
State Saved	Saved in instrument state

Remote Command	`[:SENSe]:LIST:PADJust:POINts?`
Example	`[:SENSe]:LIST:PADJust:POIN?`

3.13 Phase and Amplitude vs Time Measurement

This measurement performs narrow band long capture; phase and amplitude variation over the capture is computed.

The steps involved in the PAvT measurement include:

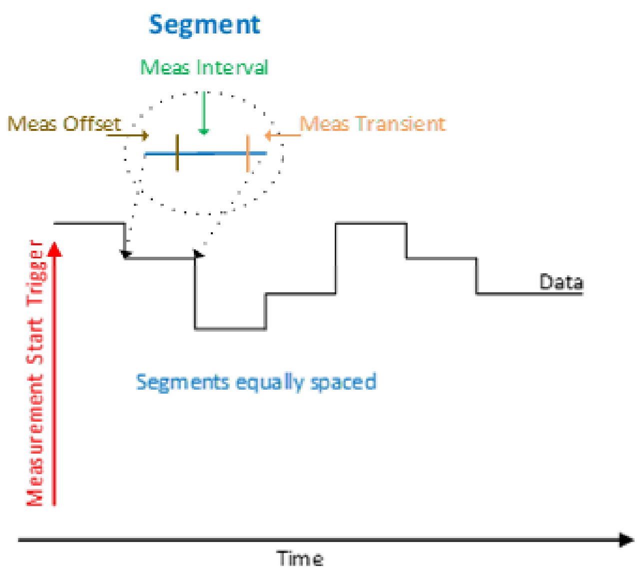
1	Instrument Setup	You configure the measurement for Center Frequency, Triggering, and Amplitude. Adjust the Amplitude Reference level, Range, or Adjust Range for Min Clipping as appropriate for the transmitted signal. Once the amplitude settings are obtained, ensure that the transmitted signal remains within the dynamic range of the instrument for proper measurement to be performed
2	Determine Frequency Error	Provide the Frequency Error, or perform a measurement of Frequency Error. The Frequency Error measurement is at narrow band with a specific sample rate. When the measurement is run, the transmitted signal must not change in frequency
3	Actual measurement	This is a long capture of the transmitted signal as the phase and amplitude of the signal changes. The power and phase for the entire captured signal will be calculated from the measured data and Frequency Error

Based on the Phase and Power calculated, additional manipulation on the data occurs to reduce the result to the request number of segments and to make the results relative to the first segment.

The first segment is called the Relative Baseline; the absolute values of the first segment are stored into the Relative Baseline result and then normalized to obtain 0° phase and 0 dB reference.

Measurement Operation

The 1st segment (the Relative Baseline) is initiated when the Trigger conditions are met, and all following segments are computed immediately thereafter based on the Meas Offset, Meas Interval, and Meas Transient. The measurement time of each segment is linear progression (segments are equally spaced).



Phase and Amplitude vs Time Measurement Commands

The following commands and queries can be used to configure the measurement, then retrieve the measurement results:

:CONFigure:PAVTime

:CONFigure:PAVTime:NDEFault

:INITiate:PAVTime

:FETCh:PAVTime[n]?

:READ:PAVTime[n]?

:MEASure:PAVTime[n]?

Remote Command Results for Phase and Amplitude vs Time

The following table describes the results returned by the FETCh, MEASure, and READ queries listed above, according to the index value n. All the return values are floating point numbers in scientific notation, they are listed in the table as integers or simple real values for readability. If no result is available, NaN (9.91E+37) is returned.

n	Results Returned
0	Returns the number of measured segments (points)
not specified or 1	Returns scalar results for the segments measured in quadruple format, Phase, Amplitude, Time and Delta Frequency Error

n	Results Returned
	For example if "Segments" on page 1992 = 5, then the return result would look like: 0, 0, 0, -168E-03, -9.63E-03, 0.9212E-03, 0.999E-03, 161.455E-03, 70.976E-03, -0.612E-03, 2.000E-03, -87.325E-03, 59.676E-03, -0.347E-03, 2.999E-03, 301.646E-03, 104.21E-03, -0.318E-03, 4.000E-03, 358.402E-03
2	Returns scalar Phase results for the segments measured, equivalent to the Phase values from the n = 1 query For example if **Segments** = 5, then the return result would look like: 0,10,-10,20,-30
3	Returns scalar Amplitude results for the segments measured, equivalent to the Amplitude values from the n = 1 query For example if **Segments** = 5, then the return result would look like: 0,-.5,-1.2,1.2,2.5
4	Returns scalar Time results for the segments measured, equivalent to the Time values from the n = 1 query For example if **Segments** = 5, then the return result would look like: 0,10,20,30,40
5	Returns scalar Frequency Error results for the segments measured For example if **Segments** = 5, then the return result would look like: 0,100000,120000,-80000,90000
6	Returns the Relative Baseline results 1. Phase 2. Amplitude For example: 125, -15.25

3.13.1 Views

The PAvT measurement has one view: "Normal" on page 1976.

This is a multiple-window View. When in a multiple-window View, you select a window by touching it. The menu controls may sometimes change depending on which window is selected.

3.13.1.1 Normal

Windows: "Graph" on page 1928, "Results" on page 1928

The PAvT measurement provides tabular result and graphical display.

3.13.2 Windows

This section describes the windows that are available in Phase and Amplitude vs Time measurements.

3.13.2.1 Graph

Corresponding Trace	Yellow: Phase vs Time Light Blue: Amplitude vs Time

3.13.2.2 Results

Displays the Frequency Error, the Relative Baseline values, and the list of textual results of the Phase and Amplitude vs Time measurement.

Results window

Name	Corresponding Results	Example
Frequency Error [Hz]	Frequency error supplied by user, or measured by invocation of Measure Frequency Error immediate action	-125 kHz
Relative Baseline [°]	Phase of the 1st segment before normalization	45°
Relative Baseline [dBm]	Amplitude of the 1st segment before normalization	-15.00 dBm
Phase [°]	The phase of the particular segment relative to the 1st segment	-45°
Amplitude [dB]	The amplitude of the particular segment relative to the 1st segment	-1.99 dB
Time [ms]	The start time of the Meas Interval for the particular segment relative to the 1st segment. When Meas Type = Normal the Time is equally spaced over the Total Meas Time	10 ms
Delta Freq Error [Hz]	Additional Frequency error of each segment	-1.00 MHz

3.13.3 Amplitude

Activates the **Amplitude** menu and selects **Reference Level** or **Reference Value** as the active function, depending on the measurement.

Some features in this menu apply to multiple measurements. Some other features apply only to specific measurements and their controls are blanked or grayed-out in measurements that do not support the feature.

3.13.3.1 Y Scale

Contains controls that pertain to the Y axis parameters of the measurement. These parameters control how data on the vertical (Y) axis is displayed and control instrument settings that affect the vertical axis.

Scale

Selects the active scale for parameter adjustments of the menu.

Remote Command	`:DISPlay:PAVTime:VIEW[1]:WINDow[1]:TRACe:Y[:SCALe] AMPLitude | PHASe` `:DISPlay:PAVTime:VIEW[1]:WINDow[1]:TRACe:Y[:SCALe]?`
Example	`:DISP:PAVT:VIEW:WIND:TRAC:Y AMPL` `:DISP:PAVT:VIEW:WIND:TRAC:Y?`
Preset	`PHASe`
State Saved	Saved in instrument state
Range	`Amplitude|Phase`

Ref Value

The reference line is at the top, center, or bottom of the graticule, depending on the value of "Ref Position" on page 1931.

Amplitude Scale

Sets the value for the reference position for the Amplitude Scale.

Remote Command	`:DISPlay:PAVTime:VIEW[1]:WINDow[1]:TRACe:Y[:SCALe]:AMPLitude:RLEVel <rel_ampl>` `:DISPlay:PAVTime:VIEW[1]:WINDow[1]:TRACe:Y[:SCALe]:AMPLitude:RLEVel?`
Example	`:DISP:PAVT:VIEW:WIND:TRAC:Y:AMPL:RLEV -10 dB` `:DISP:PAVT:VIEW:WIND:TRAC:Y:AMPL:RLEV?`
Preset	Automatically calculated
State Saved	Saved in instrument state
Min/Max	-100/+100 dB
Annotation	Ref <value> top of graph

Phase Scale

Sets the value for the reference position for the Phase Scale. The reference line is at the top, center, or bottom of the graticule, depending on the value of **Ref Position**.

Remote Command	`:DISPlay:PAVTime:VIEW[1]:WINDow[1]:TRACe:Y[:SCALe]:PHASe:RLEVel <real>` `:DISPlay:PAVTime:VIEW[1]:WINDow[1]:TRACe:Y[:SCALe]:PHASe:RLEVel?`
Example	`:DISP:PAVT:VIEW:WIND:TRAC:Y:PHAS:RLEV 90` `:DISP:PAVT:VIEW:WIND:TRAC:Y:PHAS:RLEV?`
Preset	Automatically calculated
State Saved	Saved in instrument state
Min/Max	-1000/+1000
Annotation	Ref <value> / top of graph

Scale/Div

Sets the units per division in the graph window.

Amplitude Scale

Sets the units per division of the amplitude vertical scale in the graph window.

Remote Command	`:DISPlay:PAVTime:VIEW[1]:WINDow[1]:TRACe:Y[:SCALe]:AMPLitude:PDIVision <rel_ampl>` `:DISPlay:PAVTime:VIEW[1]:WINDow[1]:TRACe:Y[:SCALe]:AMPLitude:PDIVision?`
Example	`:DISP:PAVT:VIEW:WIND:TRAC:Y:AMPL:PDIV 5` `:DISP:PAVT:VIEW:WIND:TRAC:Y:AMPL:PDIV?`
Preset	Automatically calculated
State Saved	Saved in instrument state
Range	0.10 dB to 20.00 dB
Min	0.10 dB
Max	20.00 dB
Annotation	<value> dB/ left upper of graph

Phase Scale

Sets the units per division of the phase vertical scale in the graph window.

Remote Command	`:DISPlay:PAVTime:VIEW[1]:WINDow[1]:TRACe:Y[:SCALe]:PHASe:PDIVision <real>` `:DISPlay:PAVTime:VIEW[1]:WINDow[1]:TRACe:Y[:SCALe]:PHASe:PDIVision?`
Example	`:DISP:PAVT:VIEW:WIND:TRAC:Y:PHAS:PDIV 5`

	`:DISP:PAVT:VIEW:WIND:TRAC:Y:PHAS:PDIV?`
Preset	Automatically calculated
State Saved	Saved in instrument state
Range	1 to 100
Min	1
Max	100
Annotation	<value> / left upper of graph

Ref Position

Positions the reference level at the top, center or bottom of the Y Scale display.

Amplitude Scale

Positions the Amplitude scale reference level at the top, center or bottom of the Y Scale display. Changing the reference position does not change the value of "Ref Value" on page 1929.

Remote Command	`:DISPlay:PAVTime:VIEW[1]:WINDow[1]:TRACe:Y[:SCALe]:AMPLitude:RPOSition TOP | CENTer | BOTTom` `:DISPlay:PAVTime:VIEW[1]:WINDow[1]:TRACe:Y[:SCALe]:AMPLitude:RPOSition?`
Example	`:DISP:PAVT:VIEW:WIND:TRAC:Y:AMPL:RPOS TOP` `:DISP:PAVT:VIEW:WIND:TRAC:Y:AMPL:RPOS?`
Preset	`CENTer`
State Saved	Saved in instrument state
Range	Top|Center|Bottom
Annotation	> and < are displayed both side of graph to indicate Reference Position

Phase Scale

Positions the Phase Scale reference level at the top, center or bottom of the Y Scale display. Changing the reference position does not change the value of "Ref Value" on page 1929.

Remote Command	`:DISPlay:PAVTime:VIEW[1]:WINDow[1]:TRACe:Y[:SCALe]:PHASe:RPOSition TOP | CENTer | BOTTom` `:DISPlay:PAVTime:VIEW[1]:WINDow[1]:TRACe:Y[:SCALe]:PHASe:RPOSition?`
Example	`:DISP:PAVT:VIEW:WIND:TRAC:Y:PHAS:RPOS TOP` `:DISP:PAVT:VIEW:WIND:TRAC:Y:PHAS:RPOS?`
Preset	`CENTer`

State Saved	Saved in instrument state
Range	`Top|Center|Bottom`
Annotation	> and < are displayed both side of graph to indicate Reference Position

3.13.3.2 Attenuation

Controls the attenuator functions and interactions between the attenuation system components.

There are two attenuator configurations in the X-Series. One is a Dual-Attenuator configuration consisting of a mechanical attenuator and an optional electronic attenuator. The other configuration uses a single attenuator with combined mechanical and electronic sections that controls all the attenuation functions. Different models in the X-Series come with different configurations.

– See "Dual-Attenuator Configurations" on page 1932

– See "Single-Attenuator Configuration" on page 1933

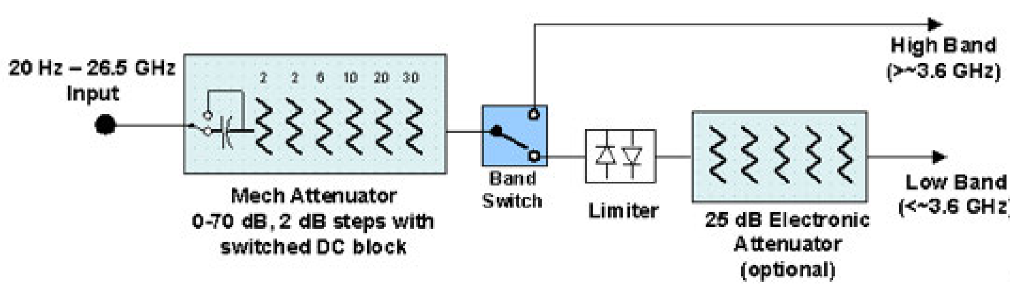
Most attenuation settings are the same for all measurements – they do not change as you change measurements. Settings like these are called “Meas Global” and are unaffected by **Meas Preset**.

Only available when the hardware set includes an input attenuator, which is typically only the case for Keysight’s benchtop instruments. For example, this tab does *not* appear in VXT models M9421A/10A/11A, nor in UXM. In UXM, all **Attenuation** and **Range** settings are disabled, as the expected input power level is handled by the Call Processing App that drives the DUT power control.

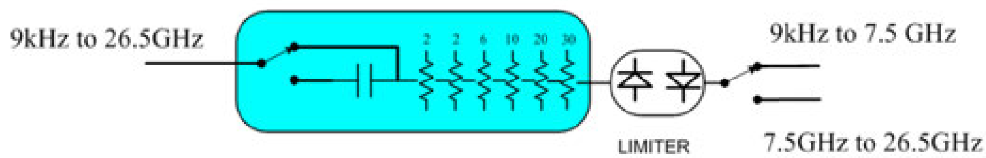
Dependencies	In measurements that support the I/Q inputs, unavailable when I/Q is the selected input. Replaced by the **Range** tab in that case

Dual-Attenuator Configurations

Configuration 1: Mechanical attenuator + optional electronic attenuator

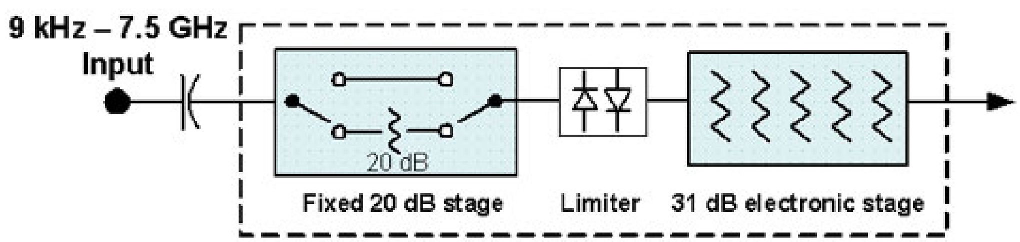


Configuration 2: Mechanical attenuator, no optional electronic attenuator



Note that Configuration 2 is not strictly speaking a dual-section attenuator, since there is no electronic section available. However, it behaves exactly like Configuration 1 without the Electronic Attenuator Option EA3, therefore for the sake of this document it is grouped into the “Dual-Attenuator” configuration.

Single-Attenuator Configuration



You can tell which attenuator configuration you have by pressing the Attenuation tab, which (in most Modes) opens the Attenuation menu. If the first control in the Attenuation menu says **Mech Atten** you have the Dual-Attenuator configuration. If the first control says **Atten** you have the Single-Attenuator configuration.

Dual Attenuator **Single Attenuator**

(Note that depending on the measurement, there may be no Auto/Man functionality on the Mech Atten control.)

In the Single-Attenuator configuration, you control the attenuation with a single control, as the fixed stage has only two states. In the Dual-Attenuator configuration, both stages have significant range, so you are given separate control of the mechanical and electronic attenuator stages.

When you have the Dual-Attenuator configuration, you may still have only a Single-Attenuator, because unless Option EA3 (the Electronic Attenuator option) is available, and you purchase it, you will have only the mechanical attenuator.

Full Range Atten

This control and **Attenuator Summary** only appear in N9041B, when the RF input is selected, the RF Input Port is set to RF Input 2, and the Full Range Attenuator is installed. The Full Range Attenuator adds a second input attenuator in front of RF Input 2, which enhances the protection and optimizes the performance of the extra internal mixers used by RF Input 2.

Remote Command	`[:SENSe]:POWer[:RF]:FRATten <rel_ampl>` `[:SENSe]:POWer[:RF]:FRATten?`
Example	`:POW:FRAT 14` `:POW:FRAT?`
Notes	When you enter an amplitude value that falls between valid values, the value will be incremented to the next smallest valid value
Dependencies	Only appears if input RF is selected, RF Input Port 2 is selected, and the Full Range Attenuator exists
Couplings	This value is never changed by any coupling, but other couplings use this value. See **Reference Level** and "Mech Atten" on page 1935 command descriptions
Preset	20 dB
State Saved	Saved in instrument state
Min	0 dB
Max	Only valid values are 0, 6, 14, 20 dB
Annotation	When the **Input** is **RF**, and the **Input Port** is **RF Input 2**, and the Full Range Attenuator is installed: On the Meas Bar, the field “Atten” displays as follows: – If the sweep is entirely < 50 GHz, the value shown after “Atten:” is equal to Mech Atten + Elec Atten + Full Range Atten – If the sweep is entirely > 50 GHz, the value shown after “Atten:” is equal to Full Range Atten – If the sweep straddles 50 GHz, the value shown after “Atten:” is preceded by the symbol “>=” and is equal to Full Range Atten In the **Amplitude**, "Y Scale" on page 1929 menu, and the Atten **Meas Bar** dropdown menu panel, a summary is displayed as follows: “Total Atten below 50 GHz” followed by the value of Full Range Atten + Mech Atten + Elec Atten “Total Atten above 50 GHz” followed by the value of Full Range Atten For example, if Mech Atten = 6 dB, Elec Atten = 4 dB, and Full Range Atten = 20 dB, the summary below is shown: – Attenuator summary: – Total Atten below 50 GHz: 30 dB – Total Atten above 50 GHz: 20 dB

Mech Atten

Labeled **Mech Atten** in Dual-Attenuator models and **Atten** in Single-Attenuator models. In the Dual-Attenuator configuration, this control only affects the mechanical attenuator.

Lets you modify the attenuation applied to the RF input signal path. This value is normally auto-coupled to the Ref Level, the Internal Preamp Gain, any External Gain that is entered, and the Max Mixer Level, as described in the table below.

See "Attenuator Configurations and Auto/Man" on page 1937

Remote Command	`[:SENSe]:POWer[:RF]:ATTenuation <rel_ampl>`
	`[:SENSe]:POWer[:RF]:ATTenuation?`
	`[:SENSe]:POWer[:RF]:ATTenuation:AUTO OFF | ON | 0 | 1`
	`[:SENSe]:POWer[:RF]:ATTenuation:AUTO?`

Example	`:POW:ATT 20`
	Dual-Attenuator configuration: sets the mechanical attenuator to 20 dB
	Single-Attenuator mode: sets the main attenuation to 20 dB (see below for definition of “main” attenuation)
	In either case, if the attenuator was in Auto, it is set to Manual
	`:POW:ATT:AUTO ON`
	Turn Auto Mech Atten ON

Dependencies	Some measurements do not support Auto setting of "Mech Atten" on page 1935. In these measurements, the **Auto/Man** selection is not available, and the Auto/Man toggle function is not available In Dual-Attenuator configurations, when the electronic attenuator is enabled, the mechanical attenuator has no auto setting, and the Auto/Man toggle function is not available. The state of Auto/Man is remembered and restored when the electronic attenuator is once again disabled. This is described in more detail in "Elec Atten" on page 1937 See "Attenuator Configurations and Auto/Man" on page 1937 for more information on the Auto/Man functionality `:POW:ATT:AUTO` is only available in measurements that support Mech Atten Auto, such as Swept SA
Couplings	If the RF Input Port is the RF Input: – If the USB Preamp is connected to USB, use 0 dB for Mech Atten – Otherwise compute the auto-selected value of Mech Atten based on **Reference Level**, Int Preamp, External Gain, Ref Level Offset, Max Mixer Level, µW Path Control and IF Gain settings. Limit this value to be no less than 6 dB (total attenuation below 6 dB can never be chosen by Auto) – In the N9041B, if the RF Input Port is RF Input 2, use the formula above and subtract the Full Range Atten value from the result to determine the Mech Atten. Limit the value so that it is never lower than 0 dB and so that total attenuation, including Full Range Atten, is never less than 6 dB

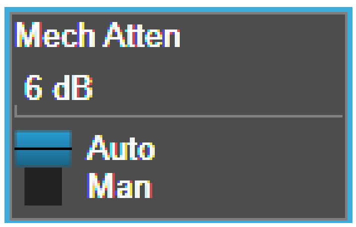
	(total attenuation, including Full Range Atten below 6 dB, can never be chosen by Auto) In External Mixing and BBIQ, where the Attenuator is not in the signal path, the Attenuator setting changes as described above when "Mech Atten" on page 1935 is in Auto, but no changes are made to the actual attenuator hardware setting until the input is changed back to the RF Input For CXA-m with option FSA (Fine-Step Attenuator or 2 dB steps), the FSA-like behavior is only available when the frequency setting is <= 7.5 GHz. So, when the frequency is changed from below 7.5 GHz to above 7.5 GHz, the attenuation setting will be changed to a multiple of 10 dB which will be no smaller than the previous setting. For example, 4 dB attenuation will be changed to 10 dB
Preset	The preset for Mech Attenuation is “Auto” The Auto value of attenuation is 10 dB ON
State Saved	Saved in instrument state
Min	0 dB The attenuation set by this control cannot be decreased below 6 dB with the knob or step keys. Values below 6 dB must be directly entered from the keypad or via SCPI. This protects against setting a dangerously small attenuation value, which can put the instrument at risk of damage to input circuitry. If the current mechanical attenuation is below 6 dB, it can be increased with the knob and step keys, but not decreased
Max	CXA Option 503 or 507: 50 dB EXA: 60 dB All other models: 70 dB Note that in the Single-Attenuator configuration, the total of ATT and EATT cannot exceed 50 dB. So, if the EATT is set to 24 dB first, the main attenuation cannot be greater than 26 dB and will be reduced accordingly; if the main attenuator is set to 40 dB first, EATT cannot be greater than 10 dB
Annotation	The current value for Total Atten is displayed in the Measurement Bar at the top of the display. A value appears for Electronic Attenuation only if the Electronic Attenuator is enabled. The annotation appears as Atten: <total> dB (e<elec>) The e letter is in amber in Single-Attenuator configurations For example: Dual-Attenuator configuration: Atten: 24 dB (e14) Indicating the total attenuation is at 24 dB and the electronic attenuation is at 14 dB Single-Attenuator configuration: A: 24 dB (e14) Indicating the total attenuation is at 24 dB and the “soft” attenuation is at 14 dB (see below for definition of “soft” attenuation) When in Manual, a # sign appears in front of Atten in the annotation

Attenuator Configurations and Auto/Man

As described under "Y Scale" on page 1929, there are two distinct attenuator configurations available in the X-Series, the single attenuator and Dual-Attenuator configurations. In Dual-Attenuator configurations, we have the mechanical attenuation and the electronic attenuation, and the current total attenuation is the sum of the electronic + mechanical attenuation. In Single-Attenuator configurations, we refer to the attenuation set using "Mech Atten" on page 1935 (or `:POW:ATT`) as the “main” attenuation; and the attenuation that is set by `:POW:EATT` as the “soft” attenuation (`:POW:EATT` is honored even in the Single-Attenuator configuration, for compatibility purposes). Then the current total attenuation is the sum of the main + soft attenuation.

See "Elec Atten" on page 1937 for more about “soft” attenuation.

NOTE In some measurements, the **Mech Atten** control has an Auto/Man function. In these measurements, an Auto/Man switch is shown on the **Mech Atten** control:



Note that in configurations that include an Electronic Attenuator, this switch is only shown when the Electronic Attenuator is disabled.

In other measurements, **Mech Atten** has no Auto/Man function. In these measurements, no switch is shown on the **Mech Atten** control:

Mech Atten also appears with no switch, as above, in configurations that include an Electronic Attenuator but when the Electronic Attenuator is enabled.

Elec Atten

Controls the Electronic Attenuator in Dual-Attenuator configurations. Does not appear in Single-Attenuator configurations, because the control of both the mechanical and electronic stages of the Single-Attenuator is integrated into the single **Atten** control.

This control includes an **Enable/Disable** toggle switch; it is only possible to enter a value for the Electronic Attenuator when this switch is in the **Enable** position.

For more details about the Electronic Attenuator, see "More Information" on page 1939

Remote Command	`[:SENSe]:POWer[:RF]:EATTenuation <rel_ampl>`
	`[:SENSe]:POWer[:RF]:EATTenuation?`
	`[:SENSe]:POWer[:RF]:EATTenuation:STATe OFF | ON | 0 | 1`
	`[:SENSe]:POWer[:RF]:EATTenuation:STATe?`

Example	`:POW:EATT 10`
	`:POW:EATT?`
	`:POW:EATT:STAT ON`
	`:POW:EATT:STAT?`

Notes	Electronic Attenuation's specification is defined only when Mechanical Attenuation is 6 dB
Dependencies	Only appears in Dual-Attenuator models with an Electronic Attenuator installed and licensed. Does not appear in models with the Single-Attenuator configuration, because in the Single-Attenuator configuration there is no "electronic attenuator"; there is only a single integrated attenuator (which has both a mechanical and electronic stage). However, in the Single-Attenuator configuration, EATT SCPI commands are accepted for compatibility with other X-series instruments, and set a "soft" attenuation. The "soft" attenuation is treated as an addition to the "main" attenuation value set by the **Attenuation** control or `:POW:ATT`, and affects the total attenuation displayed on the **Attenuation** control and the Meas Bar The electronic attenuator, and the "soft" attenuation function provided in Single-Attenuator configurations, are unavailable above the low band (0-3.6 GHz, 0-3.4 GHz, 0-3 GHz, depending on the model). If the low band range is from 0-3.6 GHz, and Stop Frequency of the instrument is > 3.6 GHz, then the **Enabled/Disabled** section of the **Elec Atten** control will be `OFF` and grayed-out If "Internal Preamp" on page 1959 is `ON` (that is, set to Low Band or Full), the electronic attenuator (and the "soft" attenuation function provided in Single-Attenuator configurations) is unavailable. In this case the **Enabled/Disabled** section of the **Elec Atten** control will be `OFF` and grayed-out If either of the above is true, and the SCPI command is sent, an error indicating that the electronic attenuator is unavailable is returned If both the above are true, pressing the control generates error message -221, in other words, the frequency range lockout takes precedence If the electronic/soft Attenuator is enabled, then the **Stop Freq** of the instrument is limited to 3.6 GHz and **Internal Preamp** is unavailable If "LNA" on page 1960 is `ON`, the electronic attenuator (and the "soft" attenuation function provided in Single-Attenuator configurations) is unavailable. In this case the **Enabled/Disabled** section of the **Elec Atten** control will be `OFF` and grayed-out. This coupling works in the following modes/measurements: – Channel Power, Occupied BW, ACP, SEM, Spurious Emissions, Power Stat CCDF measurements in all Modes – Transmit On|Off Power measurement in 5GNR Mode – Power vs. Time and Transmit Power measurement in GSM/EDGE Mode – Burst Power measurement in Spectrum Analyzer Mode

	The SCPI-only "soft" electronic attenuation for the single-attenuator configuration is not available in all measurements; in particular, it is not available in the Swept SA measurement
Couplings	Enabling and disabling the Electronic Attenuator affects the setting of the Mechanical Attenuator (in Dual-Attenuator configurations). This is described in more detail below and in "Mechanical Attenuator Transition Rules" on page 1939
Preset	0 dB OFF (Disabled) for Swept SA measurement ON (Enabled) for all other measurements that support the electronic attenuator
State Saved	Saved in instrument state
Min	0 dB
Max	Dual-Attenuator configuration: 24 dB Single-Attenuator configuration: the total of ATT and EATT cannot exceed 50 dB. So, if the EATT is set to 24 dB first, the main attenuation cannot be greater than 26 dB and will be reduced accordingly; if the main attenuator is set to 40 dB first, EATT cannot be greater than 10 dB
Annotation	See Annotation under the **Mech Atten** control description

More Information

The electronic attenuator offers finer steps than the mechanical attenuator, has no acoustical noise, is faster, and is less subject to wear. These advantages primarily aid in remote operation and are negligible for front panel use. See "Using the Electronic Attenuator: Pros and Cons" on page 1940 for a detailed discussion of the pros and cons of using the electronic attenuator.

For the Single-Attenuator configuration, for SCPI backwards compatibility, the "soft" attenuation feature replaces the Dual-Attenuator configuration's electronic attenuator. All the same couplings and limitations apply. See "Attenuator Configurations and Auto/Man" on page 1937

Mechanical Attenuator Transition Rules

When the Electronic Attenuator is enabled, the Mechanical Attenuator transitions to a state that has no Auto function. Below are the rules for transitioning the Mechanical Attenuator. Note that the information below *only* applies to the Dual-Attenuator configurations, and *only* when the Electronic Attenuator is installed:

When the Electronic Attenuation is enabled from a disabled state:

- The Mechanical Attenuator is initialized to 10 dB (this is its optimal performance setting). You can then set it as desired with SCPI, numeric keypad, step keys, or knob, and it behaves as it normally would in manual mode
- The Auto/Man state of (Mech) Atten is saved

- The Auto/Man toggle on the (Mech) Atten control disappears, and the auto rules are disabled
- The Electronic Attenuator is set to 10 dB less than the previous value of the Mechanical Attenuator, within the limitation that it must stay within the range of 0 to 24 dB of attenuation

Examples in the Dual-Attenuator configuration:

- Mech Atten at 20 dB. Elec Atten enabled, Mech Atten set to 10 dB, and Elec Atten set to 10 dB. New total attenuation equals the value before Elec Atten enabled
- Mech Atten at 0 dB. Elec Atten enabled, Mech Atten set to 10 dB, and Elec Atten set to 0 dB. New total attenuation does not equal the value before Elec Atten enabled
- Mech Atten at 40 dB. Elec Atten enabled, Mech Atten set to 10 dB, and Elec Atten set to 24 dB. New total attenuation does not equal the value before Elec Atten enabled

When the Electronic Attenuation is disabled from an enabled state:

- The Elec Atten control is grayed out
- The Auto/Man state of (Mech) Atten is restored
- If now in Auto, (Mech) Atten recouples
- If now in Man, (Mech) Atten is set to the value of total attenuation that existed before the Elec Atten was disabled. The resulting value is rounded up to the smallest value possible given the (Mech) Atten Step setting - (That is, 57 dB changes to 58 dB when (Mech) Atten Step is 2 dB)

Using the Electronic Attenuator: Pros and Cons

The electronic attenuator offers finer steps than the mechanical attenuator, has no acoustical noise, is faster, and is less subject to wear.

The “finer steps” advantage of the electronic attenuator is beneficial in optimizing the alignment of the instrument dynamic range to the signal power in the front panel as well as remote use. Thus, you can achieve improved relative signal measurement accuracy. Compared to a mechanical attenuator with 2 dB steps, the 1 dB resolution of the electronic attenuator only gives better resolution when the odd-decibel steps are used. Those odd-decibel steps are less accurately calibrated than the even-decibel steps, so one tradeoff for this superior relative accuracy is reduced absolute amplitude accuracy.

Another disadvantage of the electronic attenuator is that the spectrum analyzer loses its "Auto" setting, making operation less convenient.

Also, the relationship between the dynamic range specifications (TOI, SHI, compression, and noise) and instrument performance are less well-known with the electrical attenuator. With the mechanical attenuator, TOI, SHI, and compression threshold levels increase dB-for-dB with increasing attenuation, and the noise floor does as well. With the electronic attenuator, there is an excess attenuation of about 1 to 3 dB between 0 and 3.6 GHz, making the effective TOI, SHI, and so forth, less well known. Excess attenuation is the actual attenuation relative to stated attenuation. Excess attenuation is accounted for in the instrument calibration.

Adjust Atten for Min Clipping

Sets the combination of mechanical and electronic attenuation and gain based on the current measured signal level so that clipping will be at a minimum.

This is an immediate action function, that is, it executes once, when the control is pressed.

The algorithms that are used for the adjustment are documented under "Pre-Adjust for Min Clipping" on page 1942.

Remote Command	`[:SENSe]:POWer[:RF]:RANGe:OPTimize IMMediate`
Example	`:POW:RANG:OPT IMM`
Notes	Executing **Adjust Atten for Min Clipping** initiates the measurement
Dependencies	Does not appear in the Swept SA, RTSA, Monitor Spectrum and Complex Spectrum measurements Appears in the Waveform measurement in 5G NR Mode only

Adjust Atten

Allows you to select;

- Electric attenuator only
- Combination of Electric attenuator and Mechanical attenuator

when `[:SENSe]:POWer[:RF]:RANGe:OPTimize IMMediate` is executed.

Remote Command	`[:SENSe]:POWer[:RF]:RANGe:OPTimize:TYPE EONLy | COMBined` `[:SENSe]:POWer[:RF]:RANGe:OPTimize:TYPE?`
Example	`:POW:RANG:OPT:TYPE EONL` `:POW:RANG:OPT:TYPE?`
Dependencies	Does not appear in the Swept SA, RTSA, Monitor Spectrum and Complex Spectrum measurements

	Appears in the Waveform measurement in 5G NR Mode only
Preset	COMBined
State Saved	Saved in instrument state

Pre-Adjust for Min Clipping

If this function is ON, it applies the adjustment described under "Adjust Atten for Min Clipping" on page 1941 each time a measurement restarts. Therefore, in Continuous measurement mode, it only executes before the first measurement.

In Dual-Attenuator models, you can set **Elec+Mech Atten**, in which case both attenuators participate in the autoranging, or **Elec Atten Only**, in which case the mechanical attenuator does not participate in the autoranging. This latter case results in less wear on the mechanical attenuator and is usually faster.

See "Adjustment Algorithm" on page 1943

Selection	SCPI	Note
Off	OFF	This is the default setting
On	ON	Available in Single-Attenuator instruments. For compatibility with models that do not have an input attenuator, the ON parameter is supported and mapped to COMBined
Elec Atten Only	ELECtrical	Selects only the electric attenuator to participate in auto ranging. This offers less wear on the mechanical attenuator and is usually faster
Elec+Mech Atten	COMBined	In Dual-Attenuator models, this selects both attenuators to participate in the autoranging

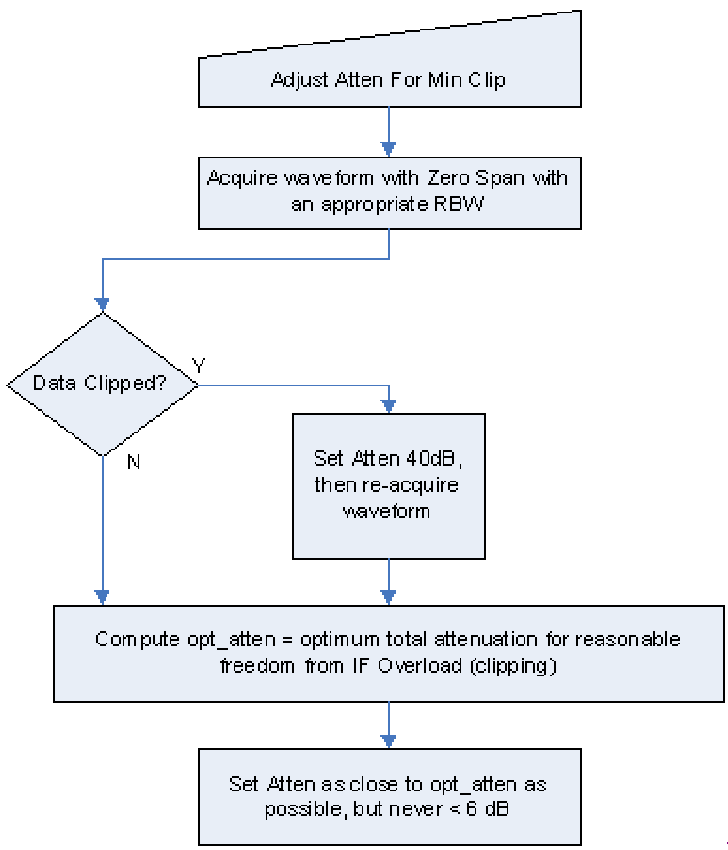
Remote Command	[:SENSe]:POWer[:RF]:RANGe:OPTimize:ATTenuation OFF | ON | ELECtrical | COMBined [:SENSe]:POWer[:RF]:RANGe:OPTimize:ATTenuation?
Example	:POW:RANG:OPT:ATT OFF :POW:RANG:OPT:ATT?
Notes	The parameter option ELECtrical sets this function to ON in Single-Attenuator models The parameter option COMBined is mapped to ELECtrical in Single-Attenuator models. If you send COMBined, it sets the function to ON and returns ELEC to a query For SCPI compatibility with models that do not have an input attenuator, the ON parameter is honored and mapped to COMBined
Dependencies	Only appears in Dual-Attenuator models with an Electronic Attenuator installed In instruments with Dual-Attenuator model, when "Elec Atten" on page 1937 is OFF or grayed-out, "Pre-Adjust for Min Clipping" on page 1942 is grayed-out Does not appear in the Swept SA, RTSA, Monitor Spectrum and Complex Spectrum measurements For the Waveform measurement, available only in 5G NR Mode

Preset	OFF when Elec Atten is Disabled at preset, otherwise ELEC
State Saved	Saved in instrument state
Range	Dual-Attenuator models: Off | Elec Atten Only | Mech + Elec Atten Single-Attenuator models: Off | On
Notes	ON aliases to "Elec Atten Only" (:POW:RANG:OPT:ATT ELEC) OFF aliases to "Off" (:POW:RANG:OPT:ATT OFF) :POW:RANG:AUTO? returns true if :POW:RANG:OPT:ATT is not OFF
Backwards Compatibility SCPI	[:SENSe]:POWer[:RF]:RANGe:AUTO ON | OFF | 1 | 0 [:SENSe]:POWer[:RF]:RANGe:AUTO?

Adjustment Algorithm

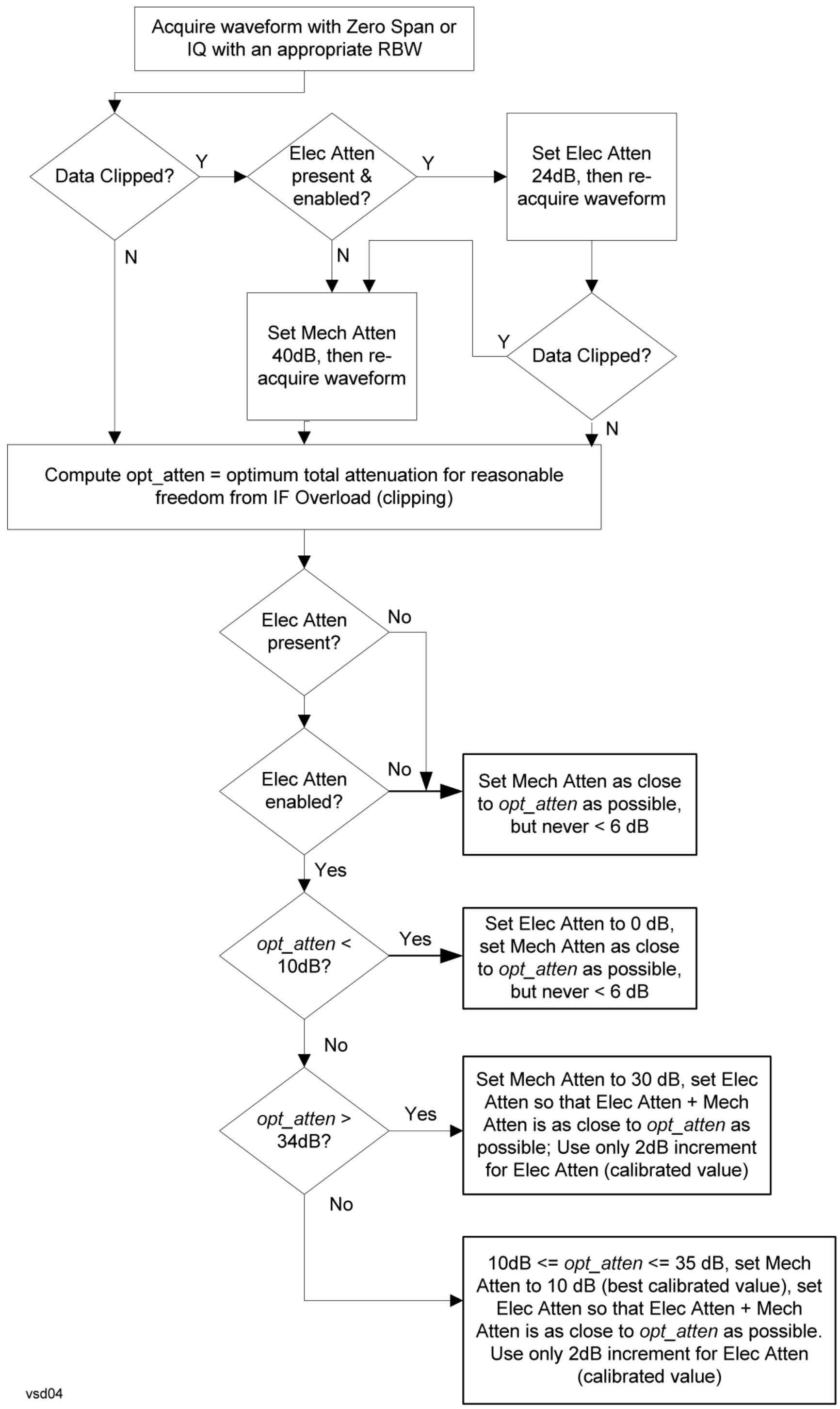
The algorithms for the adjustment are documented below:

Single-Attenuator Models



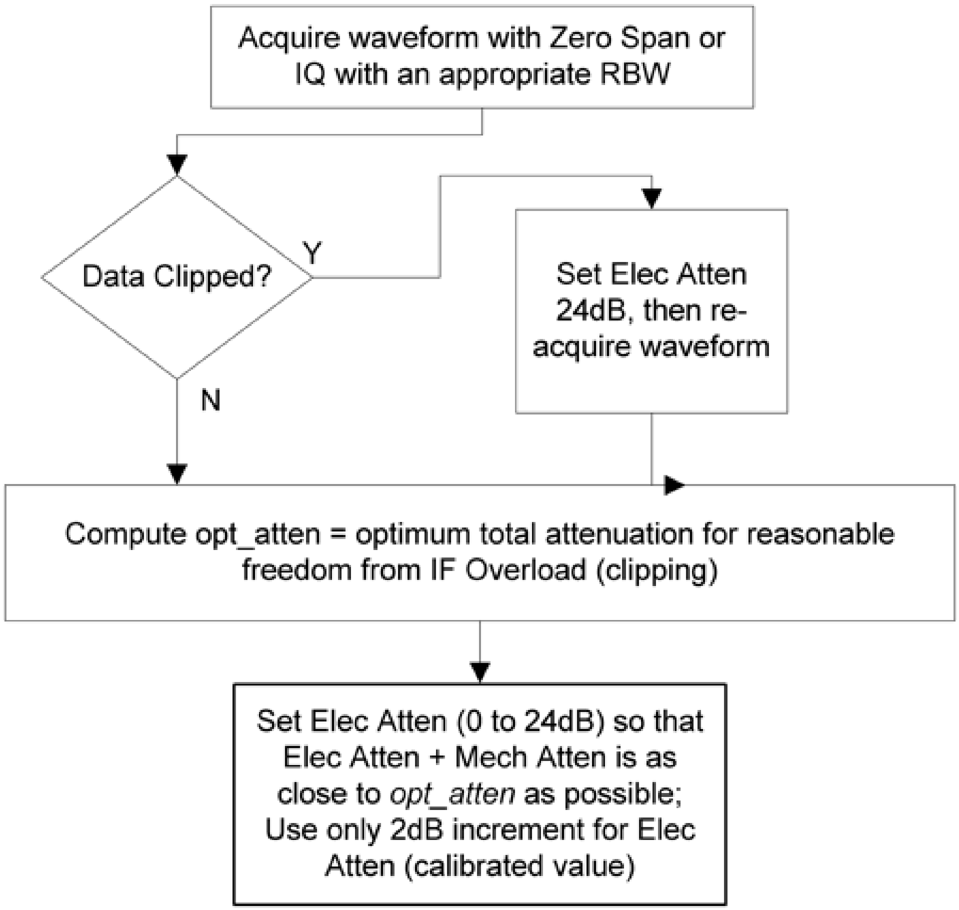
Dual-Attenuator models

"Adjust Atten for Min Clipping" on page 1941 or "Pre-Adjust for Min Clipping" on page 1942 selection is Mech + Elec Atten:


Acquire waveform with Zero Span or IQ with an appropriate RBW
Data Clipped?
Y
N
Elec Atten present & enabled?
Y
N
Set Elec Atten 24dB, then re-acquire waveform
Set Mech Atten 40dB, then re-acquire waveform
Data Clipped?
Y
N
Compute opt_atten = optimum total attenuation for reasonable freedom from IF Overload (clipping)
Elec Atten present?
No
Elec Atten enabled?
No
Yes
Set Mech Atten as close to opt_atten as possible, but never < 6 dB
opt_atten < 10dB?
Yes
No
Set Elec Atten to 0 dB, set Mech Atten as close to opt_atten as possible, but never < 6 dB
opt_atten > 34dB?
Yes
No
Set Mech Atten to 30 dB, set Elec Atten so that Elec Atten + Mech Atten is as close to opt_atten as possible; Use only 2dB increment for Elec Atten (calibrated value)
10dB <= opt_atten <= 35 dB, set Mech Atten to 10 dB (best calibrated value), set Elec Atten so that Elec Atten + Mech Atten is as close to opt_atten as possible. Use only 2dB increment for Elec Atten (calibrated value)
vsd04

"Pre-Adjust for Min Clipping" on page 1942 selection is Elec Only.

Note that the **Mech Atten** value is not adjusted, and the value previously set is used. Therefore, there is a case that IF Overload is still observed depending on the input signal level and the Mech Atten setting.



Mech Atten Step

Controls the step size used when making adjustments to the input attenuation.

Labeled **Mech Atten Step** in Dual-Attenuator models and **Atten Step** in Single-Attenuator models. In the Dual-Attenuator configuration, only affects the step size of the mechanical attenuator.

Remote Command	`[:SENSe]:POWer[:RF]:ATTenuation:STEP[:INCRement] 10 dB | 2 dB`

	`[:SENSe]:POWer[:RF]:ATTenuation:STEP[:INCRement]?`
Example	`:POW:ATT:STEP 2` `:POW:ATT:STEP?`
Notes	Has a toggle control on the front panel, but takes a specific value (in dB) when used remotely. The only valid values are 2 and 10
Dependencies	Blanked in EXA, CXA and CXA-m if option FSA (2 dB steps) is not present. If blanked, attempts to set it via SCPI yield an error
Couplings	When the attenuation step size changes, the current mechanical attenuation value is adjusted (if necessary) to be quantized to the new step size. That is, if step is set to 10 dB, mech atten is increased if necessary so it is a multiple of 10 dB
Preset	EXA, CXA and CXA-m: 10 dB (2 dB with option FSA) All other models: 2 dB
State Saved	Saved in instrument state

Max Mixer Level

Allows you to set the maximum level to be applied to the mixer for a signal at the top of the screen. By setting this value up or down you can allow more or less signal through the system.

The major impact of changes to **Max Mixer Level** is seen in changes to the value to which **Reference Level** is limited. Max Ref Level depends on Max Mixer Level and Attenuation, and therefore a higher Max Mixer Level may let you set Ref Level higher. However, changing this value can impact your TOI, compression, or dynamic range. The preset value of this function is best for most measurements.

See also "Max Mixer Lvl Rules" on page 1948.

Remote Command	`[:SENSe]:POWer[:RF]:MIXer:RANGe[:UPPer] <real>` `[:SENSe]:POWer[:RF]:MIXer:RANGe[:UPPer]?`
Example	`:POW:MIX:RANG -15 dBm` `:POW:MIX:RANG?`
Dependencies	Only appears in Swept SA and RTSA measurements
Preset	-10 dBm
State Saved	Saved in instrument state
Min	-50 dBm
Max	0 dBm

Max Mixer Lvl Rules

Allows you to optimize the Max Mixer Level setting for certain kinds of measurements.

NORMal	The historical, and thus backwards compatible, setting range (–50 to 0 dBm) and default setting (–10 dBm). The instrument has been designed so that, at the default setting, any signal below the Reference Level is extremely unlikely to create ADC overloads. At this mixer level the scale fidelity will be within specifications, thus compression with be negligible
TOI	Allows a range of settings of the "Max Mixer Level" on page 1947, –50 to –10 dBm, that can be optimum for measurements limited by the instrument third-order dynamic range. The default setting, –25 dBm, is commonly appropriate but RBW affects this. A good setting for Max Mixer Level would be higher than the optimum mixer level by half of the attenuator step size
COMPression	Allows a range of settings of the Max Mixer Level, –10 to +10 dBm or more, that can be optimum for measurements limited by the tradeoffs between instrument accuracy due to compression, and dynamic range due to the noise floor. The default setting, –3 dBm, is commonly appropriate, representing mixer drive levels that cause 1 dB or less compression at most carrier frequencies Typical measurements that would be optimized by this setting are the measurement of low sideband levels, including nulls, in angle-modulated signals (FM and PM). Also pulsed-RF measurements, including finding nulls to estimate pulse width, which are often best done with significant overdrive (compression) of the front end

Setting Name (readback)	Setting Name (verbose)	Max Mixer Level Preset Value, dBm	Max Mixer Level minimum value, dBm	Max Mixer Level maximum value, dBm
NORMal	Normal – balance TOI, noise, and compression	–10	–50	0
TOI	TOI-limited dynamic range	–25	–50	–10
COMPression	Compression-limited dynamic range	–3	–10	+30

Remote Command	`[:SENSe]:POWer[:RF]:MIXer:RULEs NORMal | TOI | COMPression` `[:SENSe]:POWer[:RF]:MIXer:RULEs?`
Example	`:POW:MIX:RULE:COMP`
Dependencies	Only appears in the Swept SA and RTSA measurements
Preset	`NORM`

3.13.3.3 Range (Baseband Input models)

Only available when Option BBA is present (I/Q Baseband Inputs), the current measurement supports option BBA, and I/Q is the selected input. In these cases, replaces the **Attenuation** tab.

Each input channel (I and Q) has four internal gain ranges. The maximum allowed voltage in each gain range is slightly more than the nominal value, so the break point between ranges is a few millivolts higher than the nominal (setting a peak voltage of 0.502 mV will still map to the 0.5 V Peak range).

Gain Setting	Volts RMS	Volts Peak	Volts Peak - Peak	dBm (50Ω)	Break Point
0 dB	0.7071	1.0	2.0	10	n/a
6 dB	0.3536	0.5	1.0	4	0.502 V Peak
12 dB	0.1768	0.25	0.5	-2	0.252 V Peak
18 dB	0.0884	0.125	0.25	-8	0.127 V Peak

Dependencies	Available only when the selected input is I/Q. If the current measurement does not support baseband inputs, an error will be displayed: "No result; Meas invalid with I/Q inputs"
State Saved	No

Range Auto/Man

The **Auto** setting for **Range** causes the range to be set based on the Y Scale settings. When **Range** is **Auto**, the I & Q Range are set based on the top of the Y Scale when the Y scale is in dB units (for example, power), or to the max(abs(top), abs(bottom)) when the Y scale reference is not at the top of the screen.

Not all measurements support **Range Auto/Man**. If **Auto** is not supported in the current measurement, this control is grayed-out, displaying **Man**, and `MAN` is returned to a SCPI query, but this does *not* change the Auto/Man setting for **Range**. When you switch to a measurement that supports **Auto**, it goes back to **Auto** if it was previously in **Auto** mode.

Remote Command	`[:SENSe]:VOLTage:IQ:RANGe:AUTO OFF | ON | 0 | 1` `[:SENSe]:VOLTage:IQ:RANGe:AUTO?`

Example	Put the I Range and Q Range in manual
	`:VOLT:IQ:RANG:AUTO OFF`
	`:VOLT:IQ:RANG:AUTO?`

Dependencies	If **Auto** is not supported, sending the SCPI command generates an error
Couplings	When in **Auto**, both I Range and Q Range are set to the same value, computed as follows: Maximum absolute value is computed for the Y Scale. The top and bottom of the graph are computed based on Ref Value, Scale/Div, and Ref Position. Formula: YMax = max(abs(top), abs(bottom))

	The I Range and Q Range are then set to YMax
Preset	ON
State Saved	Saved in instrument state
Annotation	When in Man, the Range annotation is preceded by "#"

This is an alternate form of the command to match the POWer form of the I Range and Q Range SCPI.

Remote Command	[:SENSe]:POWer:IQ:RANGe:AUTO OFF | ON | 0 | 1 [:SENSe]:POWer:IQ:RANGe:AUTO?
Example	Put the I Range and Q Range in manual :POW:IQ:RANG:AUTO OFF :POW:IQ:RANG:AUTO?
Notes	:POW:IQ:RANG:AUTO is an alternate form of :VOLT:IQ:RANG:AUTO, to maintain consistency with I Range and Q Range, which support both the POWer and VOLTage forms of the command
Preset	ON
Range	Auto | Man

I Range

The internal gain range for the I channel when the Input Path is I Only or I and I/Q. Used for both the I and Q channels when the Input Path is I+jQ.

Remote Command	[:SENSe]:VOLTage:IQ[:I]:RANGe[:UPPer] <voltage> [:SENSe]:VOLTage:IQ[:I]:RANGe[:UPPer]?
Example	Set the I Range to 0.5 V Peak :VOLT:IQ:RANG 0.5 V :VOLT:IQ:RANG?
Notes	The numeric entries are mapped to the smallest gain range whose break point is greater than or equal to the value, or 1 V Peak if the value is greater than 1 V
Couplings	When "Q Same as I" on page 1953 is On, the **I Range** value will be copied to "Q Range" on page 1951 Changing the value also sets Range = Man
Preset	Complex SPECtrum Measurement: 0.5 V Peak All others: 1 V Peak
State Saved	Saved in instrument state
Range	1 V Peak (10 dBm @ 50 Ω) | 0.5 V Peak (4 dBm @ 50Ω) | 0.25 V Peak (-2 dBm @ 50Ω) | 0.125 V Peak (-8 dBm @ 50Ω)
Min	0.125 V
Max	1 V
Annotation	The Range annotation replaces the RF Input context's "Atten" annotation

"Rng: <I Range>". When Range = Man the annotation is preceded by "#"

The I Range is not annotated in Input Path Q Only. When I Range and Q Range are the same, the annotation is "Rng: <Range>". When I Range and Q Range are different and the Input Path is Ind I/Q, the annotation is "Rng: <I Range>, <Q Range>" and "Peak" is removed from the text. Examples:

"Rng: 1 V Peak" the I Range is 1 V Peak

"Rng: 1 V, 0.5 V " the I Range is 1 V Peak and the Q Range is 0.5 V Peak

This is an alternate form of the command to allow entry as a power.

Remote Command	`[:SENSe]:POWer:IQ[:I]:RANGe[:UPPer] <ampl>` `[:SENSe]:POWer:IQ[:I]:RANGe[:UPPer]?`

Example	Set the I Range to 0.5 V Peak when Reference Z is 50 Ω, and to 1.0 V Peak when Reference Z is 75 Ω
	`:POW:IQ:RANG 4 dBm`
	`:POW:IQ:RANG?`

Notes	The `POWer` form of the command is provided for convenience. It maps to the same underlying gain range parameter as the `VOLTage` form The Reference Z (not the I channel Input Z) is used to convert the power to peak voltage, which is then used to set the I Range as with the `VOLTage` form of the command. The power values of the 4 range states (1V Peak, 0.5V Peak, 0.25V Peak, and 0.125V Peak) will vary with Reference Z. Here are some examples: 50 Ω: 10, 4, -2, -8 75 Ω: 8.2, 2.2, -3.8, -9.8 600 Ω: -0.8, -6.8, -12.8, -18.9
Preset	10.0 dBm
Range	-20 dBm to 10 dBm
Min	-20 dBm
Max	10 dBm

Q Range

The internal gain range for the Q channel. **Q Range** only applies to Input Path Q Only and Ind I/Q. For input I+jQ "I Range" on page 1950 determines both I and Q channel range settings.

Remote Command	`[:SENSe]:VOLTage:IQ:Q:RANGe[:UPPer] <voltage>` `[:SENSe]:VOLTage:IQ:Q:RANGe[:UPPer]?`

Example	Set the Q Range to 0.5 V Peak:
	`:VOLT:IQ:Q:RANG 0.5 V`
	`:VOLT:IQ:Q:RANG?`

Notes	The numeric entries are mapped to the smallest gain range whose break point is greater than or equal to the value, or 1 V Peak if the value is greater than 1 V

	Q Range is only used for Input Path Q Only and Ind I/Q. For input I+jQ, "I Range" on page 1950 determines both I and Q channel range settings
Couplings	When "Q Same as I" on page 1953 is On, the "I Range" on page 1950 value is copied to **Q Range** and the range value keys are disabled Changing the value also sets Range = Man
Preset	1 V Peak
State Saved	Saved in instrument state
Range	1 V Peak (10 dBm @ 50Ω) | 0.5 V Peak (4 dBm @ 50Ω) | 0.25 V Peak (-2 dBm @ 50Ω) | 0.125 V Peak (-8 dBm @ 50Ω)
Min	0.125 V
Max	1 V
Annotation	The Range annotation replaces the RF Input context's "Atten" annotation "Rng: <Q Range>". When Range = Man the annotation is preceded by "#" The Q Range is not annotated in Input Path I Only or I+jQ. When I Range and Q Range are the same, the annotation is "Rng: <Range>". When I Range and Q Range are different and the Input Path is Ind I/Q, the annotation is "Rng: <I Range>, <Q Range>" and "Peak" is removed from the text. Examples: "Rng: 1 V Peak" the Q Range is 1 V Peak "Rng: 1 V, 0.5 V " the I Range is 1 V Peak and the Q Range is 0.5 V Peak

This is an alternate form of the command to allow entry as a power.

Remote Command	`[:SENSe]:POWer:IQ:Q:RANGe[:UPPer] <ampl>` `[:SENSe]:POWer:IQ:Q:RANGe[:UPPer]?`

Example	Sets the Q Range to 0.5 V Peak when Reference Z is 50 **Ω**, and to 1.0 V Peak when Reference Z is 75 **Ω**:
	`:POW:IQ:Q:RANG 4 dBm`
	`:POW:IQ:Q:RANG?`

Notes	The `POWer` form of the command is provided for convenience. It maps to the same underlying gain range parameter as the `VOLTage` form of the command The Reference Z (not the Q channel Input Z) is used to convert the power to peak voltage, which is then used to set the Q Range as with the `VOLTage` form of the command. The power values of the 4 range states (1V Peak, 0.5V Peak, 0.25V Peak, and 0.125V Peak) will vary with Reference Z. Here are some examples: 50 Ω: 10, 4, -2, -8 75 Ω: 8.2, 2.2, -3.8, -9.8 600 Ω: -0.8, -6.8, -12.8, -18.9
Preset	10.0 dBm
Range	-20 dBm to 10 dBm
Min	-20 dBm
Max	10 dBm

Q Same as I

Many, but not all, usages require the I and Q channels to have an identical setup. To simplify channel setup, **Q Same as I** causes the Q channel range to be mirrored from the I channel. That way, you only need to set up one channel (the I channel). The I channel values are copied to the Q channel, so at the time **Q Same as I** is Off, the I and Q channel setups will be identical.

Remote Command	`[:SENSe]:VOLTage|POWer:IQ:MIRRored OFF | ON | 0 | 1` `[:SENSe]:VOLTage|POWer:IQ:MIRRored?`

Example	Turn off the mirroring of I Range to Q Range
	`:VOLT:IQ:MIRR OFF`
	`:POW:IQ:MIRR OFF`

Couplings	When ON, the "I Range" on page 1950 value is mirrored (copied) to the "Q Range" on page 1951
Preset	ON
State Saved	Saved in instrument state
Range	OFF|ON

3.13.3.4 Range (Non-attenuator models)

Only available for Keysight’s modular signal analyzers and certain other Keysight products, such as VXT

State Saved	No

Range

Represents the amplitude of the largest sinusoidal signal that could be present within the IF without being clipped by the ADC. For signals with high peak-to-average ratios, the range may need to exceed the rms signal power by a significant amount to avoid clipping.

This is a measurement global setting.

Remote Command	`[:SENSe]:POWer[:RF]:RANGe <real>` `[:SENSe]:POWer[:RF]:RANGe?`
Example	`:POW:RANG 10 dBm` `:POW:RANG?`
Notes	The MIN and MAX values are affected by the External Gain parameters, and by the **Center Frequency** The hardware compensates for frequency response and alters the Range setting

Preset	0 dBm
State Saved	Yes
Min	-100
Max	100
Annotation	Meas Bar

Adjust Range for Min Clipping

Sets the combination of attenuation and gain based on the current measured signal level so that clipping will be at a minimum.

This is an "immediate action" function, that is, it executes once, when the key is pressed.

This key does not appear in measurements that do not support this functionality.

Remote Command	`[:SENSe]:POWer[:RF]:RANGe:OPTimize IMMediate`
Notes	Executing Adjust Range for Min Clipping initiates the measurement
Dependencies	Does not appear in the Swept SA and Monitor Spectrum measurements

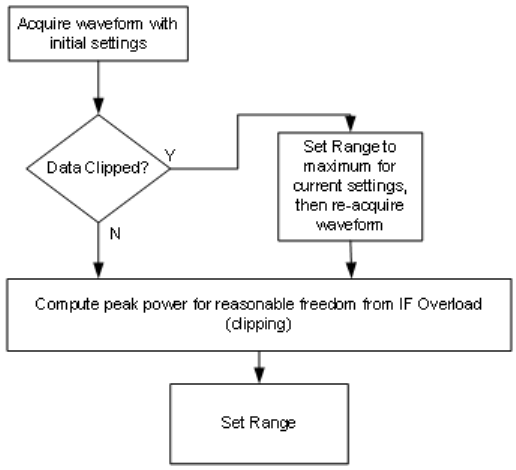
Pre-Adjust for Min Clipping

If this function is ON, it applies the adjustment described under Adjust Range For Min Clipping each time a measurement restarts. Therefore, in Continuous measurement mode, it only executes before the first measurement.

Remote Command	`[:SENSe]:POWer[:RF]:RANGe:OPTimize:ATTenuation OFF | ON | ELECtrical | COMBined` `[:SENSe]:POWer[:RF]:RANGe:OPTimize:ATTenuation?`
Notes	Because there is no attenuator control available in these models, the control displays only ON and OFF choices. However, for SCPI compatibility with other platforms, all three parameters (`ELECtrical`, `COMBined`, and ON) are honored and all are mapped to `ELECtrical`, so if any of these three parameters is sent, a subsequent query will return `ELEC`
Dependencies	Does not appear in the Swept SA and Monitor Spectrum measurements
Preset	OFF for Swept SA measurement; ON for all other measurements that support **Pre-Adjust for Min Clipping**
State Saved	Saved in instrument state

Adjustment Algorithm

The algorithm for the adjustment is documented below:



Peak-to-Average Ratio

Used with "Range (Non-attenuator models)" on page 1953 to optimize the level control in the instrument. The value is the ratio, in dB, of the peak power to the average power of the signal to be measured. A ratio of 0 should be used for sinusoidal signals; for 802.11g OFDM signals use 9 dB.

All Modes show the current value of Peak-to-Average ratio on the control. However, some Modes do not permit changing the value. In these situations, the control is grayed-out.

Remote Command	`[:SENSe]:POWer[:RF]:RANGe:PARatio <real>` `[:SENSe]:POWer[:RF]:RANGe:PARatio?`
Example	`:POW:RANG:PAR 12 dB`
Notes	In some Modes, this parameter is read-only; meaning the value will appear on the control and query via SCPI, but is not changeable. In such applications the control is grayed-out. Attempting to change the value via SCPI will be ignored but no error message will be generated
Dependencies	Does not appear in Spectrum Analyzer Mode
Preset	10 dB VXT Models M9410A/11A: 0 dB
State Saved	Saved in instrument state
Min	0 dB
Max	20 dB VXT Models M9410A/11A: 50 dB

Mixer Lvl Offset

This is an advanced setting to adjust target Range at the input mixer, which in turn affects the signal level in the instrument's IF. This setting can be used when additional optimization is needed after setting "Peak-to-Average Ratio" on page 1955. Positive values of offset optimize noise performance over distortion, negative values optimize distortion performance over noise.

Remote Command	`[:SENSe]:POWer[:RF]:RANGe:MIXer:OFFSet <real>` `[:SENSe]:POWer[:RF]:RANGe:MIXer:OFFSet?`
Example	`:POW:RANG:MIX:OFFS -5 dB`
Preset	0 dB
State Saved	Saved in instrument state
Min	-35 dB VXT Models M9410A/11A: -34 dB
Max	30 dB

3.13.3.5 Signal Path

Contains controls that pertain to the routing of the signal through the frontend of the instrument.

In general, only appears in instruments whose hardware supports this signal routing. For example, this tab does not appear in many of the modular instrument products, including VXT Model M9421A, or UXM.

This tab *does* appear in VXT Models M9410A/11A, because "Software Preselection" on page 1971 is under this tab, and VXT Models M9410A/11A implement a version of Software Preselection.

Presel Center

Adjusts the centering of the preselector filter to optimize the amplitude accuracy at the frequency of the selected marker. If the selected marker is not on when **Presel Center** is pressed, the instrument turns on the selected marker, performs a peak search, and then performs centering on the marker's center frequency. If the selected marker is already on and between the start and stop frequencies of the instrument, the instrument performs the preselector calibration on that marker's frequency. If the selected marker is already on, but outside the frequency range between **Start Freq** and **Stop Freq**, the instrument first performs a peak search, and then performs centering on the marker's center frequency.

The value displayed on "Preselector Adjust" on page 1958 changes to reflect the new preselector tuning.

Certain considerations should be observed to ensure proper operation, as detailed in "Proper Preselector Operation" on page 1957.

Remote Command	`[:SENSe]:POWer[:RF]:PCENter`
Example	`:POW:PCEN`
Notes	The rules outlined above under the control description apply for the remote command as well as the key. The result of the command depends on marker position, etc. Any message generated by the control press is also generated in response to the remote command
Dependencies	Does not appear in CXA-m, nor in VXT Models M9410A/11A Grayed-out if the microwave preselector is off – If the selected marker's frequency is below Band 1, an advisory message is generated "Preselector not used in this frequency range" and no action is taken – Grayed-out if entirely in Band 0, that is, if **Stop Freq** is below about 3.6 GHz Grayed-out if entirely above 50 GHz, that is, if **Start Freq** is above 50 GHz – Blanked in models that do not include a preselector, such as Option 503. If the remote command is sent in these instruments, accepted without error, and the query always returns 0 – Grayed-out in the Spectrogram View
Couplings	The active marker position determines where the centering will be attempted If the instrument is in a measurement such as averaging when centering is initiated, the act of centering the preselector restarts averaging, but the first average trace will not be taken until the centering is completed The offset applied to do the centering appears in "Preselector Adjust" on page 1958
Status Bits/OPC dependencies	When centering the preselector, `*OPC` does not return true until the process is complete and a subsequent measurement has completed, nor are results returned in response to `:READ` or `:MEASure` queries The `Measuring` bit remains set (true) while this command is operating, and does not go false until the subsequent sweep/measurement has completed

Proper Preselector Operation

Certain considerations should be observed to ensure proper operation:

1. If the selected marker is **Off**, the instrument turns on a marker, performs a peak search, and adjusts the preselector using the selected marker's frequency. It uses the "highest peak" peak search method unqualified by threshold or excursion, so that there is no chance of a 'no peak found' error. It continues with that peak, even if it is the peak of just noise. Therefore, for this operation to work properly, there should be a signal on-screen in a preselected range for the peak search to find

2. If the selected marker is already **On**, the instrument attempts the centering at that marker's frequency. There is no preselector for signals below about 3.6 GHz, so if the marker is on a signal below 3.6 GHz, no centering is attempted, and an advisory message is generated
3. In some models, the preselector can be bypassed. If it is bypassed, no centering is attempted in that range and a message is generated

Preselector Adjust

Lets you manually adjust the preselector filter frequency to optimize its response to the signal of interest. Only available when "Presel Center" on page 1956 is available.

For general purpose signal analysis, using **Presel Center** is recommended. Centering the filter minimizes the impact of long-term preselector drift. **Preselector Adjust** can be used instead to manually optimize the preselector. One application of manual optimization would be to peak the preselector response, which both optimizes the signal-to-noise ratio and minimizes amplitude variations due to small (short-term) preselector drifting.

When **Presel Center** is performed, the offset applied to do the centering becomes the new value of **Preselector Adjust**.

Remote Command	`[:SENSe]:POWer[:RF]:PADJust <freq>` `[:SENSe]:POWer[:RF]:PADJust?`
Example	`:POW:PADJ 100KHz` `:POW:PADJ?`
Notes	The value on the control is displayed to 0.1 MHz resolution
Dependencies	– Does not appear in CXA-m – Does not appear in VXT Models M9410A/11A – Grayed-out if microwave preselector is off – Grayed-out if entirely in Band 0, that is, if Stop Freq is lower than about 3.6 GHz – Grayed-out if entirely above 50 GHz, that is, if Start Freq is higher than 50 GHz – Blank in models that do not include a preselector, such as Option 503. If the command is sent in these instruments, it is accepted without error, and the query always returns 0 – Grayed-out in the Spectrogram View
Preset	0 MHz
State Saved	The **Preselector Adjust** value set by "Presel Center" on page 1956, or by manually adjusting **Preselector Adjust** Not saved in instrument state, and does not survive a Preset or power cycle

Min	-500 MHz
Max	500 MHz
Backwards Compatibility SCPI	[:SENSe]:POWer[:RF]:MW:PADJust [:SENSe]:POWer[:RF]:MMW:PADJust

Notes	The command has no effect, and the query always returns MWAVe
Backwards Compatibility SCPI	[:SENSe]:POWer[:RF]:PADJust:PRESelector MWAVe | MMWave | EXTernal [:SENSe]:POWer[:RF]:PADJust:PRESelector?

Internal Preamp

Accesses a menu of controls for the internal preamps. Turning on the preamp gives a better noise figure, but a poorer inter-modulation distortion (TOI) to noise floor dynamic range. You can optimize this setting for your measurement.

The instrument takes the preamp gain into account as it sweeps. If you sweep outside of the range of the preamp, the instrument will also account for that. The displayed result always reflects the correct gain.

For some measurements, when the preamp is on and any part of the displayed frequency range is below the lowest frequency for which the preamp has specifications, a warning condition message appears in the status line. For example, for a preamp with a 9 kHz lowest specified frequency: "Preamp: Accy unspec'd below 9 kHz".

Selection	Example	Note
Off	:POW:GAIN OFF	
Low Band	:POW:GAIN ON :POW:GAIN:BAND LOW	Sets the internal preamp to use only the low band. The frequency range of the installed (optional) low-band preamp is displayed in square brackets on the Low Band selection in the dropdown
Full Range	:POW:GAIN ON :POW:GAIN:BAND FULL	Sets the internal preamp to use its full range. The low band (0-3.6 GHz, 0-3.4 GHz, 0-3 GHz, depending on the model) is supplied by the low band preamp and the frequencies above low band are supplied by the high band preamp The frequency range of the installed (optional) low-band preamp is displayed in square brackets on the Full Range selection in the dropdown. If the high band option is not installed the Full Range selection does not appear

NOTE: The maximum **Center Frequency** for Low Band, displayed in square brackets, can change based on the selected IFBW for measurements that support IFBW (for example, Waveform measurement across all Modes that support it). In certain models (such as N9042B & N9032B), IFBW values <= 40 MHz have a maximum Low Band frequency of 3.6 GHz, while 40 MHz < IFBW <= 1 GHz have a maximum of 3.3 GHz, and 1 GHz < IFBW <= 1.5 GHz have a maximum of 3.5 GHz. IFBW values > 1.5 GHz do not support a **Center Frequency** that can reach the Low Band maximum frequency. In these cases, **N/A** is displayed in the square brackets for Low Band.

Remote Command	`[:SENSe]:POWer[:RF]:GAIN:BAND LOW | FULL`
	`[:SENSe]:POWer[:RF]:GAIN:BAND?`
	`[:SENSe]:POWer[:RF]:GAIN[:STATe] OFF | ON | 0 | 1`
	`[:SENSe]:POWer[:RF]:GAIN[:STATe]?`

Example	`:POW:GAIN:BAND LOW`
	`:POW:GAIN:BAND?`
	`:POW:GAIN OFF`
	`:POW:GAIN?`

Dependencies	Not available on all hardware platforms. If the preamp is not present or is unlicensed, this control is not shown Does not appear in VXT Models M9410A/11A/15A/16A If `:POW:GAIN:BAND FULL` is sent when a low band preamp is available, the preamp band parameter is set to `LOW` instead of `FULL`, and an "Option not installed" message is generated Not available when the electronic/soft attenuator is enabled
Preset	`LOW` `OFF`
State Saved	Saved in instrument state
Annotation	When the USB Preamp is not connected to USB, the Preamp annotation in the Meas Bar says “Off” if the preamp is off and displays the frequency range of the low band or full range preamp depending on the setting. For example, if the Preamp is set to Low Band and the Low Band is 3.6 GHz the annotation says “3.6 GHz”. If it is a 13.6 GHz preamp and it is set to Full Range the annotation says “13.6 GHz” When the USB Preamp is connected to USB, the Preamp annotation says “Preamp: USB” if the internal preamp is off or “Preamp: USB, Int” if the internal preamp is on (only for measurements that support the USB preamp)

LNA

Lets you turn the Low Noise Amplifier (LNA) on or off.

LNA is an additional preamplifier that provides superior DANL and frequency range compared to "Internal Preamp" on page 1959. LNA provides lower system noise

figure, especially at frequencies above 100 MHz, and can be operated up to the full range of 50 GHz instruments.

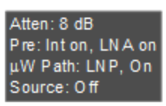
For best possible sensitivity, **LNA** can be turned on *together* with "Internal Preamp" on page 1959, although if you operate both preamps together, note that the TOI (distortion) specifications are impacted. The sensitivity improvement of this combination is substantial when operating in high band (frequencies above 3.6 GHz).

For more details about annotation, see "More Information" on page 1961

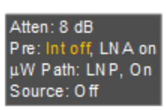
Remote Command	`[:SENSe]:POWer[:RF]:GAIN:LNA[:STATe] OFF | ON | 0 | 1` `[:SENSe]:POWer[:RF]:GAIN:LNA[:STATe]?`
Example	`:POW:GAIN:LNA ON`
Dependencies	Requires Option LNA, except for VXT models M9415A/16A Does not appear in VXT models M9421A/10A/11A May not appear in some measurements **LNA** is not available when the electronic/soft attenuator is enabled
Preset	`OFF`
State Saved	Saved in State

More Information

When **LNA** is installed, the preamp annotation changes to show the state of both **LNA** and **Internal Preamp**. Below is an example:



Note that when operating entirely in the low band (below about 3.6 GHz), if **LNA** is on, **Internal Preamp** is switched off (even if you have its switch set to ON). This is because the noise performance is actually degraded in low band if both preamps are on. In this case, the annotation reflects the actual state of the two preamps, but the **Internal Preamp** annotation displays in amber, to warn you that the actual state of **Internal Preamp** does not match its switch control display:



µW Path Control

Options for this control include **µW Preselector Bypass** (Option MPB), **Low Noise Path** (Option LNP) and **Full Bypass Enable** in the High Band path circuits.

When the µW Preselector is bypassed, flatness is improved, but will be subject to spurs from out of band interfering signals. When **Low Noise Path Enable** is selected, the instrument automatically bypasses certain circuitry in the high frequency bands that can contribute to noise, when it is appropriate based on other instrument settings.

For most applications, the preset state is **Standard Path**, which provides the best remote-control throughput, minimizes acoustic noise from switching and minimizes the risk of wear in the hardware switches, particularly in remote test scenarios where both low band and high band setups will follow in rapid succession. In this path, the bypass of the low band/high band switch and microwave preamp is never activated, which can cause some noise degradation but preserves the life of the bypass switch.

For applications that utilize the wideband IF paths, the preset state is **µW Preselector Bypass**, if option MPB is present. This is because, when using a wideband IF such as the 140 MHz IF, the µW Preselector's bandwidth can be narrower than the available IF bandwidth, causing degraded amplitude flatness and phase linearity, so it is desirable to bypass the preselector in the default case.

You may choose **Low Noise Path Enable** for a lower noise floor, especially in the 21-26.5 GHz region, though without improving many measures of dynamic range, and without giving the best possible noise floor. The preamp, if purchased and used, gives better noise floor than does **Low Noise Path Enable**, but the preamp's compression threshold and third-order intercept are much poorer than that of **Low Noise Path Enable**.

A fourth choice is **Full Bypass Enable**, which combines **µW Preselector Bypass** and **Low Noise Path Enable**. Because this can bypass most of the circuitry between the input and the first mixer, care should be taken when using this setting to avoid damaging the mixer. **Full Bypass Enable** is only available if both options LNP and MPB are present, as well as option FBP.

Path	Example	Note
Standard Path	:POW:MW:PATH STD	Normal setting for most measurements. µW Preselector in circuit, Low Noise Path disabled
Low Noise Path Enable	:POW:MW:PATH LNP	See "Low Noise Path Enable" on page 1966
µW Preselector Bypass	:POW:MW:PATH MPB	See "µW Preselector Bypass" on page 1968
Full Bypass Enable	:POW:MW:PATH FULL	See "Full Bypass Enable" on page 1969

Remote Command	[:SENSe]:POWer[:RF]:MW:PATH STD | LNPath | MPBypass | FULL [:SENSe]:POWer[:RF]:MW:PATH?
Example	:POW:MW:PATH LNP Enables the Low Noise path :POW:MW:PATH?

Notes	If "Presel Center" on page 1956 is performed, the instrument will momentarily switch to the Standard Path, regardless of the setting of **µW Path Control** The DC Block will always be switched in when the low noise path is switched in, to protect succeeding circuitry from DC. Note that this does not mean “when the low noise path is enabled” but when, based on the Low Noise Path rules, the path is actually switched in. This can happen when the selection is **Low Noise Path Enable** or **Full Bypass Enable**. In the case where the DC Block is switched in the instrument is now AC coupled. However, if you selected DC coupling, the UI would still behave as though it were DC coupled, including all annunciation, warnings, status bits, and responses to SCPI queries. This is because, based on other settings, the instrument could switch out the low noise path at any time and hence go back to being DC coupled Alignment switching ignores the settings in this menu, and restores them when finished
Dependencies	Does not appear in CXA-m, VXT Models M9410A/11A, nor in BBIQ and External Mixing – The **Low Noise Path Enable** selection does not appear unless Option LNP is present and licensed – The **µW Preselector Bypass** selection does not appear unless Option MPB is present and licensed – The **Full Bypass Enable** selection does not appear unless options LNP and MPB are both present as well as option FBP In any of these cases, if the required options are not present and the SCPI command is sent, error -241, "Hardware missing; Option not installed" is generated **Low Noise Path Enable** and **Full Bypass Enable** are grayed-out if the current measurement does not support them **Low Noise Path Enable** and **Full Bypass Enable** are not supported in Avionics and MMR Modes (non-modulation measurements). In any of these cases (that is, the feature is not supported in either measurement or Mode), if the SCPI command is sent, the following error is generated: -221, “Setting Conflict; Feature not supported for this measurement”
Preset	**Mode**: IQ Analyzer, Pulse, Avionics — **Value**: MPB option present and licensed: `MPB`; MPB option not present and licensed: `STD` **Mode**: All other Modes — **Value**: `STD`
State Saved	Save in instrument state
Range	Standard Path | Low Noise Path Enable | µW Presel Bypass | Full Bypass Enable
Annotation	In the Meas Bar, if the Standard path is chosen: µW Path: Standard If Low Noise Path is enabled but the LNP switch is not thrown: µW Path: LNP,Off If the Low Noise Path is enabled and the LNP switch *is* thrown: µW Path: LNP,On If the preselector is bypassed: µW Path: Bypass

If Full Bypass Enable is selected but the LNP switch is not thrown:

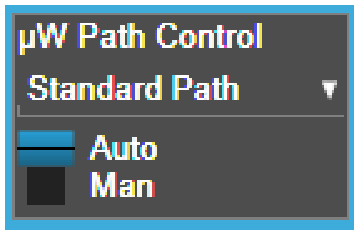
µW Path: FByp,Off

If Full Bypass Enable is selected and the LNP switch *is* thrown:

µW Path: FByp,On

µW Path Control Auto

In VMA, WLAN, 5G NR, CQM Modes, an **Auto/Man** switch is added to **µW Path Control**:



This allows the function to automatically switch based on certain Auto Rules as shown below:

VMA Mode

Measurement	When µW Path Control is in Auto
Digital Demod	Use Standard Path unless tuned frequency > 3.6 GHz and IFBW > 15 MHz, in which case choose Preselector Bypass
Monitor Spectrum	Always Presel Bypass
IQ Waveform	Use Standard Path unless tuned frequency > 3.6 GHz and IFBW > 15 MHz, in which case choose Preselector Bypass
Custom OFDM	Use Standard Path unless tuned frequency > 3.6 GHz and IFBW > 15 MHz, in which case choose Preselector Bypass
Channel Power	Always Presel Bypass
Occupied BW	Always Presel Bypass
CCDF	Use Standard Path unless tuned frequency > 3.6 GHz and IFBW > 15 MHz, in which case choose Preselector Bypass
ACP	Always Presel Bypass
SEM	Always Presel Bypass
Spurious Emissions	Always Standard Path

WLAN Mode

Measurement	When µW Path Control is in Auto
Modulation Analysis	Always Presel Bypass

Measurement	When µW Path Control is in Auto
Spectral Flatness	Always Presel Bypasss
Power vs Time	Always Presel Bypass
Monitor Spectrum	Always Presel Bypass
IQ Waveform	Always Presel Bypass
Channel Power	Always Presel Bypass
Occupied BW	Always Presel Bypass
CCDF	Always Presel Bypass
SEM	For 11be 320M, when 'Enabled Wideband IF for FFT' is OFF or 'Sweep Type Rule' is Best Dynamic Range, auto µW path is standard For other cases, auto µW path is presel bypass if presel bypass is enabled, auto µW path is standard if presel bypass is not enabled
Spurious Emissions	Always Standard Path

5G NR Mode

Measurement	When µW Path Control is in Auto
Modulation Analysis	Use Standard Path unless tuned frequency > 3.6 GHz and IFBW > 15 MHz, in which case choose Full Bypass if conditions warrant(FBP Option is available and "Allow Full Bypass in Auto" is On), otherwise choose Preselector Bypass
Monitor Spectrum	Always Standard Path
IQ Waveform	Use Standard Path unless tuned frequency > 3.6 GHz and IFBW > 15 MHz, in which case choose Full Bypass if conditions warrant(FBP Option is available and "Allow Full Bypass in Auto" is On), otherwise choose Preselector Bypass
Channel Power	Always Standard Path
Occupied BW	Always Standard Path
CCDF	Use Standard Path unless tuned frequency > 3.6 GHz and IFBW > 15 MHz, in which case choose Preselector Bypass
ACP	Always Standard Path
SEM	Always Standard Path
Spurious Emissions	Always Standard Path
Transmit On|Off Power	Use Standard Path unless tuned frequency > 3.6 GHz and Info BW > 15 MHz, in which case choose Preselector Bypass

Channel Quality Mode

Measurement	When µW Path Control is in Auto
Group Delay	Use Standard Path unless tuned frequency > 3.6 GHz and IFBW > 15 MHz, in which case choose Full Bypass if conditions warrant(FBP Option is available and "Allow Full Bypass in Auto" is On), otherwise choose Preselector Bypass

Measurement	When µW Path Control is in Auto
Monitor Spectrum	Always Standard Path
IQ Waveform	Use Standard Path unless tuned frequency > 3.6 GHz and IFBW > 15 MHz, in which case choose Preselector Bypass
CCDF	Use Standard Path unless tuned frequency > 3.6 GHz and IFBW > 15 MHz, in which case choose Preselector Bypass

Remote Command	`[:SENSe]:POWer[:RF]:MW:PATH:AUTO ON | OFF | 1 | 0` `[:SENSe]:POWer[:RF]:MW:PATH:AUTO?`
Example	`:POW:MW:PATH:AUTO ON` `:POW:MW:PATH:AUTO?`
Dependencies	Only appears in VMA, WLAN, 5G NR and CQM Modes
Couplings	See the tables above
Preset	ON
Range	ON|OFF

Low Noise Path Enable

Low Noise Path Enable provides a lower noise floor under some circumstances, particularly when operating in the 21–26.5 GHz region. With the Low Noise Path enabled, the low band/high band switch and microwave preamp are bypassed whenever *all* the following are true:

- The instrument is not in the Low Band, meaning:
- the start frequency is above 3.5 GHz and
- the stop frequency is above 3.6 GHz
- The internal preamp is not installed, or if installed, is set to **Off** or **Low Band**

Note that this means that, when any part of a sweep is done in Low Band, the Low Noise Path is not used, whether or not the **Low Noise Path Enable** is selected in the user interface. Also, if the preamp is turned on, the Low Noise Path is not used, whether or not the **Low Noise Path Enable** is selected in the user interface. The only time the Low Noise Path is used is when **Low Noise Path Enable** is selected, the sweep is completely in High Band (> 3.6 GHz) and no preamp is in use.

For measurements that use IQ acquisition, the low noise path is used when **Center Frequency** is in High Band (> 3.6 GHz) and no preamp is in use. In other words, the rules above are modified to use only the center frequency to qualify which path to switch in. This is not the case for FFTs in the Swept SA measurement; they use the same rules as swept measurements.

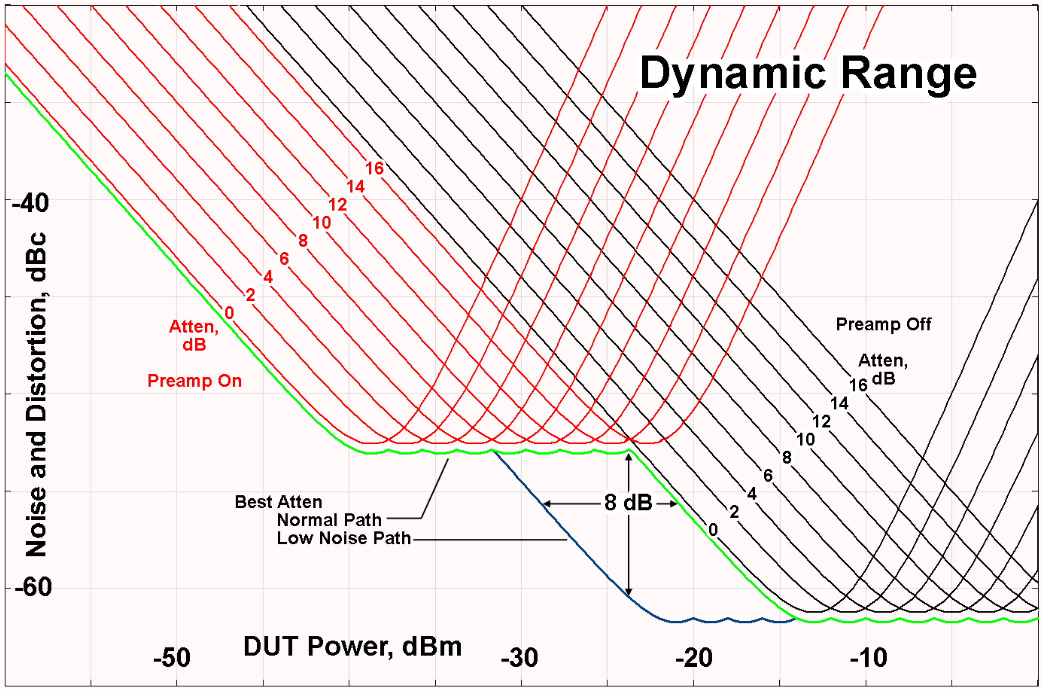
Note that the Low Noise Path, while giving improved DANL, has the disadvantage of decreased TOI performance and decreased gain compression performance relative to the standard path.

Note also that the bypass switch is a mechanical switch and has finite life, so if the **Low Noise Path Enable** is selected, it is possible to cause frequent cycling of this switch by frequently changing instrument settings such that the above conditions hold true only some of the time. A user making tests of this nature should consider opting for the **Standard Path**, which will never throw the bypass switch, at the expense of some degraded noise performance.

The low noise path is useful for situations where the signal level is so low that the instrument performance is dominated by noise even with 0 dB attenuation, but still high enough that the preamp option would have excessive third-order intermodulation or compression. The preamp, if purchased and used, gives better noise floor than does the "Low Noise Path." However, its compression threshold and third-order intercept are much poorer than that of the non-preamp path.

There are some applications, typically for signals around –30 dBm, for which the third-order dynamic range of the standard path is good enough, but the noise floor is not low enough even with 0 dB input attenuation. When the third-order dynamic range of the preamp path is too little and the noise floor of the standard path is too high, the Low Noise Path can provide the best dynamic range

The graph below illustrates the concept. It shows, in red, the performance of an instrument at different attenuation settings, both with the preamp on and off, in a measurement that is affected by both instrument noise and instrument TOI. The green shows the best available dynamic range, offset by 0.5 dB for clarity. The blue shows how the best available dynamic range improves for moderate signal levels with the low noise path switched in. In this illustration, the preamp improves the noise floor by 15 dB while degrading the third-order intercept by 30 dB, and the low noise path reduces loss by 8 dB. The attenuator step size is 2 dB.



There are other times where selecting the low noise path improves performance, too. Compression-limited measurements such as finding the nulls in a pulsed-RF spectrum can profit from the low noise path in a way similar to the TOI-limited measurement illustrated. Accuracy can be improved when the low noise path allows the optimum attenuation to increase from a small amount like 0, 2 or 4 dB to a larger amount, giving better return loss at the instrument input. Harmonic measurements, such as second and third harmonic levels, are much improved using the low noise path because of the superiority of that path for harmonic (though not intermodulation) distortion performance.

µW Preselector Bypass

Toggles the preselector bypass switch for band 1 and higher. When the microwave presel is on, the signal path is preselected. When the microwave preselector is off, the signal path is not preselected. The preselected path is the normal path for the instrument.

The preselector is a tunable bandpass filter which prevents signals away from the frequency of interest from combining in the mixer to generate in-band spurious signals (images). The consequences of using a preselector filter are its limited bandwidth, the amplitude and phase ripple in its passband, and any amplitude and phase instability due to center frequency drift.

Option MPB or pre-selector bypass provides an unpreselected input mixer path for certain X-Series signal analyzers with frequency ranges above 3.6 GHz. This signal path allows a wider bandwidth and less amplitude variability, which is an advantage when doing modulation analysis and broadband signal analysis. The disadvantage is that, without the preselector, image signals will be displayed. Another disadvantage of bypassing the preselector is increased LO emission levels at the front panel input port.

Image responses are separated from the real signal by twice the 1st IF. For IF Paths of 10 MHz and 25 MHz, the 1st IF is 322.5 MHz, so the image response and the real signal will be separated by 645 MHz. The 1st IF will be different for other IF Path settings. When viewing a real signal and its corresponding image response in internal mixing, the image response will be to the left of the real signal.

Also, the image response and the real signal typically have the same amplitude and exhibit the same shape factor.

However, if Option FS1 (Fast Sweep Capability) is enabled, the image response in the Swept SA measurement appears lower in amplitude and has a much wider shape factor compared to the real signal.

Full Bypass Enable

With **Full Bypass Enable** selected, the microwave preselector is bypassed. In addition, the low band/high band switch and microwave preamp are bypassed whenever *all* the following are true:

- The instrument is not in the Low Band, meaning:
- the start frequency is above 3.5 GHz and
- the stop frequency is above 3.6 GHz.
- the internal preamp is not installed or if installed, is set to **Off** or **Low Band**

Note that this means that, when any part of a sweep is done in Low Band, the Low Noise Path is not used, whether or not the **Full Bypass Enable** is selected in the user interface. Also, if the preamp is turned on, the Low Noise Path is not used, whether or not the **Full Bypass Enable** is selected in the user interface. The only time the Low Noise Path is used is when **Full Bypass Enable** is selected, the sweep is completely in High Band (> 3.6 GHz) and no preamp is in use.

CAUTION **When Full Bypass Enable is selected, and "Y Scale" on page 1929 is set to 0 dB, there will be a direct AC connection between the input and the first converter when the Low Noise Path switches in (when Start Freq >3.6 GHz and the Preamp is either not licensed, set to Low Band, or Off). This puts the first converter at considerable risk to be damaged by high AC power. Consequently,**

whenever **Full Bypass Enable** is selected, a warning message appears in the status bar:

“Full Bypass Enabled, maximum safe input power reduced”

Microwave Preselector Bypass Backwards Compatibility

Example	`:POW:MW:PRES OFF` Bypasses the microwave preselector
Notes	Included for Microwave Preselector Bypass backwards compatibility The `ON` parameter sets the `STD` path (`:POW:MW:PATH STD`) The `OFF` parameter sets path `MPB` (`:POW:MW:PATH MPB`)
Preset	`ON`
Backwards Compatibility SCPI	`[:SENSe]:POWer[:RF]:MW:PRESelector[:STATe] ON | OFF | 0 | 1` `[:SENSe]:POWer[:RF]:MW:PRESelector[:STATe]?`

Frequency Extender Preselection Bypass

Only applies to the high frequency path of the Frequency Extender, and only if the Frequency Extender allows it. For example, the V3050A high frequency path is 50 – 110 GHz and *does* allow control of the preselector bypass.

When the Frequency Extender’s preselection is bypassed, flatness is improved, but will be subject to spurs from out-of-band interfering signals. For bandwidths greater than 2.5 [GHz], it is recommended that the signal bypass the Frequency Extender Preselector since the max bandwidth of the Preselector can be as narrow as 2.5 [GHz].

For most applications, the preset state is `OFF`, which gives the best remote-control throughput, minimizes acoustic noise from switching, minimizes out of band spurs, and minimizes the risk of wear in the hardware switches.

Preselector and Bandwidth Conflict

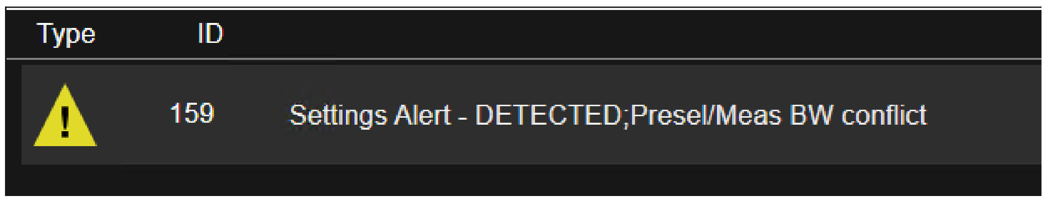
When the Frequency Extender Preselector is applied and the signal bandwidth is greater than 2.5 [GHz], then a settings alert message will show to warn the user that the signal may be distorted due to the limitation of the Frequency Extender Preselector bandwidth.

An example of the settings alert message is shown below.

Settings Alert message in the Status Bar at the bottom of the display.

Settings Alert message in the error queue

.



Software Preselection

Provided in some instruments, either to compensate for issues with provided hardware preselection or to provide the preselection function when there is no hardware preselector.

N9041B

Software Preselection compensates for the frequency range limit of the microwave preselector. Since the microwave preselector only goes up to 50 GHz, software preselection must be used to suppress and separate images above 50 GHz. The specific algorithm used for software preselection is specified by the SW Preselection Type selection – Normal or Advanced.

In N9041B, **Software Preselection** only applies for frequencies above 50 GHz, therefore it is only used for RF Input 2. Even if turned on, it is not used for other inputs, and never for frequencies below 50 GHz. This is why the label of this control contains the parenthetical note “(>~50 GHz)”.

Note that in N9041B, in Swept SA measurement, **Software Preselection** works even if the measurement is using an FFT Sweep Type. In measurements other than Swept SA, Software Preselection is not used if the measurement is using an FFT sweep type.

N9042B+V3050A

Software Preselection compensates for the frequency range limit of the microwave preselector. Since the microwave preselector only goes up to 50 GHz, software preselection must be used to suppress and separate images above 50 GHz. The specific algorithm used for software preselection is specified by the SW Preselection Type selection – Normal or Advanced.

For N9042B+V3050A, Software Preselection only applies for frequencies above 50 GHz, therefore it is only used for External RF. Even if it is turned on, it will not be used for other inputs and never for frequencies below 50 GHz. This is why the label of this control contains the parenthetical note “(>~50 GHz)”.

Note that for N9042B+V3050A, in the Swept SA measurement, Software Preselection works even if the measurement is using an FFT Sweep Type. In measurements other than Swept SA, Software Preselection is not used if the measurement is using an FFT Sweep Type.

VXT models M9410A/11A

Software Preselection is used to provide the preselection function, as there is no hardware preselector in these models. Two background traces are taken and compared point by point, and the point with the lowest amplitude from the two traces is used. This provides a method to reduce spurs that are internally generated within the VXT, but you should note the following when using Software Preselection:

– There is some speed cost due to the need to take multiple captures

– Taking the point with the lowest amplitude in each trace will make the average noise level lower at all points that do not have a spur. This can reduce the accuracy of the measurement of noise and noise-like signals

Because of the difficulty in identifying spurs manually, you are recommended to leave Software Preselection ON at all times in VXT models M9410A/11A. If you turn it off in order to speed up your measurement or improve noise accuracy, be aware of unwanted onscreen spurs.

Remote Command	`[:SENSe]:POWer[:RF]:SWPResel:STATe 0 | 1 | ON | OFF` `[:SENSe]:POWer[:RF]:SWPresel:STAT?`
Example	`:POW:SWPR:STAT 1` `:POW:SWPR:STAT?`
Dependencies	Only appears in N9041B, N9042B+V2050A, and VXT models M9410A/11A. Does not appear in all measurements
Couplings	Affects **Sweep Time** **Auto Tune** supports **Software Preselection**, so **Auto Tune** should be performed after setting the **Software Preselection** state
Preset	N9041B: OFF N9042B+V3050A: ON M9410A/11A: ON
State Saved	Saved in instrument state

SW Preselection Type

Specifies the algorithm used for software preselection.

Two hidden sweeps occur in succession. The second sweep is offset in LO frequency by 2 * IF / N. For each point in each trace, the smaller amplitude from the two traces is taken and placed in that point in the selected trace. The Peak detector is auto-selected to improve the image suppression effectiveness. Responses of each trace that lie on top of one another will remain and are valid signals. Other signals are images, which are suppressed. The action of taking the smaller of the two traces will make the average noise level lower in all points that do not have an image, thus reducing the accuracy of the measurement of noise and noise-like signals.

- `NORMal` - mathematically removes all image and multiple responses of signals present at the input
- `ADVanced` - any trace processing (such as "max hold" or trace averaging) is performed on the points of both candidate traces before the "select minimum" operation occurs. This form of processing works better for non-stationary signals, such as pulsed-RF signals

Remote Command	`[:SENSe]:POWer[:RF]:SWPResel NORMal | ADVanced` `[:SENSe]:POWer[:RF]:SWPResel?`
Example	`:POW:SWPR NORM` `:POW:SWPR?`
Dependencies	Only appears in N9041B and N9042B+V3050A. Only appears in measurements that use the Swept method Grayed-out when "Software Preselection" on page 1971 is `OFF`. The grayout message is "Unavailable unless SW Presel enabled"
Preset	N9041B: `ADVanced` N9042B+V3050A: `NORMal`
State Saved	Saved in instrument state

SW Preselection BW

Specifies the effective bandwidth to be used for Software Preselection.

The options are:

- `NORMal` – when making Swept measurements, a software preselection algorithm is used which takes up to 4 background acquisitions, then post-processes the result. This algorithm can remove images from signals with an occupied

bandwidth up to around 3 GHz. (Default/Preset setting). When making FFT measurements, this algorithm is not used, instead the same algorithm is used as for NARRow (below)

– NARRow– a software preselection algorithm is used which takes two background acquisitions, then post-processes the result to detect and remove images from wideband signals with occupied bandwidths up to 2 GHz. This increases the risk of images failing to be rejected, but improves the measurement speed

Remote Command	`[:SENSe]:POWer[:RF]:SWPResel:BW NORMal | NARRow` `[:SENSe]:POWer[:RF]:SWPResel:BW?`
Example	`:POW:SWPR:BW NARR`
Dependencies	Only appears in N9041B and N9042B+V3050A. Only appears in measurements that use the Swept method Grayed-out when "Software Preselection" on page 1971 is OFF. The grayout message is "Unavailable unless SW Presel enabled" For N9042B+V3050A, the parameter is SCPI-only, and always set to NARRow when **Software Preselection** is enabled
Preset	N9041B: NORMal N9042B+V3050A: NARRow
State Saved	Saved in instrument state

High Freq Prefilter

Lets you set the state of Prefilter for center frequencies above 1310 MHz.

In VXT Models M9410A/11A, the Receiver RF path has a bank of filters that come after the RF Attenuator in the signal path. Since this bank of filters precedes the mixer they are known as the "Prefilter" bank. Their purpose is to eliminate unwanted in-band mixing products by filtering out all but the desired frequencies before the signals get to the mixer. There are 13 prefilter bands to cover the frequencies between 9 kHz and 6000 MHz. The Prefilter provides the necessary rejection of the unwanted signal.

Remote Command	`[:SENSe]:<measurement>:PFILter[:STATe] ON | OFF | 1 | 0` `[:SENSe]:<measurement>:PFILter[:STATe]?`

Example	Enable High Freq Prefilter for the Complex Spectrum Measurement in BASIC Mode:
	`:SPEC:PFIL ON`
	Enable High Freq Prefilter for the IQ Waveform Measurement, in multiple Modes:
	`:WAV:PFIL ON`
	Enable High Freq Prefilter for the Swept SA Measurement in SA Mode:

	:SAN:PFIL ON
Dependencies	Only appears in VXT models M9410A/11A with center frequency above 1310 MHz
Preset	See "Prefilter Presets" on page 1975 below
State Saved	Saved in instrument state

Prefilter Presets

Meas	Mode	Preset
SPEC	BASIC	OFF
WAV	BASIC, WCDMA, WLAN, LTEAFDD, LTEATDD, 5GNR, VMA	OFF
MON	WCDMA, WLAN, LTEAFDD, LTEATDD, 5GNR, VMA	OFF
RHO	WCDMA	OFF
CDP	WCDMA	OFF
PCON	WCDMA	OFF
EVMQ	WCDMA	OFF
CHP	WCDMA, WLAN, LTEAFDD, LTEATDD, 5GNR, VMA, SA	OFF
OBW	WCDMA, WLAN, LTEAFDD, LTEATDD, 5GNR, VMA, SA	OFF
ACP	WCDMA, LTEAFDD, LTEATDD, 5GNR, VMA, SA	OFF
SEM	WCDMA, WLAN, LTEAFDD, LTEATDD, 5GNR, VMA, SA	OFF
PST	WCDMA, WLAN, LTEAFDD, LTEATDD, 5GNR, VMA, SA	OFF
PVT	WLAN, LTEAFDD, LTEATDD, 5GNR	OFF
EVM	WLAN, LTEAFDD, LTEATDD, 5GNR	OFF
FLAT	WLAN	OFF
EVMM	WLAN	OFF
CEVM	LTEAFDD, LTEATDD	OFF
PAVT	5GNR, VMA	OFF
DDEM	VMA	OFF
OFDM	VMA	OFF
SAN	SA	ON
HARM	SA	ON

3.13.4 BW

For this measurement, bandwidth is determined by the algorithm, and is not user-adjustable.

3.13.5 Display

Opens the **Display** menu, which lets you configure display items for the current Mode, Measurement View or Window.

3.13.5.1 Meas Display

Contains controls for setting up the display for the current Measurement, View or Window.

Display Type

Allows you to display Phase and Amplitude traces in absolute values, or values relative to the 1st sample point's phase and amplitude. The 1st sample point's phase and amplitude are different from the Relative Baseline values, which only reflect the segment averaged phase and amplitude values. Setting **Display Type** to `RELative` enables the phase and amplitude traces to start from 0 degree and 0 dB, so there is no need to adjust scale or reference between measurements.

Remote Command	`:DISPlay:PAVTime:TYPE ABSolute | RELative` `:DISPlay:PAVTime:TYPE?`
Example	`:DISP:PAVT:TYPE REL` `:DISP:PAVT:TYPE?`
Preset	`ABSolute`
State Saved	Yes
Range	`ABSolute|RELative`

3.13.5.2 View

Contains controls for selecting the current **View**, and for editing User Views.

Views

The PAvT measurement has one view: "Normal" on page 1976.

This is a multiple-window View. When in a multiple-window View, you select a window by touching it. The menu controls may sometimes change depending on which window is selected.

Normal

Windows: "Graph" on page 1928, "Results" on page 1928

The PAvT measurement provides tabular result and graphical display.

User View

Lets you choose a View from the saved User Views for the current measurement. This panel only appears if a User View exists for the current measurement.

Remote Command	`:DISPlay:VIEW:ADVanced:SELect <alphanumeric>` `:DISPlay:VIEW:ADVanced:SELect?`
Example	Select Baseband as the current View `:DISP:VIEW:ADV:SEL "Baseband"`

Notes	You must be in the measurement whose View you are trying to set to send the command. You can only set Views for the current measurement using this command
	For predefined views, the parameter is derived from the view name that is shown in the View list in the user interface. For example, if you are trying to select the Trace Zoom view in the Swept SA measurement, you send:
	`:DISP:VIEW:ADV:SEL "Trace Zoom"`
	because "Trace Zoom" is the name of the View as seen in the Mode/Meas dialog or in the Display, View menu
	You *cannot* use the legacy View parameter (which in this case would be `TZOom`) with `:DISP:VIEW:ADV:SEL`
	`<alphanumeric>` is case insensitive; you can specify mixed case, however the name will be evaluated on a single case. Thus, both of the following forms work:
	`:DISP:VIEW:ADV:SEL "Trace Zoom"`
	`:DISP:VIEW:ADV:SEL "TRACE ZOOM"`
	If the specified view is not a valid View, the query returns the error message "-224, Illegal parameter value; View with the name <alphanumeric> does not exist"
	If the display is disabled (via `:DISP:ENAB OFF`) then the error message "-221, Settings conflict; View SCPI cannot be used while Display is disabled" is generated

Backwards Compatibility SCPI	The legacy node `:DISPlay:VIEW[:SELect]` is retained for backwards compatibility, but it only supports predefined views

Restore Layout to Default

Restores the Layout to the default for Basic.

Modified Views are very temporary; if you exit the current measurement they are discarded, and they are not saved in State. To retain this View for later use, and to be able to return easily to your original Basic View, you can save your edited View as a "User View".

Save Layout as New View

Saves your new View as a User View. An alpha keyboard appears, which lets you name your new View; the default is the old View name plus a number.

Remote Command	`:DISPlay:VIEW:ADVanced:NAME <alphanumeric>`
Example	`:DISP:VIEW:ADV:NAME “Baseband”` Creates a new View named `Baseband` from the current View, and selects it as the current View
Notes	`<alphanumeric>` is case insensitive; you can specify mixed case, however the name will be evaluated on a single case If `<alphanumeric>` name already exists as a View, the error message “-224, Illegal parameter value; View <alphanumeric> already exists” is generated If the display is disabled (via `:DISP:ENAB OFF`) then the error message “-221, Settings conflict; User View SCPI cannot be used while Display is disabled” is generated

Re-Save User View

You can re-edit a User View; if you make changes, then an asterisk will appear next to the User View’s name. You can then tap **Re-Save User View** to save it back to its existing name, or **Save Layout as New View** to add another, new User View.

This is a front panel function only, there is no remote command available to perform this function. To do this remotely, you must first perform **Save Layout as New View**, then delete the old User View and rename the new one with the name of the View you just deleted.

Rename User View

You can rename the current View by giving it a new unique name. Only User Views can be renamed, if the current View is a Predefined View, an error occurs.

Remote Command	`:DISPlay:VIEW:ADVanced:REName <alphanumeric>`
Example	`:DISP:VIEW:ADV:REN “Baseband”`
Notes	`<alphanumeric>` is case insensitive; you can specify mixed case, however the name will be evaluated on a single case If the `<alphanumeric>` specifying the new name is already present in the list of View names, the error message “-224, Illegal parameter value; View <alphanumeric> already exists” is generated If the current View is a Predefined View, the error message “-224, Illegal parameter value; Cannot rename a Predefined View” is generated If the display is disabled (via `:DISP:ENAB OFF`) then the error message “-221, Settings conflict; View SCPI cannot be used while Display is disabled” is generated

Delete User View

You can delete the current View if it is a User View. The default view becomes the current view for the Measurement.

Remote Command	`:DISPlay:VIEW:ADVanced:DELete`
Example	`:DISP:VIEW:ADV:DEL`
Notes	`<alphanumeric>` is case insensitive; you can specify mixed case, however the name will be evaluated on a single case If the `<alphanumeric>` is not present in the list of View names, the error message "-224, Illegal parameter value; View <alphanumeric> does not exist" is generated If the current View is a Predefined View, the error message "-224, Illegal parameter value; Cannot delete a Predefined View" is generated If the display is disabled (via `:DISP:ENAB OFF`) then the error message "-221, Settings conflict; View SCPI cannot be used while Display is disabled" is generated

Delete All User Views

Deletes all previously saved User Views. The default view becomes the current view for the Measurement if a User View was the current view when this command was executed.

Remote Command	`:DISPlay:VIEW:ADVanced:DELete:ALL`
Example	`:DISP:VIEW:ADV:DEL:ALL`
Notes	Disabled if there are no User Views

View Editor Remote Commands

The following remote commands help you manage Views and User Views. Note that the SCPI node for User Views handles both Predefined and User Views. The legacy nodes, `:DISPlay:VIEW[:SELect]` and `:DISPlay:VIEW:NSEL`, are retained for backwards compatibility, but they only support predefined views.

View Listing Query

Returns a string containing a comma-separated list of names for *all* the Views, including User Views, available for the current Measurement.

Remote Command	`:DISPlay:VIEW:ADVanced:CATalog?`

Example	`:DISP:VIEW:ADV:CAT?`
Notes	Returns a quoted string of the available Views for the current measurement, separated by commas. The list includes names for *all* the Views, including User Views, available for the current Measurement Example: `"Normal,Trace Zoom,Spectrogram,Baseband,myView1,yourView1"` No distinction is made between Predefined and User Views If you switch measurements with the display disabled (via `:DISP:ENAB OFF`), then query the list of available Views, the result is undefined

User View Listing Query

Returns a string containing a comma-separated list of names for *only* the User Views available for the current Measurement.

Remote Command	`:DISPlay:VIEW:ADVanced:USER:CATalog?`
Example	`:DISP:VIEW:ADV:USER:CAT?`
Notes	Returns a quoted string of the available User Views for the current measurement, separated by commas. Example: `"Baseband,myView1,yourView1"` If you switch measurements with the display disabled (see "Display Enable (Remote Command Only)" on page 1983), then query the list of available Views, the result is undefined

3.13.5.3 Annotation

Contains controls for setting up the annotation for the current Mode or Measurement.

Graticule

Turns the display graticule On or Off for all windows with graticules in all measurements in the current Mode. Also turns the graticule Y-Axis annotation on and off.

Remote Command	`:DISPlay:GRATicule[:STATe] OFF | ON | 0 | 1` `:DISPlay:GRATicule[:STATe]?`
Example	`:DISP:GRAT OFF`
Notes	The graticule is the set of horizontal and vertical lines that make up the grid/divisions for the X-Axis and Y-Axis

Preset	ON
State Saved	Saved in instrument state
Backwards Compatibility SCPI	:DISPlay:WINDow[1]:TRACe:GRATicule:GRID[:STATe] OFF | ON | 0 | 1 :DISPlay:WINDow[1]:TRACe:GRATicule:GRID[:STATe]? This command is accepted for backwards compatibility with older instruments, but the WINDow, TRACe and GRID parameters are ignored

Screen Annotation

Controls the display of the annunciation and annotation around the graticule, including any annotation on lines (such as the display line, the threshold line, etc.) and the Y-Axis annotation, for all windows with screen annotation in all measurements in the current Mode.

This does *not* include marker annotation (or the N dB result). When OFF, the graticule expands to fill the entire graticule area, leaving only the 1.5% gap above the graticule, as described in the **Trace** section.

Remote Command	:DISPlay:ANNotation:SCReen[:STATe] OFF | ON | 0 | 1 :DISPlay:ANNotation:SCReen[:STATe]?
Example	:DISP:ANN:SCR OFF
Dependencies	Grayed-out and forced to OFF when **System Display Settings**, **Annotation** is OFF
Preset	ON This remains OFF through a Preset when **System Display Settings**, **Annotation** is set to OFF
State Saved	Saved in instrument state

Trace Annotation

Turns on and off the labels on the traces, showing their detector (or their Math Mode) as described in the **Trace** section, for all windows in all measurements in the current Mode for which Trace Annotation on/off is supported.

If Trace Math is being performed on a trace, then the Trace Math annotation replaces the detector annotation.

For measurements that support limit lines, this key also turns on and off the labels on the Limit Lines. The label is the Limit number annotation and Limit Comment displayed on the graph. If the length of the comment is greater than 20 characters, the first 8 characters and the last 8 characters are displayed, joined with ....

Remote Command	:DISPlay:ANNotation:TRACe[:STATe] ON | OFF | 1 | 0 :DISPlay:ANNotation:TRACe[:STATe]?

Example	:DISP:ANN:TRAC OFF
Preset	OFF
State Saved	Saved in instrument state

Control Annotation

Turns on and off the display of values on the Active Function controls for all measurements in the current Mode. This is a security feature.

Remote Command	:DISPlay:ACTivefunc[:STATe] ON | OFF | 1 | 0
	:DISPlay:ACTivefunc[:STATe]?
Example	:DISP:ACT OFF
Dependencies	Grayed out and forced to OFF when **System Display Settings**, **Annotation** is OFF
Preset	ON
	This remains OFF through a Preset when **System Display Settings**, **Annotation** is set to OFF
State Saved	Saved in instrument state

Frequency Annotation

Turns on and off the absolute frequency annotation in the main display for all windows in all measurements in the current Mode for which Frequency Annotation on/off is supported.

The affected annotations include Center Frequency, Start/Stop Frequency, Frequency Offset, Marker Frequency. Any relative frequency annotation such as Span and Marker Delta are not affected.

The frequency annotations in any other associated display, such as in Active Function, Softkey label, Limit Editor, Amp Corr Editor and Marker Table are not changed.

Frequency annotations that are not associated with the spectrum, such as RBW, IBW, Sweep Time, are excluded and they are shown regardless of this selection.

Remote Command	:DISPlay:ANNotation:FREQuency[:STATe] ON | OFF | 1 | 0
	:DISPlay:ANNotation:FREQuency[:STATe]?
Example	:DISP:ANN:FREQ OFF
Dependencies	Only appears in the Swept SA measurement in Spectrum Analyzer Mode
Preset	ON

Meas Bar

Turns the Measurement Bar at the top of the screen on and off for all measurements in the current Mode. When `OFF`, the graticule area expands to fill the area formerly occupied by the Measurement Bar.

Remote Command	`:DISPlay:ANNotation:MBAR[:STATe] OFF | ON | 0 | 1` `:DISPlay:ANNotation:MBAR[:STATe]?`
Example	`:DISP:ANN:MBAR OFF`
Dependencies	Grayed out and forced to `OFF` when **System Display Settings**, **Annotation** is `OFF`
Preset	`ON` This remains `OFF` through a Preset when **System Display Settings**, **Annotation** is set to `OFF`
State Saved	Saved in instrument state

Display Enable (Remote Command Only)

Turns the display on/off, including the display drive circuitry. The backlight stays lit to confirm that the instrument is on. The display enable setting is mode global. Theare three reasons for turning the display off:

1. To increase speed as much as possible by freeing the instrument from having to update the display
2. To reduce emissions from the display, drive circuitry
3. For security purposes

If you have turned off the display:

- and you are in local operation, the display can be turned back on by pressing any key or by sending `:SYSTem:DEFaults MISC` or `:DISPlay:ENABle ON` (neither `*RST` nor :SYSTem:PRESet enable the display)
- and you are in remote operation, the display can be turned back on by pressing the **Local** or **Esc** keys, or by sending `:SYSTem:DEFaults MISC` or `:DISPlay:ENABle ON` (neither `*RST` nor `:SYSTem:PRESet` enable the display)
- and you are using either the `:SYSTem:KLOCk` command or GPIB local lockout, then *no* front-panel key press will turn the display back on. You must turn it back on remotely.

If the display is `OFF`, many SCPI commands related to User Views and Multiscreen functionality do not work, and return the error messages “-221, Settings conflict; Screen SCPI cannot be used when Display is disabled” or “221, Settings conflict; View SCPI cannot be used while Display is disabled”. These commands include:

Name	Command
Select User View	:DISPlay:VIEW:ADVanced:SELect
Rename User View	:DISPlay:VIEW:ADVanced:REName
Delete User View	:DISPlay:VIEW:ADVanced:DELete
Create User View	:DISPlay:VIEW:ADVanced:NAME
Select Screen	:INSTrument:SCReen:SELect
Delete Screen	:INSTrument:SCReen:DELete
Delete All But This Screen	:INSTrument:SCReen:DELete:ALL
Add Screen	:INSTrument:SCReen:CREate
Rename Screen	:INSTrument:SCReen:REName
Sequencer On/Off	:SYSTem:SEQuencer

Remote Command	`:DISPlay:ENABle OFF | ON | 0 | 1` `:DISPlay:ENABle?`
Example	`:DISP:ENAB OFF`
Couplings	`:DISP:ENAB OFF` turns Backlight `OFF` and `:DISP:ENAB ON` turns Backlight `ON`, but changing Backlight settings does *not* change the state of `:DISP:ENAB`
Preset	`ON` Set by `:SYST:DEF MISC`, but not affected by `*RST` or `:SYSTem:PRESet`
State Saved	Not saved in instrument state
Backwards Compatibility Notes	`:SYST:PRES` no longer turns on `:DISPlay:ENABle` as it did in legacy analyzers

3.13.6 Frequency

Opens the **Frequency** menu, which contains controls that allow you to control the Frequency parameters of the instrument.

Some features in this menu are the same for all measurements in the current Mode – they do not change as you change measurements. Settings like these are called “Meas Global” and are unaffected by Meas Preset. For example, the Center Freq setting is the same for all measurements - it does not change as you change measurements.

3.13.6.1 Settings

Contains controls that pertain to the frequency parameters of the measurement. These parameters control where the instrument is tuned, and implications to the measurement algorithm.

Center Frequency

This function sets (and queries) the **Center Frequency** for the currently selected input. If your instrument has multiple inputs, and you select another input, **Center Frequency** changes to the value for that input. SCPI commands are available to directly set the value for a specific input.

Center Frequency is remembered as you go from input to input.

See:

– "RF Center Freq" on page 1987

– "Ext Mix Center Freq" on page 1988

– "I/Q Center Freq" on page 1989

– "Center Frequency Presets" on page 1986

Remote Command	`[:SENSe]:FREQuency:CENTer <freq>` `[:SENSe]:FREQuency:CENTer?`

Example	`:FREQ:CENT 50 MHz`
	sets Center Frequency to 50 MHz
	`:FREQ:CENT UP`
	increments the Center Frequency by the value of CF Step
	`:FREQ:CENT?`
	returns the current value of Center Frequency

Notes	Preset and Max values are dependent on Hardware Options (5xx), port selections or other aspects of the particular instrument in use If no terminator (e.g., MHz) is sent, the terminator Hz is used. If a terminator with unit other than Frequency is used, an invalid suffix error message is generated
Couplings	For E7760A, if the Input Port selected is a mmWave port, and option RF4 is not present, the frequency of the instrument and source must be the same. Thus, changing this instrument frequency will also update the source frequency. If option RF4 is present, the frequency of the instrument and source are independent
Preset	Depends on instrument's maximum frequency, mode, measurement, and selected input See "Center Frequency Presets" on page 1986 , "RF Center Freq" on page 1987, "Ext Mix Center Freq" on page 1988, and "I/Q Center Freq" on page 1989
State Saved	Saved in instrument state
Min	Depends on instrument's maximum frequency, mode, measurement, and selected input See "Center Frequency Presets" on page 1986 , "RF Center Freq" on page 1987, "Ext Mix Center Freq" on page 1988, and "I/Q Center Freq" on page 1989

Max	Depends on instrument maximum frequency, mode, measurement, and selected input See "Center Frequency Presets" on page 1986 , "RF Center Freq" on page 1987, "Ext Mix Center Freq" on page 1988, and "I/Q Center Freq" on page 1989
Status Bits/OPC dependencies	Non-overlapped

Center Frequency Presets

The following table provides the Center Frequency Presets for the Spectrum Analyzer mode, and the Max Freq, for the various frequency options:

Freq Option	CF after Mode Preset	Stop Freq after Mode Preset	Max Freq (can't tune above)
503 (all but CXA)	1.805 GHz	3.6 GHz	3.7 GHz
503 (CXA)	1.505 GHz	3.0 GHz	3.08 GHz
507 (all but CXA)	3.505 GHz	7.0 GHz	7.1 GHz
507 (CXA)	3.755 GHz	7.5 GHz	7.58 GHz
508 (all but MXE)	1.805 GHz	3.6 GHz	8.5 GHz
508 (MXE)	4.205 GHz	8.4 GHz	8.5 GHz
513	6.805 GHz	13.6 GHz	13.8 GHz
526 (except CXA and MXE)	13.255 GHz	26.5 GHz	27.0 GHz*
526 (CXA)	13.255 GHz	26.5 GHz	26.55 GHz
526 (MXE)	1.805 GHz	3.6 GHz	27.0 GHz
532	16.005 GHz	32.0 GHz	32.5 GHz
540	20.005 GHz	40.0 GHz	40.5 GHz
543	21.505 GHz	43.0 GHz	43.0 GHz
544	22.005 GHz	44.0 GHz	45.0 GHz
550	25.005 GHz	50.0 GHz	52 GHz
F03 (CXA-m)	1.505 GHz	3.0 GHz	3.08 GHz
F07 (CXA-m)	3.755 GHz	7.5 GHz	7.575 GHz
F13 (CXA-m)	6.805 GHz	13.6 GHz	13.8 GHz
F26 (CXA-m)	13.255 GHz	26.5 GHz	26.55 GHz
504 (M9421A, M8920A)	2.145 GHz	3.88GHz	3.88 GHz
506 (M9421A, M8920A)	3.245 GHz	6.08GHz	6.08 GHz
F06 (M9410A/11A)	1.0 GHz	6.08 GHz	6.08 GHz
F06 (M9415A)	1 GHz	1.08 GHz	6.6 GHz
F08 (M9415A)	1 GHz	1.08 GHz	8.6 GHz
F12 (M9415A)	1 GHz	1.08 GHz	12.9 GHz

*For option 526, the Max CF in RTSA is 26.999999995 GHz.

N9041B Center Freq Presets

Input	CF after Mode Preset	Stop Freq after Mode Preset	Max Freq (can't tune above)
Input 1, all models	25.005 GHz	50.0 GHz	52 GHz
Input 2, opt 585	42.505 GHz	85.0 GHz	86 GHz
Input 2, opt 590	45.005 GHz	90.0 GHz	92 GHz
Input 2, opt 5CX	55.005 GHz	110.0 GHz	110 GHz

Input 2, CXA and MXE

Model	CF after Mode Preset	Stop Freq after Mode Preset	Max Freq (can't tune above)
CXA opt C75	0.7505 GHz	1.5 GHz	1.58 GHz
MXE	505 MHz	1 GHz	1.000025 GHz

Tracking Generator Frequency Limits (CXA only)

Tracking Generator Option	Min Freq (clips to this freq when turn TG on and can't tune below while TG on)	If above this Freq, Stop Freq clipped to this Freq when TG turned on	Max Freq (can't tune above) while TG on
T03	9 kHz	3.0 GHz	3.08 GHz
T06	9 kHz	6.0 GHz	6.05 GHz

Tracking Generator Frequency Limits(CXA-m only)

Tracking Generator Option	Min Freq (clips to this freq when turn TG on and can't tune below while TG on)	If above this Freq, Stop Freq clipped to this Freq when TG turned on	Max Freq (can't tune above) while TG on
T03	2 MHz	3.08 GHz	3.08 GHz
T07	2 MHz	7.575 GHz	7.575 GHz
T13	2 MHz	13.8 GHz	13.8 GHz
T26	2 MHz	26.55 GHz	26.55 GHz

RF Center Freq

Specifies the RF Center Frequency. This command sets the Center Frequency to be used when the RF input is selected, even if the RF input is not the input that is selected at the time the command is sent. Note that the **Center Freq** function in the **Frequency** menu on the front panel always applies to the currently selected input.

Remote Command	`[:SENSe]:FREQuency:RF:CENTer <freq>`

	`[:SENSe]:FREQuency:RF:CENTer?`
Example	`:FREQ:RF:CENT 30 MHz` `:FREQ:RF:CENT?`
Notes	This command is the same in all modes, but the parameter is Measurement Global. So the value is independent in each mode and common across all the measurements in the mode
Dependencies	If the electronic/soft attenuator is enabled, any attempt to set Center Frequency such that the Stop Frequency would be >3.6 GHz fails and results in an advisory message. If the equivalent SCPI command is sent, this same message is generated as part of a "-221, Settings conflict" warning
Preset	See table above
State Saved	Saved in instrument state
Min	-79.999995 MHz
Max	See table above. Basically, instrument maximum frequency - 5 Hz If the knob or step keys are being used, also depends on Span

Ext Mix Center Freq

Specifies the External Mixer Center Frequency. This command sets the Center Frequency to be used when the External Mixer is selected, even if the External Mixer input is not the input which is selected at the time the command is sent. Note that the **Center Freq** function in the **Frequency** menu on the front panel always applies to the currently selected input.

Remote Command	`[:SENSe]:FREQuency:EMIXer:CENTer <freq>` `[:SENSe]:FREQuency:EMIXer:CENTer?`
Example	`:FREQ:EMIX:CENT 60 GHz` `:FREQ:EMIX:CENT?`
Notes	This command is the same in all modes, but the parameter is Measurement Global. So the value is independent in each mode and common across all the measurements in the mode
Dependencies	Ext Mix Center Freq is not available in VXT Models M9410A/11A
Couplings	When returning to External Mixing after having been switched to one of the other inputs (e.g., RF), you will come back into the settings that you had when you left External Mixing. So you will come back to the band you were in with the Center Frequency that you had. However, Span is not an input-dependent parameter, therefore you will bring the span over from the other input. Therefore, the instrument comes back with the span from the previous input, limited as necessary by the current mixer setup
Preset	When a Mode Preset is performed while in External Mixing, the Start frequency of the current Mode is set to the nominal Min Freq of the lowest harmonic range in the Harmonic Table for the current mixer setup. Similarly, the Stop frequency of the current Mode is set to the nominal Max Freq of the highest harmonic range in the Harmonic Table. The Center Freq thus presets to the point arithmetically equidistant from these two frequencies Note that if the current measurement has a limited Span available to it, and cannot achieve the Span shown in the table (Span=Stop Freq – Start Freq), the instrument uses the maximum Span the

	measurement allows, and still sets the Center Freq to the midpoint of the Start and Stop Freq values in the Harmonic Table When Restore Input/Output Defaults is performed, the mixer presets to the 11970A, whose Start and Stop frequencies are 26.5 and 40 GHz respectively. The center of these two frequencies is 33.25 GHz Therefore, after a Restore Input/Output Defaults, if you go into External Mixing and do a Mode Preset while in the Spectrum Analyzer Mode, the resulting Center Freq is 33.25 GHz
State Saved	Yes
Min	The minimum frequency in the currently selected mixer band + 5 Hz If the knob or step keys are being used, also depends on Span
Max	The maximum frequency in the currently selected mixer band - 5 Hz If the knob or step keys are being used, also depends on Span

I/Q Center Freq

Specifies the I/Q Center Frequency. This command sets the Center Frequency to be used when the I/Q input is selected, even if the I/Q input is not the input which is selected at the time the command is sent. Note that the **Center Freq** function in the **Frequency** menu on the front panel always applies to the currently selected input.

Remote Command	`[:SENSe]:FREQuency:IQ:CENTer <freq>` `[:SENSe]:FREQuency:IQ:CENTer?`
Example	`:FREQ:IQ:CENT 30 MHz`
Notes	This command is the same in all modes, but the parameter is Measurement Global. So the value is independent in each mode and common across all the measurements in the mode
Dependencies	I/Q Center Freq is not available in VXT Models M9410A/11A
State Saved	Saved in instrument state
Min	-40.049995 MHz
Max	40.049995 MHz

CF Step

Changes the step size for "Center Frequency" on page 1985, and start/stop frequency functions. Once a step size has been selected and the Center Frequency function is active, the step keys (and the `UP|DOWN` parameters for Center Frequency from remote commands) change Center Frequency by the step-size value.

Remote Command	`[:SENSe]:FREQuency:CENTer:STEP[:INCRement] <freq>`
	`[:SENSe]:FREQuency:CENTer:STEP[:INCRement]?`
	`[:SENSe]:FREQuency:CENTer:STEP:AUTO OFF | ON | 0 | 1`
	`[:SENSe]:FREQuency:CENTer:STEP:AUTO?`

Example	`:FREQ:CENT:STEP 500 MHz`
	`:FREQ:CENT UP`
	increases the current center frequency value by 500 MHz
	`:FREQ:CENT:STEP?`
	`:FREQ:CENT:STEP:AUTO ON`
	`:FREQ:CENT:STEP:AUTO?`

Notes	Preset and Max values are depending on Hardware Options (503, 507, 508, 513, 526)
Dependencies	Span, RBW, Center frequency If the electronic/soft attenuator is enabled, any attempt to change the value of the center frequency >3.6 GHz by pressing the Up-arrow key, fails and results in an advisory message. If the equivalent SCPI command is sent, this same message is generated as part of a "-221, Settings conflict" warning This control does not appear in 5G NR Mode
Couplings	When auto-coupled in a non-zero span, the center frequency step size is set to 10% of the span. When auto-coupled in zero span, the center frequency step size is set to the equivalent -3 dB RBW value
Preset	Auto `ON`
State Saved	Saved in instrument state
Min	– (the maximum frequency of the instrument). That is, 27 GHz max freq instrument has a CF step range of +/- 27 GHz. Note that this is the maximum frequency given the current settings of the instrument, so in External Mixing, for example, it is the maximum frequency of the current mixer band
Max	The maximum frequency of the instrument. That is, 27 GHz max freq instrument has a CF step range of +/- 27 GHz. Note that this is the maximum frequency given the current settings of the instrument, so in External Mixing, for example, it is the maximum frequency of the current mixer band
Status Bits/OPC dependencies	non-overlapped

Freq Offset

Enables you to set a frequency offset value to account for frequency conversions outside of the instrument. This value is added to the display readout of the marker frequency, center frequency, start frequency, stop frequency, and all other absolute frequency settings in the instrument including frequency count. When a frequency offset is entered, the value appears below the center of the graticule. To eliminate an offset, perform a Mode Preset or set the frequency offset to 0 Hz.

See "More Information" on page 1991.

Remote Command	`[:SENSe]:FREQuency:OFFSet <freq>` `[:SENSe]:FREQuency:OFFSet?`
Example	`:FREQ:OFFS 10 MHz`

	`:FREQ:OFFS?`
Notes	Preset and Max values are dependent on Hardware Options (503, 507, 508, 513, 526)
Preset	See "Center Frequency Presets" on page 1986
State Saved	Saved in instrument state
Min	-500 GHz
Max	500 GHz
Annotation	If Frequency Offset is not zero, “Freq Offset <value>” appears on the upper line of the annotation, below the graticule, in the center
Status Bits/OPC dependencies	Non-overlapped

More Information

This command does not affect any bandwidths or the settings of relative frequency parameters such as delta markers or span. It does not affect the current hardware settings of the instrument, but only the displayed frequency values. Entering an offset does not affect the trace position or display, just the value of the start and stop frequency and the values represented by the trace data. The frequency values of exported trace data, queried trace data, markers, trace data used in calculations such as N dB points, trace math, etc., are all affected by Freq Offset. Changing the offset, even on a trace that is not updating will immediately change all of the above, without taking new data.

NOTE

If a trace is exported with a nonzero Freq Offset, the exported data will contain the trace data with the offset applied. Therefore, if that trace were to be imported back into the instrument, you would want Freq Offset to be 0, or the offset would be applied again to data that is already offset. No such care need be taken when saving a State+Trace file because the data and state are saved together.

3.13.7 Marker

There is no **Marker** functionality in the PAvT Measurement.

3.13.8 Meas Setup

Contains functions for setting up the measurement parameters and also contains functions for setting up parameters global to all measurements in the mode.

3.13.8.1 Settings

Contains frequently used Meas Setup functions to which you will want the fastest access.

Segments

Sets the number of measurement results. A Segment is comprised of a Measurement Offset, Measurement Interval, and Measurement Transient.

Remote Command	`[:SENSe]:PAVTime:SEGMents <integer>` `[:SENSe]:PAVTime:SEGMents?`
Example	`:PAVT:SEGM 360` `:PAVT:SEGM?`
Preset	180
State Saved	Saved in instrument state
Min	1
Max	1000

Total Meas Time

Information only. Returns the result of (Meas Offset + Meas Interval + Meas Transient)*Segments.

Remote Command	`[:SENSe]:PAVTime:MTIMe?`
Example	`:PAVT:MTIM?`
State Saved	Saved in instrument state

Meas Interval

Sets the duration of acquisition window within the segment.

Remote Command	`[:SENSe]:PAVTime:SEGMents:INTerval <time>` `[:SENSe]:PAVTime:SEGMents:INTerval?`
Example	`:PAVT:SEGM:INT 10 us` `:PAVT:SEGM:INT?`
Couplings	Meas Interval must be > 0 s and less than (Max Capture Length/Segments) - Meas Offset - Meas Transient
Preset	1 ms

State Saved	Saved in instrument state
Min	100 ns
Max	(Max Capture Length/Segments) - Meas Offset - Meas Transient

Meas Offset

Sets the offset prior to "Meas Interval" on page 1992 within the segment.

Remote Command	`[:SENSe]:PAVTime:SEGMents:OFFSet <time>` `[:SENSe]:PAVTime:SEGMents:OFFSet?`
Example	`:PAVT:SEGM:OFFS 1 us` `:PAVT:SEGM:OFFS?`
Couplings	Meas Offset must be >= 0 s and less than (Max Capture Length/Segments) - Meas Interval - Meas Transient
Preset	0
State Saved	Saved in instrument state
Min	0
Max	(Max Capture Length/Segments) - Meas Interval - Meas Transient

Meas Transient

Sets the time between the end of the "Meas Interval" on page 1992 and the end of the segment.

Remote Command	`[:SENSe]:PAVTime:SEGMents:TRANsient <time>` `[:SENSe]:PAVTime:SEGMents:TRANsient?`
Example	`:PAVT:SEGM:TRAN 1 us` `:PAVT:SEGM:TRAN?`
Couplings	Meas Transient must be >= 0 s and less than (Max Capture Length/Segments) - Meas Offset - Meas Interval
Preset	0
State Saved	Saved in instrument state
Min/Max	Min = 0 Max = (Max Capture Length/Segments) - Meas Offset - Meas Interval

Measure Frequency Error

Measures the frequency error of the input signal at the center frequency.

This is an "immediate action" function, that is, it executes once, when the control is pressed; the trigger is effectively Free Run, because the acquisition occurs immediately regardless of the instrument trigger setting.

Remote Command	`[:SENSe]:PAVTime:FERRor:IMMediate`
Example	`:PAVT:FERR:IMM`
Status Bits/OPC dependencies	Non-overlapped

Frequency Error

The offset of the input signal from the Center Frequency. The frequency error can be determined by the instrument using "Measure Frequency Error" on page 1993, or is can be supplied by the user.

Remote Command	`[:SENSe]:PAVTime:FERRor <freq>` `[:SENSe]:PAVTime:FERRor?`
Example	`:PAVT:FERR 10 MHz` `:PAVT:FERR?`
Preset	0 Hz
State Saved	Saved in instrument state
Min	-100 MHz
Max	100 MHz
Status Bits/OPC dependencies	Non-overlapped

Frequency Error Measurement Time

Sets the acquisition time for "Measure Frequency Error" on page 1993.

Remote Command	`[:SENSe]:PAVTime:FERRor:TIME <time>` `[:SENSe]:PAVTime:FERRor:TIME?`
Example	`:PAVT:FERR:TIME 1 us` `:PAVT:FERR:TIME?`
Preset	10 ms
State Saved	Saved in instrument state
Min/Max	100 ns/500 ms

Segment Frequency Error Correction

Sets the Segment Frequency Error Correction to On or Off. When ON, frequency error is calculated simultaneously with each sample point's IQ values. The phase results are compensated with this real time frequency error, as well as the Frequency Error entered by user or calculated by "Measure Frequency Error" on page 1993.

Remote Command	[:SENSe]:PAVTime:FERRor:CORRection[:STATe] OFF | ON | 0 | 1 [:SENSe]:PAVTime:FERRor:CORRection[:STATe]?
Example	:PAVT:FERR:CORR ON :PAVT:FERR:CORR?
Preset	OFF
State Saved	Saved in instrument state

Sync Type (Models with Multiple Receivers only)

Sets the Sync Type when multiple receivers in one instrument need to sync at data acquisition. This setting is available when the instrument supports multiple receivers. Only one receiver can be set as Primary, and the others can only be set as Secondary.

Remote Command	[:SENSe]:PAVTime:SYNC OFF | PRIMary | SECondary [:SENSe]:PAVTime:SYNC?
Example	:PAVT:SYNC SEC :PAVT:SYNC?
Notes	UXM: Only Transceiver A can be configured as Primary, and Transceiver B as Secondary. Otherwise, an error message is issued This control appears only in models with multiple receivers
Preset	OFF
State Saved	Yes
Range	OFF|Primary|Secondary

Auto Couple

Immediately puts all **Auto/Man** functions into **Auto**. **Auto Couple** is confined to the current measurement only. It does not affect other measurements in the Mode.

In the **Auto** state, **Auto/Man** functions are said to be "coupled", meaning their values change as you make changes to other values in the measurement. This helps ensure accurate measurements and optimum dynamic range. **Auto Couple** is an immediate action function, and when it is executed, all the **Auto/Man** controls for the current measurement are set to **Auto**, and all measurement settings coupled to the **Auto/Man** parameters are automatically set to their optimal values.

For further details of measurement-specific settings (if any), see "Measurement-Specific Details" on page 1996 below.

Remote Command	`:COUPle ALL`
Example	`:COUP ALL`
Backwards Compatibility SCPI	`:COUPLE ALL | NONE`
Backwards Compatibility Notes	`:COUP:NONE` puts all Auto/Man parameters in manual mode, decoupling all the coupled instrument parameters. It is retained for backwards compatibility and is *not* recommended for making measurements or new designs

All **Auto/Man** parameter couplings in the measurement are set to **Auto**. This includes couplings that may be unavailable or grayed-out due to the current state. For example, in the Swept SA measurement, there is no **Auto/Man** coupling for **RBW** while in Zero Span. Nonetheless, if **Auto Couple** were executed while in Zero Span, it would set **RBW** to Auto "behind the scenes" so that, on exit from Zero Span, it would be in **Auto**.

Any **Auto/Man** selection specific (local) to the other measurements in the current Mode are not affected by **Auto Couple**. Any functions that are *not* coupled with other instrument parameters, such as ranging or leveling variables, such as **AutoRange** or **AutoScale**, are not affected.

Executing **Auto Couple** generates the informational message, "All Auto/Man functions have been set to Auto".

Each parameter, upon being set to **Auto**, selects and sets the appropriate auto-coupled value based on that parameter's coupling rules. The Dependency Resolver orchestrates the couplings for parameters that depend on one or more other parameters. The coupling and dependency rules for each parameter are defined in the section describing that parameter.

Executing **Auto Couple***does not* affect markers, marker functions, trace or display attributes, or any other instrument setting other than those specifically mentioned above.

Measurement-Specific Details

TOI (SA Mode only)

Parameters affected by **Auto Couple** are:

- Center Frequency Step
- Resolution Bandwidth
- Span/RBW Ratio
- Sweep Time
- Video BANDwidth VBW/RBW ratio
- Upper and Lower Tone (set to Sense)
- Zero span measurement Resolution Bandwidth
- Zero span measurement Dwell Time

Harmonics (SA Mode only)

Parameters affected by **Auto Couple** are:

- Resolution Bandwidth
- Fundamental Frequency
- Dwell Time
- Range Table Resolution Bandwidths
- Range Table Dwell Times

Meas Preset

Restores all the measurement parameters to their default values.

Remote Command	`:CONFigure:PAVTime`
Example	`:CONF:PAVT`
Couplings	Selecting Meas Preset restores all measurement parameters to their default values

3.13.8.2 Meas Standard

Contains controls that allow you to preset the PowerSuite measurements to conform to various communications standards.

Radio Standard Presets

Lets you specify the Radio Standard to be used. Spectrum Analyzer Mode supports many Radio Standards. You can select the desired Radio Standard using the **Radio Std Presets** dialog, which is a cascading list of standards. When you have the selected the desired Standard, press **OK** and the measurement settings will change to reflect that standard.

Remote Command	`[:SENSe]:RADio:STANdard[:SELect] NONE | JSTD | IS95a | IS97D | IS98D | GSM | W3GPP | C2000MC1 | C20001X | NADC | PDC | BLUEtooth | TETRa | WL802DOT11A | WL802DOT11B | WL802DOT11G | HIPERLAN2 | DVBTLSN | DVBTGPN | DVBTIPN | FCC15 | SDMBSE | UWBINDOOR | LTEB1M4 | LTEB3M | LTEB5M | LTEB10M | LTEB15M | LTEB20M | WL11N20M | WL11N40M | WL11AC20M | WL11AC40M | WL11AC80M | WL11AC160M | WL11AX20M | WL11AX40M | WL11AX80M | WL11AX160M | WL11BE20M | WL11BE40M | WL11BE80M | WL11BE160M | WL11BE320M | WL11AD2G | WL11AY2G16 | WL11AY4G32 | WL11AY6G48 | WL11AY8G64 | NR5GFR1B100M` `[:SENSe]:RADio:STANdard[:SELect]?`
Example	`:RAD:STAN NONE` `:RAD:STAN?`
Dependencies	Some selections appear only when support license is valid
Couplings	By changing the radio standard, the measurement parameters will be automatically set to an appropriate default value
State Saved	Saved in instrument state

The **Radio** column in the table lets you specify the device to be used. It is a global setting that affects the Device selection, between Mobile (MS) and Base Station (BTS) settings, for all relevant PowerSuite measurements. The Device SCPI command has the same effect as a selection in the **Radio** column:

Remote Command	`[:SENSe]:RADio:STANdard:DEVice BTS | MS` `[:SENSe]:RADio:STANdard:DEVice?`
Example	`:RAD:STAN:DEV MS` `:RAD:STAN:DEV?`
Preset	`BTS`
State Saved	Saved in instrument state
Range	`BTS|MS`

Chart for Standard and Available Measurements

Note that not every measurement in Spectrum Analyzer Mode is available for every standard. The chart below describes which measurements are available for each Radio Standard.

For TOI or Harmonics measurements, *no* Radio Standards are available.

	Swept SA	CHP	OBW	ACP	CCDF	Burst Power	Spurious Emission	SEM	List Sweep
None	X	X	X	X	X	X	X	X	(X)
3GPP 5G NR	(X)	X	X	X	X			X	(X)
3GPP LTE	(X)	X	X	X	X			X	(X)
3GPP W-CDMA	(X)	X	X	X	X	X		X	(X)
GSM/EDGE	(X)				X	X			(X)
cdma2000 1x	(X)	X	X	X	X	X			(X)
IS-95A	(X)	X	X	X	X	X			(X)
J-STD-008	(X)	X	X	X	X	X			(X)
IS-97D/98D	(X)	X	X	X	X				(X)
NADC	(X)	X	X	X	X	X			(X)
PDC	(X)	X	X	X	X	X			(X)
Bluetooth	(X)				X	X			(X)
W-LAN 802.11a	(X)							X	(X)
W-LAN 802.11b	(X)							X	(X)
W-LAN 802.11g	(X)							X	(X)
W-LAN 802.11n	(X)	X	X		X			X	(X)
W-LAN 802.11ac	(X)	X	X		X			X	(X)
W-LAN 802.11ax	(X)	X	X		X			X	(X)
W-LAN 802.11be	(X)	X	X		X			X	(X)
W-LAN 802.11ad	(X)	X	X		X			X	(X)
W-LAN 802.11ay	(X)	X	X		X			X	(X)
W-LAN HiperLAN/2	(X)							X	(X)
TETRA	(X)	X		X					(X)
DVB-T L/SECAM/NICAM	(X)	X			X				(X)
FCC Part 15 Subpart F	(X)	X			X				(X)
DVBT-T G/PAL/NICAM	(X)	X			X				(X)
DVB-T I/PAL/NICAM	(X)						X		(X)

	Swept SA	CHP	OBW	ACP	CCDF	Burst Power	Spurious Emission	SEM	List Sweep
S-DMB System E	(X)	X	X	X					(X)
UWB Indoor	(X)						X		(X)

General Radio Standards

The table below lists the settings and provides an example for each general Radio Standard.

None	Command Example	:RAD:STAN NONE
	IBW	2 MHz
	Span	3 MHz
	RBW	Auto rules
	VBW	Auto rules
TETRA	Command Example	:RAD:STAN TETR
	IBW	18 kHz
	Span	27 kHz
	RBW	1.2 kHz
	VBW	Auto rules
	RRC Filter	On
	RRC Filter Alpha	0.35
FCC Part15 Subpart F	Command Example	:RAD:STAN FCC15

Video Radio Standards

The table below lists the settings and provides an example for each video Radio Standard.

DVB-T L/SECAM/NICAM	Command Example	:RAD:STAN DVBTLSN
	IBW	7.61 MHz
	Span	24 MHz
	RBW	3.9 kHz
	VBW	Auto rules
	Sweep Points	8001

DVB-T G/PAL/NICAM	Command Example	:RAD:STAN DVBTGPN
	IBW	7.61 MHz
	Span	24 MHz
	RBW	3.9 kHz
	VBW	Auto rules
	Sweep Points	8001
DVB-T I/PAL/NICAM	Command Example	:RAD:STAN DVBTIPN
	IBW	7.61 MHz
	Span	24 MHz
	RBW	3.9 kHz
	VBW	Auto rules
	Sweep Points	8001
S-DMB System E	Command Example	:RAD:STAN SDMBSE
	IBW	25 MHz
	Span	37.5 MHz
	RBW	360 kHz
	VBW	Auto rules
	RRC Filter	Off
	RRC Filter Alpha	0.22

Cellular Radio Standards

The table below lists the CHP settings and provides an example for each cellular Radio Standard.

GSM/EDGE	Command Example	:RAD:STAN GSM
3GPP 5G NR	Command Example	:RAD:STAN NR5GFR1B100M
	IBW	100 MHz
	Span	150 MHz
	RBW	Auto rules
	VBW	Auto rules
3GPP W-CDMA	Command Example	:RAD:STAN W3GPP
	IBW	5 MHz
	Span	7.5 MHz
	RBW	240 kHz
	VBW	Auto rules
	RRC Filter	Off
	RRC Filter Alpha	0.22

3GPP LTE 1.4 MHz	Command Example	:RAD:STAN LTEB1M4
	IBW	1.4 MHz
	Span	2.1 MHz
	RBW	Auto rules
	VBW	Auto rules
3GPP LTE 3 MHz	Command Example	:RAD:STAN LTEB3M
	IBW	3 MHz
	Span	4.5 MHz
	RBW	Auto rules
	VBW	Auto rules
3GPP LTE 5 MHz	Command Example	:RAD:STAN LTEB5M
	IBW	5 MHz
	Span	7.5 MHz
	RBW	Auto rules
	VBW	Auto rules
3GPP LTE 10 MHz	Command Example	:RAD:STAN LTEB10M
	IBW	10 MHz
	Span	15 MHz
	RBW	Auto rules
	VBW	Auto rules
3GPP LTE 15 MHz	Command Example	:RAD:STAN LTEB15M
	IBW	15 MHz
	Span	22.5 MHz
	RBW	Auto rules
	VBW	Auto rules
3GPP LTE 20 MHz	Command Example	:RAD:STAN LTEB20M
	IBW	20 MHz
	Span	30 MHz
	RBW	Auto rules
	VBW	Auto rules
cdma2000	Command Example	:RAD:STAN C20001X :RAD:STAN C2000MC1 :RAD:STAN? (Query always returns C20001X)
	IBW	1.23 MHz
	Span	1.845 MHz

	RBW	24 kHz
	VBW	Auto rules
IS-95A	Command Example	:RAD:STAN IS95
	IBW	1.23 MHz
	Span	1.845 MHz
	RBW	24 kHz
	VBW	Auto rules
J-STD-008	Command Example	:RAD:STAN JSTD
	IBW	1.23 MHz
	Span	1.845 MHz
	RBW	24 kHz
	VBW	Auto rules
NADC	Command Example	:RAD:STAN NADC
	IBW	32.8 kHz
	Span	49.2 kHz
	RBW	1.2 kHz
	VBW	Auto rules
PDC	Command Example	:RAD:STAN PDC
	IBW	21 kHz
	Span	31.5 kHz
	RBW	6.2 kHz
	VBW	Auto rules
IS-97D/98D	Command Example	:RAD:STAN IS97D :RAD:STAN IS98D :RAD:STAN IS95C :RAD:STAN? Query always returns `IS97D`
	IBW	1.23 MHz
	Span	1.845 MHz
	RBW	24kHz
	VBW	Auto rules

Band Class (IS-97D/98D only)

The following function is only available when you have selected the standard: IS-97D/98D. It lets you select the band class.

Remote Command	`[:SENSe]:RADio:STANdard:BAND:CLASs BC0 | BC1` `[:SENSe]:RADio:STANdard:BAND:CLASs?`

Example	`:RAD:STAN:BAND:CLAS BC0` `:RAD:STAN:BAND:CLAS?`
Preset	`BC0`
State Saved	Saved in instrument state
Range	0 (800 MHz Band)|1 (1900 MHz Band)

Wireless Radio Standards

The table below lists the CHP settings and provides an example for each wireless Radio Standard.

WLAN 802.11a	Command Example	:RAD:STAN WL802DOT11A
	IBW	20 MHz
	Span	30 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11g	Command Example	:RAD:STAN WL802DOT11G
	IBW	20 MHz
	Span	30 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11b	Command Example	:RAD:STAN WL802DOT11B
	IBW	25 MHz
	Span	37.5 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11n 20 MHz	Command Example	:RAD:STAN WL11N20M
	IBW	20 MHz
	Span	30 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11n 40 MHz	Command Example	:RAD:STAN WL11N40M
	IBW	40 MHz
	Span	60 MHz
	RBW	100 kHz
	VBW	Auto rules

WLAN 802.11ac 20 MHz	Command Example	:RAD:STAN WL11AC20M
	IBW	20 MHz
	Span	30 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11ac 40 MHz	Command Example	:RAD:STAN WL11AC40M
	IBW	40 MHz
	Span	60 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11ac 80 MHz	Command Example	:RAD:STAN WL11AC80M
	IBW	80 MHz
	Span	120 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11ac 160 MHz	Command Example	:RAD:STAN WL11AC160M
	IBW	160 MHz
	Span	240 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11ax 20 MHz	Command Example	:RAD:STAN WL11AX20M
	IBW	20 MHz
	Span	30 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11ax 40 MHz	Command Example	:RAD:STAN WL11AX40M
	IBW	40 MHz
	Span	60 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11ax 80 MHz	Command Example	:RAD:STAN WL11AX80M
	IBW	80 MHz
	Span	120 MHz
	RBW	100 kHz
	VBW	Auto rules

WLAN 802.11ax 160 MHz	Command Example	:RAD:STAN WL11AX160M
	IBW	160 MHz
	Span	240 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11be 20 MHz	Command Example	:RAD:STAN WL11BE20M
	IBW	20 MHz
	Span	30 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11be 40 MHz	Command Example	:RAD:STAN WL11BE40M
	IBW	40 MHz
	Span	60 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11be 80 MHz	Command Example	:RAD:STAN WL11BE80M
	IBW	80 MHz
	Span	120 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11be 160 MHz	Command Example	:RAD:STAN WL11BE160M
	IBW	160 MHz
	Span	240 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11be 320 MHz	Command Example	:RAD:STAN WL11BE320M
	IBW	320 MHz
	Span	480 MHz
	RBW	100 kHz
	VBW	Auto rules
WLAN 802.11ad 2 GHz	Command Example	:RAD:STAN WL11AD2G
	IBW	2.16 GHz
	Span	3.24 GHz
	RBW	1 MHz
	VBW	Auto rules

WLAN 802.11ay 2.16 GHz	Command Example	:RAD:STAN WL11AY2G16
	IBW	2.16 GHz
	Span	3.24 GHz
	RBW	1 MHz
	VBW	Auto rules
WLAN 802.11ay 4.32 GHz	Command Example	:RAD:STAN WL11AY4G32
	IBW	4.32 GHz
	Span	6.48 GHz
	RBW	1 MHz
	VBW	Auto rules
WLAN 802.11ay 6.48 GHz	Command Example	:RAD:STAN WL11AY6G48
	IBW	6.48 GHz
	Span	9.72 GHz
	RBW	1 MHz
	VBW	Auto rules
WLAN 802.11ay 8.64 GHz	Command Example	:RAD:STAN WL11AY8G64
	IBW	8.64 GHz
	Span	12.96 GHz
	RBW	1 MHz
	VBW	Auto rules
3GPP 5G NR	Command Example	:RAD:STAN NR5GFR1B100M
5G NR FR1 100MHz	IBW	100 MHz
	Span	150 MHz
	RBW	Auto rules
	VBW	Auto rules

WLAN HiperLAN/2	Command Example	`:RAD:STAN HIPERLAN2`
	UWB Indoor	Command Example R A D : S T A N U W B I N D O O R
	Bluetooth	Command Example R A D : S T A N B L U E

Packet Type (Bluetooth only)

The command below sets the packet type for the Bluetooth measurement

Remote Command	`[:SENSe]:RADio:STANdard:PACKet DH1 | DH3 | DH5` `[:SENSe]:RADio:STANdard:PACKet?`
Example	`:RAD:STAN:PACK DH1` `:RAD:STAN:PACK?`
Notes	The packet length is: DH1 366 µs

	DH3	1622 µs
	DH5	2870 µs
Preset	DH1	
State Saved	Saved in instrument state	
Range	DH1 | DH3 | DH5	

Radio Standard Presets Hierarchy

General	None	
	TETRA	BTS
		MS
	FCC Part 15 Subpart F	
	APCO-25	
	DMR	
	dPMR	
Video	DVB-T	L/SECAM/NICAM
		G/PAL/NICAM
		I/PAL/NICAM
	S-DMB System E	

Cellular	3GPP 5G NR	BTS	FR1 100 MHz
		MS	FR1 100 MHz
	3GPP LTE	BTS	1.4 MHz (6 RB)
			3 MHz (15 RB)
			5 MHz (25 RB)
			10 MHz (50 RB)
			15 MHz (75 RB)
			20 MHz (100 RB)
		MS	1.4 MHz (6 RB)
			3 MHz (15 RB)
			5 MHz (25 RB)
			10 MHz (50 RB)
			15 MHz (75 RB)
			20 MHz (100 RB)
	3GPP W-CDMA	BTS	
		MS	
	GSM/EDGE	BTS	
		MS	
	cdma2000 1x	BTS	
		MS	
	IS-95A	BTS	
		MS	
	J-STD-008	BTS	
		MS	
	IS-97D/98D	BTS	Band Class 0
			Band Class 1
		MS	Band Class 0
			Band Class 1
	NADC	BTS	
		MS	
	PDC	BTS	
		MS	

Wireless	W-LAN	802.11a	
		802.11b	
		802.11g	
		802.11n	20 MHz
			40 MHz
		802.11ac	20 MHz
			40 MHz
			80 MHz
			160 MHz
		802.11ax	20 MHz
			40 MHz
			80 MHz
			160 MHz
		802.11be	20 MHz
			40 MHz
			80 MHz
			160 MHz
			320 MHz
		802.11ad	
		802.11ay	2.16 GHz
			4.32 GHz
			6.48 GHz
			8.64 GHz
		HiperLAN/2	
	Bluetooth	DH1	
		DH3	
		DH5	
	UWB Indoor		

Each Radio Standard has the preset parameter set for the measurement.

When a standard is selected, the default value of the measurement parameters are overwritten by those preset values.

When the standard is NONE, or the standard does not specify the firm RBW requirement, then the table displays “auto”, and the following definition is used to compute the proper RBW setting:

1. Compute the guard-band = [Offset Freq A] - 0.5*([Chan Integ BW] + [Ref BW])

2. Divide by 4.5. Call the result GuardbandGoalRBW

3. Compute the greater of the Reference and Offset A integration bandwidths. Divide that result by 100 and call it the ChannelWidthGoalRBW
4. Find the smallest integration bandwidth of any of the offsets; divide it by two and call the result IntegBWGoalRBW
5. Compute AutoRBWGoal = min(IntegBWGoal, max(GuardbandGoalRBW, ChannelWidthGoalRBW))
6. Compute the RBW to be selected to be the largest available RBW that is smaller than AutoRBWGoal

Measurements that are unavailable for a particular Radio Standard are grayed-out. Radio Standards that are unavailable for the current active measurement are also grayed-out.

However, remote operations, such as `:CONF` allow the measurement to be active even if it is not a supported format. In this case, the measurement configuration should be set to `NONE`.

Enable Non-Std Meas

Lets you specify whether all measurements and radio standards are enabled or not.

By default, **Enable Non-Std Measurements** is set to `NO`, so you can select only valid combinations of preset available standards and measurements. Combinations of measurement and standard that would have no valid preset value are grayed-out.

When **Enable Non-Std Measurements** is set to `YES`, all measurements and standard selections are enabled, so you can select any combination.

NOTE **If you select an unavailable measurement or unavailable radio standard using the Enable Non-Std Meas control, the measurement results may not conform to the selected standard.**

Remote Command	`[:SENSe]:RADio:STANdard:EAMeas YES | NO` `[:SENSe]:RADio:STANdard:EAMeas?`
Example	`:RAD:STAN:EAM YES` `:RAD:STAN:EAM?`
Preset	`NO`
State Saved	Saved in instrument state
Range	`YES|NO`

3.13.8.3 Advanced

Contains controls for setting advanced functions of the instrument.

IF Gain

Sets the IF Gain function to Auto, Low Gain or High Gain. These settings affect sensitivity and IF overloads.

Remote Command	`[:SENSe]:PAVTime:IF:GAIN[:STATe] ON | OFF | 1 | 0`
	`[:SENSe]:PAVTime:IF:GAIN[:STATe]?`
	`[:SENSe]:PAVTime:IF:GAIN:AUTO[:STATe] ON | OFF | 1 | 0`
	`[:SENSe]:PAVTime:IF:GAIN:AUTO[:STATe]?`

Example	`:PAVT:IF:GAIN ON`
	`:PAVT:IF:GAIN?`
	`:PAVT:IF:GAIN:AUTO ON`
	`:PAVT:IF:GAIN:AUTO?`

Notes	`ON` = high gain `OFF` = low gain
Dependencies	The IF Gain controls (FFT IF Gain and Swept IF Gain) have no effect when the U7227A USB Preamplifier is connected. This is not annotated or reflected on any control; there are no controls grayed out nor any SCPI locked out. The instrument simply behaves as though both FFT IF Gain and Swept IF Gain are set to Low regardless of the setting on the controls This control is not available in VXT model M9421A, EXM, or UXM
Preset	`OFF` `OFF`
State Saved	Saved in instrument state
Range	Low Gain|High Gain

3.13.8.4 Global

The controls in this menu apply to all Modes in the instrument.

Some controls (for example, "Global Center Freq" on page 2013) allow you to switch certain Meas Global parameters to a Mode Global state. These switches apply to all Modes that support global settings. For example, no matter what Mode you are in when you set **Global Center Freq** to `ON`, it applies to all Modes that support Global settings.

Other controls (for example, **Extend Low Band**) are actually set in this menu, but apply to all Modes.

Global Center Freq

The software maintains a Mode Global value called **Global Center Freq**.

When **Global Center Freq** is switched ON, the current Mode's center frequency is copied into the **Global Center Frequency**, and from then on all Modes that support global settings use the **Global Center Frequency**, so you can switch between any of these Modes and the **Center Frequency** remains unchanged.

Adjusting the **Center Frequency** of any Mode that supports Global Settings, while **Global Center Freq** is ON, modifies the **Global Center Freq**.

When **Global Center Freq** is switched OFF, the **Center Frequency** of the current Mode is unchanged, but now the **Center Frequency** of each Mode is once again independent.

When **Mode Preset** is pressed while **Global Center Freq** is ON, the **Global Center Freq** is preset to the preset **Center Frequency** of the current Mode.

This function resets to OFF when "Restore Defaults" on page 2016 is pressed, or when **System**, **Restore Defaults**, **All Modes** is pressed.

Remote Command	`:INSTrument:COUPle:FREQuency:CENTer ALL | NONE` `:INSTrument:COUPle:FREQuency:CENTer?`
Example	`:INST:COUP:FREQ:CENT ALL` `:INST:COUP:FREQ:CENT?`
Preset	Set to OFF on **Global** Settings, **Restore Defaults** and **System, Restore Defaults, All Modes**
Range	ALL|NONE

Preset	OFF
Backwards Compatibility SCPI	`:GLOBal:FREQuency:CENTer[:STATe] 1 | 0 | ON | OFF` `:GLOBal:FREQuency:CENTer[:STATe]?`

Global EMC Std

When this control is switched ON, the current Mode's EMC Std is copied into the **Global EMC Std**, and from then on all Modes that support global settings use the **Global EMC Std**, so you can switch between any of these Modes and the EMC Std remains unchanged.

Adjusting the EMC Std of any Mode that supports Global settings, while **Global EMC Std** is ON modifies the **Global EMC Std**.

When **Global EMC Std** is switched OFF, the EMC Std of the current Mode remains unchanged, but now the EMC Std of each Mode is once again independent. When **Mode Preset** is pressed while **Global EMC Std** is ON, **Global EMC Std** is preset to the preset EMC Std of the current Mode.

This function resets to OFF when "Restore Defaults" on page 2016 is pressed, or when **System, Restore Defaults, All Modes** is pressed.

Remote Command	`:INSTrument:COUPle:EMC:STANdard ALL | NONE` `:INSTrument:COUPle:EMC:STANdard?`
Example	`:INST:COUP:EMC:STAN ALL` `:INST:COUP:EMC:STAN?`
Dependencies	Only available if Option EMC is installed
Preset	Set to `OFF` on **Global** Settings, **Restore Defaults** and **System, Restore Defaults, All Modes**
Range	`ALL | NONE`

Global Limit Lines (Freq and Amptd)

When this control is set to `ALL`, the current Mode's Limit Line is copied into the **Global Limit Lines**, and from there to all Modes that support Global settings and use **Global Limit Lines**, so you can switch between any of these Modes and the Limit Lines remain unchanged.

Adjusting the Limit Lines of any Mode that supports **Global** Settings, while **Global Limit Lines** is `ALL`, modifies the **Global Limit Lines**.

When **Global Limit Lines** is set to `NONE`, the Limit Lines of the current Mode are unchanged, but now the Limit Lines of each Mode are once again independent. When **Mode Preset** is pressed while **Global Limit Lines** is `ALL`, **Global Limit Lines** is preset to the preset Limit Lines of the current Mode.

This function is reset to `NONE` when "Restore Defaults" on page 2016 is pressed, or when **System**, **Restore Defaults**, **All Modes** is pressed.

Remote Command	`:INSTrument:COUPle:LLINe ALL | NONE` `:INSTrument:COUPle:LLINe?`
Example	`:INST:COUP:LLIN ALL | NONE` `:INST:COUP:LLIN?`
Preset	Set to `OFF` on **Global** Settings, **Restore Defaults** and **System, Restore Defaults, All Modes**
Range	`ALL | NONE`

Extend Low Band

The software maintains a Mode Global value called **Extend Low Band**.

Under the current sweep configuration crossing over two bands, when **Extend Low Band** is turned `ON`, the instrument checks whether one band can cover the whole sweep frequency range or not. If it can, then the instrument locks the band; otherwise, it does nothing (the band crossover occurs).

This function does *not* work when **Band Lock** under **System > Service > Lock Functions** is not -1 (no Band Lock). In that case, **Band Lock** takes priority over **Extend Low Band**.

This function resets to `OFF` when "Restore Defaults" on page 2016 is pressed, or when **System**, **Restore Defaults**, **All Modes** is pressed.

Remote Command	`:INSTrument:COUPle:FREQuency:BAND:EXTend 0 | 1 | ON | OFF` `:INSTrument:COUPle:FREQuency:BAND:EXTend?`
Example	`:INST:COUP:FREQ:BAND:EXT 1` `:INST:COUP:FREQ:BAND:EXT?`
Preset	Set to `OFF` by **Global** Settings > **Restore Defaults** and **System > Restore Defaults > All Modes**
Range	`ON|OFF`

Restore Defaults

Resets all functions in the **Global** settings menu to `OFF`. Pressing **System**, **Restore Defaults**, **All Modes** has the same effect.

Remote Command	`:INSTrument:COUPle:DEFault`
Example	`:INST:COUP:DEF`
Backwards Compatibility SCPI	`:GLOBal:DEFault`

3.13.9 Sweep

Contains controls that allow you to control the sweep and measurement functions of the instrument.

3.13.9.1 Sweep/Control

Accesses controls that let you operate the sweep and control functions of the instrument, such as **Sweep Time** and **Continuous/Single**.

Sweep/Measure

Lets you toggle between **Continuous** and **Single** sweep or measurement operation. The single/continuous state is Meas Global, so the setting affects all measurements.

The front-panel key **Single/Cont** performs exactly the same function

See "More Information" on page 2017

Remote Command	`:INITiate:CONTinuous OFF | ON | 0 | 1` `:INITiate:CONTinuous?`

Example	Put instrument into **Single** measurement operation:
	`:INIT:CONT 0`
	`:INIT:CONT OFF`
	Put instrument into **Continuous** measurement operation:
	`:INIT:CONT 1`
	`:INIT:CONT ON`

Preset	`ON` Note that `:SYST:PRES` sets `:INIT:CONT` to `ON`, but `*RST` sets `:INIT:CONT` to `OFF`
State Saved	Saved in instrument state
Annunciation	The **Single/Continuous** icon in the Meas Bar changes depending on the setting: – A line with an arrow is **Single** – A loop with an arrow is **Continuous**
Backwards Compatibility Notes	X-Series A-models had **Single** and **Cont** hardkeys in place of the **SweepSingleCont** softkey. In the X-Series A-models, if in single measurement, the **Cont** hardkey (and `INIT:CONT ON`) switched to continuous measurement, but never restarted a measurement and never reset a sweep X-Series B-models have a **Cont/Single** toggle control instead of **Single** and **Cont** hardkeys, but it is still true that, if in single measurement, the **Cont/Single** toggle control never restarts a measurement and never resets a sweep

More Information

Continuous Mode	The instrument takes repetitive sweeps, averages, measurements, etc., when in continuous mode. If in average or Max/Min Hold, and the average/hold count reaches the **Average/Hold Num**, the count stops incrementing, but the instrument keeps sweeping See the **Trace** key description under **Trace Average** for the averaging formula used both before and after the **Average/Hold Num** is reached. The trigger condition must be met prior to each sweep The type of trace processing for multiple sweeps is set under the **Trace** key, with choices of **Trace Average**, **Max Hold**, or **Min Hold**
Single Mode	The instrument takes a single sweep when in **Single** mode, or if in average or Max/Min Hold, or if there is a **Waterfall** window displayed, it takes multiple sweeps until the average/hold count reaches the **Average/Hold Num**, then the count stops incrementing, and the instrument stops sweeping See the **Trace** key description under **Trace Average** for the averaging formula used. The trigger condition must be met prior to the sweep The type of trace processing for multiple sweeps is set under the **Trace** key, with choices of **Trace Average**, **Max Hold**, or **Min Hold**

If the instrument is in **Single** measurement mode, pressing the **Cont/Single** toggle control does not zero the count and does not cause the sweep to be reset; the only action is to put the instrument into Continuous measurement operation.

If the instrument is already in **Continuous** sweep:

- `:INIT:CONT 1` has no effect
- `:INIT:CONT 0` places the instrument in Single Sweep but has no effect on the current sequence until k = N, at which point the current sequence will stop and the instrument will go to the idle state

See "Restart" on page 2018 for details of `:INIT:IMMediate`.

If the instrument is already in **Single** sweep, `:INIT:CONT OFF` has no effect.

If the instrument is already in **Single** sweep, then pressing **Cont/Single** in the middle of a sweep does not restart the sweep or sequence. Similarly, pressing **Cont/Single** does not restart the sweep or sequence if the sweep is not in the idle state (for example, if you are taking a very slow sweep, or the instrument is waiting for a trigger). Even though pressing **Cont/Single** in the middle of a sweep does not restart the sweep, sending `:INIT:IMM` *does* reset it.

If the instrument is in **Single** sweep, and *not* Averaging/Holding, and you want to take one more sweep, press **Restart**.

If the instrument is in **Single** sweep, *and* Averaging/Holding, and you want to take one more sweep without resetting the Average trace or count, go to **Meas Setup** and increment the average count by 1 by pressing the **Step-Up** key while **Average/Hold Num** is the active function. You can also do this by sending `:CALC:AVER:TCON UP`.

Restart

Restarts the current sweep, or measurement, or set of averaged/held sweeps or measurements. If you are Paused, pressing **Restart** performs a Resume.

The front-panel key **Restart** performs exactly the same function.

The **Restart** function is accessed in several ways:

- Pressing the **Restart** key
- Sending `:INIT:IMM`
- Sending `:INIT:REST`

See "More Information" on page 2019

Remote	`:INITiate[:IMMediate]`

Command	`:INITiate:RESTart`
Example	`:INIT:IMM` `:INIT:REST`
Notes	`:INIT:REST` and `:INIT:IMM` perform exactly the same function
Couplings	Resets average/hold count k. For the first sweep overwrites all active (update = on) traces with new current data. For application modes, it resets other parameters as required by the measurement
Status Bits/OPC dependencies	This is an Overlapped command The `STATus:OPERation` register bits 0 through 8 are cleared , *except* bit 6 (Waiting for Periodic Sync). Initiating a measurement and Waiting for Periodic Sync could be asynchronous The `STATus:QUEStionable` register bit 9 (`INTegrity` sum) is cleared The `SWEEPING` bit is set The `MEASURING` bit is set
Backwards Compatibility Notes	For Spectrum Analysis Mode in ESA and PSA, the **Restart** hardkey and the `:INIT:REST` command restarted trace averages (displayed average count reset to 1) for a trace in **Clear Write**, but did not restart **Max Hold** and **Min Hold** In X-Series, the **Restart** hardkey and the `:INIT:REST` command restart not only **Trace Average**, but **MaxHold** and **MinHold** traces as well

More Information

The **Restart** function first aborts the current sweep or measurement as quickly as possible. It then resets the sweep and trigger systems, sets up the measurement and initiates a new data measurement sequence with a new data acquisition (sweep) taken once the trigger condition is met.

If the instrument is in the process of aligning when a **Restart** is executed, the alignment finishes before the restart function is performed.

Even when set for **Single** operation, multiple sweeps may be taken when **Restart** is pressed (for example, when averaging/holding is on). Thus, when we say that **Restart** "restarts a measurement", depending on the current settings, we may mean that it:

- Restarts the current sweep
- Restarts the current measurement
- Restarts the current set of sweeps if any trace is in Trace Average, Max Hold or Min Hold
- Restarts the current set of measurements if Averaging, or Max Hold, or Min Hold is on for the measurement

If there is no Average or Max/Min Hold function (no trace in Trace Average or Hold, or **Average/Hold Num** set to 1), and no **Waterfall** window is being displayed, a single sweep is equivalent to a single measurement. A single sweep is taken after the trigger condition is met; and the instrument stops sweeping once that sweep has completed. However, with **Average/Hold Num** >1, and at least one trace set to Trace Average, Max Hold, or Min Hold, or a **Waterfall** window being displayed, multiple sweeps/data acquisitions are taken for a single measurement. The trigger condition must be met prior to each sweep. The sweep is stopped when the average count k equals the number N set for **Average/Hold Num**.

Once the full set of sweeps has been taken, the instrument goes to the idle state. To take one more sweep without resetting the average count, increment the average count by 1, by pressing the **Step-Up** key while **Average/Hold Number** is the active function, or by sending the remote command `:CALC:AVER:TCON UP`.

Trace Update

The numeric results are not blanked at any time during the restart cycle.

For slow sweeps (see **Trace Update** section in **Trace/Detector**), the traces are updated real-time during the sweep. There may be a special circumstance in application mode measurements where an exception is made and the traces and/or results need to be blanked before displaying the new results.

To summarize, the following list shows what happens to the trace data on various events:

Event	Trace Effect
Clear/Write pressed (even if already in Clear/Write)	Set to mintracevalue
Max Hold pressed (even if already in Max Hold)	Set to mintracevalue
Min Hold pressed (even if already in Min Hold)	Set to maxtracevalue
Trace Average pressed (even if already in Trace Average)	Trace data unaffected but start new sweep/avg/hold
Restart pressed	Trace data unaffected but start new sweep/avg/hold
Parameter requiring restart changed (e.g., RBW)	Trace data unaffected but start new sweep/avg/hold

Sweep and Trigger Reset

Resetting the sweep system resets the average/hold count k to 0. It also resets the set point counter to 0. Resetting the trigger system resets the internal auto trig timer to the value set by the **Auto Trig** control.

Averaging

The weighting factor used for averaging is k. This k is also the average/hold count for how many valid sweeps (data acquisitions) have been done. This k is used for comparisons with N, as those comparisons always needs to be based on valid completed sweeps.

The displayed average/hold, K, shows the count for the sweep (data acquisition) in progress. K = k + 1, with a limit of N. The displayed value K changes from its previous value to 1 as soon as the trigger condition for the first data acquisition (sweep) is met.

Pause/Resume

Pauses a measurement after the current data acquisition is complete.

When paused, the label on the control changes to **Resume**. Pressing **Resume** un-pauses the measurement. When paused, pressing **Restart** performs a Resume.

Remote Command	`:INITiate:PAUSe` `:INITiate:RESume`
Example	`:INIT:PAUS` `:INIT:RES`
Dependencies	Not displayed in Modes that do not support pausing
Annotation	Only on control

Abort (Remote Command Only)

Stops the current measurement. Aborts the current measurement as quickly as possible, resets the sweep and trigger systems, and puts the measurement into an "idle" state. If the instrument is in the process of aligning when `:ABORt` is sent, the alignment finishes *before* the abort function is performed, so `:ABORt` does not abort an alignment.

If the instrument is set for **Continuous** measurement, it sets up the measurement and initiates a new data measurement sequence with a new data acquisition (sweep) taken once the trigger condition is met.

If the instrument is set for **Single** measurement, it remains in the "idle" state until an `:INIT:IMM` command is received.

Remote Command	`:ABORt`
Example	`:ABOR`

Notes	If :INIT:CONT is ON, then a new continuous measurement will start immediately, with sweep (data acquisition) occurring once the trigger condition has been met If :INIT:CONT is OFF, then :INIT:IMM is used to start a single measurement, with sweep (data acquisition) occurring once the trigger condition has been met
Dependencies	For continuous measurement, :ABORt is equivalent to the **Restart** key Not all measurements support this command
Status Bits/OPC dependencies	The STATus:OPERation register bits 0 through 8 are cleared , *except* bit 6 (Waiting for Periodic Sync). Initiating a measurement and Waiting for Periodic Sync could be asynchronous The STATus:QUEStionable register bit 9 (INTegrity sum) is cleared Since all the bits that feed into OPC are cleared by :ABORt, the Abort command will cause the *OPC query to return true

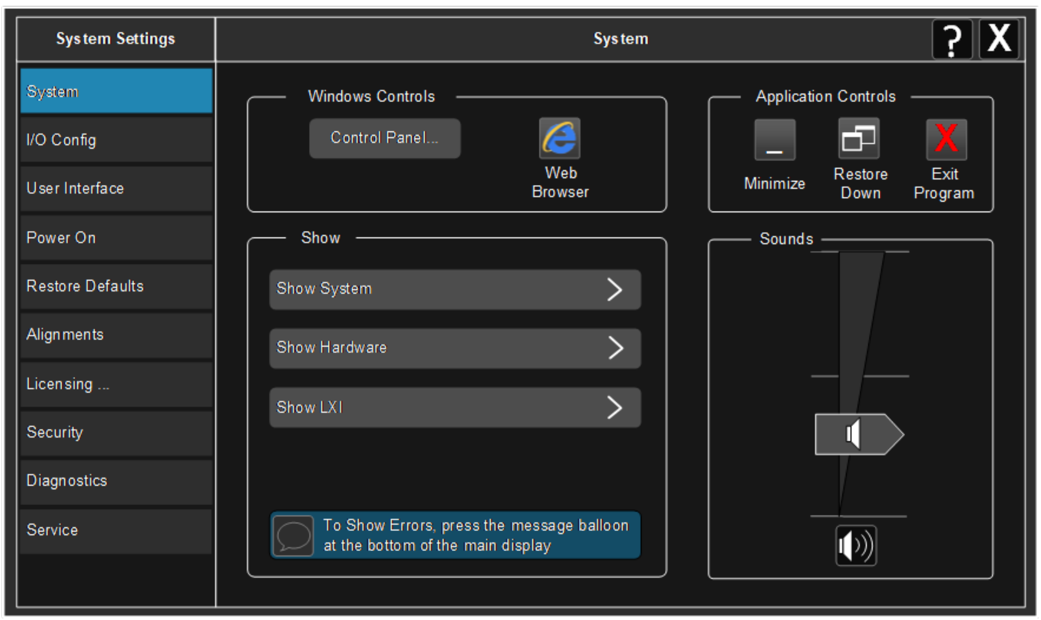
3.13.10 Trace

Trace functionality is not supported in the Phase and Amplitude vs Time measurement.

X-Series Signal Analyzers
Spectrum Analyzer Mode User's & Programmer's Reference

4 System

The **System** hardkey and the “gear” icon both open the **System Settings** dialog, which allows you to access various configuration menus and dialogs. The line of tabs down the left side let you choose various pages for configuring your instrument.



Notes	No remote command for this key specifically

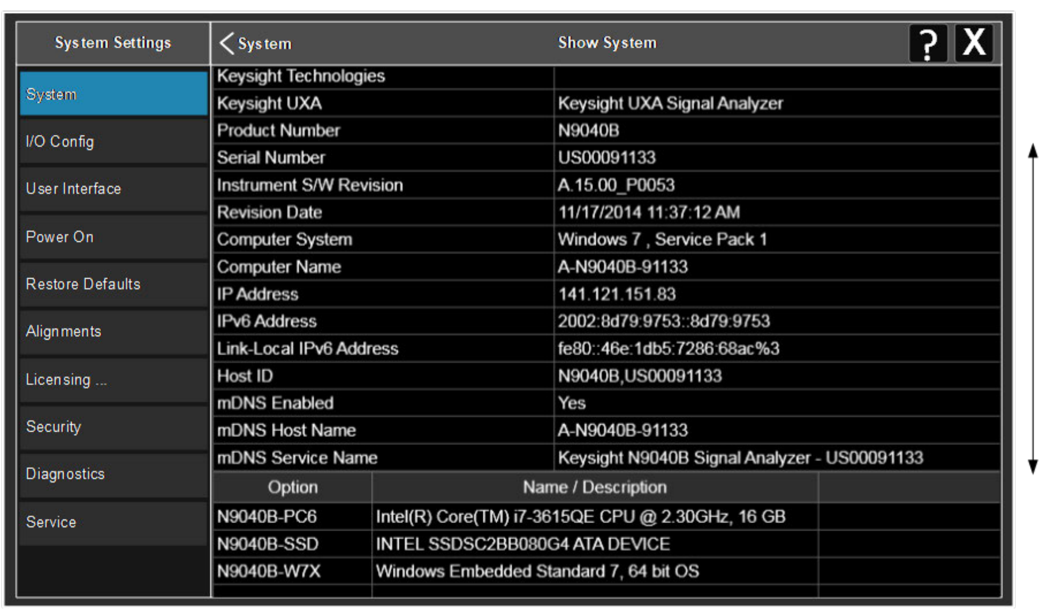
4.1 System

Allows access to several general system functions, including three **Show** screens for viewing system parameters. Several such **Show** screens are available on this and other **System** menu pages. They can also be accessed with the SCPI command described here.

Remote Command	`:SYSTem:SHOW OFF | ERRor | SYSTem | HARDware | LXI | HWSTatistics | ALIGnment | SOFTware | CAPPlication` `:SYSTem:SHOW?`
Example	`:SYST:SHOW SYST`
Notes	Displays (or exits) the System information screens
Preset	`OFF`
State Saved	No
Range	`OFF| ERRor | SYSTem | HARDware | LXI | HWSTatistics | ALIGNment | SOFTware | CAPPlication`

4.1.1 Show System

This screen is divided into three groups: product descriptive information, options tied to the hardware, and software products. Swipe up and down on this screen to scroll the display.



Example	`:SYST:SHOW SYST`

4.1.1.1 Show System contents (Remote Query Only)

Returns the contents of the **Show System** screen (the entire contents, not just the currently displayed page).

Remote Command	`:SYSTem:CONFigure[:SYSTem]?`
Example	`:SYST:CONF?`
Notes	The output is an IEEE Block format of the **Show System** contents. Each line is separated by a new-line character

4.1.1.2 Computer System description (Remote Query Only)

Returns the **Computer System** description, which consists of the operating system and patch level, as reported by operating system.

Remote Command	`:SYSTem:CSYStem?`
Example	`:SYST:CSYS?`
Notes	Returns the Computer System name and service pack level

4.1.2 Show Hardware

Displays details of the installed hardware. This information can be used to determine versions of hardware assemblies and field-programmable devices, in the advent of future upgrades or potential repair needs.

The screen is divided into two groups: product descriptive information and hardware information. The hardware information is listed in a table format.

Example	`:SYST:SHOW HARD`

4.1.3 Show LXI

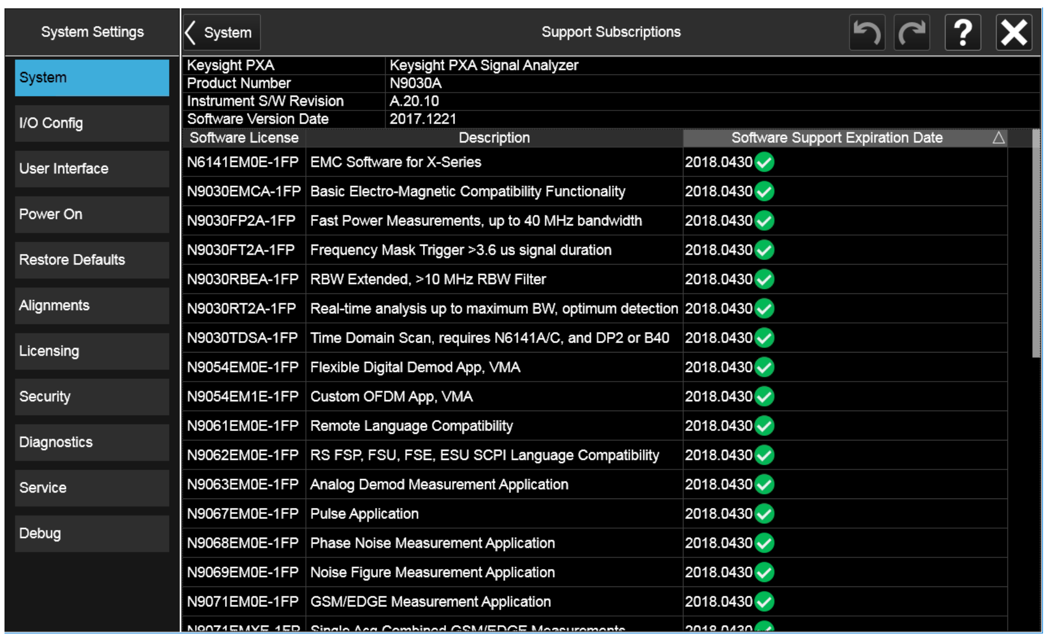
Displays the product number, serial number, firmware revision, computer name, IP address, Host ID, LXI Class, LXI Version, MAC Address, and the Auto-MDIX Capability.

Example	`:SYST:SHOW LXI`

4.1.4 Show Support Subscriptions

Displays the software support subscription information for the licenses available on the instrument.

Shows the software license, description, software support expiration date (format is `YYYY.MMDD`), and the software support status. The **Software Version Date** (format is `YYYY.MMDD`) shown in the header indicates the date required to access the latest software enhancements included in this version of the software. If any license has a **Software Support Expiration Date** earlier than the **Software Version Date**, then enhancements may be available that the license does *not* enable.



Example	`:SYST:SHOW SSINformation`

4.1.5 Show Support ID

Displays the Support ID for each license available in the instrument. Shows the **Software License**, **Description**, software support expiration date, and **Support ID** for that license.

Each license has a copy icon, which copies just the **Support ID** for that license to the Windows clipboard. This is useful to avoid typing mistakes when entering this value into another program or web site.

The **Copy all to clipboard ...** control copies all the data to the Windows clipboard, in comma-separated value (CSV) format.

Example	`:SYST:SHOW SID`

4.1.6 Control Panel...

Opens the Windows Control Panel. **Control Panel** is used to configure certain elements of Windows that are not configured via the Multitouch UI System menus.

NOTE	This feature is *not* available if Option SF1 is installed.

Control Panel is a separate Windows application, so to return to the Instrument Application, either:

- Exit by tapping on the red **X** in the upper right-hand corner
- Use **Alt+Tab**. Press and hold the **Alt** key and press and release the **Tab** key until the Instrument logo is showing in the window in the center of the screen, then release the **Alt** key

Notes	No remote command for this key

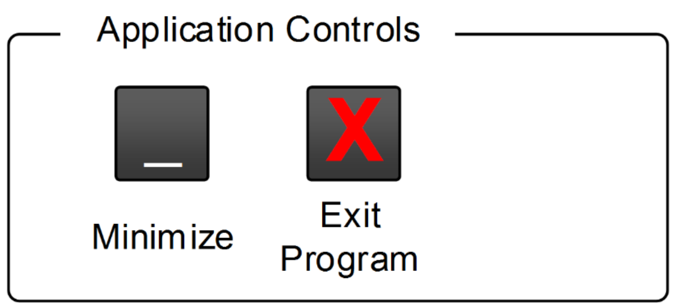
4.1.7 Web Browser

Launches the instrument's default **Web Browser**. Usually, the default is Microsoft Edge. A mouse and external keyboard are highly desirable for using the browser. To return focus to the Instrument Application, close the browser (or use **Alt-Tab**).

NOTE This feature is *not* available if Option SF1 is installed.

4.1.8 Application Controls

Lets you Minimize or Exit the application.



Pressing **Exit Program** displays a prompt asking if you are sure you want to close the program. If you select **OK**, the entire analyzer application will shut down, and you will lose any unsaved trace or measurement data.

Notes	No equivalent remote command for this key

4.1.9 Sounds

Lets you adjust the speaker volume using the slider, or mute/unmute the speaker, by tapping the **Speaker** icon.

Moving the slider up and down changes the speaker volume, and *also* unmutes the speaker if muted.

Icon when muted

4.2 I/O Config

Allows you to specify and change the I/O configuration for remote control. Controls in this menu allow configuration of the I/O ports used for SCPI remote control over GPIB and LAN.

The SCPI LAN parameters are set using controls in this menu, but configuration of LAN settings themselves is performed using the Windows Control Panel (DHCP, Gateway, Subnet Mask, etc.).

The USB port is also available for remote control, but requires no configuration.

4.2.1 GPIB

Allows you to configure the GPIB I/O port.

Dependencies	Not available in UXM

4.2.1.1 GPIB Address

Select the GPIB remote address.

Remote Command	`:SYSTem:COMMunicate:GPIB[1][:SELF]:ADDRess <integer>` `:SYSTem:COMMunicate:GPIB[1][:SELF]:ADDRess?`
Example	`:SYST:COMM:GPIB:ADDR 17`
Notes	If the GPIB port address is changed, all further communication must use the *new* address
Preset	Unaffected by **Preset**, but set to 18 by **Restore Defaults** > "Misc" on page 2079
State Saved	No
Min	0
Max	30

4.2.1.2 GPIB Controller

Sets the GPIB port into Controller (`ON`) or Device (`OFF`) mode. In the normal state, **GPIB Controller** is disabled (`OFF`), which allows the instrument to be controlled by a remote computer. When **GPIB Controller** is enabled (`ON`), the instrument can run software applications that use the instrument's computer as a GPIB controller for devices connected to the GPIB port.

NOTE **When GPIB Controller is enabled, the analyzer application itself cannot be controlled over GPIB. In this case, it can be controlled via LAN or USB. The GPIB port cannot be a Controller and Device at the same time. Only one Controller can be active on the GPIB bus at any given time. If the instrument is the Controller, an external PC cannot also be a Controller.**

To control the instrument from the software that is performing GPIB Controller operation, you can use an internal TCP/IP connection to the analyzer application. Use the following IP Address to send commands to the analyzer application:

`TCPIP0:localhost:inst0:INSTR`

Remote Command	`:SYSTem:COMMunicate:GPIB[1][:SELF]:CONTroller[:ENABle] ON | OFF | 0 | 1` `:SYSTem:COMMunicate:GPIB[1][:SELF]:CONTroller[:ENABle]?`

Example	Set GPIB port to Controller:
	`:SYST:COMM:GPIB:CONT ON`
	Set GPIB port to Device:
	`:SYST:COMM:GPIB:CONT OFF`

Notes	When the instrument becomes the Controller, Bit 0 in the Standard Event Status Register is set. When the instrument relinquishes Controller capability, bit 0 is cleared
Preset	Unaffected by Preset, but set to `OFF` (Disabled) by **Restore Defaults** > "Misc" on page 2079
State Saved	No
Range	Disabled | Enabled

4.2.2 SCPI LAN

Displays a menu for identifying and changing SCPI over a LAN configuration. There are several ways to send SCPI remote commands to the instrument over LAN.

Having multiple users simultaneously accessing the instrument over the LAN may lead to communication problems. These controls can help to prevent that, by disabling the telnet, socket, and/or SICL capability.

NOTE **When multiple instances of the application are running, Telnet port 5023, socket port 5025, SICL server inst0 and HiSLIP server Device 0 will be assigned to the first instance; Telnet port 5123, socket port 5125, SICL server inst1 and HiSLIP server Device 1 will be assigned to the second instance; Telnet port 5223, socket port 5225, SICL server inst2 and HiSLIP server Device 2 will be assigned to the third instance; Telnet port 5323, socket port 5325, SICL server inst3 and HiSLIP server Device 3 will be assigned to the fourth instance.**

– "SCPI Telnet" on page 2032
– "SCPI Socket" on page 2032
– "SICL Server" on page 2033
– "HiSLIP Server" on page 2034
– "Verbose SCPI On/Off" on page 2034
– "SCPI Socket Control Port (Remote Query Only)" on page 2036

4.2.2.1 SCPI Telnet

Turns SCPI LAN telnet capability On or Off, allowing you to limit SCPI access over LAN through telnet.

Remote Command	`:SYSTem:COMMunicate:LAN:SCPI:TELNet:ENABle OFF | ON | 0 | 1` `:SYSTem:COMMunicate:LAN:SCPI:TELNet:ENABle?`
Example	`:SYST:COMM:LAN:SCPI:TELN:ENAB OFF`
Preset	Unaffected by **Preset**, but set to ON by **Restore Defaults** > "Misc" on page 2079 If not set up or specified, the Secure Instrument Communications configuration setting: is ON
State Saved	No
Range	OFF | ON

4.2.2.2 SCPI Socket

Turns the capability to establish Socket LAN sessions ON or OFF, to limit SCPI access over LAN through socket sessions.

Connection String & Copy Button

In "SCPI LAN" on page 2031, the full SCPI connection string is displayed to the right of the **SCPI Socket**ON/OFF control. Pressing **Copy**, to the right of the string, copies the connection string to the Windows clipboard.

Remote Command	`:SYSTem:COMMunicate:LAN:SCPI:SOCKet:ENABle OFF | ON | 0 | 1` `:SYSTem:COMMunicate:LAN:SCPI:SOCKet:ENABle?`
Example	`:SYST:COMM:LAN:SCPI:SOCK:ENAB OFF`
Dependencies	If the Secure Instrument Communications configuration has disabled this connection, local changes are not allowed, and an attempt to do so results in error -221,“Disabled by Secure Instrument Communications configuration”

Preset	Unaffected by **Preset**, but set to ON by **Restore Defaults** > "Misc" on page 2079 If not set up or specified, the Secure Instrument Communications configuration setting: is ON
State Saved	No
Range	OFF|ON

4.2.2.3 SICL Server

Turns the **SICL Server** capability ON or OFF, to limit SCPI access over LAN through the SICL server. (SICL IEEE 488.2 protocol.)

Parameter	Description	Setting
Maximum Connections	The maximum number of connections that can be accessed simultaneously	5
Instrument Name	The name (same as the remote SICL address) of your instrument	inst0
Instrument Logical Unit	The unique integer assigned to your instrument when using SICL LAN	8
Emulated GPIB Name	The name (same as the remote SICL address) of the device used when communicating with your instrument	gpib7
Emulated GPIB Logical Unit	The unique integer assigned to your device when it is being controlled using SICL LAN	8
Emulated GPIB Address	The emulated GPIB address assigned to your transmitter tester when it is a SICL server (the same as your GPIB address)	18

Connection String & Copy Button

In "SCPI LAN" on page 2031, the full connection string is displayed to the right of the **SICL Server**ON/OFF control. Pressing **Copy**, to the right of the string copies the connection string to the Windows clipboard.

Remote Command	`:SYSTem:COMMunicate:LAN:SCPI:SICL:ENABle OFF | ON | 0 | 1` `:SYSTem:COMMunicate:LAN:SCPI:SICL:ENABle?`
Example	`:SYST:COMM:LAN:SCPI:SICL:ENAB OFF`
Dependencies	Not available in UXM If the Secure Instrument Communications configuration has disabled this connection, local changes are not allowed, and an attempt to do so results in error -221,“Disabled by Secure Instrument Communications configuration”
Preset	Unaffected by **Preset**, but set to ON by **Restore Defaults** > "Misc" on page 2079 If not set up or specified, the Secure Instrument Communications configuration setting: is ON
State Saved	No
Range	OFF|ON

4.2.2.4 HiSLIP Server

Turns the **HiSLIP Server** capability ON or OFF, to limit SCPI access over LAN through the HiSLIP server.

HiSLIP stands for High-Speed LAN Instrument Protocol, and is part of the IVI-6.1 specification.

Example of a VISA connection string used to connect to the HiSLIP Server on an X-Series Spectrum Analyzer:

`TCPIP0::a-n9030a-93016::hislip0::INSTR`

In the example above, `hislip0` is the HiSLIP device name that VISA users must include in HiSLIP VISA Address strings. Your HiSLIP device name may differ, depending on your VISA settings.

Connection String & Copy Button

In "SCPI LAN" on page 2031, the full connection string is displayed to the right of the **HiSLIP Server** ON/OFF control. Pressing **Copy**, to the right of the string copies the connection string to the Windows clipboard.

Remote Command	`:SYSTem:COMMunicate:LAN:SCPI:HISLip:ENABle OFF | ON | 0 | 1` `:SYSTem:COMMunicate:LAN:SCPI:HISLip:ENABle?`
Example	`:SYST:COMM:LAN:SCPI:HISL:ENAB OFF`
Preset	Unaffected by **Preset**, but set to ON by **Restore Defaults** > "Misc" on page 2079 If not set up or specified, the Secure Instrument Communications configuration setting: is ON
State Saved	No
Range	OFF | ON

4.2.2.5 Verbose SCPI On/Off

When you turn **Verbose SCPI** ON, additional information is returned by `:SYSTem:ERRor?`. The additional information consists of the characters that stimulated the error. This can aid you in debugging your test programs, by indicating where in the parsing of a SCPI command the instrument encountered an invalid command or query.

Specifically, with **Verbose SCPI** ON, `:SYSTem:ERRor?` is expanded to show the SCPI data received, with the indicator `<Err>` at the point in the stream that the error occurred.

Verbose SCPI has no effect on the **Show Errors** screen or front-panel Message Line; and only changes the response to `:SYST:ERR?`.

See the example below, where the invalid command `:SENS:BOGUS` is sent:

Normal response to `:SYST:ERR?` (using the Telnet window):

```
SCPI> SENS:BOGUS
SCPI> SYST:ERR?
-113,"Undefined header"
```

After turning on **Verbose SCPI**:

```
SCPI> SYST:BOGUS
SCPI> SYST:ERR?
-113,"Undefined header;SYST:BOGUS<Err>"
```

Remote Command	`:SYSTem:ERRor:VERBose OFF | ON | 0 | 1` `:SYSTem:ERRor:VERBose?`
Example	`:SYST:ERR:VERB ON`
Preset	Unaffected by **Preset**, but set to `OFF` by **Restore Defaults** > "Misc" on page 2079
State Saved	No
Range	`OFF|ON`

4.2.2.6 Device Clear on Disconnect

When using HiSLIP (High Speed LAN Instrument Protocol), Telnet, or Sockets, a communication session with the instrument is opened when you connect, and closed when you disconnect. This differs from other connections such as GPIB, USB and VXI-11 connections, which are never actually closed but stay open as long as the instrument is running.

When a session is closed, a Device Clear function is generated, which affects the entire instrument, not just the current connection. Thus, when using HiSLIP, Telnet, or Sockets, unexpected Device Clears may occur, which can disrupt measurements in ways that GPIB and VXI-11 “sessions” do not.

Device Clear on Disconnect enables these auto-generated Device Clears for Telnet, Socket, and HiSLIP sessions. For backwards compatibility, they are *not* generated unless you explicitly enable them.

There is no change in VXI-11, USB, or GPIB session behavior. These sessions do not close when you disconnect, have never generated Device Clear events, and still do not generate Device Clear events, regardless of the setting of this switch.

Remote Command	`:SYSTem:COMMunicate:LAN:SCPI:EOSession:DCLEar:ENABle 0 | 1 | ON | OFF` `:SYSTem:COMMunicate:LAN:SCPI:EOSession:DCLEar:ENABle?`
Example	`:SYST:COMM:LAN:SCPI:EOS:DCLE:ENAB ON`
Preset	Unaffected by **Preset**, but set to `OFF` by **Restore Defaults** > "Misc" on page 2079

State Saved	No
Range	OFF | ON

4.2.2.7 SCPI Socket Control Port (Remote Query Only)

Returns the TCP/IP port number of the control socket associated with the SCPI socket session. This query lets you obtain the unique port number to open when a device clear is to be sent to the instrument. Every time a connection is made to the SCPI socket, the instrument creates a peer control socket. The port number for this socket is random. You must use this command to obtain the port number of the control socket. To force a device clear on this socket, open the port and send the string DCL\n to the instrument.

If this query is sent to a non-SCPI Socket interface, then 0 is returned.

Remote Command	:SYSTem:COMMunicate:LAN:SCPI:SOCKet:CONTrol?
Example	:SYST:COMM:LAN:SCPI:SOCK:CONT?
Preset	Unaffected by **Preset** or **Restore Defaults** > "Misc" on page 2079
State Saved	No
Range	0 to 65534
Min	0
Max	65534
Backwards Compatibility SCPI	:SYSTem:COMMunicate:TCPip:CONTrol?

4.2.2.8 SCPI Instrument Port (Remote Query Only)

Some MIMO applications need to be able to determine the port to use to communicate with the instrument. This query returns the port number to use for communications.

Remote Command	:SYSTem:COMMunicate:LAN:INSTrument:PORT?

4.2.3 Web Password Reset

The embedded web server contains certain capabilities that are password-protected; modifying the LAN configuration of the instrument, and access to web pages that can change the settings of the instrument. The default password from the factory is:

`measure4u`

This control lets you set the web password as desired, or to reset the password to the factory default.

Selecting **Web Password Reset** displays a control for resetting the password as desired, or to the factory default. The built-in alpha keyboard appears. You may change the password from the factory default of "`measure4u`".

You can cancel this entry by pressing the **Cancel (ESC)** front-panel key.

Dependencies	Not available in UXM

4.2.4 System IDN Response

Allows you to specify a response to `*IDN?`, return the instrument to the `FACTory` response if you have changed it, or, if your test software is expecting the `*IDN` response to indicate Agilent Technologies, configure the instrument to respond with Agilent as the manufacturer.

The current `*IDN` response is displayed at the top of the panel, followed by the **System IDN Response** and **User IDN** controls.

4.2.4.1 System IDN Response

To select the factory-set response, select `FACTory`. To specify your own response, select `USER`. You can enter your desired response using "User IDN" on page 2038.

If your test software expects the response to indicate Agilent Technologies as the Manufacturer, you can configure this response by selecting `AGILent`.

Remote Command	`:SYSTem:IDN:CONFigure FACTory | AGILent | USER`
	For option details, see "More Information" on page 2037
	`:SYSTem:IDN:CONFigure?`

Example	`:SYST:IDN:CONF FACT`
Notes	Affects the response returned by all Modes of the instrument, unless the current Mode has *also* specified a custom response, in which case the current Mode's custom IDN response takes precedence over the System's, but only while that Mode is current Survives shutdown and restart of the software and therefore survives a power cycle
Preset	The `*IDN` response is reset to `FACTory` by **Restore Defaults** > "Misc" on page 2079 or **Restore Defaults** > "All" on page 2080 and survives subsequent running of the software

More Information

Here are details of the options available for the System `*IDN` response:

Factory

SCPI example:	:SYST:IDN:CONF FACT

Selects the factory default configuration of `*IDN?`, which indicates the Manufacturer as Keysight Technologies. For example,

`“Keysight Technologies,N9040B,MY00012345,A.15.00”`

where the fields are Manufacturer, Model Number, Serial Number, Firmware Revision.

NOTE In products that run multiple instances of the X-Series Application, all instances use the *same* factory System IDN response.

Agilent

SCPI example:	:SYST:IDN:CONF AGIL

Starting with software version x.14.50, the `*IDN?` response in the Factory configuration indicates the Manufacturer as Keysight Technologies. If your test software is expecting the response to indicate Agilent Technologies, you can configure the response with this menu selection or SCPI command.

For example:

`“Agilent Technologies,N9020A,MY00012345,A.05.01”`

NOTE In products that run multiple instances of the X-Series Application, all instances use the *same* Agilent System IDN response.

User

SCPI example:	:SYST:IDN:CONF USER

Selects your customized configuration of `*IDN?`

Enter your desired response using "User IDN" on page 2038.

4.2.4.2 User IDN

Allows you to specify your own response to `*IDN?`. You may enter your desired response with the Alpha Editor or a plugin PC keyboard. Once the value is entered, select `USER` under System IDN Response.

When you select this control, the active function becomes the current User string and is highlighted, so typing replaces it. If instead you wish to edit the existing string, press the left or right arrow to go to the beginning or the end.

If you enter a null string (for example, by clearing the User String while editing and then pressing **Done**), the instrument automatically reverts to the FACTory setting.

NOTE **In products that run multiple instances of the X-Series Application, all instances use the *same* User System IDN response.**

Remote Command	:SYSTem:IDN <string> :SYSTem:IDN?
Notes	The <string> must consist of four fields, each separated by a comma, example: :SYST:IDN “XYZ Corp,Model 12,012345,A.01.01” The four fields are <manufacturer>, <model number>, <serial number>, <firmware revision>. The fields are comma-delimited, so text within a field cannot contain a comma This affects the response given in all Modes of the instrument, unless the current Mode has *also* specified a custom response, in which case the current Mode’s custom IDN response takes precedence over the System’s, but only while that Mode is current Survives shutdown and restart of the software and therefore survives a power cycle Null string as parameter restores the FACTory setting, example: :SYST:IDN ""
Preset	Unaffected by **Preset**, but set to the original FACTory setting by **Restore Defaults** > "Misc" on page 2079

4.2.4.3 SYSTem:PERSona (Remote Commands Only)

The :SYSTem:PERSona command set permits setting of individual fields of the *IDN? response.

– "SYSTem:PERSona:DEFault" on page 2039
– "SYSTem:PERSona:MANufacturer" on page 2040
– "SYSTem:PERSona:MANufacturer:DEFault" on page 2040
– "SYSTem:PERSona:MODel" on page 2040
– "SYSTem:PERSona:MODel:DEFault" on page 2041

SYSTem:PERSona:DEFault

Resets the *IDN response to the instrument default.

Remote Command	:SYSTem:PERSona:DEFault :SYSTem:PERSona:DEFault?
Notes	:SYST:PERS:DEF? returns the default value of *IDN? even if the current setting of *IDN? is the

	non-default value. The query return type is a `<string>`
	`:SYST:PERS:DEF`
	is equivalent to:
	`:SYSTem:IDN ""`
	`:SYSTem:IDN:CONF DEF`

SYSTem:PERSona:MANufacturer

Sets the `MANufacturer` field of the `*IDN?` response. This is the first field of the `*IDN?` response.

Remote Command	`:SYSTem:PERSona:MANufacturer <string>` `:SYSTem:PERSona:MANufacturer?`
Notes	When setting the `MANufacturer` field, the current IDN response string is modified to replace the manufacturer field with the string specified by the command. If the resulting IDN response matches one of the predefined responses (`:SYST:IDN:CONF FACT | AGIL`), then the `:SYST:IDN:CONF` is set to the corresponding value. If the IDN response with the new manufacturer field is not one of the predefined values, then `:SYST:IDN:CONF` will be set to `USER` and `:SYST:IDN` will be set to the new IDN response string The query returns the current value of the `*IDN?` Manufacturer field

SYSTem:PERSona:MANufacturer:DEFault

Resets the `MANufacturer` field of the `*IDN?` response to the default value.

Remote Command	`:SYSTem:PERSona:MANufacturer:DEFault` `:SYSTem:PERSona:MANufacturer:DEFault?`
Notes	The query returns the default `MANufacturer` field value of `*IDN?` even if the current setting of `*IDN?` is the non-default value. The return type is a `<string>`

SYSTem:PERSona:MODel

Sets the `MODel` field of the `*IDN?` response. This is the second field of the `*IDN?` response.

Remote Command	`:SYSTem:PERSona:MODel <string>` `:SYSTem:PERSona:MODel?`
Notes	When setting the `MODel` field, the current IDN response string is modified to replace the model field with the string specified by the command. If the resulting IDN response matches one of the predefined responses (`:SYST:IDN:CONF FACT | AGIL`), then `:SYST:IDN:CONF` is set to the corresponding value. If the IDN response with the new model field is not one of the predefined values, then `:SYST:IDN:CONF` will be set to `USER` and `:SYST:IDN` will be set to the new IDN response string

	The query returns the current value of the *IDN?MODel field

SYSTem:PERSona:MODel:DEFault

Resets the MODel field of the *IDN? response to the default value.

Remote Command	:SYSTem:PERSona:MODel:DEFault :SYSTem:PERSona:MODel:DEFault?
Notes	The query returns the default MODel field value of *IDN? even if the current setting of *IDN? is the non-default value. The return type is a <string>

4.2.5 LXI

Accesses various LXI configuration properties.

Dependencies	Not available in UXM

4.2.5.1 LAN Reset

Resets the LAN connection. This sets parameters as follows, and restarts the LAN operation:

DHCP	Enabled
Automatic IP Address	Enabled
ICMP Ping Responder	Enabled
Web Password	keysight
Dynamic DNS	Enabled
mDNS and DNS-SD	Enabled
Dynamic Link Local Addressing	Enabled
Auto Negotiation	Enabled

There is no SCPI command for this function.

4.2.5.2 Device Identification (Remote Command Only)

Enabling LXI device identification places the LXI Status Indicator in the **Identify** state. Disabling LXI device identification places the LXI Status Indicator in the **No Fault** state. The LXI Status indicator is in the upper left region of the instrument's graphical user interface.

Remote Command	:LXI:IDENtify[:STATe] OFF | ON | 0 | 1

	:LXI:IDENtify[:STATe]?
Example	:LXI:IDEN ON
Preset	Not part of **Preset**, but reset to OFF by **Restore Defaults** > "All" on page 2080
State Saved	No
Range	OFF | ON

4.2.6 Restore I/O Config Defaults

Causes the group of settings associated with the **I/O Config** menu to be reset to their default values. This also happens on **Restore Misc Defaults**, which has a SCPI command.

When **Restore I/O Config Defaults** is selected, a message appears saying:

```
This will reset all of the I/O Config variables to their default state,
including the GPIB address and SCPI LAN settings
It will not affect Alignment data or settings
This action cannot be undone. Do you want to proceed?
```

The message provides **OK** and **Cancel** buttons so you can affirm or cancel the operation.

4.2.7 Query USB Connection (Remote Query Only)

Enables you to determine the speed of the USB connection.

Remote Command	:SYSTem:COMMunicate:USB:CONNection?
Example	:SYST:COMM:USB:CONN?
Notes	NONE: Indicates no USB connection has been made LSPeed: Indicates a USB low speed connection (1.5 Mbps) Note that this is reserved for future use, the T+M488 protocol is not supported on low-speed connections HSPeed: Indicates that a USB high speed connection (480 Mbps) has been negotiated FSPeed: Indicates that a USB full speed connection (12 Mbps) has been negotiated
State Saved	No
Range	NONE | LSPeed | HSPeed | FSPeed

4.2.8 USB Connection Status (Remote Query Only)

Lets you determine the current status of the USB connection.

Remote Command	`:SYSTem:COMMunicate:USB:STATus?`
Example	`:SYST:COMM:USB:STAT?`
Notes	`SUSPended` – Indicates that the USB bus is currently in its suspended state. The bus is in the suspended state when: – The bus is not connected to any controller – The controller is currently powered off – The controller has explicitly placed the USB device into the suspended state When in the suspended state, no USB activity, including start of frame packets are received `ACTive` – Indicates that the USB device is in the active state. When the device is in the active state, it receives periodic frame starts, but is not necessarily receiving or transmitting data
State Saved	No
Range	`SUSPended | ACTive`

4.2.9 USB Packet Count (Remote Query Only)

Lets you determine the number of packets received and transmitted on the USB bus.

Remote Command	`:SYSTem:COMMunicate:USB:PACKets?`
Example	`:SYST:COMM:USB:PACK?`
Notes	Two integers are returned: 1. The number of packets received since application invocation 2. The number of packets transmitted since application invocation If no packets have been received or transmitted, the response is `0,0` The packet count is initialized to `0,0` when the instrument application is started
State Saved	No

4.2.10 Lock Remote I/O Session (Remote Command only)

An instrument can support multiple remote I/O sessions at the same time. However, you cannot *simultaneously* send remote commands from multiple sessions to the same instrument. The results in such a case are undefined.

Ensure that only *one* session actively controls the instrument at a time. Other sessions must wait until the active session finishes the instrument control.

To help achieve this cooperative instrument sharing, the following remote commands are provided:

– "Lock Remote I/O Request (Remote Query only)" on page 2045

– "Unlock Remote I/O Session (Remote Command only)" on page 2046

– "Remote I/O Session Lock Name (Remote Query only)" on page 2047

– "Remote I/O Session Lock Owner (Remote Query only)" on page 2047

Example Procedure for Lock Usage

Step	Action
1	Each session tries to obtain a lock by sending `:SYSTem:LOCK:REQuest?` This query can be sent simultaneously from multiple sessions
2	Only one session will be granted. The granted session receives `1` in response to its query
3	The granted session actively controls the instrument Meanwhile, other sessions must wait, and must periodically send `:SYSTem:LOCK:REQuest?`, requesting the lock
4	When the active session finishes its task, it releases the lock by sending `:SYSTem:LOCK:RELease`
5	Now the lock has become available, so when one of the waiting sessions sends `:SYSTem:LOCK:REQuest?`, it receives `1` in response, granting the lock to that session

By repeating steps 3, 4, and 5 above, multiple sessions can share the same instrument in a cooperative fashion.

NOTE A session can query its own unique session name by sending `:SYSTem:LOCK:NAME?`. This session name is determined by the instrument.

A session also can query the name of the currently granted session by sending `:SYSTem:LOCK:OWNer?`.

NOTE Remote I/O interfaces are grouped in two types: single-session interface and multi-session interface. Both types of interfaces can be used for cooperative instrument sharing.

The recommended interface is LAN HiSLIP.

Interface	Single-session	Multi-Session
GPIB	ü	
USB-488	ü	
LAN VXI-11 (SICL)	ü	
LAN Socket		ü
LAN HiSLIP		ü
LAN Telnet		ü

If using a single-session interface, care must be taken to ensure only one client uses the single-session interface.

In particular, LAN VXI-11 (SICL) interface is a single-session interface, even though multiple clients could simultaneously connect to this interface. Such multiple VXI-11 clients share the same session context; the same status registers and the same error queue. Even a SCPI query response can be received by another client. Furthermore, the lock obtained by `:SYSTem:LOCK:REQuest?` is shared among all VXI-11 clients, allowing all of them to actively control the instrument.

If a LAN VXI-11 (SICL) interface must be used by multiple clients for a cooperative instrument sharing, then VISA locking *must* be used, *in addition to* Remote I/O Session Lock.

4.2.10.1 Lock Remote I/O Request (Remote Query only)

You can lock the SCPI control of the instrument to the I/O Interface and Session by sending `:SYSTem:LOCK:REQuest?`. This permits cooperative sharing of the instrument between multiple computers, or multiple sessions from the same computer.

Remote Command	`:SYSTem:LOCK:REQuest?`
Example	`:SYST:LOCK:REQ?`
Notes	Returns 1 if the lock request is granted, or 0 if the request is denied Lock requests on an individual interface and session can be nested and each request will increase an internal lock count by 1. For every granted request, send `:SYST:LOCK:REL` to decrement the internal lock count to fully relinquish the lock When the instrument is locked, Bit 0 is set in the Operation Instrument status register

	Disconnecting the individual interface and session releases the lock if the lock is granted to the interface and session A Device Clear over any interface and session releases the lock, regardless of the interface and session which obtained the lock The following queries are permitted over any interface and session, even if an interface has the instrument locked: – `*IDN?` – `*OPT?` – `*STB?` – `*ESR?` – `:SYSTem:DATE?` – `:SYSTem:TIME?` – `:SYSTem:PON:TIME?` – Queries in the `:STATus` subsystem – Queries in the `:SYSTem:ERRor` subsystem – Queries in the `:SYSTem:LKEY` subsystem – Queries in the `:SYSTem:LOCK` subsystem – Queries in the `:SYSTem:METRics` subsystem – Queries in the `:SYSTem:MODule` subsystem All other commands and queries result in error: -203,"Command protected; Instrument locked by another I/O session"
State Saved	Not part of Save/Recall

4.2.10.2 Unlock Remote I/O Session (Remote Command only)

You can unlock the SCPI control of the current I/O Interface and Session by sending `:SYSTem:LOCK:RELease`. Lock requests on an individual interface and session can be nested, and each request increases an internal lock count by 1. For every granted request, you will need to perform a release. The lock is not relinquished until the internal lock count reaches 0.

Remote Command	`:SYSTem:LOCK:RELease`
Example	`:SYST:LOCK:REL`
Notes	When the instrument is unlocked, Bit 0 is cleared in the Operation Instrument status register

4.2.10.3 Remote I/O Session Lock Name (Remote Query only)

Use this query to obtain the name of the current I/O Interface and Session.

Remote Command	`:SYSTem:LOCK:NAME?`
Example	`:SYST:LOCK:NAME?`
Notes	The information returned is a string of the format: `<I/O Interface>[/<IP address>/<Session ID>]` Where `IP address` and `Session ID` are only provided for interfaces that provide multiple sessions Single Session interfaces (GPIB, USB-488, and LAN VXI-11) only list interface name `Session ID` is an internally generated identifier. It is not guaranteed to be consistent across instrument software versions (the identifier is subject to change when the software of the instrument is updated). The absolute value of `Session ID` is not significant, but the identifier will be consistent for a given software version, and can be relied upon for lock owner logic comparisons

4.2.10.4 Remote I/O Session Lock Owner (Remote Query only)

Use this query to determine which I/O Interface and Session has the SCPI locked.

If no interface and session has the SCPI locked, then the return value is `NONE`.

Remote Command	`:SYSTem:LOCK:OWNer?`
Example	`:SYST:LOCK:OWN?`
Notes	The information returned is a string of the format: `<I/O Interface>[/<IP address>/<Session ID>]` Where `IP address` and `Session ID` are only provided for interfaces that provide multiple sessions Single Session interfaces (GPIB, USB-488, and LAN VXI-11) only list interface name `Session ID` is an internally generated identifier. It is not guaranteed to be consistent across instrument software versions (the identifier is subject to change when the software of the instrument is updated). The absolute value of `Session ID` is not significant, but the identifier will be consistent for a given software version, and can be relied upon for lock owner logic comparisons If no interface and session has the SCPI locked, then the return value is `NONE`

4.2.11 Multiple Network Interface Card Configuration (Remote Commands Only)

Systems that have multiple Network Interface Cards (**NICs**) require additional configuration information. The following keys can be added to the XApps configuration file:

- `PrimaryNICIpv4` – IP address value is a string with the exact IP V4 format. Required field in IP v4 networks.
- `PrimaryNICIpv6` – IP address value is a string with the exact IP V6 format. Required field in IP v6 networks.

These commands do not apply to instruments that have only one NIC. The commands apply to all modular deployments that have a controller with multiple NICs.

To configure and query these configuration options, the following remote commands are provided:

- "Multiple Network Adapters Enabled (Remote Query Only)" on page 2048
- "Config IPV4 Address (Remote Command Only)" on page 2049
- "Config IPV6 Address (Remote Command Only)" on page 2049
- "List All Physical Network Adapter IP Addresses (Remote Query Only)" on page 2049

4.2.11.1 Multiple Network Adapters Enabled (Remote Query Only)

Remote Command	`:SYSTem:COMMunicate:LAN:MULTiple:NIC:ENABled?`
Example	`:SYSTem:COMMunicate:LAN:MULTiple:NIC:ENABled?`
Notes	Applies to Instruments that have multiple Network Adapters. When more than one network adapter is present in the system, and they are **Enabled** (that is, they have a valid IP Address), this query returns: – 1, if more than one NIC enabled – 0, if only one or No NICs are enabled
State Saved	No

4.2.11.2 Config IPV4 Address (Remote Command Only)

Remote Command	`:SYSTem:COMMunicate:LAN:IPV4:CONFig <ipaddress>` `:SYSTem:COMMunicate:LAN:IPV4:CONFig?`
Example	`:SYSTem:COMMunicate:LAN:IPV4:CONFig "192.168.1.146"` `:SYSTem:COMMunicate:LAN:IPV4:CONFig?`
Notes	Applies to instruments that have multiple Network Adapters. When more than one network adapter is present in the system, you must specify in the instrument config file the IP address to use to enable Remoting channel bindings. If this is not provided, Remoting connections are likely to fail on systems where multiple NICs are enabled Sets the valid IPV4 address, passed in as string in the config file The query returns IPV4 address, as a string If config file is missing, "" (empty string) is returned Changing the IPV4 value requires a restart of the instrument software, to ensure that servers use the configured IP address
State Saved	No

4.2.11.3 Config IPV6 Address (Remote Command Only)

Remote Command	`:SYSTem:COMMunicate:LAN:IPV6:CONFig <ipaddress>` `:SYSTem:COMMunicate:LAN:IPV6:CONFig?`
Example	`:SYSTem:COMMunicate:LAN:IPV6:CONFig "2001:0db8:85a3:0000:0000:8a2e:0370:7334"` `:SYSTem:COMMunicate:LAN:IPV6:CONFig?`
Notes	Applies to instruments that have multiple Network Adapters. When more than one network adapter is present in the system, you must specify in the instrument config file the IP address to use to enable Remoting channel bindings. If this is not provided, Remoting connections are likely to fail on systems where multiple NICs are enabled Sets the valid IPV6 address, passed in as string in the config file The query returns IPV6 address, as a string If config file is missing, "" (empty string) is returned Changing the IPV6 value requires a restart of the instrument software, to ensure servers use the configured IP address
State Saved	No

4.2.11.4 List All Physical Network Adapter IP Addresses (Remote Query Only)

Remote Command	`:SYSTem:COMMunicate:LAN:PHYSical:IPADdress:LIST?`
Example	`:SYSTem:COMMunicate:LAN:PHYSical:IPADdress:LIST?`

	:"192.168.1.146,2001:0db8:85a3:0000:0000:8a2e:0370:7334"
Notes	Returns the IP Addresses of the physical network adapters found in the PC/Instrument
State Saved	No

4.3 Preload / Unload Modes

The X-Series platform supports many Modes. Each Mode that is loaded uses a portion of the total available memory. At some point, this may result in insufficient free memory. This can occur during a measurement, or when loading a new Mode. A limited number of Modes can be loaded without impacting performance.

Preload / Unload Modes allows you to select and enable Modes to be preloaded at startup, and to specify the default **Power-On Mode**.

The dialog includes the following controls:

– "Power-On Mode" on page 2051

– "Table of Modes" on page 2052

– "Preload: Select All, Preload: Deselect All" on page 2052

– "Move Up, Move Down" on page 2052

– "Unload" on page 2052

Modes that are not preloaded may be loaded at runtime as needed, resources permitting. However, note that loading more Modes increases memory consumption and may adversely impact performance.

When a memory-full situation occurs, the instrument notifies you with the following message:

```
Out of memory; Insufficient resources. Please save state if needed. You have
following options:

1. Open System Settings > Configure Preload Modes to unload unused Modes

2. Reconfigure preloaded Modes on the above dialog, close and restart the
analyzer SW

3. Close and restart the analyzer SW
```

Option 1 allows you to unload unused Modes and continue running the software, without having to restart it.

The command `:INSTrument:UNLoad <mode>` provides equivalent functionality; see "Unload" on page 2052.

4.3.1 Power-On Mode

Displays a list of licensed Modes. Use this control to change the factory default Power-On Mode. The instrument will execute the selected Mode after power up. Selecting the Power-On Mode here automatically enables that Mode for preloading.

4.3.2 Table of Modes

The table of Modes becomes scrollable when the number of Modes exceeds the dialog's displayable size.

Use the check boxes in the **Preload** column to enable or disable the preloading of the Modes that you want.

Use the check boxes in the **Unload** column to select the Modes that you want to unload.

The Unload check boxes are grayed-out when the Modes are used by other Modes.

Example:

5G NR & V2X Mode cannot be loaded when either Sequence Analyzer Mode or Power Amplifier Mode are already loaded, because these Modes use 5G NR & V2X Mode. To unload 5G NR & V2X Mode, both Sequence Analyzer Mode and Power Amplifier Mode must be unloaded first.

When the active Mode is unloaded, the screen becomes blank except for the message; "`No Mode is active`". You can then select another desired Mode.

When multiple screens are open, and a Mode is unloaded, inactive screens that have that Mode as their active Modes are closed.

The active screen is never closed.

4.3.3 Preload: Select All, Preload: Deselect All

Toggles the **Preload** checkbox state for all Applications listed, except for the Power-On Application, which is always selected.

4.3.4 Move Up, Move Down

The default order in which Applications are listed in the table is the order in which they are displayed in the **Mode/Measurement/View** Selector dialog. To change the order in this list, select the desired Application row from the table, then click **Move Up** or **Move Down** to move it to the desired position.

4.3.5 Unload

Unloads the specified Mode.

Remote	`:INSTrument:UNLoad <mode>`

Command	
Example	`:INST:UNL NR5G`

Notes	Error message if the specified Mode is not available,
	`-224,"Illegal parameter value;<mode> is not a valid choice"`
	Error message if the specified Mode is not loaded and therefore cannot be unloaded,
	`-221,"Settings conflict;<mode> is not loaded"`
	Error message if the specified Mode is used by other Modes and therefore cannot be unloaded,
	`-221,"Settings conflict;<mode> is used by <other modes>"`
	Error message if the specified Mode does not support Unload Mode feature and therefore cannot be unloaded,
	`-221,"Settings conflict;Feature not supported for this Mode"`

4.3.6 Loaded Modes (Remote Query Only)

Returns a list of loaded Modes.

Remote Command	`:SYSTem:APPLication:LOADed?`
Example	`:SYST:APPL:LOAD?`
Preset	Not affected by Preset

4.3.7 User Interface

Configures functions specific to the User Interface, such as the menu panel orientation and the display color theme.

4.3.7.1 Menu Panel Position

Allows the Menu Panel to be positioned on the `RIGHt` or `LEFT` side of the display.

Remote Command	`:SYSTem:DISPlay:MPPosition RIGHt | LEFT` `:SYSTem:DISPlay:MPPosition?`
Example	`:SYST:DISP:MPP LEFT`
Preset	This is unaffected by **Preset** but is set to `RIGHt` by **Restore Defaults** > "User Interface" on page 2078 or **Restore Defaults** > "All" on page 2080
State Saved	Power On Persistent (survives shutdown and restart)

4.3.7.2 Menu Panel Tabs

Allows the **Menu Panel Tabs** to be positioned on the `RIGHt` or `LEFT` side of the menu panel.

Remote Command	`:SYSTem:DISPlay:MPTab RIGHt | LEFT` `:SYSTem:DISPlay:MPTab?`
Example	`:SYST:DISP:MPT LEFT`
Preset	This is unaffected by **Preset** but is set to `RIGHt` by **Restore Defaults** > "User Interface" on page 2078 or **Restore Defaults** > "All" on page 2080
State Saved	Power On Persistent (survives shutdown and restart)

4.3.7.3 Annotations Local Settings/All Off

Overrides the annotation settings for all measurement in all modes and turns them all off. This provides the security based "annotation off" function of previous instruments; hence it uses the legacy SCPI command.

When this control is set to **All Off**, the **Screen Annotation, Meas Bar, Trace Annotation,** and **Control Annotation** controls under the **Display, Annotation** menu are grayed-out and forced to `OFF` for all measurements in all modes. When **Local Settings** is selected, you can set the local annotation settings on a measurement-by-measurement basis.

Remote Command	`:DISPlay:WINDow[1]:ANNotation[:ALL] OFF | ON | 0 | 1` `:DISPlay:WINDow[1]:ANNotation[:ALL]?`
Example	`:DISP:WIND:ANN OFF`
Preset	This is unaffected by **Preset** but is set to `ON` by **Restore Defaults** > "User Interface" on page 2078, **Restore Defaults** > "Misc" on page 2079 or **Restore Defaults** > "All" on page 2080
State Saved	Power On Persistent (survives shutdown and restart)
Backwards Compatibility Notes	The `WINDow` parameter and optional subopcode is included for backwards compatibility but ignored – all windows are equally affected

4.3.7.4 Display Theme

Allows you to change the **Display Theme**. This is similar to the Themes selection under Page Setup and Save Screen Image.

The two available themes are:

- FILLed: this is the normal theme using filled objects
- OUTLine: this theme uses color, but does not use fill for most areas on the display. It is ideal for images that need to be printed on inkjet printers. Although setting **Display Theme** to OUTLine does not affect screen image saves or prints, it does show you exactly how screen images will look when using the OUTLine theme under **Save Screen Image**, and how prints will look when using the OUTLine theme under **Page Setup**.

NOTE **Although the OUTLine theme eliminates most of the filled area, some objects remain filled. In particular, the selected marker remains filled with the green marker color, to distinguish it from the other markers. This is important, as it is the selected marker whose readout appears in the upper right corner of the display.**

Remote Command	`:DISPlay:THEMe TDColor | TDMonochrome | FCOLor | FMONochrome | FILLed | OUTLine` `:DISPlay:THEMe?`
Example	`:SYST:DISP:THEM OUTL` sets the display style to OUTLine
Notes	To permit code compatibility with A-model X-Series Signal Analyzer instruments, the command parameters from the A-models are mapped as follows: – TDColor and TDMonochrome are both mapped to FILLed (exact full color representation of what is on the screen) – FCOLor and FMONochrome are both mapped to OUTLine (uses color for traces and other items, but most filled areas are white) There is no Monochrome theme in the B-model instruments, so the monochrome commands for the A-model instruments yield color themes The query of :DISPlay:THEMe? always returns FILLed or OUTLine. It never returns FCOLor, FMONochrome, TDColor, or TDMonochrome
Preset	This is unaffected by **Preset** but is set to FILLed by **Restore Defaults** > "User Interface" on page 2078, **Restore Defaults** >"Misc" on page 2079 or **Restore Defaults** >"All" on page 2080
State Saved	Power On Persistent (survives shutdown and restart)

4.3.7.5 Backlight

Turns the display **Backlight** on and off. This setting may interact with settings under the Windows **Power** menu.

When the backlight is OFF, pressing ESC, TAB, SPACE, ENTER, UP, DOWN, LEFT, RIGHT, DEL, BKSP, CTRL, or ALT turns the backlight ON without affecting the application. Pressing any other key turns backlight ON, and could potentially perform the action as well.

Remote Command	`:DISPlay:BACKlight ON | OFF` `:DISPlay:BACKlight?`

Example	Turn backlight ON:
	`:DISP:BACK ON`
	Turn backlight OFF:
	`:DISP:BACK OFF`

Preset	Pressing any key turns the backlight back ON, as does **Restore Defaults** > "User Interface" on page 2078, **Restore Defaults** >"Misc" on page 2079 or **Restore Defaults** >"All" on page 2080
State Saved	Not saved in State

4.3.7.6 Backlight Intensity

Allows the **Backlight Intensity** to be controlled from the UI settings panel.

Remote Command	`:SYSTem:DISPlay:BACKlight:INTensity <integer>` `:SYSTem:DISPlay:BACKlight:INTensity?`
Example	`:SYST:DISP:BACK:INT 67`
Preset	100
State Saved	Power On Persistent (survives shutdown and restart)
Range	0-100

4.3.7.7 Hints

Hints are descriptions that provide additional information for a control. You can set **Hints** to be enabled or disabled.

Remote Command	`:SYSTem:DISPlay:HINTs[:STATe] OFF | ON | 0 | 1` `:SYSTem:DISPlay:HINTs?`
Example	`:SYST:DISP:HINT OFF`
Preset	This is unaffected by **Preset** but is set to ON by **Restore Defaults** > "User Interface" on page 2078 or **Restore Defaults** >"All" on page 2080
State Saved	Power On Persistent (survives shutdown and restart)

4.3.7.8 Numeric Entry Auto Open

Configures whether the **Numeric Entry** Panel will appear immediately when an active function control is activated (Auto Open ON), or be deferred until you touch it again or begin to enter a value (Auto Open OFF). When configured for Auto Open

OFF (the default), adjusting the value with the front panel Up/Down keys or the RPG hides the **Numeric Entry** Panel.

Remote Command	:SYSTem:DISPlay:NEPimmediate ON | OFF | 1 | 0 :SYSTem:DISPlay:NEPimmediate?
Example	:SYST:DISP:NEP OFF
Preset	This is unaffected by **Preset** but is set to ON by **Restore Defaults** > "User Interface" on page 2078 or **Restore Defaults** >"All" on page 2080
State Saved	Power On Persistent (survives shutdown and restart)

4.3.7.9 Touch On/Off

Turns the touch functionality on and off on the display. If OFF, you can turn it back on using the front panel **Touch On/Off** key, or by using a mouse to toggle this control.

Preset	Always starts up ON Unaffected by **Preset** but is turned ON by **Restore Defaults** > "User Interface" on page 2078 or **Restore Defaults** >"All" on page 2080
State Saved	Not saved in state, not affected by **Preset**, not Power On Persistent (does not survive shutdown and restart)

4.3.7.10 Control Size

Configures the size of the controls in the user interface. This can be used to make screen dumps from a large screen instrument match those from a smaller screen instrument, to make the controls more readable on a large-screen instrument, or to display more information on a smaller screen instrument.

Remote Command	:DISPlay:UINTerface:CSIZe SMALl | LARGe :DISPlay:UINTerface:CSIZe?
Example	:DISP:UINT:CSIZ LARG
Preset	This is unaffected by **Preset** but is set to SMALl by **Restore Defaults** > "User Interface" on page 2078 or **Restore Defaults** >"All" on page 2080
State Saved	Power On Persistent (survives shutdown and restart)

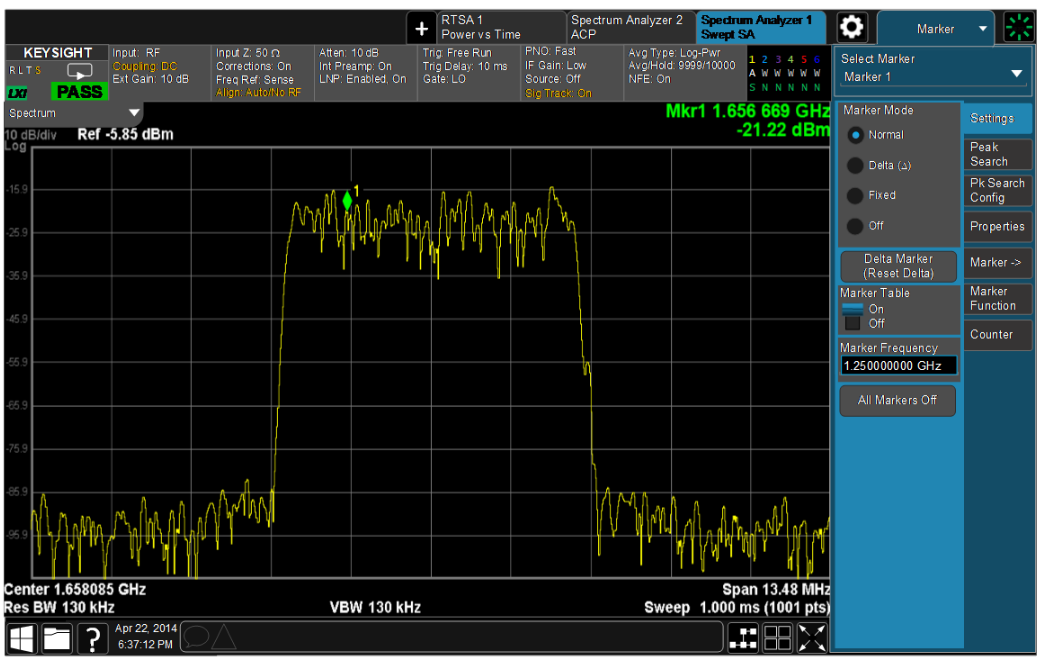
4.3.7.11 Quick Save Mode

When **Quick Save Mode** is NORMal (the default setting), the instrument does an immediate save of a new file of the same type and to the same directory as the previous **Save** action. When **Quick Save Mode** is in the PROMpt state, instead of immediately performing a **Save**, the Alpha Keyboard appears with the proposed auto-filename in the entry area. You can then press **Enter** to accept the auto filename, or edit the name then press **Enter**. This allows you to easily save a file with a custom file name.

Remote Command	`:MMEMory:STORe:QSAVe NORMal | PROMpt` `:MMEMory:STORe:QSAVe?`
Example	`:MMEM:STOR:QSAV PROM`
Preset	This is unaffected by **Preset** but is set to `NORMal` by **Restore Defaults** > "User Interface" on page 2078 or **Restore Defaults** > "All" on page 2080
State Saved	Power On Persistent (survives shutdown and restart)

4.3.7.12 Screen Tabs Left/Right

This switch, when in the `RIGHt` position, makes the screen tabs start on the right and build across to the left, thus minimizing the finger travel over to the screen tab when there is only one screen. When tabs are added from right to left, they appear as below:



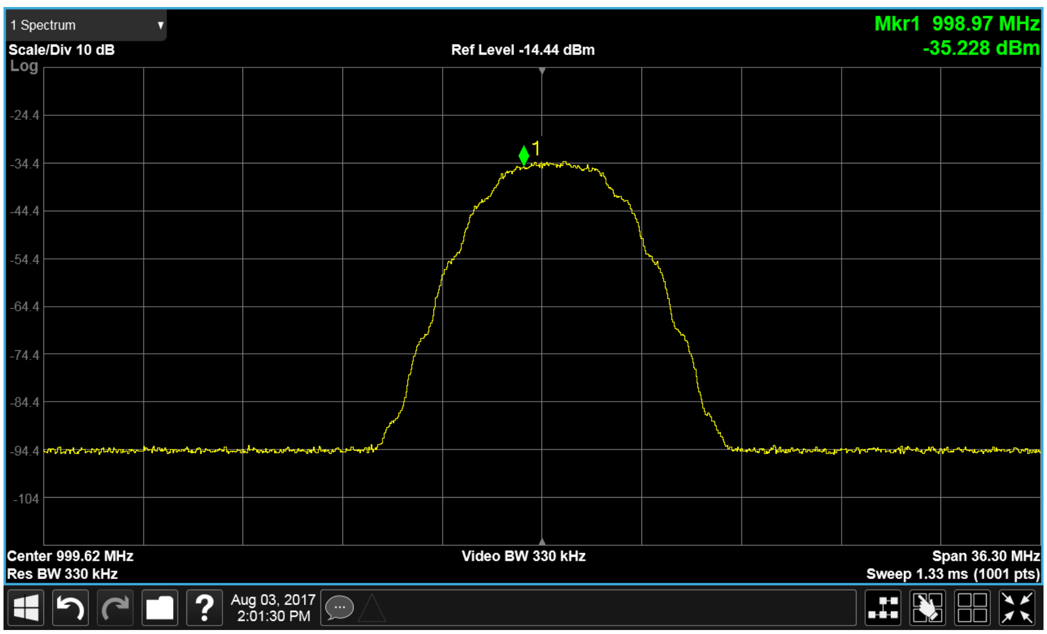
The default is `LEFT`.

Remote Command	`:DISPlay:UINTerface:STAB RIGHt | LEFT` `:INSTrument:SCReen:STAB?`

Example	`:DISP:UINT:STAB RIGH`
Preset	This is unaffected by **Preset** but is set to `LEFT` by **Restore Defaults** > "User Interface" on page 2078 or **Restore Defaults** > "All" on page 2080
State Saved	Power On Persistent (survives shutdown and restart)

4.3.7.13 Hide Screen Tabs in Full Screen

This switch, when in the `ON` position, causes the Screen Tabs to be hidden when in Full Screen view, thus maximizing the display area available for results. By also turning off the Meas Bar (in the **Display, Annotation** menu), you can maximize the available area for results, as shown below:

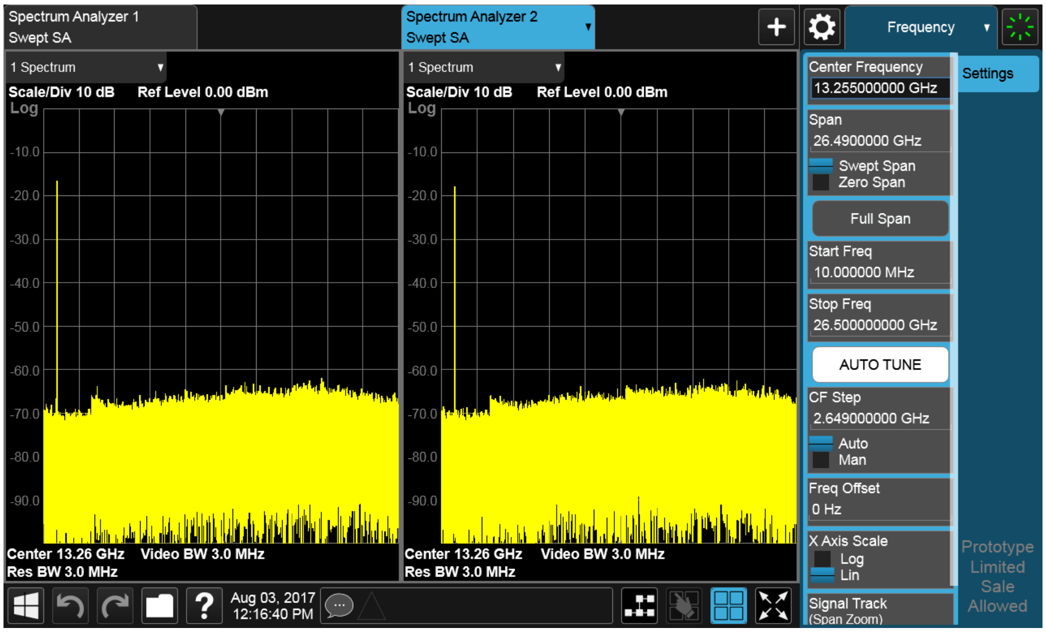


Remote Command	`:DISPlay:UINTerface:HTABs ON | OFF | 1 | 0`
	`:DISPlay:UINTerface:HTABs?`
	`:DISPlay:UINTerface:STFScreen ON | OFF | 1 | 0`
	Implemented but with wrong sense; ON turns them off and OFF turns them on; so, don't document to customer

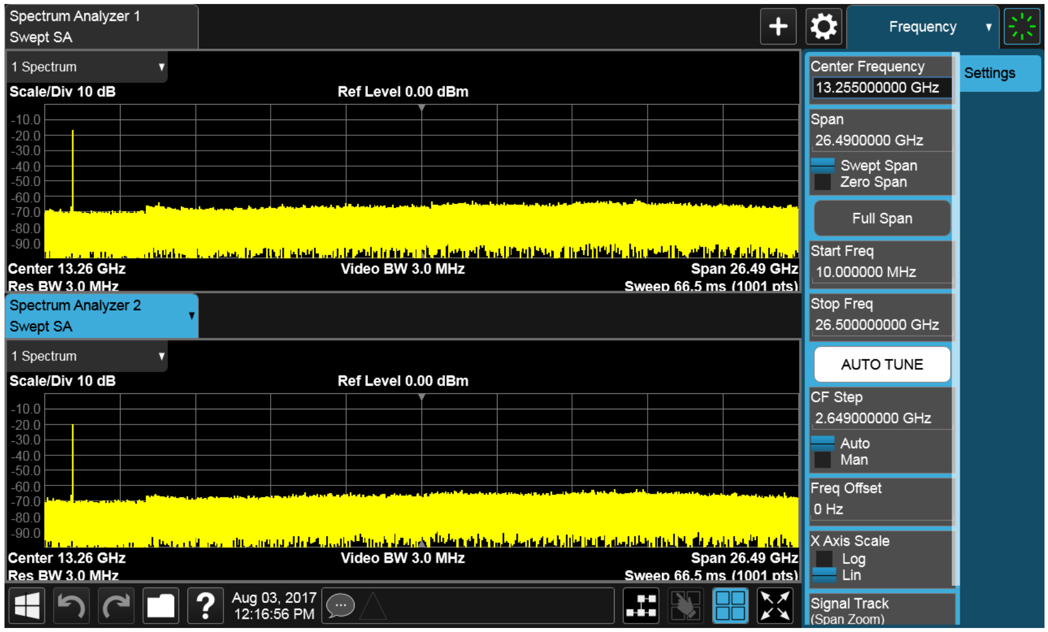
Example	`:DISP:UINT:HTAB ON` Hide the tabs in full screen
Preset	This is unaffected by **Preset** but is set to `OFF` by **Restore Defaults** > "User Interface" on page 2078 or **Restore Defaults** > "All" on page 2080
State Saved	Power On Persistent (survives shutdown and restart)

4.3.7.14 2-Screen Orientation

When you add a second Screen using the “+” control on the Screen Tabs bar, normally the screen is added to the right of the first screen. However, sometimes it is better to add the new screen below the first screen rather than to the right, as shown below.



New screen added to the right (horizontal orientation)



New screen added below (vertical orientation)

The **2-Screen Orientation** switch allows you to choose between these two orientations for 2-Screen configurations. The default is the `HORizontal` configuration, two Screens side-by-side.

Remote Command	`:INSTrument:SCReen:ORIentation VERTical | HORizontal`
Example	`:INST:SCR:ORI VERT` Set the 2 screens to be above/below each other
Preset	`HOR` This is unaffected by **Preset** but is set to `HORizontal` by **Restore Defaults** > "User Interface" on page 2078 or **Restore Defaults** > "All" on page 2080

4.3.7.15 Clock Format

Allows the **Clock Format** to be switched between 12-Hour Format (`HR12`) and 24-Hour Format (`HR24`).

Remote Command	`:SYSTem:DISPlay:CFORmat HR12 | HR24` `:SYSTem:DISPlay:CFORmat?`
Example	`:SYST:DISP:CFOR HR12`
Preset	`HR12`
State Saved	Power On Persistent (survives shutdown and restart)
Range	12-Hour | 24-Hour

4.3.7.16 Language

Accesses the selection of **Language** displayed on the menus and controls. `ENGLish` is the default.

All Measurement Applications that share common controls will display the localized controls.

The description on the control labels is bounded by the control size. Any given language will have labels in that language that are shorter or longer than the equivalent label in English. Any localized text on the controls that does not fit the label size remains in English. Thus, for any given menu, controls may be displayed in English *and* the selected language.

- Labels that are acronyms, engineering, or technology specific terms may remain in English.
- All Application and Measurement names remain in English.
- All data in exported files remain in English.
- The Diagnostic and Service menus in the System Subsystem remain in English.
- The Windows operating system must remain in English. Changing the **Region and Language** settings in the Windows Control Panel is not supported.

External keyboards in English are supported. Localized external keyboards are not supported. When the language selected is not English, a message is displayed to explain that any external keyboard must remain in English.

Other aspects of the Graphical User Interface remain in English. The Remote User Interface (SCPI) remains in English.

Remote Command	`:SYSTem:DISPlay:LANGuage ENGLish | RUSSian` `:SYSTem:DISPlay:LANGuage?`

Example	`:SYST:DISP:LANG ENGL`
	`:SYST:DISP:LANG RUSS`
	Requires Option AKT

Preset	This is unaffected by **Preset** but is set to `ENGLish` by **Restore Defaults** > "User Interface" on page 2078,**Restore Defaults** >"Misc" on page 2079 or **Restore Defaults** >"All" on page 2080

4.3.7.17 Restore User Interface Defaults

Causes the group of settings associated with the **User Interface** menu to be reset to their default values. This also happens on **Restore Misc Defaults**.

When **User Interface** is selected, a message appears saying:

```
This will reset all of the User Interface variables to their default state,
including the menu panel location, display theme, and language.
It will not affect Alignment data or settings.
This action cannot be undone. Do you want to proceed?
```

The message provides **OK** and **Cancel** buttons for you to affirm or cancel the operation.

Example	`:SYST:DEF UINT`

4.3.7.18 User Interface Type (Remote Query Only)

Use this query to determine if the instrument is running the Multi-Touch user interface or Softkey user interface. This is an easy way to distinguish between A-models (Softkey) instruments and Touch UI (Multi-Touch) instruments.

Remote Command	`:DISPlay:UINTerface:TYPE?`
Example	`:DISP:UINT:TYPE?`
Notes	The query returns `MULTITOUCH` for instruments with the Multi-Touch UI or `SOFTKEY` for instruments with the Softkey UI

4.4 Power On

Lets you select how the instrument should power on.

NOTE In products that run multiple instances of the X-Series Application, the same Power On type is shared between all the instances.

4.4.1 Power On State

Lets you select whether the instrument powers up in a default state, or some other state. The options are:

– `MODE` and Input/Output Defaults

– `USER` Preset

– `LAST` State

Remote Command	`:SYSTem:PON:TYPE MODE | USER | LAST` `:SYSTem:PON:TYPE?`

Example	`:SYST:PON:TYPE MODE`
	`:SYST:PON:TYPE USER`
	`:SYST:PON:TYPE LAST`

Preset	This is unaffected by **Preset** but is set to `MODE` by **Restore Defaults** > "All" on page 2080
State Saved	No
Backwards Compatibility SCPI	`:SYSTem:PON:TYPE PRESet` The `PRESet` parameter is supported for backward compatibility only, and behaves the same as `MODE`

Mode and Input/Output Defaults

When the instrument is powered-on in `MODE` and Input/Output Defaults, it performs "Restore Mode Defaults" on page 2188 for all Modes in the instrument, and performs **Restore Input/Output Defaults**.

Persistent parameters (such as Amplitude Correction tables or Limit tables) are not affected at power-on, even though they are normally cleared by **Restore Input/Output Defaults** and/or **Restore Mode Defaults**.

User Preset

Sets **Power On State** to `USER` Preset. When the instrument is powered on in User Preset, it will **User Preset** each mode and switch to the "Power On Application" on page 2066. **Power OnUser Preset** does not affect any settings other than those set by a normal **User Preset**.

Backwards Compatibility Note: Power On: **User Preset** causes the instrument to power up in the "Power On Application" on page 2066, *not* the last Mode the instrument was in prior to shutdown. Also, **Power On**: **User Preset** will **User Preset** all Modes. This does *not* exactly match legacy behavior.

NOTE **In products that run multiple instances of the X-Series Application, the same User Preset is shared between all the instances.**

NOTE **An instrument can never power up for the first time in `USER` preset.**

Last State

Sets **Power On State** to `LAST`. When the instrument is powered on, it will put all modes in the last state they were in prior to when the instrument was put into Power Standby, and it will start up in the mode it was last in prior to powering off the instrument. The saving of the active mode prior to shutdown happens behind the scenes when a controlled shutdown is requested, either via the front panel **Standby** key, or the remote command `:SYSTem:PDOWn`. The non-active modes are saved as they are deactivated and recalled by Power On: Last State.

Power On: **Last State** only works if you completed a controlled shutdown prior to powering on in `LAST`. If a controlled shutdown is not completed when in **Power On**: **Last State**, the instrument powers up in the last active Mode, but it may not power up in the active Mode's last state. If an invalid Mode state is detected, a **Mode Preset** occurs. To control the shutdown under remote control, use `:SYSTem:PDOWn`.

Backwards Compatibility Note: It is no longer possible to power-up the instrument in the last Mode the instrument was running with that Mode in the preset state. (ESA/PSA `SYST:PRESET:TYPE MODE` with `SYST:PON:PRESET`) You can power-on the instrument in the last Mode the instrument was running in its last state (`:SYST:PON:TYPE LAST`), or you can specify the Mode to power-up in its preset state (`:SYST:PON:MODE <mode>`).

NOTE **In products that run multiple instances of the X-Series Application, each instance has a unique Last State.**

NOTE **An instrument can never power up for the first time in `LAST`.**

If line power to the instrument is interrupted, for example by pulling the line cord plug or by switching off power to a test rack, **Power OnLast State** may not work properly. For proper operation, **Power On Last State** depends on your shutting down the instrument using the **Standby** key or the `:SYSTem:PDOWn` command. This ensures the last state of each Mode is saved and can be recalled during a power-up.

4.4.2 Power On Application

Accesses a menu that lists the available Modes, and lets you select which Mode is to be the **Power On Application**. Whichever application is selected runs at power-on when the Power On Type is set to "`MODE` and Input/Output Defaults".

NOTE In products that run multiple instances of the X-Series Application, the same Power On Application is shared between all the instances.

Remote Command	`:SYSTem:PON:MODE <mode>`
	where `<mode>` is an item from the same set that can be sent using the `:INSTrument[:SELect]` command
	`:SYSTem:PON:MODE?`

Example	`:SYST:PON:MODE SA`
Notes	The displayed list of possible Modes (and remote parameters) depends on which Modes are installed in the instrument

Preset	Unaffected by **Preset** but is set by **Restore Defaults** > "All" on page 2080 to `SA`, except in the cases noted below:
	N8973B, N8974B, N8975B, N8976B: `NFIG`
	`VXT models`: `BASIC`
	`M9410E/11E/15E/16E`: `BASIC`

State Saved	No

4.4.3 FPGA Configuration

Lets you choose which FPGA image you want loaded into the instrument.

Depending on your hardware configuration, your instrument may contain a Field Programmable Gate Array (FPGA) which handles much of the processing for some of the mathematically intensive features, such as Time Domain Scan (Option TDS) and Enhanced Sweep Speed (Option FS2). The FPGA is not big enough to hold the functionality for both options, so you must decide which FPGA program you want loaded.

When licenses allow for both FPGA image versions to be available, and you have not explicitly chosen an FPGA image version, then, when the firmware is updated, the Time Domain Scan version will be loaded. In the absence of all licenses, the Enhanced Sweep Speed version will be loaded. Once you have explicitly chosen an FPGA image version, using the FPGA Configuration dialog, any future firmware updates will continue to load the chosen version as long as it is licensed.

Example: loading the Time Domain Scan FPGA image, removing the TDS license, and then updating the firmware will result in the Enhanced Sweep Speed version being loaded.

When multiple capabilities are licensed, the FPGA Configuration presents a dialog that tells you that there is insufficient space to fit all the licensed capabilities, and asks you to choose one of the FPGA programs (images).

If you remove licenses, it is possible to end up with an unlicensed capability loaded in the FPGA while a licensed capability is not loaded. In this case, the dialog does not present the **Preference** group and shows a message about unlicensed/licensed capabilities. You can dismiss the dialog if the licensed capability is not currently needed, and you do not want to take the time to load the licensed FPGA image. However, this dialog will continue to appear each time the instrument is restarted.

Behavior when the Enhanced Sweep Speed FPGA Image is Loaded

When the Enhanced Sweep Speed version of the FPGA image is loaded, sweep behavior still depends on the licenses:

- Option FS2 gives full FPGA enhanced sweep speed
- Option FS1 gives software implemented enhanced sweep speed
- Neither Option FS1 nor FS2 – no enhanced sweep speed
- Both Options FS1 and FS2 – same as Option FS2, the full FPGA enhanced sweep speed

If EMI Receiver Mode and TDS option are licensed, and the Enhanced Sweep Speed FPGA image is loaded, then you will not have the proper FPGA image loaded to fully support EMI Receiver Mode. In particular, the Frequency Scan measurement cannot use Scan Type “Time Domain Scan” (this is the normally the default Scan Type for instruments with the TDS option). Instead, EMI Receiver Mode behaves as if the TDS option is not licensed.

Behavior when the Time Domain Scan FPGA Image is loaded

When the Time Domain Scan version of the FPGA image is loaded, EMI Receiver Mode works as expected with the TDS option licensed, but the Option FS2 capability silently reverts to FS1 behavior.

Switching Between Enhanced Sweep Speed and Time Domain Scan FPGA Images

You cannot have both full TDS and FS2 images at the same time, so to switch to the other image, you must go through the process of reloading the FPGA by choosing the desired image with the Selected FPGA control, and pressing "Load FPGA" on page 2070, or issuing the “Load FPGA” SCPI command below with the proper parameter.

Incorrect FPGA Configuration

If EMI Receiver Mode, Option TDS, or Option FS2 license is removed while the FPGA image for that license is loaded, the instrument ends up in an incorrect configuration, since the loaded FPGA image version has support for unlicensed functionality that is not accessible and does not support the currently licensed functionality. It will still function, but when the instrument recognizes this situation at startup, it automatically displays the **FPGA Configuration** dialog. The only selections available will be the licensed ones, but you can choose to dismiss the dialog and continue with the current FPGA image version if you do not want to take the time to load the correct FPGA image. The dialog will continue to be presented at each startup until the correct FPGA image is loaded.

FPGA Updates When Firmware Installs

The FPGA image and X-Series firmware are tightly coupled, so whenever the firmware is updated, the FPGA image is also checked and updated if needed. The rules for choosing between Time Domain Scan and Enhanced Sweep Speed versions of the FPGA image are:

1. Always use Time Domain Scan FPGA image for MXE
2. If neither EMC Mode nor Option TDS nor Option FS2 are licensed, the Enhanced Sweep Speed FPGA image is loaded
3. If EMC Mode and Option TDS are licensed and Option FS2 is not licensed, the Time Domain Scan FPGA image is loaded
4. If EMC Mode and Option TDS are not licensed, and Option FS2 is licensed, the Enhanced Sweep Speed FPGA image is loaded
5. If all are licensed
   a. If "FPGA Load Preference" on page 2069 is **Time Domain Scan**, the Time Domain Scan FPGA image is loaded

b. If **FPGA Load Preference** is **Enhanced Sweep Speed**, the Enhanced Sweep Speed FPGA image is loaded

c. If **FPGA Load Preference** is **Prompt at Startup**:

   a. If the last FPGA Configuration Load was Time Domain Scan, the Time Domain Scan FPGA image is loaded

   b. If the last FPGA Configuration Load was Enhanced Sweep Speed, the Enhanced Sweep Speed FPGA image is loaded

   c. If no FPGA has been explicitly loaded, the Time Domain Scan FPGA image is loaded

4.4.3.1 FPGA Load Preference

Select either image from the radio buttons at the top of the dialog:

Option	SCPI	Description
Time Domain Scan	TDS	Load the Time Domain Scan version of the FPGA image
Enhanced Sweep Speed	FS2	Load the Enhanced Sweep Speed version of the FPGA image
Prompt at Startup	PROMpt	Prompt at each startup, displaying the **FPGA Configuration** dialog. You can choose to continue with the currently loaded FPGA image version, or load a different version

If you select the image that is already loaded, you will not be prompted again. If you select a different one, the Selected FPGA control changes to that one and you must then press "Load FPGA" on page 2070 to load the other image.

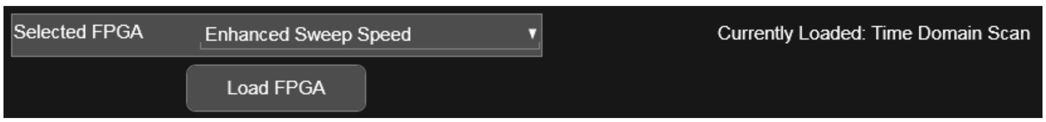
When installing new firmware, the **FPGA Load Preference** setting is used to load the preferred FPGA image version if more than one version is available. Selecting **Prompt at Startup** causes you to be prompted at each startup to select the desired version of the FPGA image.

Remote Command	`:SYSTem:PON:FPGA:PREFerence TDS | FS2 | PROMpt`
Example	`:SYST:PON:FPGA:PREF TDS` `:SYST:PON:FPGA:PREF?`
Notes	This SCPI is always available, but if the hardware does not support multiple FPGA image choices, the returned value is always: NA = Not available for this hardware Also, when not supported, any attempt to change away from NA generates error -224, “Illegal parameter value”
Dependencies	Dialogs and menus available only when EMC Mode, Option TDS and Option FS2 are all licensed

Preset	PROMpt Not affected by **Mode Preset** but set to PROMpt by **Restore Defaults** > "All" on page 2080 or **Power On**

4.4.3.2 Load FPGA

Depending on the "FPGA Load Preference" on page 2069 selection, there may be a mismatch between the desired FPGA image, and the one that is currently loaded. In that case the **Load FPGA** control at the bottom of the dialog is not grayed-out, and you must press it to actually load the desired FPGA image. The image that is currently loaded is shown on the right:



If you have a mismatch, but do not actually load the other image, the **FPGA Load Preference** is remembered, but the image you had before remains until you return to this dialog and press **Load FPGA**, or until the next time the instrument firmware is updated.

If you press **Load FPGA**, the X-series software exits, the FPGA update program runs, and the instrument reboots. After rebooting, the new image will be loaded in the FPGA.

NOTE This can take 15 minutes or more.

CAUTION If power is lost during the FPGA load process, the FPGA can become corrupted, in which case the only solution is to return it to Keysight for servicing.

Remote Command	`:SYSTem:PON:FPGA:LOAD TDS | FS2`

Example	`:SYST:PON:FPGA:LOAD TDS`
	For options, see Dependencies row below
	`:SYST:PON:FPGA:LOAD?`

Notes	If the specified FPGA image version is the one already loaded, then the command does nothing. If the FPGA image needs to change, the analyzer software exits (terminating the SCPI session), and the FPGA update utility is launched. Once the FPGA has updated, the instrument will reboot This SCPI is always available, but if the hardware does not support multiple FPGA image choices, the value returned is always: NA = Not available for this hardware Also, when not supported, any attempt to change away from NA generates error -224, “Illegal parameter value”
Dependencies	Available only when there are multiple versions of the FPGA image that could be loaded

	Selection limited to licensed features: – TDS selection requires EMC Mode and Option TDS – FS2 requires Option FS2 The UI is blanked when there is only one licensed selection, and that selection is already loaded. Sending the SCPI for an unlicensed selection results in error: -224, “Illegal parameter value; <option> is not licensed”
Preset	None. Not affected by **Mode Preset** nor any "Restore Defaults" on page 2077

4.4.4 Restore Power On Defaults

This selection causes the **Power On** settings to be reset to their default values.

When this button is pressed, a message appears saying:

This will reset Power On State and Power On Application to their default state.

It will not affect Alignment data or settings.

This action cannot be undone. Do you want to proceed?

The message provides **OK** and **Cancel** buttons for you to confirm or cancel the operation.

Example	`:SYST:DEF PON`

4.4.5 Configure Applications – Desktop application

The **Configure Applications** utility runs from the instrument’s desktop. You must close the Instrument Application before running **Configure Applications.**

This utility can be used to:

– select applications (Modes) for preload

– determine how many Modes can fit in memory at one time

– specify the order of the Modes in the Mode menu.

The utility consists of a window with instructions, a set of **Select Application** checkboxes, a “fuel bar” style memory gauge, and keys that help you set up your configuration.

NOTE **In products that run multiple instances of the X-Series Application, the same Configure Applications utility is shared between all the instances.**

For more details, see the following topics:

– "Preloading Applications" on page 2072
– "Access to Configure Applications utility" on page 2072
– "Virtual memory usage" on page 2073

Example	Display the Config Applications screen: `:SYST:SHOW CAPP`

Preloading Applications

During runtime, if a Mode that is not preloaded is selected using the **Mode** menu or by sending SCPI commands, there will be a pause while the Application is loaded. During this pause, a message that says "`Loading application, please wait …`" is displayed. Once loaded, the application stays loaded, so the next time you select it during a session, there is no delay.

Preloading lets you "preload" at startup, to eliminate the runtime delay. Preloading an application causes it to be loaded into the instrument's memory when the analyzer program starts up. If you do this, the delay will increase the time it takes to start up the analyzer program, but this may be preferable to having to wait the first time you select an application. Note that, once an application is loaded into memory, it cannot be unloaded without exiting and restarting the analyzer program.

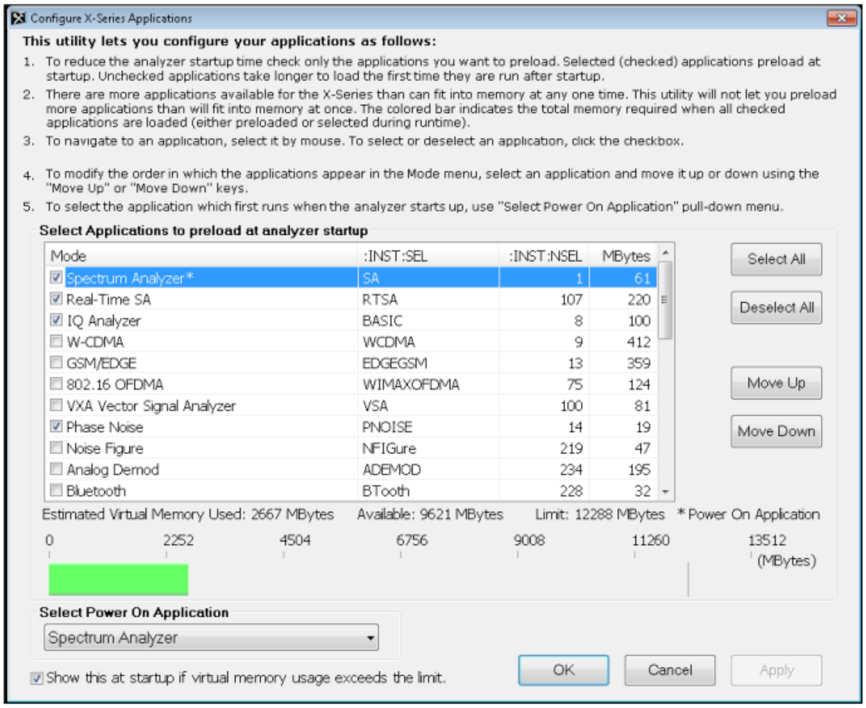
Note that there are more applications available for X-Series than can fit into Windows Virtual Memory. By allowing you to choose which licensed applications to load at startup, the **Configure Applications** utility allows you to make optimal use of the instrument memory.

Access to Configure Applications utility

A version of the utility runs the first time you power up the instrument after purchasing it from Keysight. The utility automatically configures preloads so that as many licensed applications as possible are preloaded while keeping the total estimated virtual memory usage below the limit. This auto-configuration only takes place at the very first run, and after analyzer software upgrades.

At any time, you can manually start the **Configure Applications** utility by closing the analyzer application and double-tapping the **Configure Applications** icon on the desktop.

The utility's main dialog looks like this:



Instructions are provided below and in the utility. Use the utility to find a configuration that works best for you, and then restart the analyzer program.

Select All	Marks all applications in the selection list. This allows you to enable all applications licensed on the instrument for pre-loading, or is a convenience for selecting all applications in one operation and then letting you deselect individual applications
Deselect All	Clears the marks from all applications in the selection list, except the Power On application. The Power On application cannot be eliminated from the pre-load list
Move Up Move Down	The application list is the order that applications appear in the Mode Menu. These keys let you shift the selected application up or down in the list, thus moving the selected application earlier or later in the Mode Menu
Select Power On Application	This is the same as the “Power On Application” selection on the Power On page of the System Settings dialog

Virtual memory usage

There are more applications available for X-Series than can fit into memory at any one time, so the **Configure Applications** utility includes a memory tracker that serves two purposes:

1. It will not let you preload more applications than will fit into memory at once
2. You can determine how many of your favorite applications can reside in memory at one time

The utility provides a graphical representation of the amount of memory (note that the amount of memory shown here is *virtual* memory, which is a limitation imposed by the operating system, not by the amount of physical memory you have in your instrument). You select applications to preload by checking the boxes on the left. Checked applications preload at startup. The colored fuel bar indicates the total memory required when all the checked applications are loaded (either preloaded or selected during runtime).

Here is what the fuel bar colors mean:

– RED: the applications you have selected cannot all fit into the instrument's memory. You must deselect applications until the fuel bar turns yellow

– YELLOW: the applications you have selected can all fit into the instrument's memory, but there is less than 10% of the memory left, probably not enough to load any other applications, either via preload or by selecting a Mode while the instrument is running

– GREEN: The indicator is green when <90% of the memory limit is consumed. This means the applications you have selected can all fit into the instrument's memory with room to spare. You will be able to load one or more other applications without running out of memory

If Sequence Analyzer is selected to be preloaded, all apps that are part of the Sequencer Mode (GSM/EDGE, WCDMA, CDMA2K and 1xEVDO) are preloaded (if licensed).

4.4.6 Configure Applications - Instrument boot-up

When the Instrument Application starts, a dialog box similar to the one you see when you run Configure Applications is displayed, allowing you to choose which licensed applications are to be loaded. This dialog is only displayed if the memory required to pre-load all the licensed applications exceeds the virtual memory available.

4.4.7 Configure Applications - Remote Commands

The following topics provide details on using remote commands to configure the list of applications you want to load into the instrument memory, or query the virtual memory utilization for your applications.

- "Configuration list (Remote Command Only)" on page 2075
- "Configuration Memory Available (Remote Query Only)" on page 2075
- "Configuration Memory Total (Remote Query Only)" on page 2075
- "Configuration Memory Used (Remote Query Only)" on page 2076
- "Configuration Application Memory (Remote Query Only)" on page 2076

4.4.7.1 Configuration list (Remote Command Only)

Used to set or query the list of applications to be loaded in-memory.

Remote Command	`:SYSTem:PON:APPLication:LLISt <string of INSTrument:SELect names>` `:SYSTem:PON:APPLication:LLISt?`
Example	`:SYST:PON:APPL:LLIS "SA,BASIC,WCDMA"`
Notes	`<string of INSTrument:SELect names>` contains items that are valid options for the `:INSTrument:SELect` command The order of the `<INSTrument:SELect names>` specifies the order in which the applications are loaded into memory, and the order that they appear in the **Mode** menu `Error message -225 "Out of Memory"` is reported when more applications are listed than can reside in virtual memory. When this occurs, the existing applications load list is unchanged
Preset	Not affected by Preset
State Saved	Not saved in instrument state

4.4.7.2 Configuration Memory Available (Remote Query Only)

Returns the amount of Virtual Memory remaining.

Remote Command	`:SYSTem:PON:APPLication:VMEMory[:AVAilable]?`
Example	`:SYST:PON:APPL:VMEM?`
Preset	Not affected by Preset

4.4.7.3 Configuration Memory Total (Remote Query Only)

Returns the limit of Virtual Memory allowed for applications.

Remote Command	`:SYSTem:PON:APPLication:VMEMory:TOTal?`
Example	`:SYST:PON:APPL:VMEM:TOT?`
Preset	Not affected by Preset

4.4.7.4 Configuration Memory Used (Remote Query Only)

Returns the amount of Virtual Memory used by all measurement applications.

Remote Command	`:SYSTem:PON:APPLication:VMEMory:USED?`
Example	`:SYST:PON:APPL:VMEM:USED?`
Preset	Not affected by Preset

4.4.7.5 Configuration Application Memory (Remote Query Only)

Returns the amount of Virtual Memory a particular application consumes.

Remote Command	`:SYSTem:PON:APPLication:VMEMory:USED:NAME? <INSTrument:SELect name>`
Example	`:SYST:PON:APPL:VMEM:USED:NAME? CDMA2K`
Notes	`<INSTrument:SELect name>` is an item from the same set used by the `:INSTrument:SELect` command If the name provided is invalid, 0 (zero) is returned
Preset	Not affected by Preset

4.5 Restore Defaults

Provides initialization of system setting groups, including the option to set the entire instrument back to a factory default state.

NOTE In products that run multiple instances of the X-Series Application, all instances have the same factory default states for **Restore Defaults**.

Remote Command	`:SYSTem:DEFault [ALL] | ALIGn | INPut | MISC | MODes | PON | UINTerface | SCReen`
Example	`:SYST:DEF`
State Saved	No

4.5.1 Input/Output

Input/Output Preset resets the group of settings and data associated with the **Input/Output** front-panel key to their default values. These settings are not affected by a **Mode Preset** because they are associated with connections to the instrument, which you will probably not want to reset every time you press **Mode Preset**.

By using **Input/Output** Preset and "Restore Mode Defaults" on page 2188, a full preset of the current mode will be performed, with the caveat that since **Input/Output** Preset is a global function, it will affect *all* modes.

This is the same as the **Input/Output Preset** button in the **Preset** dropdown and the **Input/Output** menu.

When **Input/Output** is selected, a message appears saying:

```
This will reset all of the Input/Output variables to their default state, including which input is selected, all Amplitude Correction settings and data, all External Mixing settings, all Frequency Reference settings and all Output settings

It will not affect Alignment data or settings

This action cannot be undone. Do you want to proceed?
```

The dialog includes **OK** and **Cancel** controls, for you to confirm or cancel the operation.

Example	`:SYST:DEF INP`

4.5.2 I/O Config

Causes the group of settings associated with the **I/O Config** menu to be reset to their default values. This also happens on **Restore Misc Defaults**, which has a SCPI command, although **I/O Config** does not.

When **I/O Config** is selected, a message appears saying:

```
This will reset all of the I/O Config variables to their default state,
including the GPIB address and SCPI LAN settings
```

```
It will not affect Alignment data or settings
```

```
This action cannot be undone. Do you want to proceed?
```

The dialog includes **OK** and **Cancel** controls, for you to affirm or cancel the operation.

4.5.3 User Interface

Causes the group of settings associated with the **User Interface** menu to be reset to their default values. This also happens on a **Restore Misc Defaults**.

When **User Interface** is selected, a message appears saying:

```
This will reset all of the User Interface variables to their default state,
including the menu panel location, display theme, and language
```

```
It will not affect Alignment data or settings
```

```
This action cannot be undone. Do you want to proceed?
```

The dialog includes **OK** and **Cancel** controls, for you to affirm or cancel the operation.

Example	`:SYST:DEF UINT`

4.5.4 Power On

Causes the **Power On** settings to be reset to their default values.

The Power On settings are **Power On State** and **Power On Application**.

When **Power On** is selected, a message appears saying:

```
This will reset Power On State and Power On Application to their default state
```

```
It will not affect Alignment data or settings
```

```
This action cannot be undone. Do you want to proceed?
```

The dialog includes **OK** and **Cancel** controls, for you to affirm or cancel the operation.

Example	`:SYST:DEF PON`

4.5.5 Alignments

Causes the **Alignments** system settings to be reset to their default values. This does not affect any Alignment data stored in the system.

After performing this function, it may impact the auto-alignment time of the instrument until a new alignment baseline has been established.

When **Alignments** is selected, a message appears saying:

```
This will reset all of the settings for the Alignment system to their default values
```

```
No alignment data will be erased
```

```
This action cannot be undone. Do you want to proceed?
```

The dialog includes **OK** and **Cancel** controls, for you to affirm or cancel the operation.

Example	`:SYST:DEF ALIG`

4.5.6 Misc

Causes miscellaneous system settings to be reset to their default values.

CAUTION **This function resets the GPIB address to 18.**

When **Misc** is selected, a message appears saying:

```
This will reset miscellaneous system settings to their default values. This includes settings for I/O Config (GPIB and SCPI LAN), the User Interface, the Save/Recall system, and the Preset type
```

```
It will not affect Alignment data or settings
```

```
This action cannot be undone. Do you want to proceed?
```

The dialog includes **OK** and **Cancel** controls, for you to affirm or cancel the operation.

This Miscellaneous group contains settings that are *not* part of the other Restore Defaults groups. These include:

- All settings on the **I/O Config** page of the **System Settings** dialog
- All settings in the following table:

Miscellaneous Setting	Default Value
The SYST:PRES:TYPE	MODE
Auto File Name Number	000
Save Type	State
State Save To	Register 1
Screen Save To	SCREEN000.png
Save/Recall Shortcuts	Deleted
Display Theme	Filled
Backlight	ON
System Annotation	Local Settings
Language	English
DISP:ENABle	ON
Full Screen	Off

Example `:SYST:DEF MISC`

4.5.7 All

Comprehensively resets **All** instrument settings to their factory default values.

Resets all **System Settings** groups, performs "Restore Mode Defaults" on page 2188 for all Modes in the instrument, and switches back to the power-on mode. Does not affect the User Preset file, or any user saved files.

When **All** is selected, a message appears:

```
This will reset all of the settings in the instrument to their factory default
values, including the state of all Modes and Screens, the GPIB settings, the
Alignment settings, and the Power On Mode

It will not affect Alignment data or settings

This action cannot be undone. We recommend canceling this operation and
restoring settings individually (I/O Config, User Interface, Alignments, etc.)
instead

Do you want to proceed?
```

The dialog includes **OK** and **Cancel** controls, for you to confirm or cancel the operation.

NOTE **If you are using a Keysight USB External Mixer, then you will need to perform Refresh USB Mixer Connection** (SCPI command `:MIX:BAND USB`) **after Restore Defaults > All**.

Example	`:SYST:DEF ALL`
Couplings	**All** causes the currently running measurement to be aborted, and sets all modes to a consistent state, so it is unnecessary to couple any settings

Backwards Compatibility SCPI

Notes	`:SYST:PRES:PERS` is the same as `:SYST:DEF ALL`
Backwards Compatibility SCPI	`:SYSTem:PRESet:PERSistent`

4.6 Alignments

Accesses the alignment system of the instrument. You can control the automatic alignments, view alignment statistics and manually perform alignments.

The current setting of the alignment system is displayed in the Meas Bar along the top of the display. For conditions that may cause specifications to be impacted, this annotation will be in amber.

4.6.1 Auto Align

Lets you configure the automatic background alignments and the alerts from the automatic alignment system.

Dependencies	Does not appear in VXT or M9410E/11E/15E/16E

4.6.1.1 Auto Align

Configures the method the automatic background alignment will use when it runs.

Automatic background alignments are run periodically between measurement acquisitions. The instrument's software determines when alignments are to be performed to maintain warranted operation. The recommended setting for Auto Align is Normal.

Auto Align execution *cannot* be aborted with the **Cancel (ESC)** key. To interrupt **Auto Align** execution, select **Auto Align Off**.

Remote Command	`:CALibration:AUTO ON | LIGHt | PARTial | OFF`
	For details of each option, see "Auto Align Options" on page 2083
	`:CALibration:AUTO?`

Example	`:CAL:AUTO ON`
Notes	While Auto Align is executing, bit 0 of Status Operation register is set
Couplings	Auto Align is set to Off if Restore Align Data is invoked
Preset	This is unaffected by **Preset** but is set to ON by **Restore Defaults** > "Alignments" on page 2079
State Saved	No
Annotation	In the Meas Bar: – Normal with "All But RF" off: Auto (white) – Normal with "All But RF" on: Auto/No RF (amber) – Partial: Partial (amber)

	– Off: Off (amber)
Status Bits/OPC dependencies	When **Auto Align** is executing, Bit 0 in the Status Operational register is set An interfering signal at the RF Input may prevent automatic alignment of the RF subsystem. If this occurs, the Error Condition message "Align RF skipped" is reported, the Status Questionable Calibration bit 11 is set, and the alignment proceeds. When a subsequent alignment of the RF subsystem succeeds, either by the next cycle of automatic alignment or from an Align Now, RF, the Error Condition and Status Questionable Calibration bit 11 are cleared
Backwards Compatibility SCPI	`:CALibration:AUTO ALERt` Parameter `ALERt` is for backwards compatibility only, and is mapped to `PARTial`

Auto Align Options

The available settings for Auto Align are as follows:

Normal

SCPI example `:CAL:AUTO ON`

Auto Align, **Normal** turns on the automatic alignment of all measurement systems. This selection maintains the instrument in warranted operation across varying temperature and over time.

If the condition "Align Now All required" is set, transitioning to **Auto Align**, **Normal** performs the required alignments, clears the "Align Now All required" condition, then continues with further alignments as required to maintain the instrument adequately aligned for warranted operation.

When **Auto Align**, **Normal** is selected, the **Auto Align Off** time is set to zero.

When **Auto Align**, **Normal** is selected, the Meas Bar indicates Align: Auto (in white) or Align: Auto/No RF (in amber). The amber color reminds you that you are responsible for maintaining the RF alignment of the instrument.

Alignment processing because of the transition to **Normal** is executed sequentially. Thus, `*OPC?` or `*WAI` following `:CAL:AUTO ON` will return when the alignment processing is complete.

Light

SCPI example `:CAL:AUTO LIGH`

Auto Align, **Light** turns on the automatic alignment of all measurement systems. The **Auto Align**, **Light** selection allows more drift in amplitude accuracy to allow much less frequent measurement interruptions to perform alignments. The temperature changes required to trigger each alignment are increased by a factor of three. Alignments also expire from time as well as temperature. In a stable thermal environment, the alignments occur one-ninth as often as in Normal. With these less frequent alignments, all accuracy specifications (those expressed with ±x dB tolerances) change by nominally a factor of 1.4.

If the condition “Align Now, All required” is set, transitioning to **Auto Align**, **Light** performs the required alignments, clears the “Align Now, All required” condition, and continues with further alignments as required to maintain the instrument adequately aligned for warranted operation.

Alignment processing because of the transition to **Light** is executed sequentially. Thus, `*OPC?` or `*WAI` following `:CAL:AUTO LIGHT` will return when the alignment processing is complete.

When **Auto Align**, **Light** is selected, the **Auto Align Off** time is set to zero.

When **Auto Align**, **Light** is selected, the Settings Panel indicates Align: Light.

Partial

SCPI example `:CAL:AUTO PART`

Auto Align, **Partial** disables the full automatic alignment and the maintenance of warranted operation for the benefit of improved measurement throughput. Accuracy is retained for the Resolution Bandwidth filters and the IF Passband, which is critical to FFT accuracy, demodulation, and many measurement applications. With Auto Align set to Partial, you are now responsible for maintaining warranted operation by updating the alignments when they expire. The Auto Align, Alert mechanism will notify you when alignments have expired. One solution to expired alignments is to perform the Align All, Now operation. Another is to return the Auto Align selection to Normal.

Auto Align, **Partial** is recommended for measurements where the throughput is so important that a few percent of improvement is more valued than an increase in the accuracy errors of a few tenths of a decibel. One good application of **Auto Align**, **Partial** would be an automated environment where the alignments can be called during overhead time when the device-under-test is exchanged.

When **Auto Align**, **Partial**, is selected the elapsed time counter begins for **Auto Align Off** time.

When **Auto Align**, **Partial** is selected, the Settings Panel indicates Align: Partial in an amber color. The amber color reminds you that you are responsible for maintaining the warranted operation of the instrument.

Off

SCPI example `:CAL:AUTO OFF`

Auto Align, **Off** disables automatic alignment and the maintenance of warranted operation, for the benefit of maximum measurement throughput. With **Auto Align**

set to **Off**, you are now responsible for maintaining warranted operation by updating the alignments when they expire. The Auto Align, Alert mechanism will notify you when alignments have expired. One solution to expired alignments is to perform the **Align All**, **Now** operation. Another is to return the **Auto Align** selection to **Normal**.

The **Auto Align Off** setting is rarely the best choice, because **Partial** gives almost the same improvement in throughput while maintaining the warranted performance for a much longer time. The choice is intended for unusual circumstances, such as the measurement of radar pulses where you might want the revisit time to be as consistent as possible.

When **Auto AlignOff** is selected, the **Auto Align Off** time is initialized and the elapsed time counter begins.

When **Auto AlignOff** is selected, the Settings Panel indicates Align: Off in an amber color. The amber color reminds you that you are responsible for maintaining the warranted operation of the instrument.

4.6.1.2 All but RF

Configures automatic alignment to include or exclude the RF subsystem. (Eliminating the automatic alignment of the RF subsystem prevents the input impedance from changing. The normal input impedance of 50 ohms can change to an open circuit when alignments are being used. Some devices under test do not behave acceptably under such circumstances, for example by showing instability.)

When **All but RF** is `ON`, the operator is responsible for performing an **Align Now RF** when RF-related alignments expire. The Auto Align, Alert mechanism will notify you to perform an **Align Now All** when the combination of time and temperature variation is exceeded.

When **All But RF** is `ON`, the Settings Panel indicates Align: Auto/No RF (in amber). The amber color reminds you that you are responsible for maintaining the RF alignment of the instrument.

Remote Command	`:CALibration:AUTO:MODE ALL | NRF` `:CALibration:AUTO:MODE?`
Example	`:CAL:AUTO:MODE NRF`
Preset	Unaffected by **Preset** but set to `ALL` by **Restore Defaults** > "Alignments" on page 2079
State Saved	No

4.6.1.3 Alert

The instrument signals an **Alert** when conditions exist such that you will need to perform a full alignment (for example, **Align Now All**). Alert can be configured in one of four settings:

Setting	Option
Time & Temperature	TTEMperature
Time & Temperature Light	LIGHt
7 days	WEEK
None	NONE

With **Auto Align** set to **Normal**, the configuration of **Alert** is not relevant, because the instrument's software maintains the instrument in warranted operation.

A confirmation is required when a selection other than `TTEMperature` is chosen. This prevents accidental deactivation of alerts. When setting **Alert** from the front panel to any value but `TTEMperature`, confirmation is required to transition into this setting of Alert. The confirmation dialog is:

```
This will suppress alerts from the Alignment system, which would notify you when
an Alignment is required to maintain warranted operation. Without the alerts you
will be responsible for performing an Align Now All at appropriate intervals to
maintain warranted operation

Do you want to proceed?
```

The dialog includes **OK** and **Cancel** controls, for you to affirm or cancel the operation.

No confirmation is required when **Alert** is configured through a remote command.

For more information see "Time & Temperature" on page 2086

Remote Command	`:CALibration:AUTO:ALERt TTEMperature | LIGHt | DAY | WEEK | NONE` `:CALibration:AUTO:ALERt?`
Example	`:CAL:AUTO:ALER TTEM`
Preset	Unaffected by **Preset** but set to `TTEMperature` by **Restore Alignment Defaults**
State Saved	No
Status Bits/OPC dependencies	When an alert is generated, the condition message "Align Now All required" appears in the Status Bar, and bit 14 is set in the Status Questionable Calibration register

The settings for **Alert** are detailed below.

Time & Temperature

SCPI Example	CAL:AUTO:ALER TTEM

The instrument signals an alert when alignments expire due to the combination of the passage of time and changes in temperature. The alert is the Error Condition message "Align Now All required". If this choice for Alert is selected, the absence of an alert means that the instrument alignment is sufficiently up-to-date to maintain warranted accuracy.

Time & Temperature Light

SCPI Example	`CAL:AUTO:ALER LIGH`

This is a light version of Time & Temperature which means for this setting the time/temperature changes required to trigger an alert are increased by a factor of three and the time alerts will occur one-ninth as often as for Time and Temperature.

24 hours

SCPI Example	`CAL:AUTO:ALER DAY`

The instrument signals an alert after a time span of 24 hours since the last successful full alignment (for example, **Align Now All** or completion of a full **Auto Align**). You may want to select this option in an environment where the temperature is stable on a daily basis, at a small risk of accuracy errors in excess of the warranted specifications. The alert is the Error Condition message “Align Now All required”.

7 days

SCPI Example	`CAL:AUTO:ALER WEEK`

The instrument signals an alert after a time span of 168 hours since the last successful full alignment (for example, **Align Now All** or completion of a full **Auto Align**). You may want to select this option in an environment where the temperature is stable on a weekly basis, at a modest risk of accuracy degradations in excess of warranted performance. The alert is the Error Condition message “Align Now All required”.

None

SCPI Example	`CAL:AUTO:ALER NONE`

The instrument does not signal an alert. This is provided for rare occasions where you are making a long measurement that cannot tolerate **Auto Align** interruptions, and must have the ability to capture a screen image at the end of the measurement without an alert posted to the display. Keysight does not recommend using this selection in any other circumstances, because of the risk of accuracy performance drifting well beyond expected levels without the operator being informed.

4.6.2 Align Now

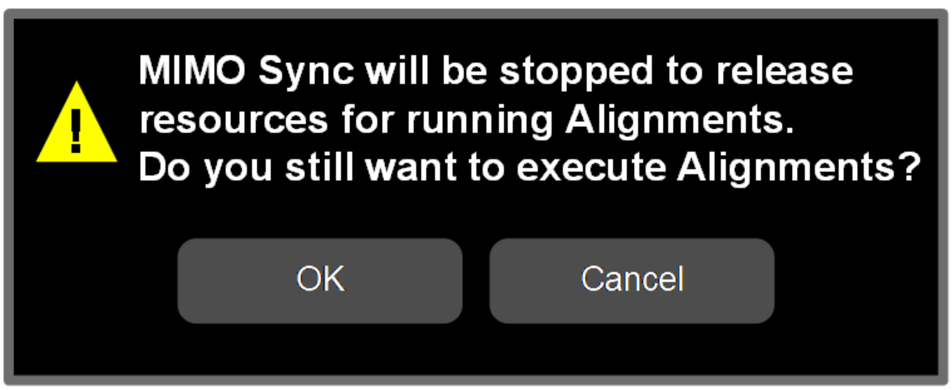
Accesses alignment processes that are immediate action operations. They perform complete operations and run until they are complete.

Executing immediate alignments from SCPI can be problematic due to the length of time required for the alignments to complete. Alignment commands are by their nature sequential, meaning they must complete before any other SCPI commands can be processed. In many cases the alignment itself will take longer than the typical SCPI timeout value. Furthermore, status cannot be easily queried while a sequential command is running.

For this reason, overlapped versions of the **Align Now** commands are provided. When using these No-Operation-Pending (`NPENDing`) commands, the SCPI thread will not be blocked (will be released immediately), so that you can use `:STATus:OPERation:CONDition?` to query the alignment status bit and use `:STATus:QUEStionable:CALibration:CONDition?` to check the alignment results. As an example, `:CALibration[:ALL]:NPENDing` is the overlapped replacement for `:CALibration[:ALL]`.

While the alignment is executing, the coming NOP calibration will be ignored, and `error message "Setting Conflict, Alignment is in process"` will be posted. Also, any other operations to the instrument will be pended and postponed until the alignment is completed. The operations include: Preset, Initiate a new measurement, Device clear and so on. Accordingly, changing parameters will not take effect although the UI is updated immediately. To avoid unexpected timeouts and results, these operations are not recommended during any such alignments.

NOTE The Alignments are not performed if the MIMO Sync is running, because the MIMO and Alignments require the same hardware resource. If the instrument is in MIMO Sync and you press a button to execute Alignments, a pop-up window appears as below. Click **OK** to stop MIMO and execute Alignments.



If the instrument is in MIMO sync, and you send a SCPI command to run Alignments, the align process is not executed, and a warning is generated. To execute Alignments, you must first stop MIMO via SCPI (or manually).

Controls in this Dialog

The selection and order of controls displayed in this dialog depends on the instrument type and options. Select the control of interest from the following list:

- "Align Now All" on page 2089
- "Align Now All but RF" on page 2091
- "Align Now RF" on page 2093
- "Align Now Expired" on page 2094
- "Align Now Preselector" on page 2095
- "Align Now All but RF Preselector" on page 2096
- "Align Now RF Presel Only (20 Hz to 3.6 GHz)" on page 2096
- "Align Now External Mixer" on page 2097
- "Align Source" on page 2098
- "Align Receiver" on page 2099
- "Align Fast" on page 2099
- "Align LO Leakage" on page 2100
- "Align IF Cable" on page 2100
- "Align RRH Amplitude" on page 2100
- "Align LO Clock" on page 2101
- "Align VXT Transceiver" on page 2102
- "Align External Mixer Path" on page 2106
- "Align Low Band" on page 2107
- "Align High Band" on page 2107

4.6.2.1 Align Now All

In PXE, the key label is **Align Now All (plus RF Presel 20 Hz – 3.6 GHz)**

Immediately executes an alignment of all subsystems. The instrument stops any measurement currently underway, performs the alignment, then restarts the measurement from the beginning (similar to pressing the **Restart** key).

If an interfering user signal is present at the RF Input, the alignment is performed on all subsystems except the RF. After completion, the Error Condition message “Align RF skipped” is generated. In addition, the Error Condition message “Align Now, RF required" is generated, and bits 11 and 12 are set in the Status Questionable Calibration register.

The query form of the remote commands (`:CALibration[:ALL]?` or `*CAL?`) invokes the alignment of all subsystems and returns a success or failure value. An interfering user signal is not grounds for failure; if the alignment was able to succeed on all portions but unable to align the RF because of an interfering signal, the resultant will be the success value.

Successful completion of **Align Now All** will clear the "Align Now All required" Error Condition, and clear bit 14 in the Status Questionable Calibration register. It will also begin the elapsed time counter for Last Align Now All Time, and capture the Last Align Now All Temperature.

If the Align RF subsystem succeeded in aligning (no interfering signal present), the elapsed time counter begins for Last Align Now, RF Time, and the temperature is captured for the Last Align Now, RF Temperature. In addition, the Error Conditions "Align RF skipped" are cleared, the Error Condition "Align Now, RF required" is cleared, and bits 11 and 12 are cleared in the Status Questionable Calibration register

Align Now All can be interrupted, by pressing the **Cancel (ESC)** front-panel key, or remotely with Device Clear followed by the `:ABORt` SCPI command. When this occurs, the Error Condition message "Align Now All required" is generated, and bit 14 is set in the Status Questionable Condition register. This is because new alignment data may be employed for an individual subsystem, but not a cohesive set of data for all subsystems.

In many cases, you might find it more convenient to change alignments to **Normal**, instead of executing **Align Now All**. When the Auto Align process transitions to **Normal**, the instrument will immediately start to update only the alignments that have expired, thus efficiently restoring the alignment process.

Remote Command	`:CALibration[:ALL]` `:CALibration[:ALL]?`
Example	`:CAL`
Notes	`:CALibration[:ALL]?` returns 0 if successful, or 1 if failed `:CALibration[:ALL]?` is the same as `*CAL?` While **Align Now All** is performing the alignment, the Calibrating bit (Bit 0 in the Status Operation register) is set. Completion, or termination, will clear Bit 0 in the Status Operation register This command is sequential; it must complete before further SCPI commands are processed. Interrupting the alignment from remote is accomplished by invoking Device Clear followed by the `:ABORt` command Successful completion will clear bit 14 in the Status Questionable Calibration register An interfering user signal is not grounds for failure of **Align Now All**. However, Bits 11 and 12 are set in the Status Questionable Calibration register to indicate Align Now, RF is required An interfering user-supplied signal will result in the instrument requiring an Align Now, RF with the

	interfering signal removed
Couplings	Initializes the time for the Last Align Now All Time Records the temperature for the Last Align Now All Temperature If Align RF component succeeded, initializes the time for the Last Align Now, RF Time If Align RF component succeeded, records the temperature for the Last Align Now, RF Temperature
Status Bits/OPC dependencies	Bits 11, 12, or 14 may be set in the Status Questionable Calibration register

IEEE Command

Remote Command	`*CAL`
Example	`*CAL?`
Notes	Returns 0 if successful, or 1 if failed `:CALibration[:ALL]?` is exactly the same as `*CAL?`, including all conditions, status register bits, and couplings See additional remarks described with `:CALibration[:ALL]?`

Overlapped Command

Remote Command	`:CALibration[:ALL]:NPENding`
Example	`:CAL:NPEN`
Notes	`:CALibration[:ALL]:NPENding` is the same as `:CALibration[:ALL]`, including all conditions, status register bits, except this SCPI command *does not block* the SCPI session, so you should use status register bits to query whether the calibration is successfully completed or not Typical usage is: 1. `:CALibration:ALL:NPENding` (Start a calibration) 2. `:STATus:OPERation:CONDition?` (Check if the calibration is completed or not, If bit 0 is set, then the system is doing calibration, you should repeat this SCPI query until the bit is cleared) 3. `:STATus:QUEStionable:CALibration:CONDition?` (Check if there are any errors/-failures in previous calibration procedure

4.6.2.2 Align Now All but RF

In PXE, the key label is **Align Now All but RF (not including RF Presel)**

Immediately executes an alignment of all subsystems except the RF subsystem. The instrument will stop any measurement currently underway, perform the alignment, and then restart the measurement from the beginning (similar to pressing the **Restart** key). This can be used to align portions of the instrument that are not impacted by an interfering user input signal.

This operation might be chosen instead of **All** if you do not want the device under test to experience a large change in input impedance, such as a temporary open circuit at the instrument input.

The query form of the remote commands (`:CALibration:NRF?`) invokes the alignment and returns a success or failure value.

Successful completion of **Align Now All but RF** clears the “Align Now All required” Error Condition, and clears Bit 14 in the Status Questionable Calibration register. If “Align Now All required” was in effect prior to executing **All but RF**, the Error Condition message “Align Now RF required” is generated and Bit 12 in the Status Questionable Calibration register is set. It will also begin the elapsed time counter for Last Align Now All Time, and capture the Last Align Now All Temperature.

Align Now All but RF can be interrupted, by pressing the **Cancel (ESC)** front-panel key, or remotely with Device Clear followed by the `:ABORt` SCPI command. When this occurs, the Error Condition message “Align Now All required” is generated, and Bit 14 is set in the Status Questionable Condition register. This is because new alignment data may be used for an individual subsystem, but not a full new set of data for all subsystems.

Remote Command	`:CALibration:NRF` `:CALibration:NRF?`
Example	`:CAL:NRF`
Notes	Returns 0 if successful, or 1 if failed While **Align Now All but RF** is performing the alignment, Bit 0 in the Status Operation register is set. Completion, or termination, will clear Bit 0 in the Status Operation register This command is sequential; it must complete before further SCPI commands are processed. Interrupting the alignment from remote is accomplished by invoking Device Clear followed by the `:ABORt` command Successful completion clears Bit 14 in the Status Questionable Calibration register and sets Bit 12 if invoked with “Align Now All required”
Couplings	Initializes the time for the Last Align Now All Time Records the temperature for the Last Align Now All Temperature
Status Bits/OPC dependencies	Bits 12 or 14 may be set in the Status Questionable Calibration register

Overlapped Command

Remote Command	`:CALibration:NRF:NPENding`
Example	`:CAL:NRF:NPEN`
Notes	`:CALibration:NRF:NPENding` is the same as `:CALibration:NRF`, including all conditions, status register bits, except that this SCPI command *does not block* the SCPI session, so you should use status register bits to query whether the calibration is successfully completed or not Typical usage is:

1. `:CALibration:NRF:NPENding` (start the All but RF calibration)
2. `:STATus:OPERation:CONDition?` (If bit 0 is set, then the system is doing calibration, you should do re-query until this bit is cleared)
3. `:STATus:QUEStionable:CALibration:CONDition?` (to check if there are any errors/-failures in previous calibration procedure)

4.6.2.3 Align Now RF

In PXE, the key label is **Align Now RF Only**

Immediately executes an alignment of the RF subsystem. The instrument stops any measurement currently underway, performs the alignment, then restarts the measurement from the beginning (similar to pressing the **Restart** key).

This operation might be desirable if the alignments had been set to not include RF alignments, or if previous RF alignments could not complete because of interference which has since been removed.

If an interfering user signal is present at the RF Input, the alignment will terminate and generate the Error Condition message “Align RF skipped”, and Error Condition “Align Now, RF required”. In addition, bits 11 and 12 will be set in the Status Questionable Calibration register.

The query form of the remote commands (`:CALibration:RF?`) invokes the alignment of the RF subsystem and returns a success or failure value. An interfering user signal is grounds for failure.

Successful completion of **Align Now RF** begins the elapsed time counter for Last Align Now, RF Time, and capture the Last Align Now, RF Temperature.

Align Now RF can be interrupted, by pressing the **Cancel (ESC)** front-panel key, or remotely with Device Clear followed by the `:ABORt` SCPI command. When this occurs, the Error Condition message “Align Now, RF required” is generated, and Bit 12 is set in the Status Questionable Condition register. None of the new alignment data is used.

Remote Command	`:CALibration:RF` `:CALibration:RF?`
Example	`:CAL:RF`
Notes	Returns 0 if successful, or 1 if failed (including interfering user signal) While **Align Now RF** is performing the alignment, Bit 0 in the Status Operation register is set. Completion, or termination, clears Bit 0 in the Status Operation register This command is sequential; it must complete before further SCPI commands are processed. Interrupting the alignment from remote is accomplished by invoking Device Clear followed by the `:ABORt` command

	Successful completion clears the Error Conditions "Align RF skipped" and the Error Conditions "Align RF failed" and "Align Now, RF required", and clears Bits 3, 11, and 12 in the Status Questionable Calibration register A failure encountered during alignment generates the Error Condition message "Align RF failed" and sets Bit 3 in the Status Questionable Calibration register An interfering user signal will result in Bits 11 and 12 being set in the Status Questionable Calibration register, to indicate Align Now, RF is required An interfering user supplied signal results in the instrument requiring **Align Now RF** with the interfering signal removed
Couplings	Initializes the time for the Last Align Now, RF Time Records the temperature for the Last Align Now, RF Temperature
Status Bits/OPC dependencies	Bits 11, 12, or 14 may be set in the Status Questionable Calibration register

Overlapped Command

Remote Command	`:CALibration:RF:NPENding`
Example	`:CAL:RF:NPEN`
Notes	`:CALibration:RF:NPENding` is the same as `:CALibration:RF`, including all conditions, status register bits, except that this SCPI command *does not block* the SCPI session, so you should use status register bits to query whether the calibration is successfully completed or not Typical usage is: 1. `:CALibration:RF:NPENding` (Start a RF calibration) 2. `:STATus:OPERation:CONDition?` (If Bit 0 is set, then the system is doing calibration, you should do re-query until this bit is cleared) 3. `:STATus:QUEStionable:CALibration:CONDition?` (to check if there are any errors/- failures in previous calibration procedure)

4.6.2.4 Align Now Expired

Alignments can be Expired when **Auto Align** is `PARTial` or `OFF`.

This control runs the alignments that have expired. This differs from performing **Align All, Now**., which performs an alignment of all subsystems regardless of whether they are needed or not, whereas **Execute Expired Alignments** aligns only the individual subsystems that have become due.

Remote Command	`:CALibration:EXPired` `:CALibration:EXPired?`
Example	`:CAL:EXP?`
Notes	`:CALibration:EXPired?` returns 0 if successful, or 1 if failed

	While **Align Now Expired** is performing the alignment, the Calibrating bit (Bit 0 in the Status Operation register) is set. Completion, or termination, clears Bit 0 in the Status Operation register This command is sequential; that is, it must complete before further SCPI commands are processed. Interrupting the alignment from remote is accomplished by invoking Device Clear followed by `:ABORt` Successful completion clears bit 14 in the Status Questionable Calibration register An interfering user signal is not grounds for failure of **Align Now Expired**. However, if RF Alignment was required, Bits 11 and 12 are set in the Status Questionable Calibration register to indicate Align Now, RF is required
Status Bits/OPC dependencies	Bits 11, 12, or 14 may be set in the Status Questionable Calibration register

4.6.2.5 Align Now Preselector

Normally, Preselector Alignment runs during power up, and during the twenty minutes after power up, whenever there is a 1-degree internal temperature change.

This alignment is also run when an "Align Now All" on page 2089 is performed. This feature is helpful during the 20-minute warm-up time to correct for preselector drift while alignments are being held off. This feature can also be used in lieu of using the Preselector Center functionality, to improve speed throughput for remote testing with minimal impact to amplitude accuracy specs. The algorithm centers the preselector at the upper and lower operating frequencies of the YTF preselector.

The **Align Now Preselector** alignment is *not* a substitute for the Characterizer Preselector Advanced Alignment, which creates the default preselector centering curves for the YTF Preselector and is typically run annually.

Remote Command	`:CALibration:PRESelector` `:CALibration:PRESelector?`
Example	`:CAL:PRES`
Notes	Returns 0 if successful, or 1 if failed (including interfering user signal) While **Align Now Preselector** is performing the alignment, Bit 0 in the Status Operation register is set. Completion, or termination, clears Bit 0 in the Status Operation register This command is sequential; that is, it must complete before further SCPI commands are processed. Interrupting the alignment from remote is accomplished by invoking Device Clear followed by `:ABORt` Successful completion clears the Error Conditions “Align Preselector failed” and clears Bit 3 in the Status Questionable Calibration Failure (Extended) register A failure encountered during alignment generates the Error Condition message “Align Preselector failed” and sets Bit 3 in the Status Questionable Calibration Failure (Extended) register
Status Bits/OPC dependencies	Bit 3 may be set in the Status Questionable Calibration Failure (Extended) register

4.6.2.6 Align Now All but RF Preselector

Only available in models with the RF Preselector, such as the N9048B. It is identical to the "Align Now All" on page 2089 (plus RF Presel) function, except that the RF Preselector is only partially aligned. Only the System Gain, Mechanical attenuator and Electronic attenuator alignments on the RF Preselector path are aligned. The purpose of these alignments is to improve the RF Preselector path amplitude variation compared to the bypass path.

Remote Command	`:CALibration:NRFPselector` `:CALibration:NRFPselector?`
Example	`:CAL:NRFP`
Dependencies	Only appears in N9048B. Sending the SCPI command or query in other models generates an error
Status Bits/OPC dependencies	Bits 12 or 14 may be set in the Status Questionable Calibration register

4.6.2.7 Align Now RF Presel Only (20 Hz to 3.6 GHz)

Only available in models with the RF Preselector, such as the N9048B. It executes an alignment of the RF Preselector section. The receiver will stop any measurement currently underway, perform the alignment, and then restart the measurement from the beginning (similar to pressing the **Restart** key). *Only* the RF Preselector is aligned; no Align Now All function is performed first.

The query (`:CALibration:RFPSelector:ONLY?`) invokes the alignment of the RF Preselector on both Conducted and Radiated Band, and returns a success or failure value. Successful completion clears the “Align 20 Hz to 3.6 GHz required” Error Condition, and clears Bit 1 and Bit 2 in the Status Questionable Calibration Extended Needed register.

The elapsed time counter will begin for Last Align Now, Conducted Time and Last Align Now Radiated Time and the temperature is captured for Last Align Now, Conducted Temperature and Last Align Now, Radiated Temperature. The alignment can be interrupted by pressing the **Cancel (ESC)** front-panel key or remotely with Device Clear followed by the `:ABORt` SCPI command. When this occurs, the Error Condition “Align 20 Hz to 3.6 GHz required” is set because new alignment data may be employed for an individual subsystem, but not a cohesive set of data for all subsystems.

The “Align 20 Hz to 3.6 GHz required” Error Condition will appear when this alignment has expired. The user is now responsible to perform the Align Now, 20 Hz to 3.6 GHz in order to keep the receiver in warranted operation. This alignment can only be performed by the user, as it is not part of the Auto Align process.

Remote Command	`:CALibration:RFPSelector:ONLY`

	`:CALibration:RFPSelector:ONLY?`
Example	`:CAL:RFPS:ONLY`
Notes	Query returns 0 if successful, or 1 if failed When Align 20 Hz to 3.6 GHz is performing the alignment, bit 0 in the Status Operation register is set. Completion, or termination, will clear bit 0 in the Status Operation register This command is sequential; it must complete before further SCPI commands are processed. Interrupting the alignment from remote is accomplished by invoking Device Clear followed by the `:ABORt` command. Successful completion clears Bits 1 and 2 in the Status Questionable Calibration Extended Needed register and Bits 0 and 1 in Status Questionable Calibration Extended Failure register A failure encountered during alignment sets the Error Condition "20 Hz to 3.6 GHz Alignment Failure", sets Bits 1 and 2 in the Status Questionable Calibration Extended Needed register, and Bit 9 in Status Questionable Calibration register
Dependencies	Only appears in N9048B. Sending the SCPI command or query in other models generates an error This key is grayed-out if the instrument is displaying an "Align Now All required" message. If you press the key while it is grayed-out, you will see the informational message, "Align Now All required first"
Couplings	Initializes the time for the Last Align Conducted Now, Conducted Time Initializes the time for the Last Align Radiated Now, Radiated Time Records the temperature for the Last Align Conducted Now, Conducted Temperature Records the temperature for the Last Align Radiated Now, Radiated Temperature
Status Bits/OPC dependencies	Bit 8 or 9 may be set in the Status Questionable Calibration register Bit 1 and 2 may be set in the Status Questionable Calibration Extended Needed register Bit 0 and 1 may be set in the Status Questionable Calibration Extended Failure register

4.6.2.8 Align Now External Mixer

Immediately executes an alignment of the External Mixer that is plugged into the USB port. The instrument stops any measurement currently underway, performs the alignment, then restarts the measurement from the beginning (similar to pressing the **Restart** key). As this alignment calibrates the LO power to the mixer, this is considered an LO alignment; and failure is classified as an LO alignment failure.

The query (`:CALibration:EMIXer?`) invokes the alignment of the External Mixer and returns a success or failure value.

Remote Command	`:CALibration:EMIXer` `:CALibration:EMIXer?`
Example	`:CAL:EMIX`
Notes	Returns 0 if successful, or 1 if failed While **Align Now External Mixer** is performing the alignment, Bit 0 in the Status Operation register is set. Completion, or termination, clears Bit 0 in the Status Operation register This command is sequential; it must complete before further SCPI commands are processed.

	Interrupting the alignment from remote is accomplished by invoking Device Clear followed by the `:ABORt` command A failure encountered during alignment generate the Error Condition message “Align LO failed” and sets Bit 5 in the Status Questionable Calibration register. Successful completion clears the “Align LO failed” message and Bit 5 in the Status Questionable Calibration register
Dependencies	This control does not appear unless option EXM is present and is grayed-out, unless a USB mixer is plugged in to the USB
Status Bits/OPC dependencies	Bit3 may be set in the Status Questionable Calibration Extended Failure register

4.6.2.9 Align Source

Accesses source alignment processes that are immediate action operations. They perform complete operations and run until they are complete.

The instrument stops any sequence of the source, performs the alignment, then restarts the sequence from the beginning.

Note: This alignment corrects slow-rate drift, which does not impair specifications for time periods shorter than one week. Thus, it is required to perform this alignment on a weekly basis to maintain specifications. This alignment typically takes >2 minutes to complete.

There is no alert available for the source alignment. Operators are responsible for checking temperature shift since the last **Align Now Source** to determine whether the source alignment needs to be executed.

Remote Command	`:CALibration:INTernal:SOURce[:ALL]` `:CALibration:INTernal:SOURce[:ALL]?`
Example	`:CAL:INT:SOUR`
Notes	`:CAL:INT:SOUR?` Initiates an Alignment and returns 0 if successful, or 1 if failed
Dependencies	Only appears in VXT models M9410A/11A
Couplings	Initializes the time for the Last Align Source Now, All Time Records the temperature for the Last Align Source Now, All Temperature

Overlapped Command

Remote Command	`:CALibration:INTernal:SOURce[:ALL]:NPENding`
Example	`:CAL:INT:SOUR:NPEN`
Notes	`:CALibration:INTernal:SOURce[:ALL]:NPENding` is the same as `:CALibration:INTernal:SOURce[:ALL]`, including all conditions and status register bits, except that this SCPI command *does not block* the SCPI session, so you should use status register bits to query whether the calibration is successfully completed or not Typical usage is:

	1. `:CALibration:INTernal:SOURce:NPENding` (start an internal source calibration) 2. `:STATus:OPERation:CONDition?` (Check if the calibration is completed or not, If Bit 0 is set, then the system is doing calibration. Repeat this query until the bit is cleared) 3. `:STATus:QUEStionable:CALibration:EXTended:FAILure:CONDition?` (Check if Bit 14 is set or not. If this bit is set, that means there are some errors in previous internal source calibration)
Dependencies	Only appears in VXT models M9410A/11A

4.6.2.10 Align Receiver

Accesses receiver alignment processes that are immediate action operations. They perform complete operations and run until they are complete.

NOTE **This alignment corrects slow-rate drift, which does not impair specifications for time periods shorter than one week. Thus, it is required to perform this alignment on a weekly basis to maintain specifications. This alignment typically takes >2 minutes to complete.**

There is no alert available for the receiver alignment. Operators are responsible for checking temperature shift since the last Align Now, Align Receiver, to determine whether the receiver alignment needs to be executed.

Remote Command	`:CALibration:INTernal:RECeiver[:ALL]` `:CALibration:INTernal:RECeiver[:ALL]?`
Example	`:CAL:INT:REC`
Notes	The query initiates an Alignment and returns 0 if successful, or 1 if failed
Dependencies	Only appears in VXT models M9410A/11A
Couplings	Initializes the time for the Last Align Receiver Now, All Time Records the temperature for the Last Align Receiver Now, All Temperature

4.6.2.11 Align Fast

Accesses fast alignment processes, which are immediate action operations and perform complete operations, running until they are complete.

This aligns the subsystem that is most sensitive to temperature and time and includes:

- compensating the DC offset, gain imbalance and quadrature phase imbalance of IQ Modulator and/or Demodulator
- compensating the gain offset of RF path

It is suggested to perform Fast Alignment every 8 hours or when temperature has changed more than 5°C from the previous Fast Alignment.

Remote Command	`:CALibration:INTernal:FAST[:ALL]` `:CALibration:INTernal:FAST[:ALL]?`
Example	`:CAL:INT:FAST`
Notes	The query initiates an Alignment and returns 0 if successful, or 1 if failed
Dependencies	Only appears in VXT models M9410A/11A /15A/16A

4.6.2.12 Align LO Leakage

Accesses LO Leakage alignment processes, which are immediate action operations and perform complete operations, running until they are complete.

This alignment reduce the LO Leakage of the instrument.

Remote Command	`:CALibration:INTernal:LOLeakage` `:CALibration:INTernal:LOLeakage?`
Example	`:CAL:INT:LOL`
Notes	The query initiates an Alignment and returns 0 if successful, or 1 if failed
Dependencies	Only appears in VXT models M9410A/11A /15A/16A

4.6.2.13 Align IF Cable

Accesses IF Cable alignment processes, which are immediate action operations and perform complete operations, running until they are complete.

This alignment aligns the IF cabling to the remote heads.

Remote Command	`:CALibration:INTernal:RRHead:IFCable` `:CALibration:INTernal:RRHead:IFCable?`
Example	`:CAL:INT:RRH:IFC`
Notes	The query initiates an Alignment and returns 0 if successful, or 1 if failed
Dependencies	Only appears in VXT based solutions with M1740A/41A/42A/49A/49B RRH
Backwards Compatibility SCPI	`:CALibration:INTernal:IFCable` `:CALibration:INTernal:IFCable?`

4.6.2.14 Align RRH Amplitude

This is an immediate action operation, which runs until complete.

Aligns the Amplitude of Remote Radio Head. This operation could take quite a long time to run.

CAUTION For M1741A/49A/49B RRH, make sure to connect 50-ohm terminations to Head Tx/Rx 1 and 2 ports.

Remote Command	`:CALibration:INTernal:RRHead:AMPLitude` `:CALibration:INTernal:RRHead:AMPLitude?`
Example	`:CAL:INT:RRH:AMPL?`
Notes	The query initiates an Alignment and returns 0 if successful, or 1 if failed
Dependencies	Only appears in VXT based solutions with M1741A/42A/49A/49B RRH
Backwards Compatibility SCPI	`:CALibration:INTernal:RRHAmp` `:CALibration:INTernal:RRHAmp?`

4.6.2.15 Align Fast RRH Amplitude

This is an immediate action operation, which runs until complete.

Compare to Align RRH Amplitude, it aligns the amplitude of Remote Radio Head with a wider frequency interval. This operation takes about one minute.

Remote Command	`:CALibration:INTernal:RRHead:AMPLitude:FAST` `:CALibration:INTernal:RRHead:AMPLitude:FAST?`
Example	`:CAL:INT:RRH:AMPL:FAST?`
Notes	The query initiates an alignment and returns 0 if successful, or 1 if failed
Dependencies	Only appears in VXT based solutions with M1742A RRH

4.6.2.16 Align RRH LO Power

This is an immediate action operation, which runs until complete.

Aligns the LO Power of Remote Radio Head.

Remote Command	`:CALibration:INTernal:RRHead:LOPower` `:CALibration:INTernal:RRHead:LOPower?`
Example	`:CAL:INT:RRH:LOP`
Notes	The query initiates an alignment and returns 0 if successful, or 1 if failed
Dependencies	Only appears in VXT based solutions with M1741A/49A/49B RRH

4.6.2.17 Align LO Clock

This is an immediate action operation, which runs until complete.

Synchronizes RRH LO Clocks.

Remote Command	`:CALibration:INTernal:RRHead:LOSync` `:CALibration:INTernal:RRHead:LOSync?`
Example	`:CAL:INT:RRH:LOS?`
Notes	The query initiates an Alignment and returns 0 if successful, or 1 if failed
Dependencies	Only appears in VXT based solutions with M1741A/42A/49A/49B RRH
Backwards Compatibility SCPI	`:CALibration:INTernal:LOSync` `:CALibration:INTernal:LOSync?`

4.6.2.18 Align VXT Transceiver

In M941xE(M941xA+M9471A) system, accesses alignment processes in VXT Transceiver(M9410A/11A/15A/16A), which are immediate action operations and perform complete operations, running until they are complete.

The instrument stops any measurement currently underway, performs the alignment, then restarts the measurement from the beginning (similar to pressing the **Restart** key).

There is no alert available for the VXT Transceiver alignment. Operators are responsible for checking temperature shift since the last **Align VXT Transceiver** to determine whether the VXT Transceiver alignment needs to be executed.

Remote Command	`:CALibration:INTernal:VXT:TRANsceiver` `:CALibration:INTernal:VXT:TRANsceiver?`
Example	`:CAL:INT:VXT:TRAN`
Notes	The query initiates an Alignment and returns 0 if successful, or 1 if failed
Dependencies	Only appears on M9410E/11E/15E/16E

4.6.2.19 Align up down converter

In M941xE(M941xA+M9471A) system, accesses alignment processes in up down converter (M9471A), which are immediate action operations and perform complete operations, running until they are complete.

The instrument stops any measurement currently underway, performs the alignment, then restarts the measurement from the beginning (similar to pressing the **Restart** key).

There is no alert available for the up down converter alignment. Operators are responsible for checking temperature shift since the last **Align up down converter** to determine whether the up down converter alignment needs to be executed.

Remote Command	`:CALibration:UPDown:CONVerter` `:CALibration:UPDown:CONVerter?`
Example	`:CAL:UPD:CONV`
Notes	The query initiates an Alignment and returns 0 if successful, or 1 if failed
Dependencies	Only appears on M9410E/11E/15E/16E

4.6.2.20 Align Selected Freq Ranges

VXT models M9410A/11A provide five alignments: **Align Now** All, **Align Source**, **Align Receiver**, **Align Fast** and **Align LO Leakage**. Every time you execute one of these alignments, the system performs a full span alignment. To save time, it is possible to limit the range of alignment frequency settings. **Align Selected Freq Ranges** allows you to set the start and stop frequency of an alignment.

The example below shows the steps for processing Align Receiver on VXT model M9410A, specifying a frequency range from 1.3 GHz to 1.8 GHz, and 2.5 GHz to 3.9 GHz.

- First row: set the Start and Stop Frequency to 1.3 GHz and 1.8 GHz. Enable the first row
- Second row: set the Start and Stop Frequency to 2.5 GHz and 3.9 GHz. Enable the second row
- Click **Align Receiver**. A message appears: “Aligning Selected Freq Ranges 1 of 7”

The equivalent SCPI command sequence is:

```
:CAL:INT:ASFR ON
:CAL:INT:ASFR:FRAN 1.3 GHz, 1.8 GHz, 2.5 GHz, 3.9 GHz
:CAL:INT:REC
```

Remote Command	`:CALibration:INTernal:ASFRanges[:STATe] ON | OFF | 1 | 0` `:CALibration:INTernal:ASFRanges?`
Example	`:CAL:INT:ASFR ON` `:CAL:INT:ASFR?`
Notes	When **Align Selected Freq Ranges** is ON, the table is displayed for setting up the frequency ranges to be aligned
Dependencies	Only available in: – VXT models M9410A/11A – VXT models M9410A/11A with RRH and/or CIU – M9410E/11E

	Only functional for the following alignments: – Align Now All of VXT models M9410A/11A and M9410E/11E – Align Source – Align Receiver – Align Fast – Align LO Leakage – Align VXT Transceiver of M910E/11E – Align Up Down Converter of M9410E/11E **Align Selected Freq Ranges** only guarantees the hardware performance within the frequency range
Preset	`OFF`

Enable Extended Freq Range

Allows you to set frequency ranges for VXT models M9410A/11A/15A with Remote Head and/or CIU. When Enable Extended Freq Range is not active, the frequency range is limited by VXT models only.

Remote Command	`:CALibration:INTernal:ASFRanges:EXTend[:STATe] ON | OFF | 1 | 0` `:CALibration:INTernal:ASFRanges:EXTend[:STATe]?`
Example	`:CAL:INT:ASFR:EXT ON` `:CAL:INT:ASFR:EXT?`
Dependencies	Only available in VXT models M9410A/11A/15A/16A with Remote Head and/or CIU Only available when **Align Specified Freq Ranges** is `ON`
Preset	`OFF`

Frequency Range

Allows you to set the alignment frequency range.

Remote Command	`:CALibration:INTernal:ASFRanges:FRANges <startFreq>,<stopFreq>[,<startFreq>,<stopFreq>][,<startFreq>,<stopFreq>][,<startFreq>,<stopFreq>][,<startFreq>,<stopFreq>]`
Example	`:CAL:INT:ASFR:FRAN 1.3 GHz,1.8 GHz,2.5 GHz,3.9 GHz` `:CAL:INT:ASFR:FRAN?`
Notes	`<startFreq>`: Start frequency of an alignment `<stopFreq>`: Stop frequency of an alignment To process alignment for a single frequency point, set `<startFreq>` = `<stopFreq>`

Dependencies	Only appears when "Align VXT Transceiver" on page 2102 is ON `Error message "Invalid alignment frequency range"` is reported if start and stop frequencies are invalid, such as: 1. Stop frequency - Start frequency < 0 2. the count of start and stop frequency is not even 3. the frequency is out of range. See "More Information" on page 2105 4. more than 5 pairs of start and stop frequency are listed
Preset	1.0 GHz, 2.0 GHz

More Information

When "Enable Extended Freq Range" on page 2104 is not active, the frequency range depends on the VXT models. The table below lists the Start and Stop Frequency Ranges for VXT models M9410A/11A/15A:

Hardware	Options	Min Frequency	Max Frequency
M9410A/11A	F06	330 MHz	6.08 GHz
M9410A/11A	F06 & EP6	330 MHz	6.6 GHz
M9410A/11A	F06 & LFE & EP6	6.5 kHz	6.6 GHz
M9415A/16A	F06	330 MHz	6.6 GHz
M9415A/16A	F08	330 MHz	8.6 GHz
M9415A/16A	F12	330 MHz	12.9 GHz

When **Enable Extended Freq Range** is active, the frequency range depends on the extensions connected to VXT models. The table below lists the Start and Stop Frequency Range of VXT models with Radio Heads/CIU:

Connected with Radio Heads/CIU	Min frequency	Max frequency	IF Frequency range
VXT + CIU	5.9 GHz	12 GHz	1.4 GHz ~ 4.6 GHz
VXT + CIU + RRH	24.25 GHz	43.5 GHz	2.5 GHz ~ 4.5 GHz
VXT + M1742A	10 GHz	32 GHz	3.0 GHz ~ 5.5 GHz

NOTE **The Min frequency and Max frequency are also the preset frequencies. It is recommended to keep the preset frequency range for VXT models with extensions. An alignment with the full IF Frequency range will be executed ignoring the specific ranges.**

The table below lists the Frequency Range of M941xE(VXT Models with M9471A)

Products with M9471A	Preset	Receiver minimum settable frequency	Source minimum settable (center)frequency	Minimum center frequency with Spec	Receiver maximum settable(center) frequency	Source maximum settable (center) frequency
M941xE without LFE option	1 GHz	330.000005 MHz	330 MHz	380MHz	26.499999995 GHz	26.5GHz
M941xE with LFE option (LFE option in M9411A or M9471A)	1 GHz	750.005 KHz	750 KHz	1MHz	26.499999995 GHz	26.5GHz

NOTE

The minimum spec frequency is 380 MHz, but the receiver minimum settable center frequency is 330.000005 MHz, the source minimum settable center frequency is 330 MHz.

With Option LFE in M9411A or in M9471A, the receiver minimum settable frequency is 750.005 kHz, the source minimum settable frequency is 750 kHz, but Spec to customer only ensure down to 1 MHz.

Enable

Enables or disables the selected frequency ranges.

Preset	`Row 1: ON` `Other rows: OFF`

4.6.2.21 Align External Mixer Path

Immediately executes an alignment of the External Mixer Path inside the VXT models M9415A/16A. External Mixer Path is used when the RF Port is connected to an external Remote Radio Head (RRH). It provides a better performance compared to the normal path. External Mixer Path Alignment covers frequencies from 2.4 GHz to 3.4 GHz of the external mixer path.

NOTE

This alignment corrects slow-rate drift, which does not impair specifications for time periods shorter than one week. Thus, you need only perform this alignment on a weekly basis to maintain specifications. This alignment typically takes >2 minutes to complete.

There is no alert for the External Mixer Path alignment. You are responsible for checking the temperature shift since the last **Align Now, External Mixer Path**, to determine whether the external mixer path alignment needs to be executed.

Remote Command	`:CALibration:INTernal:EMPath` `:CALibration:INTernal:EMPath?`
Example	`:CAL:INT:EMP`
Notes	The query initiates an alignment and returns 0 if successful, or 1 if failed
Dependencies	Only appears in VXT models M9415A/16A when Option MXP is installed
Couplings	Initializes the time for the Last Align External Mixer Path Now, All Time Records the temperature for the Last Align External Mixer Path Now, All Temperature

4.6.2.22 Align Low Band

Accesses Low Band alignment processes that are immediate action operations. They perform complete operations and run until they are complete. Low Band Alignment covers frequencies from 380 MHz to 4.3 GHz of the non-external mixer path.

NOTE **This alignment corrects slow-rate drift, which does not impair specifications for time periods shorter than one week. Thus, you need only perform this alignment on a weekly basis to maintain specifications. This alignment typically takes >2 minutes to complete.**

There is no alert for the Low Band alignment. You are responsible for checking the temperature shift since the last **Align Now, Align Low Band**, to determine whether the Low Band alignment needs to be executed.

Remote Command	`:CALibration:INTernal:LBANd[:ALL]` `:CALibration:INTernal:LBANd[:ALL]?`
Example	`:CAL:INT:LBAN`
Notes	The query initiates an Alignment, and returns 0 if successful, or 1 if failed
Dependencies	Only appears in VXT models M9415A/16A
Couplings	Initializes the time for the Last Align Low Band Now, All Time Records the temperature for the Last Align Low Band Now, All Temperature

4.6.2.23 Align High Band

Accesses High Band alignment processes that are immediate action operations. They perform complete operations and run until they are complete. High Band Alignment covers frequencies from 4.3 GHz to 12 GHz of the non-external mixer path.

NOTE	This alignment corrects slow-rate drift, which does not impair specifications for time periods shorter than one week. Thus, you need only perform this alignment on a weekly basis to maintain specifications. This alignment typically takes >2 minutes to complete.

There is no alert for the High Band alignment. You are responsible for checking the temperature shift since last **Align Now, Align High Band**, to determine whether the High Band alignment needs to be executed.

Remote Command	`:CALibration:INTernal:HBANd[:ALL]` `:CALibration:INTernal:HBANd[:ALL]?`
Example	`:CAL:INT:HBAN`
Notes	The query initiates an Alignment, and returns 0 if successful, or 1 if failed
Dependencies	Only appears in VXT models M9415A/16A
Couplings	Initializes the external time for the Last Align High Band Now, All Time Records the temperature for the Last Align High Band Now, All Temperature

4.6.3 Path Delay Calibration

Path Delay Calibration is used to remove the time delay differences between multiple power channels of a module.

Dependencies	Only available in VXT modules M9410A/11A Only for modules with matched Digital board hardware version, which means the modules are in same FPGA version The matched hardware version information is in below table

	Digital board Hardware version	Matched module
M9410A	2,3,4,6,10,11	Yes
M9410A	12, 13	Yes
M9411A	18	Yes
M9411A	20,21	Yes
M9411A	12,13	Yes
M9411A	0,1,2,3,4,6,10,11	Yes

4.6.3.1 Source Path Delay Calibration

Accesses the Source Path Delay Calibration processes, which are immediate-action operations and perform complete operations, running until they are complete.

NOTE Connect the RF In of the primary module to the OUT port (COMMON, PORT 1) of the combiner.

NOTE Before performing Path Delay Calibration of Sources, please confirm that:

NOTE Each of the RF Out ports is connected to the RF In port of the Primary channel, using an RF combiner.

NOTE The cables between the combiner and the Source output ports are of the same length.

NOTE A pop-up window appears (as shown below); press OK to continue calibration.

NOTE If the is in MIMO sync, and you send a SCPI command to run Calibration, the calibration process is not executed and instrument a warning is generated ("-221,Setting Conflict; Calibrations are not available while MIMO Sync is On"). To execute Calibration, you must first stop MIMO, manually or via SCPI.

Remote Command	`:CALibration:PDELay:SOURce` `:CALibration:PDELay:SOURce?`
Example	`:CAL:PDEL:SOUR`
Notes	The query initiates an Alignment and returns 0 if successful, or 1 if failed If the calibration process detected a faulty state, an error will be generated: "Misc/System Alignment Failure". Calibration will be aborted. Please see event log for more information: 1. Cables are not connected 2. Power control failure 3. Hardware failure 4. M9300A 10MHz reference open failure
Dependencies	Only appears in VXT models M9410A/11A Only for modules with matched Digital board hardware version, which means the modules are in same FPGA version

4.6.3.2 Path Delay Correction On/Off(Remote Command only)

On/Off the path delay correction to enable the calibration data on the source of the module.

Remote Command	`:CALibration:PDELay:CORRection ON | OFF` `:CALibration:PDELay:CORRection?`
Example	`:CAL:PDEL:CORR ON`
Notes	If the **Path Delay Calibration** has never been performed and there is no calibration correction data in the controller, an alert is generated
Preset	`OFF`
Range	`ON|OFF`

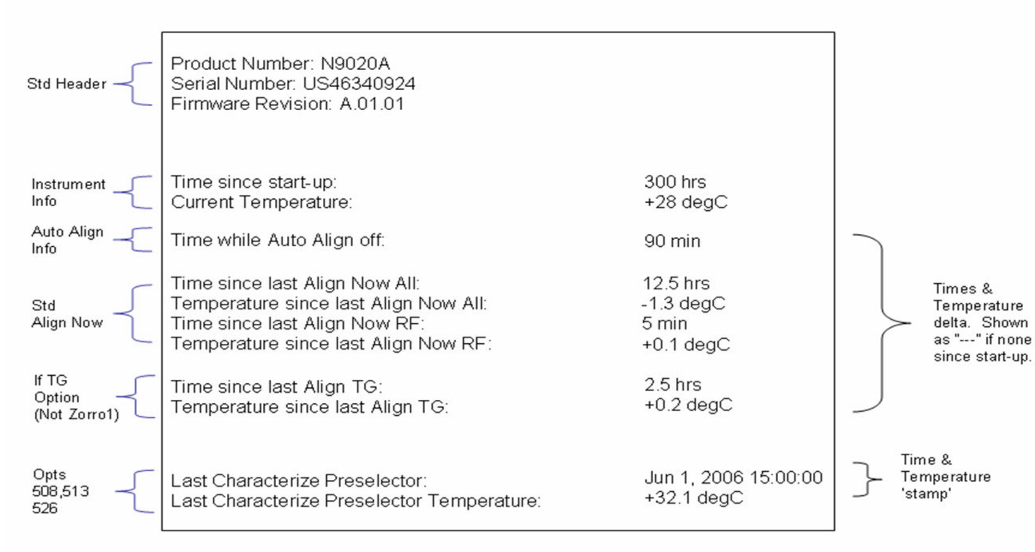
4.6.4 Show Alignment Statistics

Shows alignment information you can use to ensure that the instrument is operating in a specific manner. The **Show Alignment Statistics** screen is where you can view time and temperature information.

Values displayed are only updated when the **Show Alignment Statistics** screen is invoked. They are not updated while the **Show Alignment Statistics** screen is being displayed. The remote commands that access this information obtain current values.

Note that some of these statistics only display if your instrument supports them; for example, Last Source Align Now All Time only shows up in instruments which contain a source which supports auto alignments.

An example of the **Show Alignment Statistics** screen would be similar to:



“Time while Auto Align off” is not available in VXT models M9410A/11A.

A successful **Align Now, RF** sets the Last Align RF temperature to the current temperature, and resets the Last Align RF time. A successful **Align Now All** or **Align Now All but RF** sets the Last Align Now All temperature to the current temperature, and resets the Last Align Now All time. A successful **Align Now All** also resets the Last Align RF items if the RF portion of the **Align Now** succeeded.

Example	`:SYST:SHOW ALIGN`
Notes	The values displayed on the screen are only updated upon entry to the screen, and not updated while the screen is being displayed

The following data-specific queries are available:

Query Time since Startup

Remote Command	`:SYSTem:PON:TIME?`
Example	`:SYST:PON:TIME?`
Notes	Value is the time since the most recent start-up in seconds
State Saved	No

Query Current Temperature

Remote Command	`:CALibration:TEMPerature:CURRent?`
Example	`:CAL:TEMP:CURR?`
Notes	Value is in degrees Centigrade
State Saved	No

Query Current Temperature at Remote Radio Head

Remote Command	`:CALibration:TEMPerature:CURRent:RRHead?`
Example	`:CAL:TEMP:CURR:RRH?`
Notes	Value is in degrees Centigrade
Dependencies	Only appears when Align RRH Amplitude is available
State Saved	No

Query Current Temperature at Remote Radio Head LO

Remote Command	`:CALibration:TEMPerature:CURRent:RRHead:LO?`
Example	`:CAL:TEMP:CURR:RRH:LO?`
Notes	Value is in degrees Centigrade
Dependencies	Only appears when Align RRH LO Power is available
State Saved	No

Query Time since Last Align Now All

Remote Command	`:CALibration:TIME:LALL?`
Example	`:CAL:TIME:LALL?`
Notes	Value is the elapsed time, in seconds, since the last successful **Align Now All** or **Align Now All but RF** was executed
State Saved	No

Query Temperature of Last Align Now All

Remote Command	`:CALibration:TEMPerature:LALL?`
Example	`:CAL:TEMP:LALL?`
Notes	Value is in degrees Centigrade at which the last successful **Align Now All** or **Align Now All but RF** was executed
State Saved	No

Query Time since Last Align Now Receiver

Remote Command	`:CALibration:TIME:INTernal:RECeiver?`
Example	`:CAL:TIME:INT:REC?`
Notes	Value in hours since the last successful **Align Now Receiver**
Dependencies	Only appears in VXT models M9410A/11A
State Saved	No

Query Temperature of Last Align Now Receiver

Remote Command	`:CALibration:TEMPerature:INTernal:RECeiver?`
Example	`:CAL:TEMP:INT:REC?`
Notes	Value in degrees Centigrade when the last successful **Align Now Receiver** was executed
Dependencies	Only appears in VXT models M9410A/11A
State Saved	No

Query Time since Last Align Now Source

Remote Command	`:CALibration:TIME:INTernal:SOURce?`
Example	`:CAL:TIME:INT:SOUR?`
Notes	Value in hours since the last successful **Align Now Source**
Dependencies	Only appears in VXT models M9410A/11A
State Saved	No

Query Temperature of Last Align Now Source

Remote Command	`:CALibration:TEMPerature:INTernal:SOURce?`
Example	`:CAL:TEMP:INT:SOUR?`
Notes	Value in degrees Centigrade when the last successful **Align Now Source** was executed
Dependencies	Only appears in VXT models M9410A/11A
State Saved	No

Query Time since Last Align Now Fast

Remote Command	`:CALibration:TIME:INTernal:FAST?`
Example	`:CAL:TIME:INT:FAST?`
Notes	Value in hours since the last successful **Align Now Fast**
Dependencies	Only appears in VXT models M9410A/11A/15A/16A
State Saved	No

Query Temperature of Last Align Now Fast

Remote Command	`:CALibration:TEMPerature:INTernal:FAST?`
Example	`:CAL:TEMP:INT:FAST?`
Notes	Value in degrees Centigrade when the last successful **Align Now Fast** was executed
Dependencies	Only appears in VXT models M9410A/11A/15A/16A
State Saved	No

Query Time since Last Align Now LO Leakage

Remote Command	`:CALibration:TIME:INTernal:LOLeakage?`
Example	`:CAL:TIME:INT:LOL?`
Notes	Value in hours since the last successful **Align Now LO Leakage**
Dependencies	Only appears in VXT models M9410A/11A/15A/16A
State Saved	No

Query Temperature of Last Align Now LO Leakage

Remote Command	`:CALibration:TEMPerature:INTernal:LOLeakage?`
Example	`:CAL:TEMP:INT:LOL?`
Notes	Value in degrees Centigrade when the last successful **Align Now LO Leakage** was executed
Dependencies	Only appears in VXT models M9410A/11A/15A/16A
State Saved	No

Query Time since Last Align Now IF Cable

Remote Command	`:CALibration:TIME:INTernal:RRHead:IFCable?`
Example	`:CAL:TIME:INT:RRH:IFC?`
Notes	Value in hours since the last successful **Align Now IF Cable**
Dependencies	Only appears in VXT based solutions with M1740A/41A/42A/49A/49B RRH
State Saved	No
Backwards Compatibility SCPI	`:CALibration:TIME:INTernal:IFCable?`

Query Temperature of Last Align Now IF Cable

Remote Command	`:CALibration:TEMPerature:INTernal:RRHead:IFCable?`
Example	`:CAL:TEMP:INT:RRH:IFC?`
Notes	Value in degrees Centigrade when the last successful **Align Now IF Cable** was executed
Dependencies	Only appears in VXT based solutions with M1740A/41A/42A/49A/49B RRH
State Saved	No
Backwards Compatibility SCPI	`:CALibration:TEMPerature:INTernal:IFCable?`

Query Time since Last Align LO Clock

Remote Command	`:CALibration:TIME:INTernal:RRHead:LOSync?`

Example	:CAL:TIME:INT:RRH:LOS?
Notes	Value in hours since the last successful Align LO Clock
Dependencies	Only appears in VXT based solutions with M1741A/42A/49A/49B RRH
State Saved	No
Backwards Compatibility SCPI	:CALibration:TIME:INTernal:LOSync?

Query Temperature of Last Align LO Clock

Remote Command	:CALibration:TEMPerature:INTernal:RRHead:LOSync?
Example	:CAL:TEMP:INT:RRH:LOS?
Notes	Value in degrees Centigrade when the last successful Align LO Clock was executed
Dependencies	Only appears in VXT based solutions with M1741A/42A/49A/49B RRH
State Saved	No
Backwards Compatibility SCPI	:CALibration:TEMPerature:INTernal:LOSync?

Query Time since Last Align RRH Amplitude

Remote Command	:CALibration:TIME:INTernal:RRHead:AMPLitude?
Example	:CAL:TIME:INT:RRH:AMPL?
Notes	Value in hours since the last successful Align RRH Amplitude
Dependencies	Only appears in VXT based solutions with M1741A/42A/49A/49B RRH
State Saved	No
Backwards Compatibility SCPI	:CALibration:TIME:INTernal:RRHAmp?

Query Temperature of Last Align RRH Amplitude

Remote Command	:CALibration:TEMPerature:INTernal:RRHead:AMPLitude?
Example	:CAL:TEMP:INT:RRH:AMPL?
Notes	Value in degrees Centigrade when the last successful Align RRH Amplitude was executed
Dependencies	Only appears in VXT based solutions with M1741A/42A/49A/49B RRH
State Saved	No
Backwards Compatibility SCPI	:CALibration:TEMPerature:INTernal:RRHAmp?

Query Time since Last Align Fast RRH Amplitude

Remote Command	:CALibration:TIME:INTernal:RRHead:AMPLitude:FAST?
Example	:CAL:TIME:INT:RRH:AMPL:FAST?
Notes	Value in hours since the last successful Align Fast RRH Amplitude
Dependencies	Only appears in VXT based solutions with M1742A RRH
State Saved	No

Query Temperature of Last Align Fast RRH Amplitude

Remote Command	:CALibration:TEMPerature:INTernal:RRHead:AMPLitude:FAST?
Example	:CAL:TEMP:INT:RRH:AMPL:FAST?
Notes	Value in degrees Centigrade when the last successful Align Fast RRH Amplitude was executed
Dependencies	Only appears in VXT based solutions with M1742A RRH
State Saved	No

Query Time since Last Align RRH LO Power

Remote Command	:CALibration:TIME:INTernal:RRHead:LOPower?
Example	:CAL:TIME:INT:RRH:LOP?
Notes	Value in hours since the last successful Align RRH LO Power
Dependencies	Only appears in VXT based solutions with M1741A/49A/49B RRH
State Saved	No

Query Temperature of Last Align RRH LO Power

Remote Command	:CALibration:TEMPerature:INTernal:RRHead:LOPower?
Example	:CAL:TEMP:INT:RRH:LOP?
Notes	Value in degrees Centigrade when the last successful Align RRH LO Power was executed
Dependencies	Only appears in VXT based solutions with M1741A/49A/49B RRH
State Saved	No

Query Time since Last Align Now RF

Remote Command	:CALibration:TIME:LRF?
Example	:CAL:TIME:LRF?
Notes	Value is the elapsed time, in seconds, since the last successful **Align Now, RF** was executed, either individually or as a component of **Align Now All**
State Saved	No

Query Temperature of Last Align Now RF

Remote Command	`:CALibration:TEMPerature:LRF?`
Example	`:CAL:TEMP:LRF?`
Notes	Value is in degrees Centigrade at which the last successful **Align Now RF** was executed, either individually or as a component of **Align Now All**
State Saved	No

Query Time since Last Align IF

Remote Command	`:CALibration:TIME:LIF?`
Example	`:CAL:TIME:LIF?`
Notes	Value is the elapsed time, in seconds, since the last successful **Align IF** was executed
State Saved	No

Query Temperature of Last Align IF

Remote Command	`:CALibration:TEMPerature:LIF?`
Example	`:CAL:TEMP:LIF?`
Notes	Value is in degrees Centigrade at which the last successful **Align IF** was executed
State Saved	No

Query Time since Last Characterize Preselector

Remote Command	`:CALibration:TIME:LPReselector?`
Example	`:CAL:TIME:LPR?`
Notes	Value is the date and time the last successful **Characterize Preselector** was executed. The date is separated from the time by a space character Returns “” if no **Characterize Preselector** has ever been performed on the instrument
Dependencies	In models that do not include preselectors, this command is not enabled and any attempt to set or query yields an error
State Saved	No

Query Temperature of Last Characterize Preselector

Remote Command	`:CALibration:TEMPerature:LPReselector?`
Example	`:CAL:TEMP:LPR?`
Notes	Value is in degrees Centigrade at which the last successful **Characterize Preselector** was executed

Dependencies	In models that do not include preselectors, this command is not enabled and any attempt to set or query yields an error
State Saved	No

Query Time since Auto Align Off

Remote Command	`:CALibration:AUTO:TIME:OFF?`
Example	`:CAL:AUTO:TIME:OFF?`
Notes	Value is the elapsed time, in seconds, since **Auto Align** has been set to **Off** or **Off with Alert**. The value is 0 if **Auto Align** is `ALL` or `NORF`
State Saved	No

Query Time since Last Align Now 20 Hz - 30 MHz

Remote Command	`:CALibration:TIME:RFPSelector:LCONducted?`
Example	`:CAL:TIME:RFPS:LCON?`
Notes	Values are the date and time the last successful **Align Now, 20 Hz – 30 MHz** was executed. The date is separated from the time by a semi-colon character
State Saved	No

Query Temperature of Last Align Now 20 Hz - 30 MHz

Remote Command	`:CALibration:TEMPerature:RFPSelector:LCONducted?`
Example	`:CAL:TEMP:RFPS:LCON?`
Notes	Value is in degrees Centigrade at which the last successful **Align Now, 20 Hz – 30 MHz** was executed
State Saved	No

Query Time since Last Align Now 30 MHz - 3.6 GHz

Remote Command	`:CALibration:TIME:RFPSelector:LRADiated?`
Example	`:CAL:TIME:RFPS:LRAD?`
Notes	Value is the date and time the last successful **Align Now, 30 MHz – 3.6 GHz** was executed. The date is separated from the time by a semi-colon character
State Saved	No

Query Temperature of Last Align Now 30 MHz - 3.6 MHz

Remote Command	`:CALibration:TEMPerature:RFPSelector:LRADiated?`
Example	`:CAL:TEMP:RFPS:LRAD?`
Notes	Value is in degrees Centigrade at which the last successful **Align Now, 30 MHz – 3.6 GHz** was executed
State Saved	No

Query Next Scheduled Alignment Time

Remote Command	`:CALibration:RFPSelector:SCHeduler:TIME:NEXT?` Returns data using the following format: YYYY/MM/DD; HH:MM:SS
Example	`:CAL:RFPS:SCH:TIME:NEXT?`

Notes	The next run time will be updated based on the start date/time and recurrence set by the user
	“date” is representation of the date the task will run in the form:
	`YYYY/MM/DD`
	where:
	– `YYYY` is the four-digit representation of year. (for example, 2009)
	– `MM` is the two-digit representation of month. (for example, 01 to 12)
	– `DD` is the two-digit representation of the day. (for example, 01 to 28, 29, 30 or 31 depending on the month and year)
	“time” is a representation of the time of day the task will run in the form:
	`HH:MM:SS`
	where:
	– `HH` is the two-digit representation of the hour in 24-hour format
	– `MM` is the two-digit representation of minute
	– `SS` is the two-digit representation of seconds

State Saved	No

Query Time since Last Align Now External Mixer Path

Remote Command	`:CALibration:TIME:INTernal:EMPath?`
Example	`:CAL:TIME:INT:EMP?`
Notes	Value in hours since the last successful **Align Now External Mixer Path**
Dependencies	Only appears option MXP is installed
State Saved	No

Query Temperature of Last Align Now External Mixer Path

Remote Command	`:CALibration:TEMPerature:INTernal:EMPath?`
Example	`:CAL:TEMP:INT:EMP?`
Notes	Value in degrees Centigrade when the last successful **Align Now External Mixer Path** was executed
Dependencies	Only appears option MXP is installed
State Saved	No

Query Time since Last Align Now Low Band

Remote Command	`:CALibration:TIME:INTernal:LBANd?`
Example	`:CAL:TIME:INT:LBAN?`
Notes	Value in hours since the last successful **Align Now Low Band**
Dependencies	Only appears in VXT models M9415A/16A
State Saved	No

Query Temperature of Last Align Now Low Band

Remote Command	`:CALibration:TEMPerature:INTernal:LBANd?`
Example	`:CAL:TEMP:INT:LBAN?`
Notes	Value in degrees Centigrade when the last successful **Align Now Low Band** was executed
Dependencies	Only appears in VXT models M9415A/16A
State Saved	No

Query Time since Last Align Now High Band

Remote Command	`:CALibration:TIME:INTernal:HBAN?`
Example	`:CAL:TIME:INT:HBAN?`
Notes	Value in hours since the last successful **Align Now High Band**
Dependencies	Only appears in VXT models M9415A/16A
State Saved	No

Query Temperature of Last Align Now High Band

Remote Command	`:CALibration:TEMPerature:INTernal:HBANd?`
Example	`:CAL:TEMP:INT:HBAN?`
Notes	Value in degrees Centigrade when the last successful **Align Now High Band** was executed
Dependencies	Only appears in VXT models M9415A/16A
State Saved	No

Query Time since Last Align VXT Transceiver

Remote Command	`:CALibration:TIME:INTernal:VXT:TRANsceiver?`
Example	`:CAL:TIME:INT:VXT:TRAN?`
Notes	Value in hours since the last successful **Align VXT Transceiver** Returns NaN if Align VXT Transceiver has never been performed on the instrument
Dependencies	Only appears in M9410E/11E/15E/16E
State Saved	No

Query Temperature of Last Align VXT Transceiver

Remote Command	`:CALibration:TEMPerature:INTernal:VXT:TRANsceiver?`
Example	`:CAL:TEMP:INT:VXT:TRAN?`
Notes	Value in degrees Centigrade when the last successful **Align VXT Transceiver** was executed Returns 9.91E+37(NaN) if Align VXT Transceiver has never been performed on the instrument
Dependencies	Only appears in M9410E/11E/15E/16E
State Saved	No

Query Time since Last Align Up Down Converter

Remote Command	`:CALibration:TIME:UPDown:CONVerter?`
Example	`:CAL:TIME:UPD:CONV?`
Notes	Value in hours since the last successful **Align Up Down Converter** Returns NaN if Align Up Down Converter has never been performed on the instrument
Dependencies	Only appears in M9410E/11E/15E/16E
State Saved	No

Query Temperature of Last Align Up Down Converter

Remote Command	`:CALibration:TEMPerature:UPDown:CONVerter?`
Example	`:CAL:TEMP:UPD:CONV?`
Notes	Value in degrees Centigrade when the last successful **Align Up Down Converter** was executed Returns 9.91E+37(NaN) if Align Up Down Converter has never been performed on the instrument
Dependencies	Only appears in VXT models M9410A/11A and M9410E/11E
State Saved	No

Query Time since Last Path Delay Calibration

Remote Command	`:CALibration:TIME:PDELay:SOURce?`

Example	`:CAL:TIME:PDEL:SOUR?`
Notes	The value is the elapsed time in hours since the last successful **Path Delay Calibration** has been performed Returns NaN if the **Path Delay Calibration** has never been performed
State Saved	No

Query Temperature of Last Path Delay Calibration

Remote Command	`:CALibration:TEMPerature:PDELay:SOURce?`
Example	`:CAL:TEMP:PDEL:SOUR?`
Notes	The value is in degrees Centigrade at which the last successful **Path Delay Calibration** has been performed Returns 9.91E+37(NaN) if the **Path Delay Calibration** has never been performed
State Saved	No

4.6.5 Timebase DAC

Lets you change the setting of the **Timebase DAC** from a factory calibrated setting to your own desired setting.

The display shows the current **Timebase DAC** setting at the top, and gives you a choice of `CALibrated` or `USER` setting. There is also a field for you to enter your desired setting.

Dependencies	Does not appear in VXT and M941xE

4.6.5.1 Timebase DAC

Allows control of the internal 10 MHz reference oscillator timebase. This may be used to adjust for minor frequency alignment between your signal's reference and the internal frequency reference. This adjustment has no effect if the instrument is operating with an External Frequency Reference.

If the value of the **Timebase DAC** changes (by switching to `CALibrated` from `USER` with **User Value** set to a different value, or in `USER` with a new value entered) an alignment may be necessary. The alignment system will take appropriate action; which will either invoke an alignment or cause an **Alert**.

The `CALibrated` setting sets the **Timebase DAC** to the value established during factory or field calibration. In this case the value displayed at the top of the screen is the calibrated value.

The USER setting sets the **Timebase DAC** to the value set on the **User Value** control. In this case the value displayed at the top of the screen is the user value.

Remote Command	`:CALibration:FREQuency:REFerence:MODE CALibrated | USER` `:CALibration:FREQuency:REFerence:MODE?`
Example	`:CAL:FREQ:REF:MODE CAL`
Notes	If the value of the timebase is changed the alignment system automatically performs an alignment or alerts that an alignment is due
Dependencies	Not available in UXM
Preset	Unaffected by **Preset**, but set to `CALibrated` by **Restore Defaults** > "Alignments" on page 2079
State Saved	No

4.6.5.2 User Value

Lets you set the **Timebase DAC** to a value other than the value established during the factory or field calibration. The current value of the DAC is displayed at the top of the screen. This will be the Calibrated value if **Timebase DAC** is set to `CALibrated`.

Remote Command	`:CALibration:FREQuency:REFerence:FINE <integer>` `:CALibration:FREQuency:REFerence:FINE?`
Example	`:CAL:FREQ:REF:FINE 8191`
Notes	If the value of the timebase is changed the alignment system automatically performs an alignment or alerts that an alignment is due
Couplings	Setting `:CAL:FREQ:REF:FINE` sets `:CAL:FREQ:REF:MODE USER`
Preset	Unaffected by **Preset**, but set to the factory setting by **Restore Defaults** > "Alignments" on page 2079
State Saved	No
Min	0
Max	16383
Backwards Compatibility SCPI	`:CALibration:FREQuency:REFerence:COARse` ESA hardware contained two DAC controls for the Timebase. In X-Series the command `:CALibration:FREQuency:REFerence:FINE` is the method for adjusting the timebase. The `COARse` option is provided as an alias to `FINE`

Backwards Compatibility Command

Remote Command	`:CALibration:FREQuency:REFerence:COARse <integer>` `:CALibration:FREQuency:REFerence:COARse?`
Example	`:CAL:FREQ:REF:COAR 8191`
Notes	This is an alias for `:CAL:FREQ:REF:FINE`. Any change to `COARse` is reflected in `FINE` and *vice-versa*. See `:CAL:FREQ:REF:FINE` for description of functionality
Couplings	Setting `:CAL:FREQ:REF:COAR` sets `:CAL:FREQ:REF:MODE USER`

4.6.6 Advanced

Accesses alignment processes that are immediate action operations that perform operations that run until complete. **Advanced** alignments are performed on an irregular basis, or require additional operator interaction.

Dependencies	Not available in UXM

4.6.6.1 Characterize Preselector

The Preselector tuning curve drifts over temperature and time. Recognize that the Amplitude, Presel Center function adjusts the preselector for accurate amplitude measurements at an individual frequency. Characterize Preselector improves the amplitude accuracy by ensuring the Preselector is approximately centered at all frequencies without the use of the Amplitude, Presel Center function. Characterize Preselector can be useful in situations where absolute amplitude accuracy is not of utmost importance, and the throughput savings or convenience of not performing a Presel Center is desired. Presel Center is required prior to any measurement for best (and warranted) amplitude accuracy.

Keysight recommends that the Characterize Preselector operation be performed yearly as part of any calibration, but performing this operation every three months can be worthwhile.

Characterize Preselector immediately executes a characterization of the Preselector, which is a YIG-tuned filter (YTF). The instrument stops any measurement currently underway, performs the characterization, then restarts the measurement from the beginning (similar to pressing the **Restart** key).

The query (`:CALibration:YTF?`) invokes the alignment of the YTF subsystem, and returns a success or failure value.

A failure encountered during alignment generates the Error Condition message “Characterize Preselector failure” and sets Bit 3 in the `STATus:QUEStionable:CALibration:EXTended:FAILure` status register. Successful completion of **Characterize Preselector** clears this Condition. It also begins the elapsed time counter for Last Characterize Preselector Time, and captures the Last Characterize Preselector Temperature.

The last Characterize Preselector Time and Temperature survives across the power cycle, as this operation is performed infrequently.

NOTE **The Characterize Preselector function can be interrupted, by pressing the Cancel (ESC) front-panel key, or remotely with Device Clear followed by the `:ABORt SCPI` command. None of the new characterization data is then used.**

However, since the old characterization data is purged at the beginning of the characterization, you now have an uncharacterized preselector. You should re-execute this function and allow it to finish before making any further preselected measurements.

Remote Command	`:CALibration:YTF` `:CALibration:YTF?`
Example	`:CAL:YTF`
Notes	`:CALibration:YTF?` returns 0 if successful, or 1 if failed (including interfering user signal) While **Advanced**, **Characterize Preselector** is performing the alignment, Bit 0 in the Status Operation register is set. Completion, or termination, clears Bit 0 in the Status Operation register This command is sequential; it must complete before further SCPI commands are processed. Interrupting the alignment from remote is accomplished by invoking Device Clear followed by the `:ABORt` command Successful completion clears Bit 9 in the Status Questionable Calibration register A failure encountered during alignment generates the Error Condition message “Characterize Preselector failed” and sets Bit 9 in the Status Questionable Calibration register For Options that support frequencies > 3.6 GHz only
Dependencies	This control does not appear in models that do not contain preselectors. In these models the SCPI command is accepted without error, but no action is taken
Couplings	Initializes the time for the Last Characterize Preselector Time Records the temperature for the Last Characterize Preselector Temperature

Overlapped Command

Remote Command	`:CALibration:YTF:NPENding`
Example	`:CAL:YTF:NPEN`
Notes	`:CALibration:YTF:NPENding` is the same as `:CALibration:YTF`, including all conditions, status register bits, except that this SCPI command *does not block* the SCPI session, so you should use status register bits to query if the calibration is successfully completed or not Typical usage is: 1. `:CALibration:YTF:NPENding` (Start a YTF calibration) 2. `:STATus:OPERation:CONDition?` (Check if the calibration is completed or not, If Bit 0 is set, then the system is doing calibration, and you should repeat this query until the bit is cleared) 3. `:STATus:QUEStionable:CALibration:EXTended:FAILure:CONDition?` (Check whether Bit 2 is set. If this bit is set, that means there are some errors in previous internal source calibration)

4.6.6.2 Characterize Reference Clock

Calibrates the Reference Input Phase with the External Reference Output. This feature is only available when either option DP2 or B40 is present. It requires connecting the 10 MHz OUT to the EXT REF IN port with a BNC cable before running the characterization.

See "Front panel guided calibration sequence" on page 2127

Remote Command	`:CALibration:REFerence:CLOCk?`

Example	`:CAL:REF:CLOC:INIT?`
	connect cable
	`:CAL:REF:CLOC?`
	disconnect cable
	`:CAL:REF:CLOC:END?`

Notes	`:CALibration:REFerence:CLOCk?` returns 0 if successful, or 1 if failed
Dependencies	Option DP2 or B40
Couplings	Initializes the time for the Last Characterize Reference Clock Time Records the temperature for the Last Characterize Reference Clock Temperature. Expected to be run after `:CAL:REF:CLOC:INIT`, and before `:CAL:REF:CLOC:END`

Remote Command	`:CALibration:REFerence:CLOCk:INITialize?`
Example	`:CAL:REF:CLOC:INIT?`
Notes	Returns 0 if successful, or 1 if failed
Dependencies	Option DP2 or B40
Couplings	Expected to be run before sending `:CAL:REF:CLOC?`. This will stop the current measurement when it has completed (does not abort the current data acquisition), and prepare the instrument for the expected cabling

Remote Command	`:CALibration:REFerence:CLOCk:END?`
Example	`:CAL:REF:CLOC:END?`
Notes	Returns 0 if successful, or 1 if failed
Dependencies	Option DP2 or B40
Couplings	Expected to be run after sending `:CAL:REF:CLOC?`, and after removing the cable used in that Characterize Reference Clock step. This will resume any queued measurements, and concludes the reference clock characterization

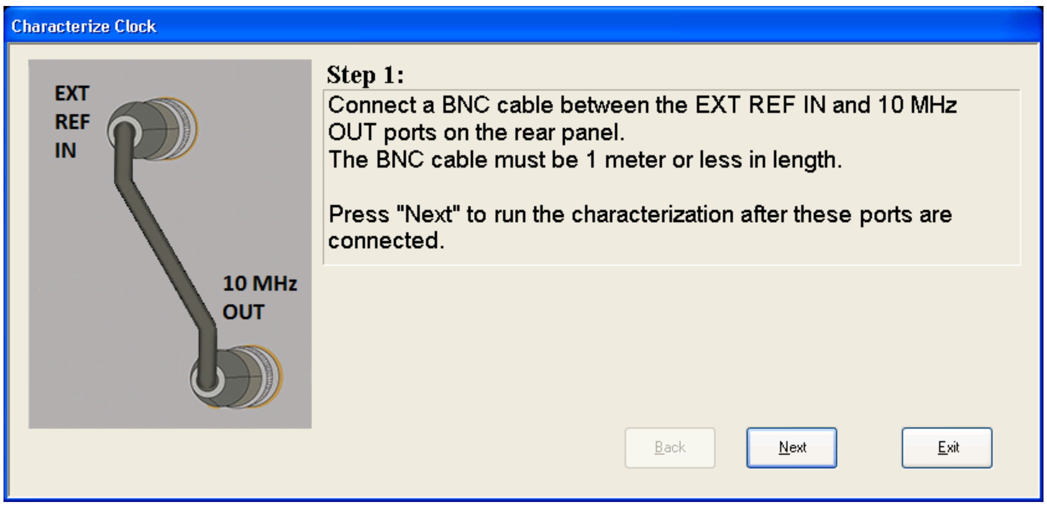
Remote Command	`:CALibration:TIME:REFerence:CLOCk?`
Example	`:CAL:TIME:REFerence:CLOCk?`

Notes	Value is the date and time the last successful Characterize Reference Clock was executed. The date is separated from the time by a space character. Returns "" if Characterize Reference Clock has never been performed on the instrument
Dependencies	Option DP2 or B40
State Saved	No

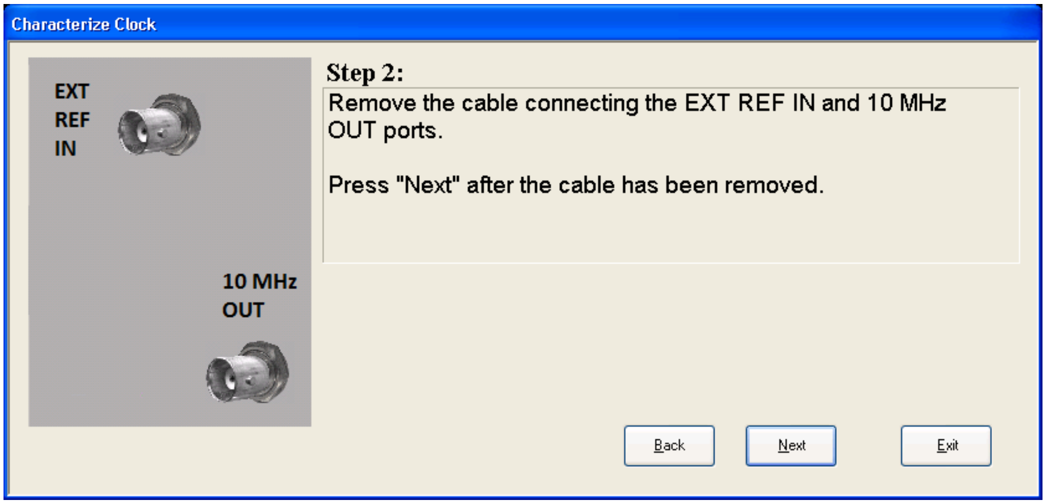
Front panel guided calibration sequence

When selecting **Characterize Reference Clock** via the front panel, the following form is displayed.

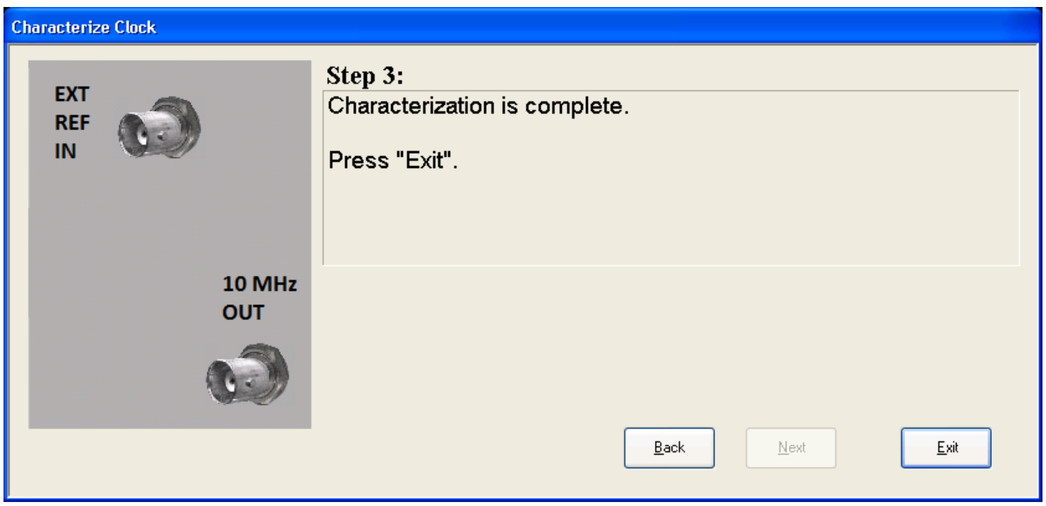
Step 1 of the guided calibration sequence:



Step 2 of the guided calibration sequence:



Step 3 of the guided calibration sequence:



4.6.6.3 Characterize Noise Floor

On instruments with the NF2 license installed, the calibrated Noise Floor used by Noise Floor Extensions should be refreshed periodically. To do this, press Characterize Noise Floor. When you press this control, the instrument stops any measurement currently underway, and a dialog appears with an OK and Cancel button that says:

```
This action will take several minutes to perform. Please disconnect all cables
from the RF input and press Enter to proceed. Press ESC to cancel
```

When you press Enter or OK, the characterization proceeds. After the characterization, the instrument restarts the measurement from the beginning (similar to pressing the **Restart** key). The characterization takes many minutes to run.

The noise floor model used by Noise Floor Extensions includes an estimation of the temperature behavior of the noise floor, but this is only an estimation. The noise floor changes little with the age of the components. However, even small changes in the estimated level of the noise floor can make large changes in the effective noise floor, because the effective noise floor is the error in the estimation of the noise floor. Keysight recommends that the **Characterize Noise Floor** operation be performed when the instrument is operating at an ambient temperature that is significantly different than the ambient temperature at which this alignment was last run. In addition, Keysight recommends that the **Characterize Noise Floor** operation be performed after the first 500 hours of operation, and once every calendar year.

The noise floor model from the last operation of **Characterize Noise Floor** survives across the power cycle.

NOTE	The **Characterize Noise Floor** function can be interrupted, by pressing the **Cancel (ESC)** front-panel key, or remotely with Device Clear followed by the `:ABORt SCPI` command. None of the new characterization data is then used. However, since the old characterization data is purged at the beginning of the characterization, you now have an uncharacterized noise floor. You should re-execute this function and allow it to finish before making any further measurements with NFE. Until you do, the instrument will display a "Characterize Noise Floor required" message and set bit 12 in the Status Questionable Calibration register (`STATus:QUEStionable:CALibration:EXTended:NEEDed`).

Remote Command	`:CALibration:NFLoor` `:CALibration:NFLoor?`
Example	`:CAL:NFL`
Notes	`:CALibration:NFLoor?` returns 0 if successful, or 1 if failed (including interfering user signal) This command is sequential; it must complete before further commands are processed. Interrupting the alignment from remote is accomplished by invoking Device Clear followed by the `:ABORt` command
Dependencies	This control does not appear in models that do not contain NF2. In these models the command is accepted without error, but no action is taken
Couplings	Successful completion of **Characterize Noise Floor** begin the elapsed time counter or the Last Characterize Noise Floor Time

Remote Command	`:CALibration:TIME:NFLoor?`
Example	`:CAL:TIME:NFL?`
Notes	Value is the date and time the last successful **Characterize Noise Floor** was executed. The date is separated from the time by a space character Returns "" if no **Characterize Noise Floor** has ever been performed on the instrument

Dependencies	In models that do not include NF2, this command is not enabled and any attempt to set or query yields an error
State Saved	No

Remote Command	`:CALibration:TEMPerature:NFLoor?`
Example	`:CAL:TEMP:NFL?`
Notes	Value is the temperature of the last successful **Characterize Noise Floor** was executed Returns "" if no **Characterize Noise Floor** has ever been performed on the instrument
Dependencies	In models that do not include NF2, this command is not enabled and any attempt to set or query yields an error
State Saved	No

Remote Command	`:CALibration:TIME:ELAPsed:NFLoor?`
Example	`:CAL:TIME:ELAP:NFL?`
Notes	Value is the elapsed time the instrument was powered-on since the last successful **Characterize Noise Floor** was executed Returns "" if no **Characterize Noise Floor** has ever been performed on the instrument
Dependencies	In models that do not include NF2, this command is not enabled and any attempt to set or query yields an error
State Saved	No

4.6.6.4 Calibration Temperature History

The following queries let you retrieve various statistics regarding the Calibration Temperature history.

Minimum Temperature Within Last Number of Seconds

Lets you query the minimum temperature within the last number of seconds. If no data exists for the requested time, the returned value is 9.91e+37.

Remote Command	`:CALibration:TEMPerature:MINimum? <seconds>`
Example	`:CAL:TEMP:MIN? 60`

Maximum Temperature Within Last Number of Seconds

Lets you query the maximum temperature within the last number of seconds. If no data exists for the requested time, the returned value is 9.91e+37.

Remote Command	`:CALibration:TEMPerature:MAXimum? <seconds>`
Example	`:CAL:TEMP:MAX? 60`

Temperature Seconds Ago

Lets you query temperature X seconds ago. If no data exists for the requested time, the returned value is 9.91e+37.

Remote Command	`:CALibration:TEMPerature:AGO? <seconds>`
Example	`:CAL:TEMP:AGO? 75`

Oldest Temperature Value

Lets you query the oldest recorded temperature value.

Remote Command	`:CALibration:TEMPerature:OLDest[:TEMPerature]?`
Example	`:CAL:TEMP:OLD?`

Oldest Temperature Time

Lets you query how long ago the oldest temperature value was recorded.

Remote Command	`:CALibration:TEMPerature:OLDest:SEConds?`
Example	`:CAL:TEMP:OLD:SEC?`

4.6.6.5 TDS Alignment

Only appears in N9038B (MXE-B) when Option TDS is installed and licensed.

The TDS alignment includes `AlignNowAll` and `RFPresel` alignment. Immediately executes an alignment of the TDS subsystem. The instrument stops any measurement currently underway, performs the alignment, and then restarts the measurement from the beginning (similar to pressing the **Restart** key).

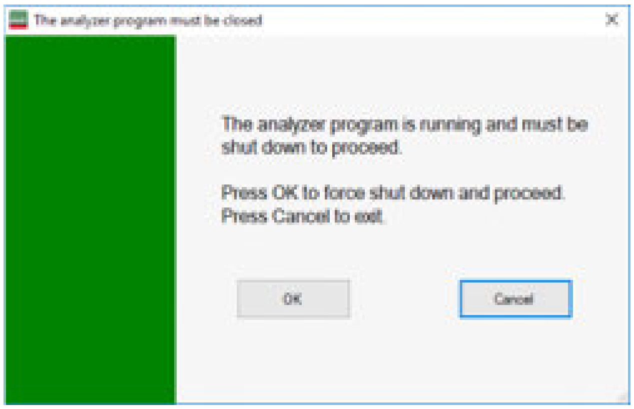
Align TDS can be interrupted by pressing the **Cancel (ESC)** front-panel key or from remote with Device Clear followed by `:ABORt`. When this occurs, no new TDS alignment data will be employed.

Remote Command	`:CALibration:TDS`
	Params missing? What does the query return?
	`:CALibration:TDS?`

Example	`:CAL:TDS`
Notes	This command is sequential; it must complete before further commands are processed. Interrupting the alignment from remote is accomplished by invoking Device Clear followed by the `:ABORt` command
Dependencies	Only appears in N9038B (MXE-B) models with Option TDS installed and licensed

4.6.6.6 Backup or Restore Align Data...

Opens the utility for backing-up or restoring alignment data. Since this utility cannot be run while the instrument software is running, a prompt tells you to shut down the instrument first:



Press **OK** and the instrument will shut down and open the backup utility.

Alignment data for the instrument resides on the hard drive in a database. Keysight uses high quality hard drives; however, it is highly recommended the alignment data be backed-up to storage outside of the instrument. Additionally, for customers who use multiple CPU Assemblies or multiple disk drives, the alignment that pertains to the instrument must be transferred to the resident hard drive after a CPU or hard drive is replaced. This utility facilitates backing-up and restoring the alignment data.

NOTE **This utility allows you to navigate to any location of the Windows file system. If you are backing up alignment data to storage outside of the instrument, then it is assumed that you will use a USB memory device, or Mapped Network Drive.**

Processor Assembly types PC6 and PC7 contain a removable SD memory card. When one of these CPUs is installed, the Backup and Restore Alignment Data wizard defaults to the SD card as the backup location. At every power-on, the software will check to determine if the calibration data on the SD memory card (the backup) is newer than the data in use on the disk. In such situations, before the application is loaded, you are given the opportunity to restore the data from the backup. If you respond **Yes**, the Backup and Restore Alignment Data wizard (see "Alignment Data Wizard (without Flash)" on page 2133) will be invoked to perform the restore.

Processor Assembly types PC6S and PC7S contain an internal flash EEPROM, as well as a removable SD card. When one of these CPUs is installed, the Backup and Restore Alignment Data wizard defaults to the internal flash as the backup location.

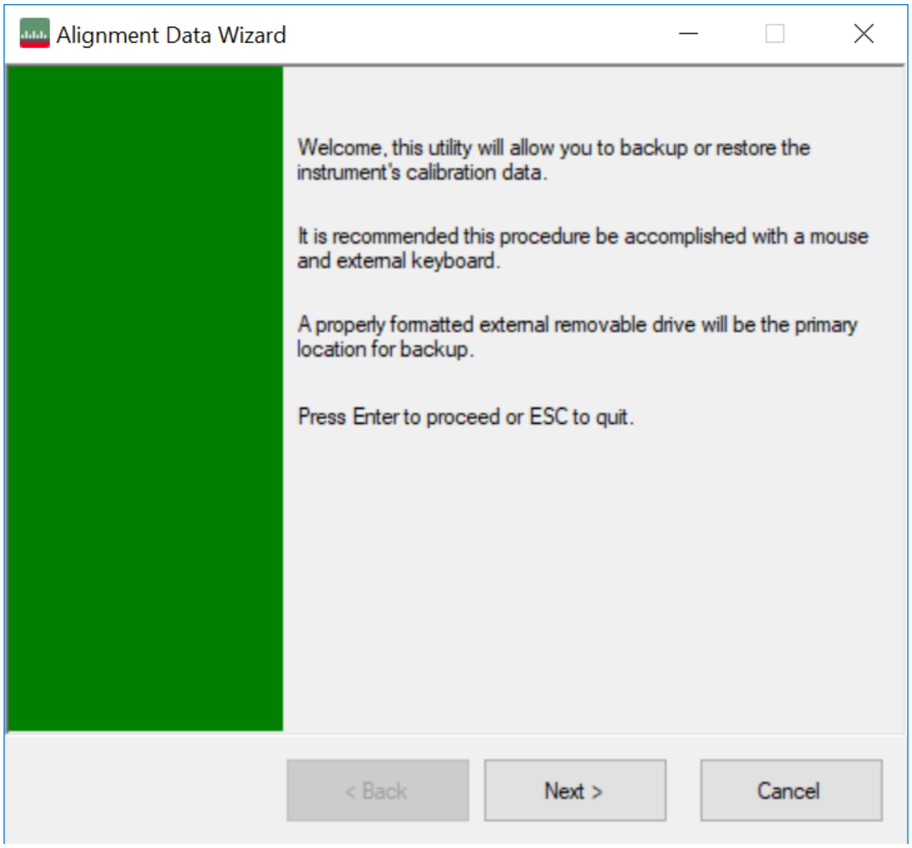
As with the PC6 and PC7, at every power-on, the software compares the timestamp of the backup on the flash and the timestamp of the alignment data in use on the disk. If the backup on the flash has newer data, you are given the opportunity to restore the data from the backup before the application is loaded. If you respond **Yes**, the Backup and Restore Alignment Data wizard (see "Alignment Data Wizard (with Flash)" on page 2143) will be invoked and will prompt you to restore that backup.

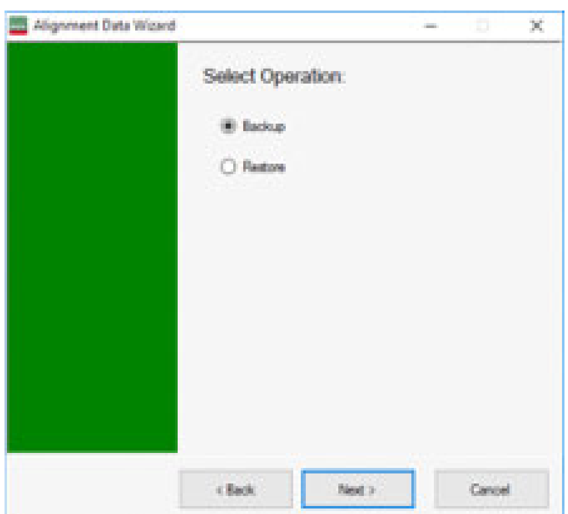
For purposes of these instructions, “alignment data” and “calibration data” are used interchangeably.

Dependencies	Not available in UXM
Remote Command	`:CALibration:DATA:DEFault`
Example	`:CAL:DATA:DEF`
Notes	Restores the alignment data files to their default state
Couplings	Sets **Auto Align** to `OFF`. Sets Bit 14 in the Status Questionable Calibration register. The Error Condition message “Align Now All required” is generated

Alignment Data Wizard (without Flash)

Guides you through the operation of backing-up or restoring the alignment data.

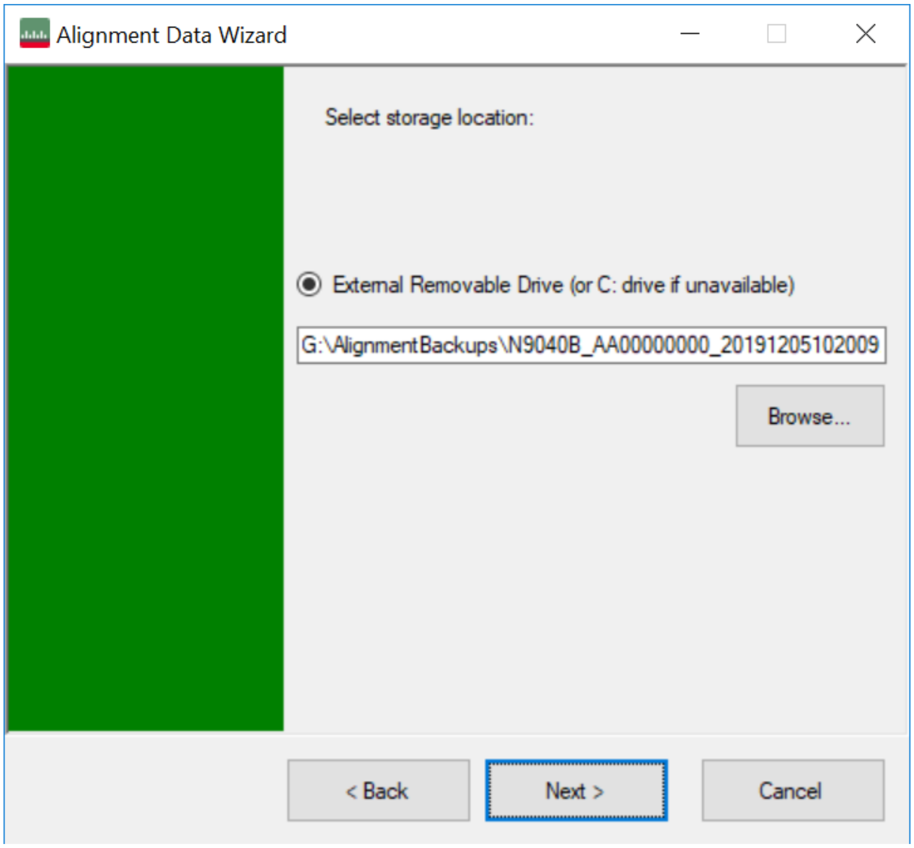




The default backup location for instruments *without* internal flash will be the first drive identified as an external drive (USB or LAN) if such is available; or, if not, the internal D: partition.

The default file name is <model number>_<serial number>_<date in YYYYMMDDHHMMSS>.bkz.

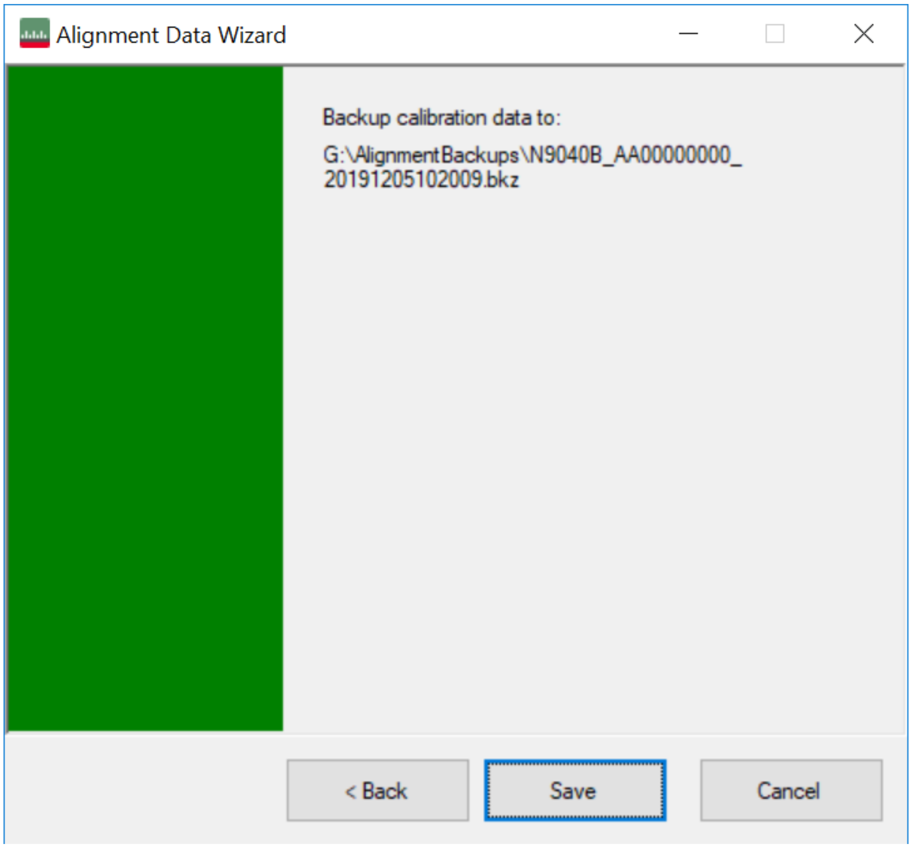
The default file extension for legacy backup files was `.bak`. The Backup and Restore operations support both the `.bak` (legacy format) and `.bkz` formats.

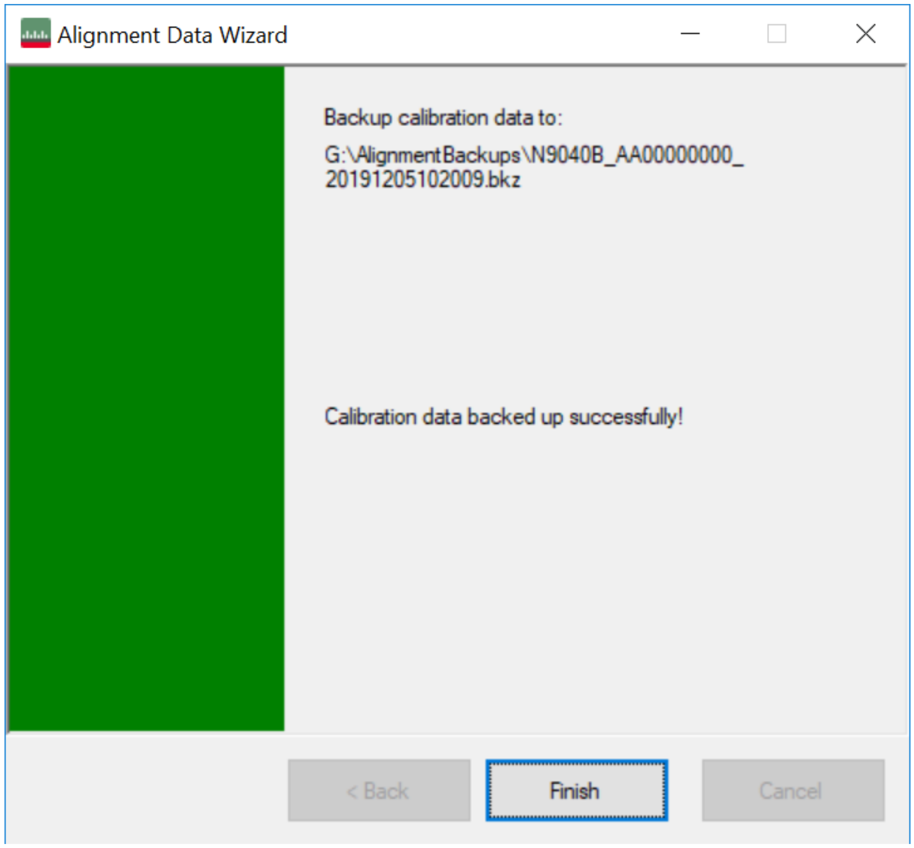


If a USB drive is present, it will be selected by default. The path defaults to the `AlignmentBackups` folder, and a filename is automatically created, in the form: <model>_<serial number>_<date><time>.bkz

If you wish to enter a customer filename, you can do so with an external keyboard, or by opening the onscreen Alpha keyboard, by pressing the **Keyboard** hardkey on the front panel:

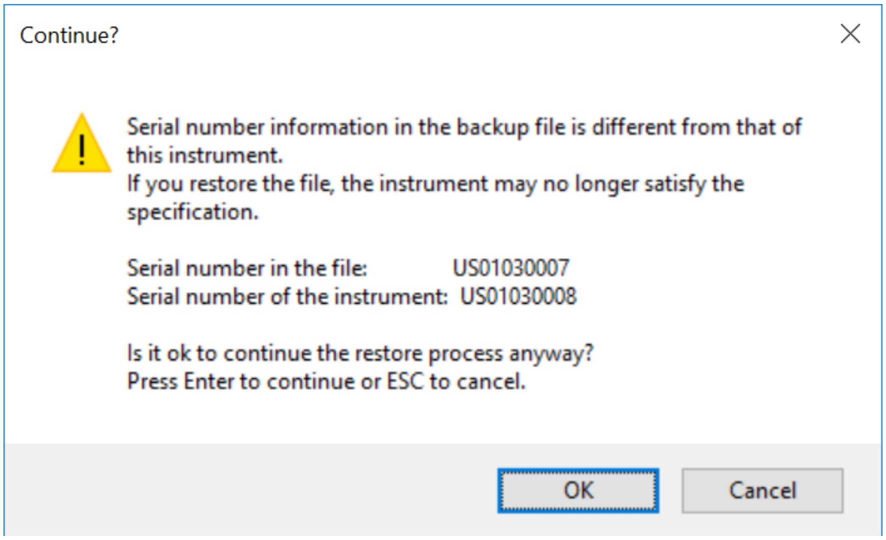
When the **Next >** button is pressed, you will be prompted to create a new folder if the chosen path does not yet exist.


Alignment Data Wizard
Backup calibration data to:
G:\AlignmentBackups\N9040B_AA00000000_
20191205102009.bkz
< Back
Save
Cancel

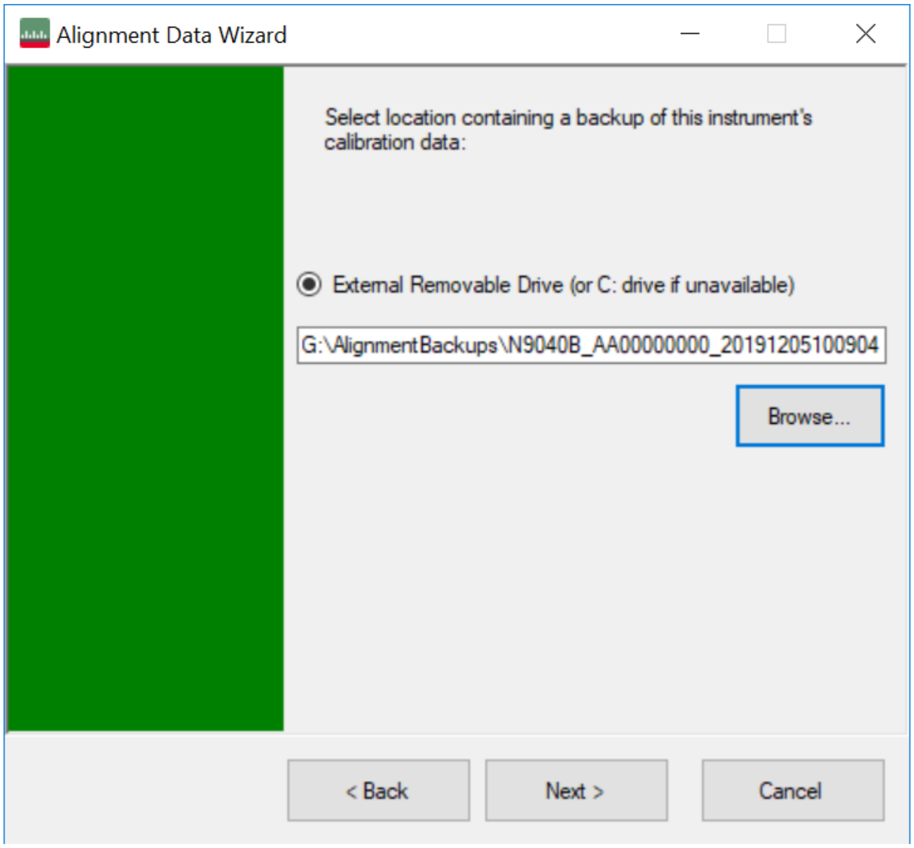


The restore operation checks the validity of the restore file using the database's built-in file validation. If the restore file is corrupt, the existing alignment data will remain in use.

If the serial number information in the backup file being restored is different from that of the instrument, the following message appears (the serial numbers shown are examples):

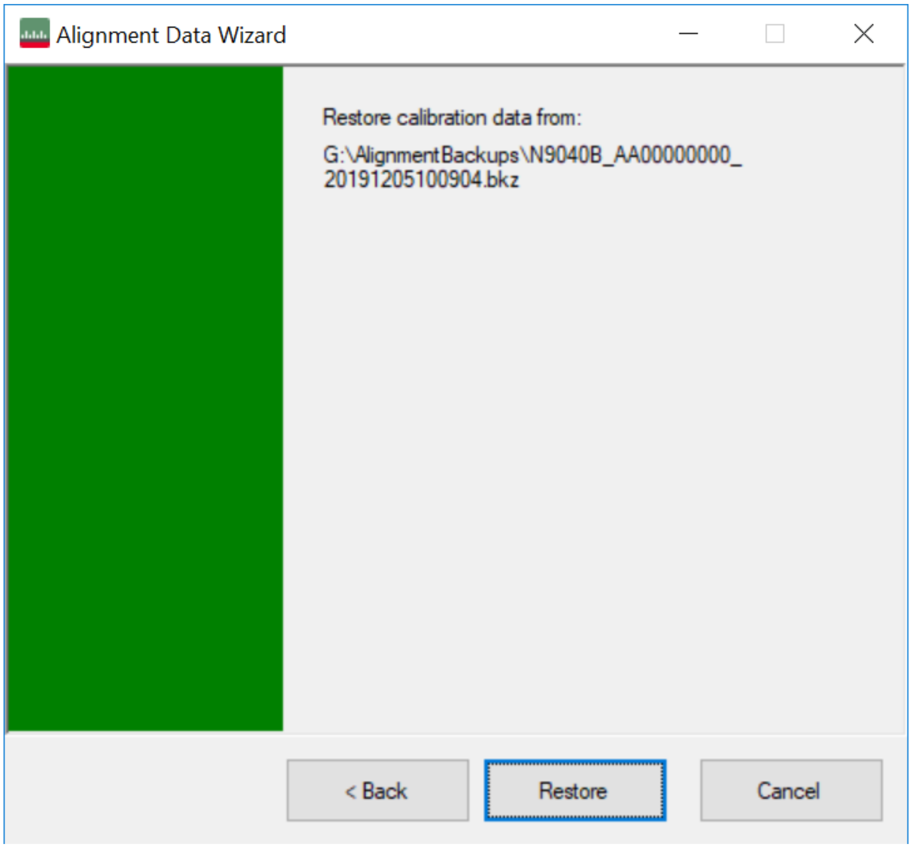


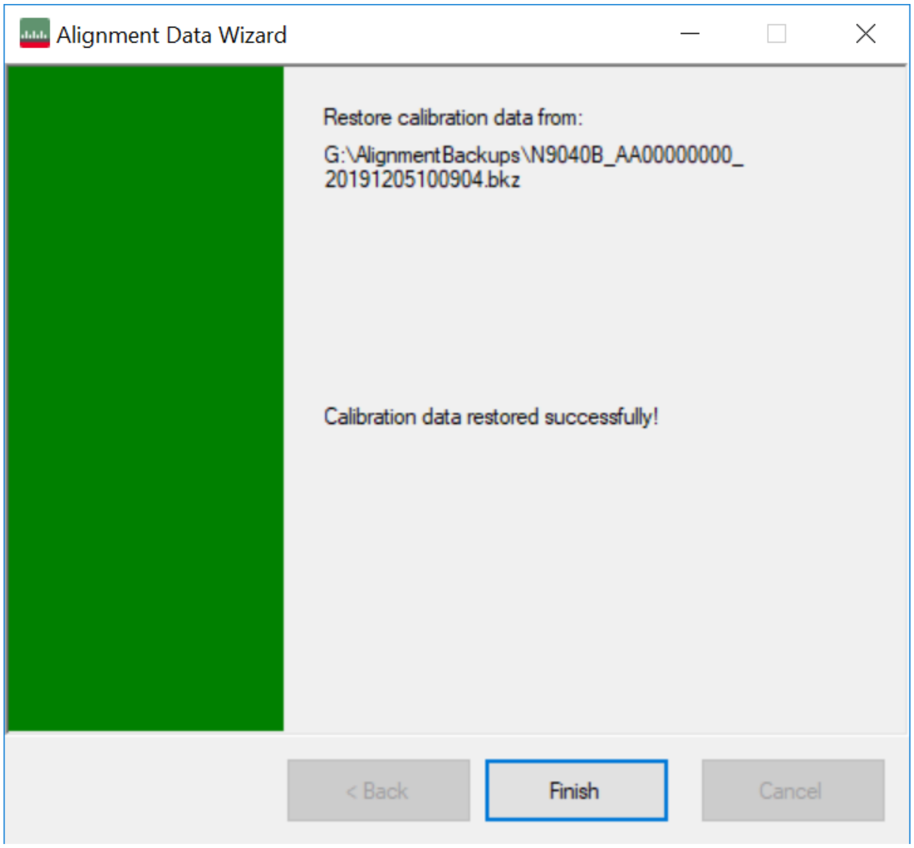
The default restore location for instruments *without* internal flash will be the first drive identified as an external drive (USB or LAN) if such is available; or, if not, the internal D: partition. The default restore file will be the most recent file that matches the default backup file name format: <model number>_<serial number>_<date>.bkz



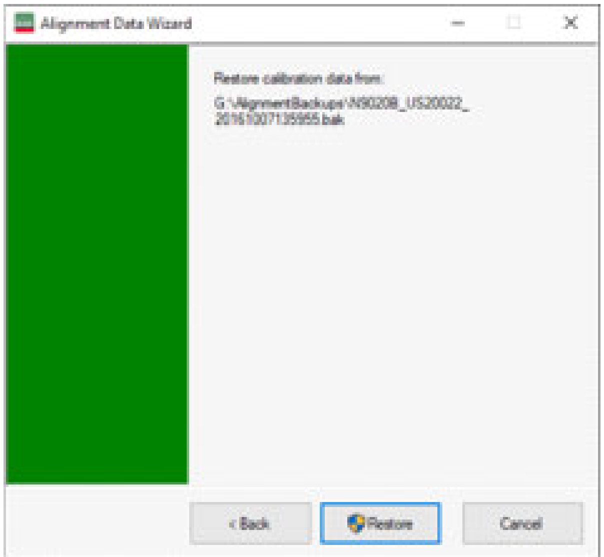
Changing the drive letter also modifies the path displayed in the box below. When this step is first loaded, the drive drop-down menu is populated with connected drives, which provide you with read access.

The path defaults to the `AlignBackups` folder. The most recent backup (`*.bkz` or `*.bak`) file in the folder will also be selected by default.


Alignment Data Wizard
Restore calibration data from:
G:\AlignmentBackups\N9040B_AA00000000_
20191205100904.bkz
< Back
Restore
Cancel



When restoring data in the legacy `.bak` format, Administrator privileges are required. You will be prompted when you attempt a restore (indicated by the UAC Shield on the **Restore** button below).



Perform Backup (without Flash) (Remote Command Only)

Invokes an alignment data backup operation to the provided location.

NOTE: **Keysight recommends that the specified location should be external to the instrument (USB or Mapped Network Drive).**

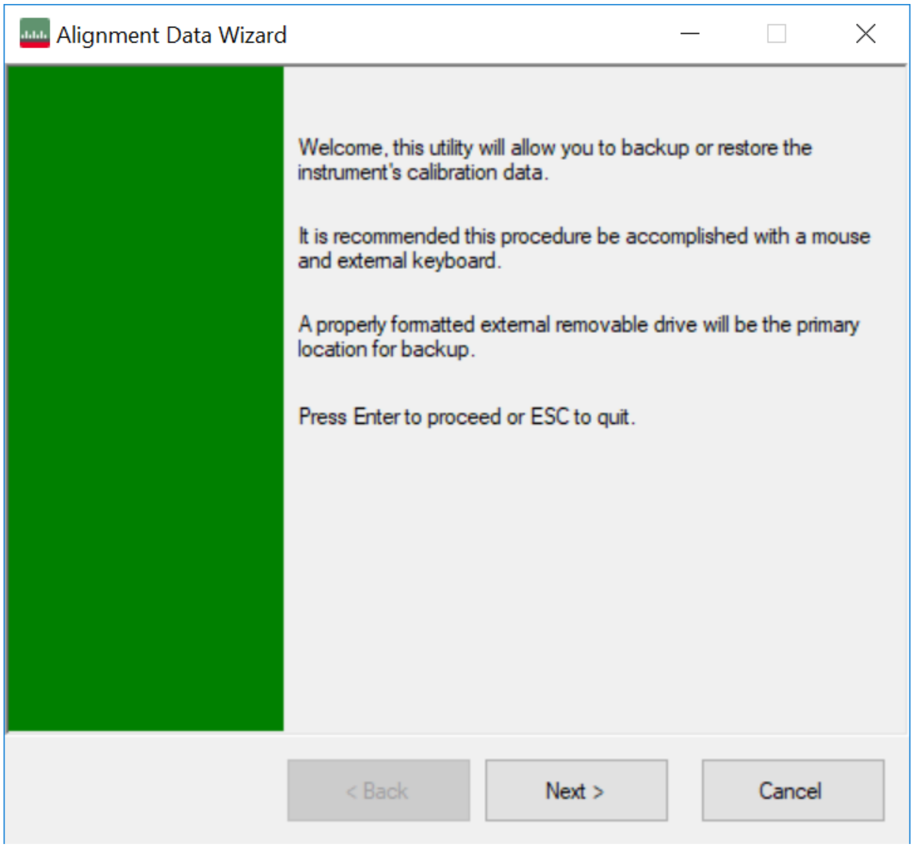
Remote Command	:CALibration:DATA:BACKup <filename>
Example	:CAL:DATA:BACK "F:\AlignDataBackup_N9020A_US00000001_2008140100.bkz"

Perform Restore (without Flash) (Remote Command Only)

Invokes an alignment data restore operation from the provided filename.

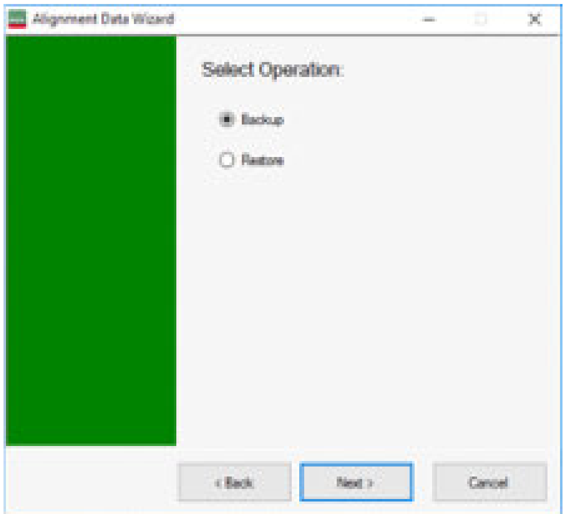
Remote Command	:CALibration:DATA:RESTore <filename>
Example	:CAL:DATA:REST "F:\ AlignDataBackup_N9020A_US00000001_2008140100.bkz"

Alignment Data Wizard (with Flash)



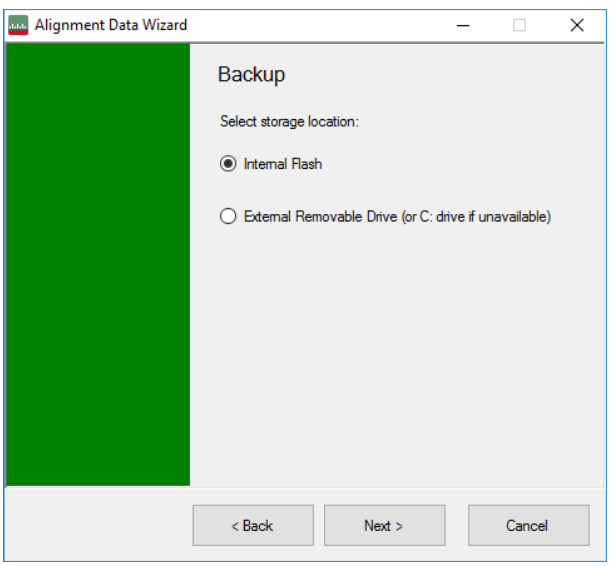
If your instrument has Processor Assembly type PC6S or PC7S (see "Show System" on page 2024) the instrument has an internal flash EEPROM that can store a backup of the alignment data. In this case, the interface to the Alignment Data Wizard is enhanced to accommodate this internal storage. This section details the use of this internal flash. For details on using external storage, see the previous section ("Alignment Data Wizard (without Flash)" on page 2133).

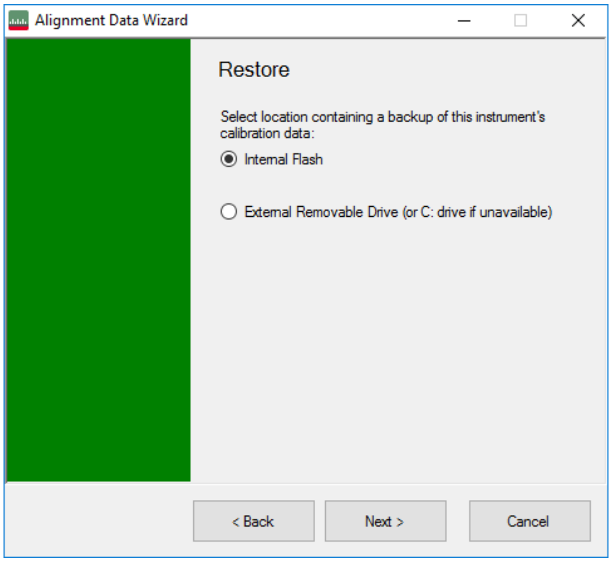
The Alignment Data Wizard guides you through the operations of backing up or restoring alignment data.



Having selected **Backup** or **Restore**, you then select the source or destination for the alignment data. As shown below, you can select either:

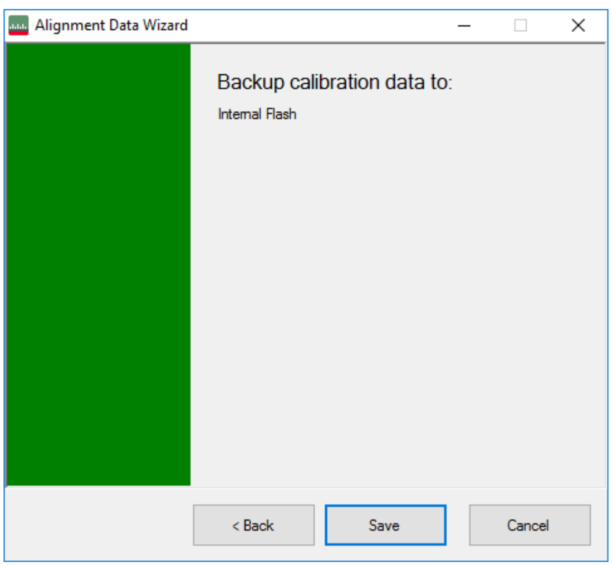
- Internal flash EEPROM, or,
- External Removable Drive (which includes the SD card described in "Backup or Restore Align Data..." on page 2132)

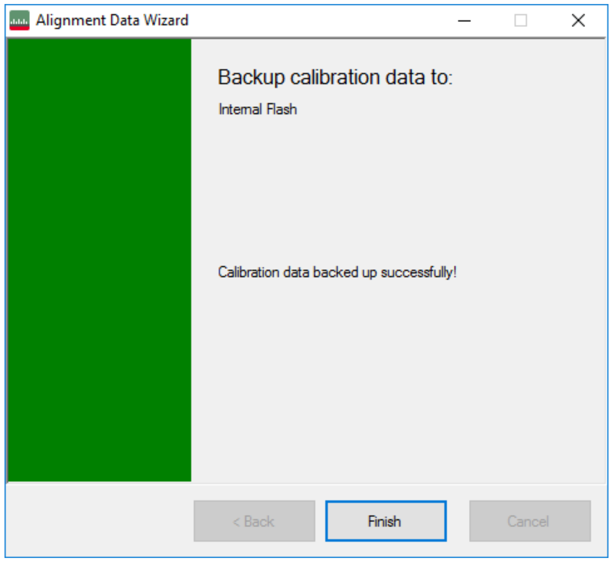




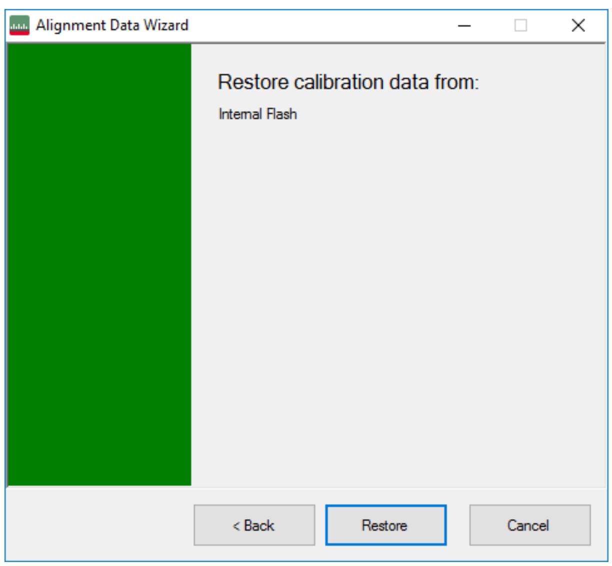
The final page of the wizard asks you to confirm the choices made in the previous pages. When the operation is complete, an indication is displayed on the same page, as below.

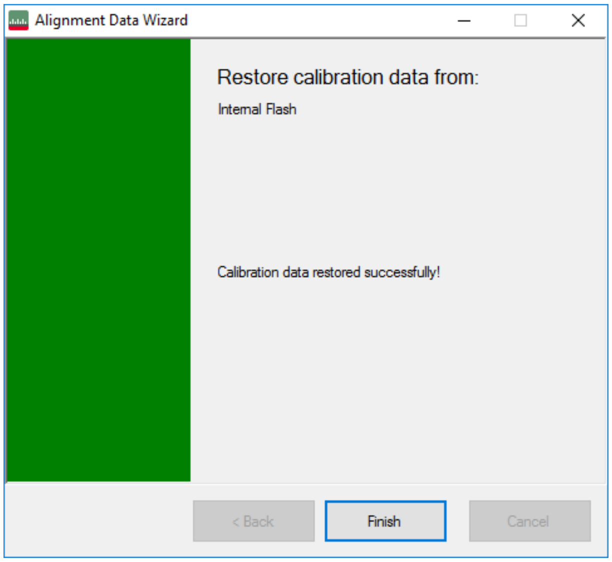
Backup



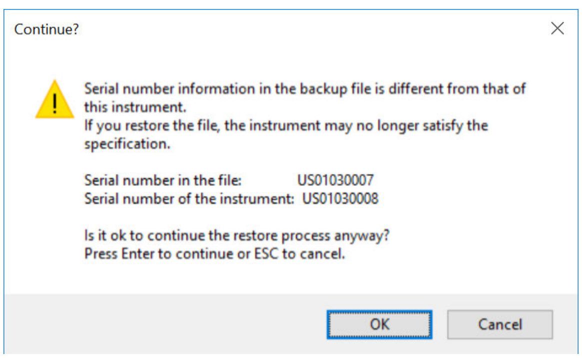

Alignment Data Wizard
Backup calibration data to:
Internal Flash
Calibration data backed up successfully!
< Back
Finish
Cancel

Restore

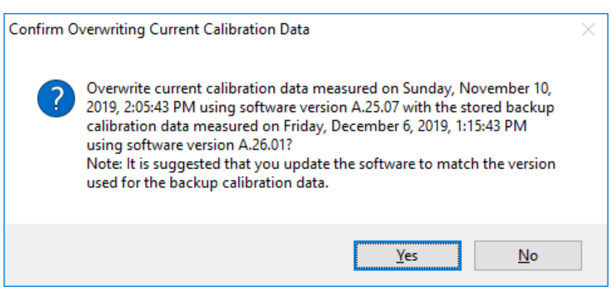

Alignment Data Wizard
Restore calibration data from:
Internal Flash
< Back
Restore
Cancel



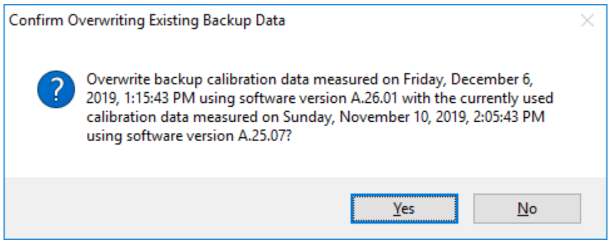
When restoring alignment data, if the serial number information in the backup file being restored is different from that of the instrument, the following message appears (the serial numbers shown are examples):



Immediately before the actual restoration, a final confirmation message is displayed detailing what is being restored and the current database that will be overwritten on the disk (the dates and versions are examples):



When backing up alignment data to the flash, if there is already an existing backup on the flash, a final confirmation message is displayed detailing what is being backed up and what will be overwritten on the flash (again, the dates and versions are examples):



Perform Backup (with Flash) (Remote Command Only)

Invokes an alignment data backup operation to the internal flash EEPROM.

Remote Command	`:CALibration:DATA:INTernal:BACKup`
Example	`:CAL:DATA:INT:BACK`

Perform Restore (With Flash) (Remote Command Only)

Invokes an alignment data restore operation from the internal flash EEPROM.

Remote Command	`:CALibration:DATA:INTernal:RESTore`
Example	`:CAL:DATA:INT:REST`

Restore Alignment Defaults

Causes the Alignment system settings to be reset to their default values. This does not affect any Alignment data stored in the system.

After performing this function, it may impact the auto-alignment time of the instrument until a new alignment baseline has been established.

When **Alignments** is selected, a message appears saying:

`This will reset all of the settings for the Alignment system to their default values`

`No alignment data will be erased`

`This action cannot be undone. Do you want to proceed?`

The dialog includes **OK** and **Cancel** controls, for you to affirm or cancel the operation.

Align Now All must be executed if the value of the Timebase DAC results in a change.

Example	`:SYST:DEF ALIG`
Notes	Alignment processing that results as the transition to **Auto Align Normal** will be executed sequentially; thus `*OPC?` or `*WAI` will wait until the alignment processing is complete

The parameters affected are:

Parameter	Setting
Timebase DAC	Calibrated
Timebase DAC setting	Calibrated value
Auto Align State	Normal (if the instrument is not operating with default alignment data, Off otherwise)
Auto Align All but RF	Off
Auto Align Alert	Time & Temperature

4.6.6.7 oGRF Preselector

This menu and all its submenus are only available in models with the RF Preselector, such as N9038B, or N9048B.

Dependencies	Only available in RF Preselector models

Align Now, 20 Hz to 30 MHz

Immediately executes an alignment of the receiver subsystem. The receiver will stop any measurement currently underway, perform an Align Now All, then perform the RF Preselector alignment, and then restart the measurement from the beginning (similar to pressing the Restart key).

The query `:CALibration:RFPSelector:CONDucted?` invokes the alignment of the RF Preselector on Conducted Band and returns a success or failure value. Successful completion clears the “Align 20 Hz to 30 MHz required” Error Condition, and clears bit 1 in the Status Questionable Calibration Extended Needed register. The elapsed time counter will begin for Last Align Now, Conducted Time, and the temperature is captured for the Last Align Now, Conducted Temperature. The alignment can be interrupted by pressing the Cancel (ESC) front-panel key or remotely with Device Clear followed by the :ABORt SCPI command. When this occurs, the Error Condition “Align 20 Hz to 30 MHz required” is set because new alignment data may be employed for an individual subsystem, but not a cohesive set of data for all subsystems.

The “Align 20 Hz to 30 MHz required” Error Condition will appear when this alignment has expired. User is now responsible to perform the Align Now, 20 Hz to 30 MHz to keep the receiver in warranted operation. This alignment can only be performed by user as it is not part of the Auto Align process.

Remote Command	`:CALibration:RFPSelector:CONDucted` `:CALibration:RFPSelector:CONDucted?`
Example	`:CAL:RFPS:COND`
Notes	The query returns 0 if successful, or 1 if failed When Align 20 Hz to 30 MHz is performing the alignment, bit 0 in the Status Operation register is set. Completion, or termination, will clear bit 0 in the Status Operation register This command is sequential; it must complete before further SCPI commands are processed. Interrupting the alignment from remote is accomplished by invoking Device Clear followed by the :ABORt command. Successful completion will clear bit 1 in the Status Questionable Calibration Extended Needed register and bit 0 in Status Questionable Calibration Extended Failure register A failure encountered during alignment will set the Error Condition “20 Hz to 30 MHz Alignment Failure” and set both bit 1 in the Status Questionable Calibration Extended Needed register and bit 9 in Status Questionable Calibration register
Dependencies	Does not appear in non-RF Preselector models, setting or querying the SCPI will generate an error
Couplings	Initializes the time for the Last Align Conducted Now, Conducted Time Records the temperature for the Last Align Conducted Now, Conducted Temperature
State Saved	No
Status Bits/OPC dependencies	Bit 8 or 9 may be set in the Status Questionable Calibration register Bit 1 may be set in the Status Questionable Calibration Extended Needed register Bit 0 may be set in the Status Questionable Calibration Extended Failure register

Align Now, 30 MHz to 3.6 GHz

Immediately executes an alignment of the receiver subsystem. The receiver will stop any measurement currently underway, perform an Align Now All, then perform the RF Preselector alignment, and then restart the measurement from the beginning (similar to pressing the **Restart** key).

The query (`:CALibration:RFPSelector:RADiated?`) invokes the alignment of the RF Preselector on Radiated Band and returns a success or failure value. Successful completion clears the “Align 30 MHz to 3.6 GHz required” Error Condition, and clears bit 2 in the Status Questionable Calibration Extended Needed register. The elapsed time counter begins for Last Align Now, Radiated Time, and the temperature is captured for the Last Align Now, Radiated Temperature. The alignment can be interrupted by pressing the **Cancel (ESC)** front-panel key, or remotely with Device Clear followed by `:ABORt`. When this occurs, the Error Condition “Align 30 MHz to 3.6 GHz required” is set, because new alignment data may be employed for an individual subsystem, but not a cohesive set of data for all subsystems.

The “Align 30 MHz to 3.6 GHz required” Error Condition appears when this alignment has expired. You must now perform **Align Now, 30 MHz to 3.6 GHz** to keep the receiver in warrantied operation.

Remote Command	`:CALibration:RFPSelector:RADiated` `:CALibration:RFPSelector:RADiated?`
Example	`:CAL:RFPS:RAD`
Notes	The query returns 0 if successful, or 1 if failed When **Align 30 MHz to 3.6 GHz** is performed, alignment, bit 0 in the Status Operation register is set. Completion, or termination, clears bit 0 in the Status Operation register This command is sequential; it must complete before further SCPI commands are processed. Interrupting the alignment from remote is accomplished by invoking Device Clear followed by `:ABORt`. Successful completion clears bit 2 in the Status Questionable Calibration Extended Needed register and bit 1 in Status Questionable Calibration Extended Failure register A failure encountered during alignment sets the Error Condition “30 MHz to 3.6 GHz Alignment Failure” and sets both bit 2 in the Status Questionable Calibration Extended Needed register and bit 9 in Status Questionable Calibration register
Dependencies	Does not appear in non-RF Preselector models, setting or querying the SCPI will generate an error
Couplings	Initializes the time for the Last Align Radiated Now, Radiated Time Records the temperature for the Last Align Radiated Now, Radiated Temperature
State Saved	No
Status Bits/OPC dependencies	May set Bit 8 or 9 in the Status Questionable Calibration register May set Bit 2 in the Status Questionable Calibration Extended Needed register May set Bit 1 in the Status Questionable Calibration Extended Failure register

Align Now, 20 Hz to 3.6 GHz

Immediately executes an alignment of the receiver subsystem. The receiver will stop any measurement currently underway, perform an Align Now All, then perform the RF Preselector alignment, and then restart the measurement from the beginning (similar to pressing the **Restart** key).

The query (`:CALibration:RFPSelector:FULL?`) invokes the alignment of the RF Preselector on both Conducted and Radiated Band and return a success or failure value. Successful completion clears the “Align 20 Hz to 3.6 GHz required” Error Condition, and clears bit 1 and bit 2 in the Status Questionable Calibration Extended Needed register. The elapsed time counter begins for Last Align Now, Conducted Time and Last Align Now Radiated Time and the temperature is captured for Last Align Now, Conducted Temperature and Last Align Now, Radiated Temperature. The alignment can be interrupted by pressing the **Cancel (ESC)** front-panel key or remotely with Device Clear, followed by `:ABORt`. When this occurs, the Error Condition “Align 20 Hz to 3.6 GHz required” is set, because new alignment data may be employed for an individual subsystem, but not a cohesive set of data for all subsystems.

The “Align 20 Hz to 3.6 GHz required” Error Condition appears when this alignment has expired.You must now perform the Align Now, 20 Hz to 3.6 GHz to keep the receiver in warrantied operation.

Remote Command	`:CALibration:RFPSelector:FULL` `:CALibration:RFPSelector:FULL?`
Example	`:CAL:RFPS:FULL`
Notes	The query returns 0 if successful, or 1 if failed When Align 20 Hz to 3.6 GHz is performed, alignment, bit 0 in the Status Operation register is set. Completion, or termination, clears bit 0 in the Status Operation register This command is sequential; it must complete before further SCPI commands are processed. Interrupting the alignment from remote is accomplished by invoking Device Clear, followed by `:ABORt`. Successful completion clears bit 1, bit 2 in the Status Questionable Calibration Extended Needed register and bit 0, bit 1 in Status Questionable Calibration Extended Failure register A failure encountered during alignment sets the Error Condition “20 Hz to 3.6 GHz Alignment Failure” and sets bit1, bit 2 in the Status Questionable Calibration Extended Needed register and bit 9 in Status Questionable Calibration register
Dependencies	Does not appear in non-RF Preselector models, setting or querying the SCPI generates an error
Couplings	Initializes the time for the Last Align Conducted Now, Conducted Time Initializes the time for the Last Align Radiated Now, Radiated Time Records the temperature for the Last Align Conducted Now, Conducted Temperature Records the temperature for the Last Align Radiated Now, Radiated Temperature
State Saved	No
Status Bits/OPC dependencies	May set Bit 8 or 9 in the Status Questionable Calibration register May set Bit 1 and 2 in the Status Questionable Calibration Extended Needed register May set Bit 0 and 1 in the Status Questionable Calibration Extended Failure register

Alert

Enables or disables the display of RF Preselector alignment required message on the status line. The instrument powers up with Alert ON.

Remote Command	`:CALibration:RFPSelector:ALERt ON | OFF | 0 | 1` `:CALibration:RFPSelector:ALERt?`
Example	`:CAL:RFPS:ALER OFF`
Notes	Error Condition is generated when alert is ON and any of the RF Preselector alignments has expired
Preset	Unaffected by Preset, but set to ON by **Restore Defaults** > "Alignments" on page 2079
State Saved	No
Range	OFF | ON

4.6.6.8 Scheduler

Setting the Scheduler to ON triggers execution of the scheduled task based on the recurrence and time set in the scheduler since the last successful of the specific alignment. A warning condition of “RF Preselector alignment scheduler is ON” appears when the scheduler is set to ON. OFF prevents the Scheduler from running any scheduled task.

Remote Command	`:CALibration:RFPSelector:SCHeduler:STATe ON | OFF | 0 | 1` `:CALibration:RFPSelector:SCHeduler:STATe?`
Example	`:CAL:RFPS:SCH:STAT OFF`
Preset	Unaffected by Preset, but set to ON by **Restore Defaults** > "Alignments" on page 2079
State Saved	No
Range	OFF|ON

Schedule Setup

Lets you schedule a task to run automatically at the background based on the recurrence and time set in the scheduler. Make sure that the instrument’s local time is accurate, because the Scheduler relies on this information to execute the task.

This dialog contains the following controls:

- "Task" on page 2153
- "Date/Time" on page 2154
- "Hour" on page 2155
- "Minute" on page 2155
- "Recurrence" on page 2155
- "Number of Weeks" on page 2155
- "Day" on page 2156

Task

There are 3 tasks that can be selected for the scheduler to run.

- Task 1 is the 20 Hz to 30 MHz alignment
- Task 2 is the 30 MHz to 3.6 GHz alignment

– Task 3 is the 20 Hz to 3.6 GHz alignment

Remote Command	`:CALibration:RFPSelector:SCHeduler:TASK T1 | T2 | T3` `:CALibration:RFPSelector:SCHeduler:TASK?`
Example	`:CAL:RFPS:SCH:TASK T1`
Notes	Changing the task does not reset the Scheduler time, and the alignment is based on the current scheduled configuration to occur
Preset	Unaffected by **Preset** but set to `T3` by **Restore Defaults** > "Alignments" on page 2079
State Saved	No
Range	Task 1 | Task 2 | Task 3

Date/Time

Lets you configure the scheduler to run a task starting from this date and time. The date and time rely on the instrument's local time to execute a scheduled task. The date format is "YYYY/MM/DD" and the time is 24-hour clock.

Remote Command	`:CALibration:RFPSelector:SCHeduler:TIME:STARt "date","time"`
	`:CALibration:RFPSelector:SCHeduler:TIME:STARt?`
	This query returns data using the format "YYYY/MM/DD; HH:MM:SS"

Example	`:CAL:RFPS:SCH:TIME:STAR "2009/8/20","12:00:00"`
Notes	`"date"` is the date the task will run, in the form `YYYY/MM/DD` where: – `YYYY` is the four-digit representation of year (for example, 2009) – `MM` is the two-digit representation of month (for example, 01 to 12) – `DD` is the two-digit representation of the day (for example, 01 to 28, 29, 30 or 31 depending on the month and year) `"time"` is the time of day the task will run, in the form `HH:MM:SS` where: – `HH` is the two-digit representation of the hour in 24-hour format – `MM` is the two-digit representation of minute – `SS` is the two-digit representation of seconds
Preset	Unaffected by **Preset** but set to Current date and 00:00:00 by **Restore Defaults** > "Alignments" on page 2079
State Saved	No

Hour

Lets you configure the hour for the scheduled task. The command to configure the date and time parameters of the scheduler is the same; but they each have their own front panel-control.

Notes	See "Date/Time" on page 2154
Preset	Unaffected by **Preset** but set to Current hour and 00 by **Restore Defaults** > "Alignments" on page 2079
State Saved	No

Minute

Lets you configure the minute for the scheduled task. The command to configure the date and time parameters of the scheduler is the same; but they each have their own front panel-control.

Notes	See "Date/Time" on page 2154
Preset	Unaffected by **Preset** but set to Current minute and 00 by **Restore Defaults** > "Alignments" on page 2079
State Saved	No

Recurrence

Lets you configure the scheduler to run the task recurrently on a scheduled date and time. You can schedule it to run daily, weekly, or alternate weeks.

Remote Command	`:CALibration:RFPSelector:SCHeduler:RECurrence DAY | WEEK | OFF` `:CALibration:RFPSelector:SCHeduler:RECurrence?`
Example	`:CAL:RFPS:SCH:REC DAY`
Preset	Unaffected by **Preset** but set to `OFF` by **Restore Defaults** > "Alignments" on page 2079
State Saved	No
Range	`DAY | WEEK | OFF`

Number of Weeks

Lets you set the number of weeks that the scheduler will wait to trigger a task.

Remote Command	`:CALibration:RFPSelector:SCHeduler:RECurrence:WEEK <integer>` `:CALibration:RFPSelector:SCHeduler:RECurrence:WEEK?`

Example	`:CAL:RFPS:SCH:REC:WEEK 2`
Notes	New scheduled date to run the alignment task is updated when this parameter is changed
State Saved	No
Range	1-52
Min	1
Max	52

Day

Lets you set the Day of the Week the scheduler will run a scheduled task.

Remote Command	`:CALibration:RFPSelector:SCHeduler:RECurrence:DAY SUN | MON | TUE | WED | THU | FRI | SAT` `:CALibration:RFPSelector:SCHeduler:RECurrence:DAY?`
Example	`:CAL:RFPS:SCH:REC:DAY SUN`
State Saved	No
Range	Sunday | Monday | Tuesday | Wednesday | Thursday | Friday | Saturday

4.7 Licensing

Accesses capabilities for configuring the licenses in your instrument.

4.7.1 License Manager

Opens the License Explorer for Fixed and Transportable licenses.

NOTE This feature is not available if Option SF1 is installed.

For help on licensing, select **Help** in the menu bar at the top of the License Explorer window.

There are also several remote commands available for licensing. See:

– "Install License (Remote Command Only)" on page 2165
– "Remove License (Remote Command Only)" on page 2165
– "List Licenses (Remote Query Only)" on page 2166
– "Validate License (Remote Query Only)" on page 2167
– "Host ID Query (Remote Query Only)" on page 2167
– "List Borrowed Licenses (Remote Query Only)" on page 2162
– "Return a Borrowed License (Remote Command Only)" on page 2163

Notes	No equivalent remote command for this control

4.7.2 System Software Version Date

The date of the newest features introduced in this release of the firmware. This is *not* necessarily the same as the build date of the firmware, because the version date only changes when new features are added. For example, if A.18.06 has only defect fixes and no new features compared to A.18.05, then both A.18.05 and A.18.06 would have the same software version date.

For any feature to be enabled, the SW Support Expiration Date of the enabling license must be greater than or equal to the software version date when that feature was first introduced. See the Keysight web site for features related to a specific software application and their required support date.

The SCPI response is 3 integer values: `<year>,<month>,<day>`.

Remote Command	`:SYSTem:SOFTware:VERSion:DATE?`
Example	`:SYST:SOFT:VERS:DATE?`

4.7.3 Software Support Expiration Date

This date is encoded in each software license's Version field in the `YYYY.MMDD` format. It specifies the end date of the support contract associated with this license. When a support contract is renewed, a new license is issued with an updated Version corresponding to the new contract's end date. The functionality available for a license is determined by the features available before the expiration date. For example, if feature X is introduced in a release with System Software Version Date of `2017.0831`, then a license with a Software Support Expiration Date of `2017.0831` or greater would enable feature X, but `2017.0830` or earlier would not enable feature X.

The SCPI response is 3 integer values: `<year>,<month>,<day>`.

Remote Command	`:SYSTem:LKEY:SOFTware:SUPPort:EXPiration:DATE? <feature>`
Example	`:SYST:LKEY:SOFT:SUPP:EXP:DATE? "N9084EM0E-1FP"`
Dependencies	When `<feature>` is not a valid license, one of the following errors will be issued: – -224,"IllegalParameterValue;License is not installed" – -224,"IllegalParameterValue;Unknown license feature" – -224,"IllegalParameterValue;Support contract not offered for this license"

4.7.4 Network Licenses

Network Licenses are available over the customer's network from a server the customer configures. The server has a count for each license and will only allow instruments to "check-out" a license up to that count. Once the count is reached for a specific license, further check-outs fail until one of the licenses is checked back in to the server. What this means is that it is possible for an instrument to have different features available to it based on what licenses are still available on the server when it tries to get licenses.

Setting up network licenses is done via the Keysight Floating License Manager (available on external Keysight web) and it has an Installation Guide that can be downloaded from that web page.

4.7.4.1 Application Licenses

Application Licenses (like N9077EM0E-1NP) are automatically checked out when entering the Mode that uses them, and they are automatically checked-in when leaving that Mode. Because the server may have already checked out the last license for the application to another instrument, there is now the possibility that a mode switch will fail because a required license could not be checked out from the server. If the server has a limited number of licenses compared to the number of users desiring to use that license, this may mean that switching from Mode A to Mode B then back to Mode A may fail when returning to Mode A because another instrument checked out the last available license while the user was in Mode B. Also, for Modes with multiple licenses for different features (like Multi-Standard Radio), the features available may also change when switching out of the Mode and back into it.

So, when using network licenses, it is necessary to check `:SYST:ERR?` after every Mode switch, to verify that it successfully switched. If the Mode's required licenses were not successfully checked out, the instrument posts the error:

-310,"System error; feature not licensed"

There is also a potential performance issue when using network licenses, because the instrument must communicate with the server on each license check-out and check-in. This operation is usually fast (a few milliseconds), but it depends on the network communication lag between the instrument and server. For remote servers on slow or congested networks, this could be significantly slower than that.

4.7.4.2 Instrument Software Options

Instrument software licenses are those that are reported via `*OPT?` the same as HW options. For example, N9040RT1B-1NP is an instrument software option, and is reported via `*OPT?` as `RT1`. Note that the license is composed of the model number (in this case `N9040B`) combined with the option code (`RT1`).

When instrument software options are available from a network server, the instrument automatically checks them out at start-up, and only checks them in when shutting down.

4.7.4.3 License Checked Out Query (Remote Query Only)

Shows whether the specified license is checked out from a server. Since network served licenses may not always be available when there are limited licenses available compared to the desired number of users, the features available on an instrument can vary. Use this query to see whether the feature is currently checked-out to the instrument. The return value is boolean (0 or 1), returning 1 if the feature exists and is checked out from a server. Note that querying a license that is local to the instrument (-xFP or -xTP) also returns 0, even though the license exists and is valid, because it does not require a check-out. Also, querying a license that does not exist returns 0.

Remote Command	`:SYSTem:LKEY:COUT? <feature>`
Example	`:SYST:LKEY:COUT? "N9080EM0E"` `1`
Notes	`<"OptionInfo">` contains the feature and the version. You must specify the feature but can omit the version. If you omit the version, the system regards it as the latest one Return Value: 0 if not checked out, 1 if checked out

4.7.4.4 List Licenses Checked Out (Remote Query Only)

Lists the licenses checked out from a server. Since network served licenses may not always be available when there are limited licenses available compared to the desired number of users, the features available on an instrument can vary. Use this query to see which features are currently checked-out to the instrument.

Remote Command	`:SYSTem:LKEY:COUT:LIST?`

Example	`:SYST:LKEY:COUT:LIST?`
	`#284`
	`N9073EM0E,2018.0831`
	`N9077EM0E,2018.0831`
	`N9080EM0E,2018.0831`
	`N9081EM0E,2018.0831`

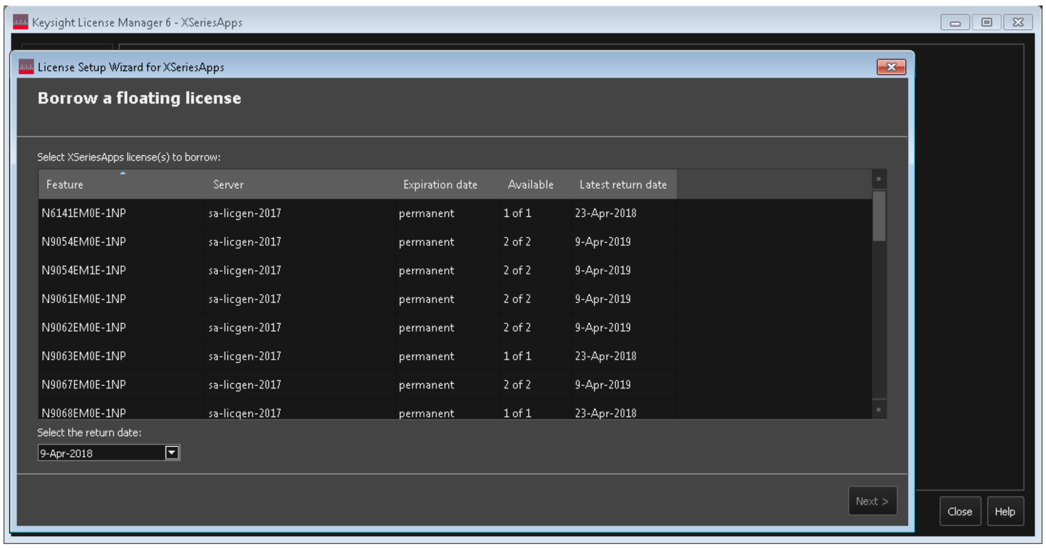
4.7.4.5 Borrowed Network Licenses

Network licenses can be borrowed from the network license server for a time. The maximum amount of time a license can be borrowed is specified in the license installed on the server and is set at the time the license is generated by Keysight. As part of the borrow operation, you specify how long to borrow the license. This borrow period is in hours and can be any time up to the maximum allowed by the license. Once borrowed, the license appears as a local license and can be used even when not connected to the network, and the instrument software treats them the same as other time-based licenses that are installed on the instrument. This means the licenses are validated when the instrument is started and then are used without the overhead of checking them out and back in when switching Modes. At the time of the borrow, a time is specified for how long the license will be borrowed. When that time expires, the license is automatically returned to the network license server even if the instrument is not connected to the network. If you are done with the license before it automatically returns to the network server, the license can be explicitly returned earlier.

4.7.4.6 Borrow a License

Licenses are borrowed by using the Keysight License Manager 6 application. This can be launched from the **System Licensing** screen.

Graphic



The corresponding remote command is:

Remote Command	`:SYSTem:LKEY:BORRow "<feature>[,<version>]",<return date>` `:SYSTem:LKEY:BORRow? "<feature>[,<version>]"`

Example	`:SYST:LKEY:BORR "N9080EM0E","20-Aug-2018"`
	`:SYST:LKEY:BORR? "N9080EM0E"`
	`:"20-Aug-2018"`

Notes	If `<version>` is not specified, the highest available version will be borrowed The `<return date>` is the day when the borrow will automatically be returned to the server
Dependencies	For the command, when `<feature>` is not a valid license, or when a license is not currently available for borrowing, one of the following errors is issued: – -224,“IllegalParameterValue;License is not installed” – -224,“IllegalParameterValue;Unknown license feature”

- -224,“IllegalParameterValue;License not available for borrowing”

Additionally, the return date is evaluated. If it is not a valid date, the following error is issued:

- -224,“IllegalParameterValue;Invalid return date”
- -200,"Execution error; No Available Borrow Licenses For Feature: <feature>"

The return date may be clipped to the maximum borrow allowed by the license. When this happens, the following warning is issued:

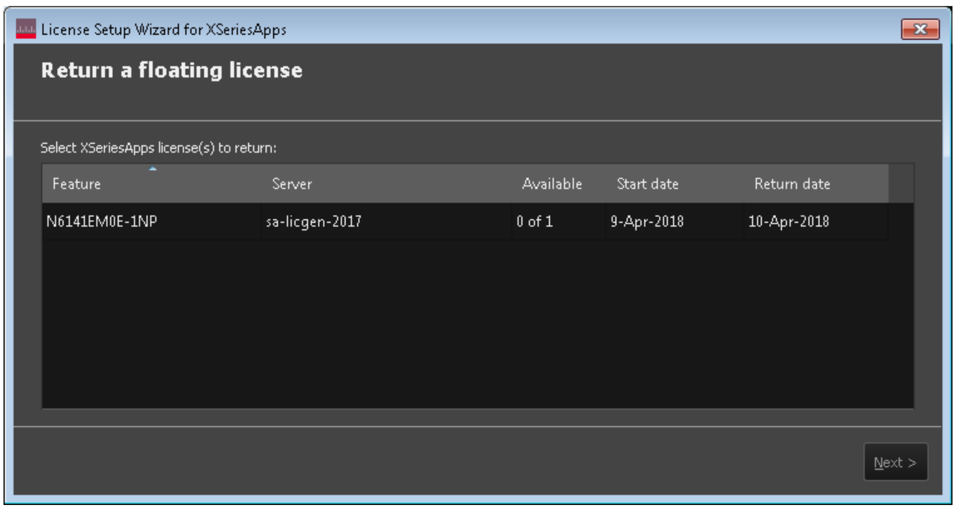
- -221,”Return date clipped to maximum of <max date>”

For the query, the return is the borrow return date (as a string in `dd-mmm-yyyy` format) if the license is borrowed. In all other cases, (not borrowed, not installed, etc.) the return is an empty string

4.7.4.7 Listing Borrowed Licenses and Return a Borrowed License

The Keysight License Manager 6 can also be used to see the currently borrowed licenses or return a license before the automatic return time.

Graphic



List Borrowed Licenses (Remote Query Only)

Remote Command	`:SYSTem:LKEY:BORRow:LIST?`
Example	`:SYST:LKEY:BORR:LIST?` `#266`

N9073EM0E,2018.0831,20-Aug-2018

N9077EM0E,2018.0831,20-Aug-2018

Return a Borrowed License (Remote Command Only)

Remote Command	:SYSTem:LKEY:BORRow:RETurn "<feature>"
Example	:SYST:LKEY:BORR:RET "N9080EM0E"
Dependencies	When <feature> is not a valid license or when a license is not borrowed, one of the following errors is issued: – -224,"IllegalParameterValue;License is not installed" – -224,"IllegalParameterValue;Unknown license feature" – -224,"IllegalParameterValue;License not borrowed"

4.7.4.8 Enabling Network Checkouts While Borrowed

The default for borrowed license use is that you will be explicitly borrowing all desired network licenses, and that all other available network licenses should be ignored. This allows you to intentionally limit the functionality available to the instrument to what is explicitly borrowed.

For example, the RT1/RT2 options that enable the RTSA Mode are automatically checked out when the instrument is started, because the hardware must be configured for them at startup time. If you do not intend to use RTSA, then by borrowing only the licenses you want to use and disabling other network checkouts, the RT1/RT2 licenses will not be checked out at startup. This leave more RTSA licenses available for others to use. Note that the instrument must be restarted after the borrowing has been done to ensure the release of any network licenses already acquired.

If your intent in borrowing is to ensure access to a particular feature or application, but you still want to opportunistically use other features or applications, the default behavior can be changed to enable network license checkouts even when licenses have been borrowed.

Remote Command	:SYSTem:LKEY:BORRow:NETWork:COUT:ENABle
Example	:SYST:LKEY:BORR:NETW:COUT:ENAB 0 :SYST:LKEY:BORR:NETW:COUT:ENAB?
Dependencies	Only visible when licensing is configured to use a network server. SCPI is always available
Preset	Unaffected by **Preset** but set to 0 by **Restore Defaults** > "Misc" on page 2079 or **Restore Defaults** > "All" on page 2080
State Saved	Power On Persistent (survives shutdown and restart)

4.7.5 USB Portable Licenses

The USB Portable license is implemented with a physical dongle that is a USB device, like a USB thumb drive. It has a Host ID fixed in the dongle HW. It does not contain any writable data and so is acceptable to high security A/D customers. Transporting licenses from one instrument to another just requires moving the dongle and license files to the desired instrument. The license files can be installed on many instruments, but they will only be valid the one instrument that has the dongle. The use of USB portable licenses requires that the Keysight Floating License Manager is installed on the instrument. The licenses can then be added to the instrument's server.

USB Portable licenses are checked out and in like Network licenses. Because the licenses are local, there will be no network latency involved in the check-out/check-in, but there can still be a slight performance degradation compared to Fixed and Transportable licenses. If the instrument allows multiple concurrent instances of the X-Series software (as is the case for modular products), there may also be availability issues if all licenses are already checked out to other X-Series instances. Plugging/un-plugging the dongle is equivalent to transporting a license to/from the instrument, however, the software must be restarted whenever the dongle is plugged in.

4.7.6 Configuring Network and USB Portable Licenses

The Keysight Floating License Manager must be used to configure the Network or USB Portable licenses before the licenses can be used. Currently, an instrument can only be configured for Network or USB Portable licenses or both.

- To set up USB Portable licenses, in the Keysight Floating License Manager select "Start a floating license server with a license file" and add files containing the USB Portable licenses desired
- To set up Network licenses, in the Keysight Floating License Manager select "Connect to a floating license server" and enter the network server's name preceded by the "@" character (example: "@myserver")
- To set up both Network and USB Portable license, first configure the USB Portable license, then configure the Network licenses, but append ";@localhost" to the server name (example: "@myserver;@localhost"). Whenever the configuration is changed, the X-Series software must be restarted

4.7.7 Floating License Manager

Opens the License Explorer for Network and USB Portable licenses.

NOTE **This feature is not available if Option SF1 is installed.**

For help on licensing, select **Help** in the menu bar at the top of the License Explorer window.

4.7.8 Install License (Remote Command Only)

Used to add a license to the instrument.

An example of such a command would be as below. The parameter is a unique 120-character code for each license.

```
SYST:LKEY “N9073A-1FP”,”027253AD27F83CDA5673A9BA5F427FDA5E4F25AEB1017638211AC9F60D9C639FE539735909C551DE0A91”
```

Another example using one of the optional clauses.

```
SYST:LKEY "N9063EM0E-1FP,2019.0330","02220210867E187713C9AFD4C90EA0DE2B674615DD0255798EE5B237A146A0D4E411E0ABFE04D3CAFDFA","ISSUED=30-Mar-2018"
```

NOTE **This command does not work for Transportable, Network or USB Portable licenses.**

Remote Command	`:SYSTem:LKEY <"OptionInfo">, <"LicenseInfo">,<"Optional1">,<"Optional2">,<"Optional3">,<"Optional4">,<"Optional5">`
Notes	`<”OptionInfo”>` contains the feature and the version. You must specify the feature but can omit the version. If you omit the version, the system regards it as the latest one, since the system knows which version is supported for each feature `<”LicenseInfo”>` contains the signature, the expiration date, and serial number for transport if transportable. You must specify the signature, but you can omit the other information. If you omit the expiration date, the system regards it as permanent. If you omit the serial number, the system regards it as non-transportable. As a result, this supports reverse compatibility `<”Optional#”>` are optional parameters that may be needed to match the information in the original license

4.7.9 Remove License (Remote Command Only)

Removes a particular license.

An example of such a command would be as below. The parameter is a unique 120-character code for each license.

```
SYST:LKEY:DEL “N9073A-
```

```
1FP”,”027253AD27F83CDA5673A9BA5F427FDA5E4F25AEB1017638211AC9F60D9C639FE53973590
9C551DE0A91”
```

NOTE: This command does not work for Transportable, Network or USB Portable licenses.

Remote Command	`:SYSTem:LKEY:DELete <"OptionInfo">,<"LicenseInfo">`
Notes	`<”OptionInfo”>` contains the feature and the version. You must specify the feature but can omit the version. If you omit the version, the system regards it as the latest one, if more than one version is installed `<”LicenseInfo”>` contains the signature, the expiration date, and whether be transportable. You must specify the signature, but you can omit the other information. If you omit the expiration date, the system regards it as permanent. If you omit the transportability, the system regards it as non-transportable. As a result, this supports reverse compatibility

4.7.10 List Licenses (Remote Query Only)

Returns a list of installed licenses.

Remote Command	`:SYSTem:LKEY:LIST?`

Notes	Return Value:
	An `<arbitrary block data>` of all the installed instrument licenses
	The format of each license is as follows
	`<Feature>,<Version>,<Signature>,<Expiration Date>,<Serial Number for Transport>,…`
	Return Value Example:
	`#3136`
	`N9073A-1FP,1.000,B043920A51CA`
	`N9060A-2FP,1.000,4D1D1164BE64`
	`N9020A-508,1.000,389BC042F920`
	`N9073A-1F1,1.000,5D71E9BA814C,13-aug-2005`
	<arbitrary block data> is:
	`#NMMM<data>`
	Where:
	`N` is the number of digits that describes the number of `MMM` characters. For example, if the data was 55 bytes, N would be 2
	`MMM` would be the ASCII representation of the number of bytes. In the previous example, N would be 55
	`<data>` ASCII contents of the data
	Additional fields may appear depending on the type of license (Fixed, Transportable, Network, USB Portable)

4.7.11 Validate License (Remote Query Only)

Lets you query whether a particular license is currently valid.

Remote Command	`:SYSTem:LKEY? <"OptionInfo">`
Example	`:SYST:LKEY? "N9073A-1FP"`
Notes	`<”OptionInfo”>` contains the feature and the version. You must specify the feature but can omit the version. If you omit the version, the system regards it as the latest one Return Value: `<”LicenseInfo”>` if the license is valid, null otherwise `<”LicenseInfo”>` contains the signature, the expiration date, and serial number if transportable Return Value Example: `“B043920A51CA”`

4.7.12 Host ID Query (Remote Query Only)

Returns the Host ID as a string.

Remote Command	`:SYSTem:HID?`

4.8 Security

Accesses capabilities for operating the instrument in a security-controlled environment.

The **Security** page of the **System** menu has two controls: **USB Read/Write** and **Restore Security Defaults**.

Dependencies	Not available in UXM

4.8.1 USB Write Protect

The Windows operating system can be configured to disable write access to the USB ports for users who are in a secure environment where transferring data from the instrument is prohibited. The **USB Write Protect** control is a convenient way for you to disable write access to USB.

NOTE This control is only available to users with Administrator privileges.

Remote Command	`:SYSTem:SECurity:USB:WPRotect[:ENABle] ON | OFF | 0 | 1` `:SYSTem:SECurity:USB:WPRotect[:ENABle]?`

Example	Set USB ports to Read-only:
	`:SYST:SEC:USB:WPR ON`
	Set USB ports to Read-Write:
	`:SYST:SEC:USB:WPR OFF`

Notes	When the USB ports are in Read-only mode, then no data can be stored to USB, including the internal USB memory used for a back-up location for the calibration data
Dependencies	Grayed-out unless the current user has Administrator privileges
Preset	Unaffected by **Preset** or any "Restore Defaults" on page 2077. A Keysight Recovery sets the USB to write protect `OFF`
State Saved	No
Range	Read-Write | Read only

4.8.2 Restore Security Defaults

Sets USB Read/Write to Enable.

NOTE This control is only available to users with Administrator privileges.

4.9 Diagnostics

Displays a slider that allows you to view Hardware Statistics.

Dependencies	Not available in UXM

4.9.1 Show Hardware Statistics

Provides a display of various hardware statistics. The statistics include the following:

– Mechanical relay cycles (on models with mechanical relays)

– High and Low temperature extremes

– Elapsed time that the instrument has been powered-on (odometer)

Modular instruments display only time and temperature information.

Example	`:SYST:SHOW HWST`
Notes	The values displayed on the screen are only updated upon entry to the screen and not updated while the screen is being displayed

4.9.2 Pathwave Calibration Advisor...

This is a separate application that helps maintain your instrument at peak performance. You can set the cal interval, configure cal due reminders, check the cal status, view cal certificates and test reports, and contact Keysight for a cal service.

The embedded help documentation can be accessed in the instrument at: C:\Program Files\Keysight\Calibration Advisor\PCA.chm, or via the **?** button at the top right of the **PathWave Calibration Advisor** window.

4.9.3 Query the Mechanical Relay Cycle Count (Remote Query Only)

Returns the count of mechanical relay cycles.

Remote Command	`:SYSTem:MRELay:COUNt?`
Example	`:SYST:MREL:COUN?`
Notes	Query Only The return value is a comma-separated list of the individual counts for each mechanical relay The position of the relays in the list is:

	`"<Cal Signal>,<AC/DC>,<2dB #1 Atten>,<2dB #2 Atten>,<6dB Atten>,<10dB Atten>,<20dB Atten>,<30dB Atten>,<Fixed Atten>,<Low Noise Path Switch>,<Presel Bypass>"` Items in the list not pertaining to your hardware configuration return as `-999` for those items
Dependencies	*Not* supported by E6607C

4.9.4 Query the Operating Temperature Extremes (Remote Query Only)

Returns the low operating temperature extreme value. The value survives a power-cycle and is the temperature extreme encountered since the value was reset by the factory or service center.

Remote Command	`:SYSTem:TEMPerature:LEXTreme?`
Example	`:SYST:TEMP:LEXT?`
Notes	Value is in degrees Celsius at which the lowest operating temperature has been recorded since 1st power-up
State Saved	No

Returns the high operating temperature extreme value. The value survives a power-cycle and is the temperature extreme encountered since the value was reset by the factory or service center.

Remote Command	`:SYSTem:TEMPerature:HEXTreme?`
Example	`:SYST:TEMP:HEXT?`
Notes	Value is in degrees Celsius at which the highest operating temperature has been recorded since 1st power-up
State Saved	No

4.9.5 Query the Elapsed Time since 1st power on (Remote Query Only)

Returns the elapsed on-time in minutes since 1st power-on.

Remote Command	`:SYSTem:PON:ETIMe?`
Example	`:SYST:PON:ETIM?`
Notes	Query Only

4.10 Service

Accesses capabilities performed in the factory or under instructions from repair procedures. This key is only visible when the logged-in user is "`advanceduser`" or "`saservice`". The first access to the **Service** menu after invoking the instrument application will require an authentication Service Code.

Dependencies	Not available in UXM

4.11 SCPI Recorder

Allows you to view active recording content, and edit the content. Right-click or touch and hold on any UI control to display a menu allowing you to record the SCPI associated with the control.

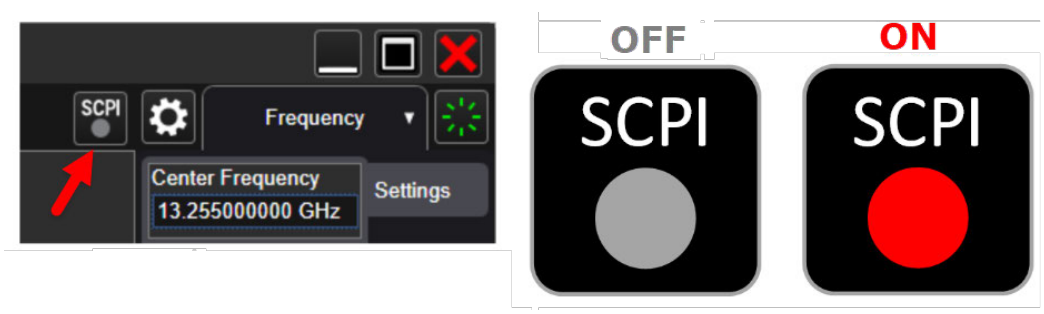
Selecting this tab displays the **Recorder** dialog on the right. The dialog displays the recorder table with the data in chronological order of recording. The Function Label column shows the feature name, for example, Center Frequency, and the SCPI column shows the full mnemonic corresponding to the feature.

4.11.1 Continuous SCPI Recording

Toggles the state of continuous recording.

When enabled (ON), *all* user interaction with settings that are Immediate Actions, and that have associated SCPI commands or queries, are added as recording entries in chronological order. Not every User Interface action has a corresponding SCPI command/query, for example, navigation actions between dialogs and menus in the User Interface do not have corresponding SCPI commands. All settings or a measurement that are accessible via menus have SCPI commands, so modifying those settings will create entries in the Recorder.

As a convenience, this feature can also be toggled (without visiting the SCPI Recording menu) by clicking the SCPI icon which has been added to the left of the "gear" icon (as illustrated below):



NOTE When recording is turned on, some entries are automatically created and added to the recording. These are: :INST:CONF:<mode>:<meas> (see "Mode" on page 87) and *OPC? (see "*OPC? - Operation Complete" on page 2726). These commands set the current Mode and Measurement, perform a **Mode Preset**, then cause the instrument to wait for the completion of any previous commands. When **Continuous SCPI Recording** fills the recording container to the limit, a warning message is displayed to notify you that the recording container is full and recording will be stopped, unless the recording limit is increased.

NOTE To maintain the integrity of recording, stop recording *before* sending remote commands to the instrument. Changes made to the instrument via remote SCPI are *not* recorded.

4.11.2 Recording Limit

When "Continuous SCPI Recording" on page 2172 is enabled, every change you make is recorded into the recording system, which can lead to extremely large recordings.

This value limits how much content can be saved into the recording table. You may change this number to suit your needs, but the value cannot be less than 0 or greater than 500. When the recording length reaches the limit, a warning is displayed to indicate that the recording size has reached the limit and recording will be stopped.

The default limit is 250. If the limit is reduced after recording entries are added, the reduced count cannot be less than the current number of entries in the recording. If the newly-entered limit is smaller than the existing number of entries, then the actual new limit is set to the current number of entries. Increasing the limit will increase memory consumption.

4.11.3 Play All

Clicking this control causes each of the entries in the SCPI Recorder table to be executed.

If execution results in any errors, then a message box showing the SCPI command, and its corresponding error are displayed after play has completed.

4.11.4 Play Selected

You can select a row in the SCPI recording table, then click **Play Selected** to play that entry. **Play Selected** is disabled if the recording table is empty, or when no row is selected. You can then select another row and play the selection, but, if you want to play back in a particular order, you must execute the plays in the desired sequence.

After playing the selected entry, the selected row is moved down by one entry.

4.11.5 Copy

Copies the SCPI column data to the system clipboard, to make it available for Paste operations.

4.11.6 Insert *OPC? Below

Certain queries and commands must be sent during instrument programming, but there is no corresponding user-interface control for these commands. This control allows you to insert one such query: `*OPC?` below the selected row.

4.11.7 Move Up

Moves the selected / highlighted row up by 1 slot. Note that moving a mode or measurement switch entry in the table may impact context for subsequent entries in the table.

4.11.8 Move Down

Moves the selected / highlighted row down by 1 slot. Note that moving a mode or measurement switch entry in the table may impact context for subsequent entries in the table.

4.11.9 Delete Row

Deletes the selected entry from the recording table. Note that some entries may have subsequent entries related to the row that you delete, for example, `*OPC?`, which may be added automatically after a mode or measurement switch.

4.11.10 Delete All

Deletes all entries from the recording table. A warning message is displayed: “All recording data will be deleted”.

To confirm that you want to delete the entire recording content, click **OK**, or click **Cancel** to avoid deleting it.

4.12 System Remote Commands (Remote Commands Only)

These commands have no front-panel key equivalent.

- "List installed Options (Remote Query Only)" on page 2175
- "Lock the Front-panel keys (Remote Command Only)" on page 2176
- "Lock Workstation (Remote Command Only)" on page 2176
- "List SCPI Commands (Remote Query Only)" on page 2178
- "Front Panel activity history (Remote Query only)" on page 2178
- "SCPI activity history (Remote Query only)" on page 2179
- "Instrument start time (Remote Query only)" on page 2179
- "SCPI Version Query (Remote Query Only)" on page 2180
- "Date (Remote Command Only)" on page 2180
- "Time (Remote Command Only)" on page 2180
- "Input Overload Enable (Remote Command Only)" on page 2181
- "Power Up (Remote Query Only)" on page 2181

4.12.1 List installed Options (Remote Query Only)

Lists the installed options that pertain to the instrument (signal analyzer).

Remote Command	`:SYSTem:OPTions?`
Example	`:SYST:OPT?`
Notes	The return string is a comma-separated list of the installed options. For example: `“503,P03,PFR”` `:SYSTem:OPTions?` and `*OPT?` are the same
State Saved	No

4.12.2 Lock the Front-panel keys (Remote Command Only)

Disables the instrument keyboard to prevent local input when the instrument is controlled remotely. Annunciation showing a “K” for `KLOCk` (keyboard lock) alerts the local user that the keyboard is locked. `KLOCk` is similar to the GPIB Local Lockout function; namely that no front-panel keys are active except for the **Power Standby** key. (The instrument is allowed to be turned-off if `KLOCk` is `ON`.) The `KLOCk` command is used in remote control situations where Local Lockout cannot be used.

Although primary intent of `KLOCk` is to lock-out the front panel, it will lock-out externally connected keyboards through USB. `KLOCk` has no effect on externally connected pointing devices (mice).

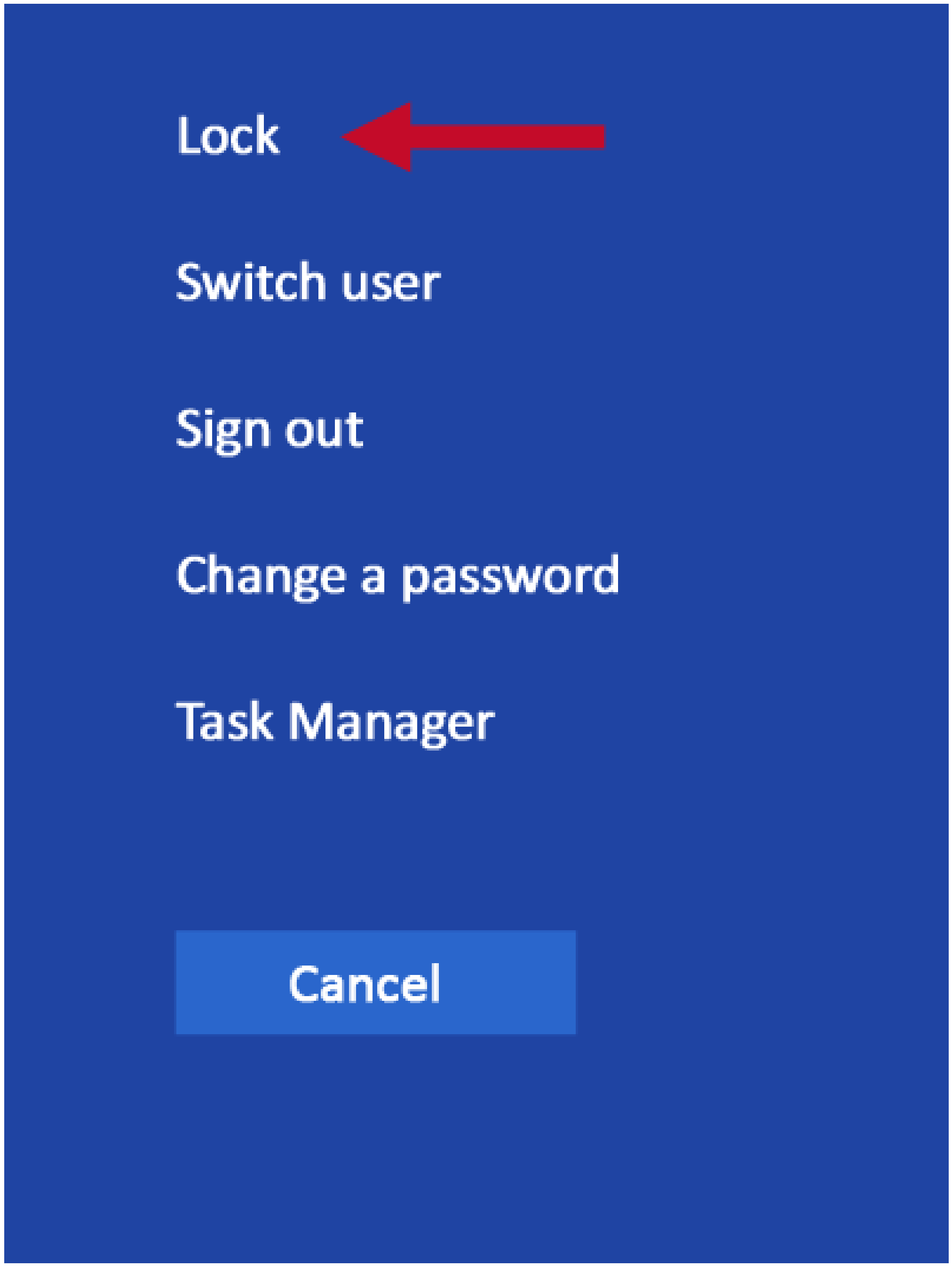
The front panel ‘**Local’** key (**Cancel**/**Esc**) has no effect if `KLOCk` is `ON`.

See also "Local Button" on page 134.

Remote Command	`:SYSTem:KLOCk OFF | ON | 0 | 1` `:SYSTem:KLOCk?`
Example	`:SYST:KLOC ON`
Notes	Keyboard lock remains in effect until turned-off, or until the instrument is power-cycled
Preset	Initialized to `OFF` at startup, unaffected by **Preset**
State Saved	No

4.12.3 Lock Workstation (Remote Command Only)

Performs the same functionality as the `Win+L` function or the “Lock” function on the `CTL-ALT-DEL` screen in Windows.



As soon as you do this, the computer is locked. The initial login screen appears; no-one can access the computer at that point unless they have an account and know the account's password.

Failure to initiate adds an error to the Windows event log for SA;

"LockWorkStation - Failed to initiate function"

See also "Local Button" on page 134.

Remote Command	:SYSTem:LWSTation
Example	:SYST:LWST
Notes	The lock remains in effect until a user logs in
State Saved	No

4.12.4 List SCPI Commands (Remote Query Only)

Outputs a list of the valid SCPI commands for the currently selected Mode.

Remote Command	:SYSTem:HELP:HEADers?
Example	:SYST:HELP:HEAD?
Notes	The output is an IEEE Block format, with each command separated with the New-Line character (0x0A)

4.12.5 Front Panel activity history (Remote Query only)

Instrument front panel usage can be monitored using :SYSTem:METRics:FPANel?. The monitoring occurs for front panel hardkey or softkey operation (including mouse or touch operation on instruments with Multi-Touch User Interface). The information of the usage pertains to the activity since the instrument application was started; the information does not persist after the application is terminated, or the instrument has been rebooted.

To prevent the front panel from being placed into Remote the monitoring must occur via an I/O protocol such as LAN Socket, or the remote program performing the monitoring must explicitly place the instrument into Local after the query has been performed.

Remote Command	:SYSTem:METRics:FPANel?
Example	:SYST:METR:FPAN?
Notes	The return value is a string with the format "YYYY-MM-DD<space>HH:MM:SS", in instrument local time If no front panel activity has occurred since the instrument was booted (instrument application started), the return value will be the time the instrument application started. The instrument application start time can be obtained with the query :SYSTem:METRics:STIMe?

4.12.6 SCPI activity history (Remote Query only)

Instrument remote operation usage via SCPI can be monitored using `:SYSTem:METRics:SCPI?`. The monitoring occurs for SCPI control from any I/O channel (GPIB, USB, or LAN). The information of the usage pertains to the activity since the instrument application was started; the information does not persist after the application is terminated, or the instrument has been rebooted.

Remote Command	`:SYSTem:METRics:SCPI?`
Example	`:SYST:METR:SCPI?`
Notes	The return value is a string with the format "YYYY-MM-DD<space>HH:MM:SS", in instrument local time The following commands are excluded from the history accounting: – `*IDN?` – `*OPT?` – `:SYSTem:DATE?` – `:SYSTem:TIME?` – `:SYSTem:PON:TIME?` – Queries in the `:SYSTem:ERRor` subsystem – Queries in the `:SYSTem:LKEY` subsystem – Queries in the `:SYSTem:METRics` subsystem – Queries in the `:SYSTem:MODule` subsystem If no SCPI activity has occurred since the instrument was booted (instrument application started), the return value will be the time the instrument application started. The instrument application start time can be obtained with `:SYSTem:METRics:STIMe?`

4.12.7 Instrument start time (Remote Query only)

To determine if instrument activity has occurred, `:SYSTem:METRics:STIMe?` can be used to determine the instrument application start time.

Remote Command	`:SYSTem:METRics:STIMe?`
Example	`:SYST:METR:STIM?`
Notes	The return value is a string with the format "YYYY-MM-DD<space>HH:MM:SS", in instrument local time

4.12.8 SCPI Version Query (Remote Query Only)

Returns the SCPI version number with which the instrument complies. The SCPI industry standard changes regularly. This command indicates the version used when the instrument SCPI commands were defined.

Remote Command	`:SYSTem:VERSion?`
Example	`:SYST:VERS?`

4.12.9 Date (Remote Command Only)

The recommended access to the Date, Time, and Time zone of the instrument is through the Windows native control (Control Panel, or accessing the Task Bar). You may also access this information remotely, as shown in here and in "Time (Remote Command Only)" on page 2180.

Sets or queries the date in the instrument.

Remote Command	`:SYSTem:DATE "<year>,<month>,<day>"` `:SYSTem:DATE?`
Example	`:SYST:DATE "2006,05,26"`
Notes	`<year>` is the four-digit representation of year (for example, 2006) `<month>` is the two-digit representation of year (01 to 12) `<day>` is the two-digit representation of day (01 to 28, 29, 30, or 31, depending on the month and year) Unless the current account has Power User or Administrator privileges, sending this command generates an error, and no action is taken

4.12.10 Time (Remote Command Only)

Sets or queries the time in the instrument.

Remote Command	`:SYSTem:TIME "<hour>,<minute>,<second>"` `:SYSTem:TIME?`
Example	`:SYST:TIME "13,05,26"`
Notes	`<hour>` is the two-digit representation of the hour in 24-hour format `<minute>` is the two-digit representation of minute `<second>` is the two-digit representation of second Unless the current account has Power User or Administrator privileges, sending this command generates an error, and no action is taken

4.12.11 Input Overload Enable (Remote Command Only)

Input Overload errors are reported using the Input Overload status bit (bit 12 in the Measurement Integrity Status Register). Input Overloads (for example, ADC Overload errors) can come and go with great frequency, generating many error events (for example, for signals just on the verge of overload), and so are not put into the SCPI error queue by default. Normally the status bit is the only way for detecting these errors remotely.

Use this command to enable or disable Input Overload reporting to the SCPI queue. By default, reporting is disabled. Send `:SYSTem:ERRor:OVERload ON`. to enable, or `:SYSTem:ERRor:OVERload OFF` to disable. In either case, Input Overloads *always* set the status bit.

NOTE: **For versions of firmware before A.10.01, Input Overload was only a Warning and so was never available in the SCPI queue, although it did set the status bit. For A.10.01 and later, Input Overload is an error, which can be enabled to the SCPI queue using this command.**

Remote Command	`:SYSTem:ERRor:OVERload[:STATe] 0 | 1 | OFF | ON`
Example	Enable overload errors: `:SYST:ERR:OVER 1`
Preset	Set to `OFF` by **Restore Misc Defaults** (no Overload errors go to SCPI)
State Saved	Saved in instrument state

4.12.12 Power Up (Remote Query Only)

Returns a list of errors encountered during the application boot-up, such as: mismatch FW-FPGA, missing Calibration data, missing hardware, and construction errors.

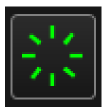
Remote Command	`:SYSTem:ERRor:PUP?`
Notes	If no error occurs, the return value is: "No Power Up Errors" Return Value: `<List of error strings>` in <IEEE488 Block> format Return Value Example: "Power up errors, see details in Windows Event Log" "Unmatched FPGA Version(s), See details in Windows Event Log"

5 Preset

The Preset functions can be accessed in two ways:

– By pressing the **Mode Preset** or **User Preset** front panel keys:

– From the menu "Preset Dropdown" on page 2185, which appears when you press the green **Preset** icon (in the upper right corner of the display):



Types of Preset

The table below shows all possible presets, their corresponding SCPI commands and front-panel access methods.

Instrument settings are tiered in scope from those local to the current measurement to those global to all measurements and Modes. There are presets tailored to each scope. The table identifies the scope of each preset type.

NOTE To get a Mode back to a fully predefined state, you should execute a Restore Mode Defaults and an Input/Output Preset, but since Input/Output Preset is a global function it will affect ALL modes.

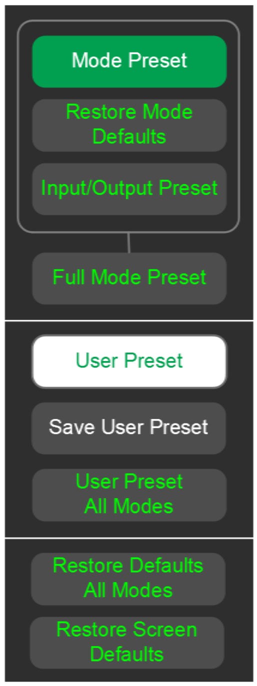
Type Of Preset	SCPI Command	Scope of Preset	Front Panel Access
"Auto Couple" on page 1995	`:COUPle ALL`	Local to the current measurement, only affects Auto/Man variables	Meas Setup menu
Meas Preset	`:CONFigure:<meas>`	Local to the current measurement Does not preset the RF Source	Meas Setup menu
"Mode Preset" on page 2186	`:SYSTem:PRESet`	Local to the current Mode, global to all measurements in the Mode, affects most but not all parameters in the Mode Does not affect **Input/Output** or **System** variables Presets the RF Source	Mode Preset key "Preset Dropdown" on page 2185
"Restore Mode	`:INSTrument:DEFault`	Local to the current Mode, global to	"Preset

Type Of Preset	SCPI Command	Scope of Preset	Front Panel Access
Defaults" on page 2188		all measurements in the Mode, affects all parameters in the Mode, but does not affect **Input/Output** or **System** variables Does not preset the RF Source.	Dropdown" on page 2185
"Restore Defaults All Modes" on page 2195	`:SYSTem:DEFault MODes`	Affects all parameters in *all* Modes, but does not affect **Input/Output** or **System** variables Presets the RF Source	"Preset Dropdown" on page 2185
"Restore Screen Defaults" on page 2198	`:SYSTem:DEFault SCReen`	Deletes all Screens but one, restores that screen to its default mode and performs Mode Preset for that mode Does not affect **Input/Output** or **System** variables Presets the RF Source	"Preset Dropdown" on page 2185
"User Preset" on page 2191	`:SYSTem:PRESet:USER`	Local to the current Mode, global to all measurements in the Mode, affects all parameters in the Mode, as well as **Input/Output** variables Does not affect **System** variables	User Preset key "Preset Dropdown" on page 2185
"User Preset All Modes" on page 2194	`:SYSTem:PRESet:USER:ALL`	Same as **User Preset**, but affects all Modes in the current Screen	"Preset Dropdown" on page 2185
"User Preset All Screens" on page 2196		Affects the entire Screen Configuration; global to all Modes and Screens	"Preset Dropdown" on page 2185
`*RST`	`*RST`	Same as **Mode Preset**. Additionally always sets **Single/Cont** to **Single**	Not available from front panel
"Input/Output Preset" on page 2189	`:SYSTem:DEFault INPut`	Affects all **Input/Output** variables Does not preset the RF Source	Input/Output menu "Preset Dropdown" on page 2185 System > Restore Defaults
"Full Mode Preset" on page 2190	`:SYSTem:PRESet:FULL`	Same as **Mode Preset** + **Restore Mode Defaults** + **Input/Output Preset**. Essentially a factory preset of the current Mode Presets the RF Source	"Preset Dropdown" on page 2185
"Restore User	`:SYSTem:DEFault UINTerface`	Affects all variables in the "User	System > Restore

Type Of Preset	SCPI Command	Scope of Preset	Front Panel Access
Interface Defaults" on page 2062		Interface" group Does not preset the RF Source	Defaults User Interface tabs
"Restore Power On Defaults" on page 2071	`:SYSTem:DEFault PON`	Affects all variables in the "Power On" group Presets the RF Source	System > Restore Defaults Power On tabs
"Restore Alignment Defaults" on page 2148	`:SYSTem:DEFault ALIGn`	Affects all variables in the "Alignments" group Presets the RF Source	System > Restore Defaults Alignments tabs
"Restore Defaults" on page 2077 (Misc)	`:SYSTem:DEFault MISC`	Affects various variables not reset by other commands Presets the RF Source	System > Restore Defaults
"Restore Defaults" on page 2077 (All)	`:SYSTem:DEFault [ALL]` `:SYSTem:PRESet:PERSistent`	Affects all variables Presets the RF Source	System > Restore Defaults

5.1 Preset Dropdown

The Preset dropdown contains the following controls. In the image below, click a control for details of that control.



5.2 Mode Preset

Returns the current Mode to a known state. **Mode Preset***only* presets the current Screen; it does not affect any other Screens.

Mode Preset also presets the RF Source. In this sense, it is equivalent to pressing **Source Preset** on the **Input/Output, RF Source** menu panel.

Mode Preset can be executed from the "Preset Dropdown" on page 2185, or by pressing the **Mode Preset** front panel key:

It does the following for the currently active Mode:

- Aborts the currently running measurement
- Switches to the default measurement and displays the default menu for that measurement
- Sets most parameters for the Mode and all its Measurements to a preset state
- Clears the input and output buffers
- Sets Status Byte to 0

Mode Preset does *not* cause a Mode switch, nor affect any **Input/Output** or **System** settings (those set in the **System Settings** dialog).

Furthermore, some Mode settings are unaffected by **Mode Preset** (for example, Noise Floor Extensions, Limit Line data, reference marker numbers, etc.) These are only reset by "Restore Mode Defaults" on page 2188. In each parameter's definition table there is a note that indicates whether it is reset by **Mode Preset** or by **Restore Mode Defaults**.

See "Preset" on page 2182 for more details.

Remote Command	`:SYSTem:PRESet`
Example	`:SYST:PRES`
Notes	`*RST` is preferred over :`SYST:PRES` for remote operation. `*RST` performs **Mode Preset**, as done by the `:SYST:PRES` command, and sets the measurement mode to **Single** measurement rather than **Continuous**, for optimal remote control throughput See also "*RST - Reset" on page 2727
Status Bits/OPC dependencies	Clears all pending OPC bits. The Status Byte is set to 0

Backwards Compatibility Notes	In X-Series, the legacy "Factory Preset" has been replaced by **Mode Preset**, which only presets the currently active Mode, not the entire instrument. In X-Series, you preset the entire instrument by using **System**, **Restore System Defaults All**, which behaves essentially the same way as restore System Defaults did in ESA and PSA There is also no "Preset Type" as there was in PSA. The green **Mode Preset** front-panel key does a Mode Preset, and the **User Preset** front-panel key does a User Preset. The old `PRESet:TYPE` command is ignored (without generating an error), and `SYST:PRES` without a parameter does **Mode Preset** The settings and correction data under the **Input/Output** front-panel key (examples: Input Z Corr, Ext Amp Gain, etc.) are no longer part of any Mode, so they are not preset by **Mode Preset**. They are preset by **Restore Input/Output Defaults**, **Restore System Defaults All**. Note that because "User Preset" on page 2191 performs Recall State, and all these settings are saved in State, they *are* recalled when using **User Preset**

5.3 Restore Mode Defaults

Most settings within a Mode are affected by "Mode Preset" on page 2186, but some Mode settings are unaffected (for example, Noise Floor Extensions, Limit Line data, reference marker numbers, etc.) **Restore Mode Defaults** resets all these additional settings, as well as all the **Mode Preset** settings, *except* the RF Source.

In each parameter's definition table, there is a note that indicates whether that parameter is reset by **Mode Preset** or by **Restore Mode Defaults**.

Note that a Recall State affects all a Mode's settings, both the **Mode Preset** settings and the ones additionally affected by **Restore Mode Defaults**.

Restore Mode Defaults can be executed from the "Preset Dropdown" on page 2185.

When **Restore Mode Defaults** is selected, a message appears saying

```
This will reset all of the current Mode's variables to their default state.
This action cannot be undone. Do you want to proceed?
```

The message provides **OK** and **Cancel** buttons, to let you confirm or cancel the reset operation.

Remote Command	`:INSTrument:DEFault`
Example	`:INST:DEF`
Notes	Clears all pending OPC bits. The Status Byte is set to 0
Couplings	Causes the currently running measurement to be aborted, and causes the default measurement to be active. Sets the Mode to a consistent state, with all default couplings set

5.4 Input/Output Preset

Resets the group of settings and data associated with the **Input/Output** front-panel key to their default values. These settings are not affected by "Mode Preset" on page 2186, because they are generally associated with connections to the instrument, which generally should remain unaltered.

All the variables set under the **Input/Output** front panel key are reset by **Input/Output Preset**, including Amplitude Corrections and Data (described in the **Corrections** section), with the exception of **RF Source** settings, which are unaffected.

By using **Input/Output Preset** and "Restore Mode Defaults" on page 2188, a full preset of the current Mode can be performed, with the caveat that, since **Input/Output Preset** is a global function, it affects *all* Modes.

Input/Output Preset can be executed from the **Input/Output** menu, from the "Preset Dropdown" on page 2185, or from the **Restore Defaults** menu under the **System** key.

When **Input/Output Preset** is selected, a message appears saying:

```
"This will reset all of the Input/Output variables to their default state, including which input is selected, all Amplitude Correction settings and data, all External Mixing settings, all Frequency Reference settings and all Output settings.

It will not affect Alignment data or settings.

It will not affect RF Source settings.

This action cannot be undone. Do you want to proceed?"
```

The message provides **OK** and **Cancel** buttons, to let you confirm or cancel the operation.

Example	`:SYST:DEF INP` Presets all **Input/Output** variables to their factory default values

5.5 Full Mode Preset

Same as performing "Mode Preset" on page 2186, "Restore Mode Defaults" on page 2188, and "Input/Output Preset" on page 2189. Essentially a factory preset of the current Mode.

When **Full Mode Preset** is selected, a message appears saying:

```
This will reset all of the current Mode’s variables and all of the Input/Output
variables to their default state, including Input and Output selection and
settings, Amplitude Correction, Frequency Reference and RF Source settings.

It will not affect Alignment data or settings.

This action cannot be undone. Do you want to proceed?
```

The message provides **OK** and **Cancel** buttons, to let you confirm or cancel the operation.

Remote Command	`:SYSTem:PRESet:FULL`
Example	`:SYST:PRES:FULL`
Status Bits/OPC dependencies	Clears all pending OPC bits. The Status Byte is set to 0

5.6 User Preset

Recalls a state previously saved using "Save User Preset" on page 2193. You can save a **User Preset** state for each Mode, allowing you to define your own favorite state for each Mode and recall it at the touch of a single button.

User Preset can be executed by pressing the **User Preset** front panel key, or from the "Preset Dropdown" on page 2185.

Because **User Preset** is actually a Recall State, rather than a predefined Preset, it works a little differently from "Mode Preset" on page 2186, in that it affects all the variables that normally only reset on "Restore Mode Defaults" on page 2188, and it affects the **Input/Output** variables, because both of these are included in State files.

A default **User Preset** file is provided for each Mode, which simply matches the current Mode's state after **Restore Mode Defaults** and "Input/Output Preset" on page 2189 has been performed.

NOTE In products that run multiple instances of the X-Series Application, all instances use the same location to save User Preset state. So, saving User Preset of one instance will overwrite the Save User Preset of another instance.

Remote Command	`:SYSTem:PRESet:USER`

Example	Save the User Preset:
	`:SYST:PRES:USER:SAVE`
	Recall the User Preset:
	`:SYST:PRES:USER`

Notes	`:SYST:PRES:USER:SAVE` is used to save the current state as the user preset state If loading a User Preset file from a different instrument, some settings may be limited and/or coupled differently, since the capabilities of the mode may have changed from when the User Preset file was saved
Status Bits/OPC dependencies	Clears all pending OPC bits. The Status Byte is set to 0
Backwards Compatibility Notes	In X-Series A-models, the **User Preset** key opened a menu that let you select from User Preset, Save User Preset, or User Preset All Modes. In B-models, the **User Preset** key immediately performs a **User Preset**, and the menu items are found under the **Preset** dropdown **User Preset** actually loads a state, and in legacy analyzers, it was possible to load a state without affecting the trace data, limit lines or correction data. Similarly, it was possible to do a User Preset without affecting the trace data, limit lines or correction data

In X-Series, “state” always includes all of this data; so whenever state is loaded, or **User Preset** is executed, all the traces, limit lines and corrections are affected

In ESA and PSA, **User Preset** affected the entire instrument’s state. In X-Series, **User Preset** only recalls the state for the active Mode. There is a User Preset file for each Mode. **User Preset** can never cause a Mode switch as it could in legacy analyzers. If you want to recall all Modes to their user preset file state, perform User Preset *after* switching into each Mode

User Preset recalls Mode state, which can now include data, such as traces, whereas in ESA and PSA, User Preset did not affect data

5.7 Save User Preset

Saves the state of the currently active Mode in a unique location, for recall by the key "User Preset" on page 2191. Each Mode has one such location, so, for each Mode, one User Preset can be defined.

Save User Preset can be executed from the "Preset Dropdown" on page 2185.

All the Mode variables are saved, including those reset by "Mode Preset" on page 2186, those only reset by "Restore Mode Defaults" on page 2188, and all **Input/Output** variables, so when you subsequently press **User Preset**, the instrument returns to the exact same setup that existed when you pressed **Save User Preset**. Thus, **User Preset** has wider scope than **Mode Preset**.

Remote Command	`:SYSTem:PRESet:USER:SAVE`
Example	`:SYST:PRES:USER:SAVE`
Notes	`:SYST:PRES:SAVE` creates the same file as if you requested `*SAV` or `:MMEM: STOR:STAT`, except that **Save User Preset** does not allow you to specify the file name or location

5.8 User Preset All Modes

Recalls all the User Preset files for each Mode, switches to the Power-on Mode, and activates the saved measurement from the Power-on Mode **User Preset** file.

User Preset All Modes can be executed from the "Preset Dropdown" on page 2185

See also "User Preset" on page 2191.

Remote Command	`:SYSTem:PRESet:USER:ALL`
Example	`:SYST:PRES:USER:SAVE` `:SYST:PRES:USER:ALL`
Notes	`:SYST:PRES:USER:SAVE` is used to save the current state as the user preset state
Status Bits/OPC dependencies	Clears all pending OPC bits. The Status Byte is set to 0

5.9 Restore Defaults All Modes

Resets all Modes in the current Screen back to their default states, just as **Restore Mode Defaults** does, switches the current Screen to the Power-on Mode, and causes the default measurement for the **Power On Mode** to be active in the current Screen. Only the current Screen is affected.

Restore Defaults All Modes can be executed from the "Preset Dropdown" on page 2185.

When **Restore Defaults All Modes** is selected, a message appears saying:

```
This will reset all of the variables for all of the Modes in the current Screen
to their default state. This action cannot be undone. Do you want to proceed?
```

The message provides **OK** and **Cancel** buttons.

Example	`:SYST:DEF MOD`
Couplings	Causes the currently running measurement to be aborted, a switch to the Power-on Mode, and activates the default measurement for the Power-on Mode

5.10 User Preset All Screens

Recalls a screen configuration previously saved using "Save User Preset All Screens" on page 2197. The complete configuration of all Screens is loaded, including the state of each Screen.

Because **User Preset All Screens** performs a Recall State as part of its function, it affects all variables that are normally only reset by "Restore Mode Defaults" on page 2188, and affects **Input/Output** variables, because both are included in State files.

Note that recalling a screen configuration in this manner wipes out your current screen configuration, and all states of all Screens.

Notes	"Save User Preset All Screens" on page 2197 is used to save the current screen configuration as the “user preset all screens” configuration If loading a **User Preset All Screens** file from a different instrument, some settings may be limited and/or coupled differently, since the capabilities of the Mode may have changed from when the **User Preset All Screens** file was saved
Status Bits/OPC dependencies	Clears all pending OPC bits The Status Byte is set to 0

5.11 Save User Preset All Screens

Saves the current Screen Configuration in a unique location, for recall by "User Preset All Screens" on page 2196.

Save User Preset All Screens can be executed from the "Preset Dropdown" on page 2185.

Besides the screen configuration, *all* Mode variables of all Screens are saved, including those reset by "Mode Preset" on page 2186, and those only reset by "Restore Mode Defaults" on page 2188, as well as all **Input/Output** variables, so when you subsequently press **User Preset All Screens**, the instrument returns to the exact Screen setup that existed when you pressed **Save User Preset All Screens**.

Notes	Creates the same file as if you requested **Screen Config + State** save, except that **Save User Preset All Screens** does not allow you to specify the file name or location

5.12 Restore Screen Defaults

Resets the Screen configuration to the factory default; deleting all screens, all screen names, all screen states, and setting "Multiscreen" on page 174 to Off. A single screen will remain, set to the Power-on Mode, in a preset state with the default screen name.

Restore Screen Defaults can be executed from the "Preset Dropdown" on page 2185.

When **Restore Screen Defaults** is selected, a message appears saying:

```
This function will delete all defined screens and their settings. This action
cannot be undone.

Do you want to proceed?
```

The message provides **OK** and **Cancel** buttons.

Example	`:SYST:DEF SCReen`

5.13 Preset Type (Remote Command Only)

Remote Command	`:SYSTem:PRESet:TYPE FACTory | MODE | USER` `:SYSTem:PRESet:TYPE?`
Example	`:SYST:PRES:TYPE FACT`
Notes	Supported for backwards compatibility only. It is a no-op, which does not change the behavior of any preset operation
Preset	Unaffected by Preset, but set to `MODE` by **Restore System Defaults->All**
State Saved	No

5.14 Restart Instrument (Shutdown)

Shuts down the instrument, then reboots it.

Remote Command	`:SYSTem:PUP`
Example	`:SYST:PUP`

5.15 Restart Application (Application Shutdown)

Restarts the instrument application without rebooting the instrument. Before you send this command, make sure you have saved any trace or measurement data that you want to preserve.

Remote Command	`:SYSTem:PUP:PROCess`
Example	`:SYST:PUP:PROC` After sending this command, you must wait for the instrument software to restart
Notes	You cannot use `*WAI` or `*OPC?` to synchronize operation after a restart. This command stops and restarts the instrument application, so the SCPI operation is terminated and restarted A remote program must wait a fixed time before resuming sending commands to the instrument. The appropriate wait time depends on which applications are pre-loaded

5.16 System Log Off (Remote Command Only)

Provides a means to terminate all open Windows applications, and log off the current user. This is equivalent to performing the Windows command:

```
shutdown -l -f -t0
```

Remote Command	`:SYSTem:LOFF`
Example	`:SYST:LOFF`
Notes	Initiates an immediate log off of the current user. Exits the instrument application, so any unsaved measurement results will be lost. You cannot use `*WAI` or `*OPC?` to synchronize operation. In addition to the instrument application, all other Windows programs will be terminated, without the opportunity to save any work in progress. To perform a subsequent login, and regain instrument operation, human intervention will be required

5.17 Power Standby (Instrument Shutdown)

Pressing the power switch powers down the instrument. You are warned that shutting down will cause the application to lose unsaved data, and the instrument lets you respond to this warning before shutting down.

The command below has the same effect, except that you can specify Normal mode (`NORMal`) or Forced mode(`FORCe`):

- In `NORMal` mode, the system waits until you respond to the warning prompt
- In `FORCe` mode, the system shuts down after 20 seconds, and all data will be lost

If the instrument is not properly shut down prior to removal of line power, the system will validate the Journaling File System and the Power-On Last State (if the instrument is in Power-On Last State) during the following power-on. If a problem is detected, a message appears indicating that the system 'recovered' from an inappropriate shutdown. This is only an issue if **Power-On Type** is Last State. If the Last State is not valid, the instrument will power up in the last active Mode, but will perform "Mode Preset" on page 2186.

Remote Command	`:SYSTem:PDOWn [NORMal | FORCe]`
Example	`:SYST:PDOW` Executes a normal shutdown
Notes	If no parameter is sent, `NORMal` is assumed

6 Input/Output

Accesses menus that let you control the Input/Output parameters of the instrument. In general, these are functions associated with external connections to the instrument, either to the inputs or the outputs.

Input/output connections tend to be based on situation-specific hardware set up. For that reason, input/output settings do *not*, in general, change when you perform a Mode Preset. You can revert to the default values in one of three ways:

- Use **Restore Input/Output Defaults**, in the **Input/Output** menu
- Use **System->Restore System Defaults->Input/Output Settings**
- Use **System -> Restore System Defaults->All**

The settings survive a Preset and a Power cycle.

A few Input/Output settings *do* respond to Mode Preset. For example, if the Calibrator is on, **Preset** turns it off, and if DC coupling is in effect, **Preset** switches it to AC. These exceptions are noted in the SCPI tables for the excepted functions.

Input/Output features are common across multiple Modes and Measurements. In general, they do not change when you change Mode or Measurement, although some controls appear only in certain measurements.

6.1 RF Source

Lets you control and configure the internal RF Source. This tab only appears in models that support a built-in independent RF Source, which include E7760B, and modular products such as EXM and VXT.

External Source Control and built-in Tracking Sources are controlled using the **Source** tab in **Meas Setup**.

Dependencies	Only appears in models that support a built-in independent RF Source, such as E7760B, EXM and VXT

6.1.1 RF Output

Sets the source RF power output state.

Remote Command	`:OUTPut[:EXTernal][:STATe] ON | OFF | 1 | 0` `:OUTPut[:EXTernal][:STATe]?`
Example	`:OUTP OFF` `:OUTP?`
Notes	This setting is for the independent mode and has no effect on the "List Sequencer" on page 2215. If **Sequencer** is ON, the List Sequencer controls the source output, and this key is grayed-out When **Sequencer** is OFF, makes source leave List Sequencer and this setting is blanked out, taking effect immediately
Dependencies	For E7760B, the RF Output cannot be set to ON if the RF Output port is set to NONE. If you attempt to set RF Output to ON in this situation, the error message -221, “Settings conflict; Source Output is not available while Output Port is None” is displayed `:OUTPut:EXTernal[:STATe]` is supported only when Option ESC is installed. Otherwise, only `:OUTPut[:STATe]` is supported
Preset	OFF
Range	ON|OFF

6.1.2 RF Output Port

Specifies the RF Output Port used by the internal source.

Switching from the RF Output port to one of the RFIO ports changes the transmitter performance of the instrument.

The NONE selection is available to allow setting a half-duplex port to an Input, if it was previously assigned as an Output. Set the Output to NONE first, then any port can be assigned as an Input.

When using VXT M9410A/11A/15A/16A with Remote Radio Heads (such as the Keysight M1740A mmWave Transceiver for 5G), the choices in the dropdown menu appear as:

Head h RFHD p

For example, if you have two Radio Heads (numbered 1 and 2), each of which have two RF half-duplex ports, the choices for these ports will appear as below:

Head and Port	Choice in dropdown	SCPI parameter
Head 1, port RF Tx/Rx 1	Head 1 RFHD 1	RRH1RFHD1
Head 1, port RF Tx/Rx 2	Head 1 RFHD 2	RRH1RFHD2
Head 2, port RF Tx/Rx 1	Head 2 RFHD 1	RRH2RFHD1
Head 2, port RF Tx/Rx 2	Head 2 RFHD 2	RRH2RFHD2

When using the E7770A Common Interface Unit, outputs may come from the DUT IF OUT ports on the rear of the CIU or the half-duplex ports on the front of the CIU labeled DUT IF In/Out. You would select GUI parameter IF Out n or SCPI parameter IFOutn for the DUT IF OUT ports or GUI parameter IFHD n or SCPI parameter IFHDn for the DUT IF In/Out ports. See "RF Input Port" on page 2319 “Parameters for VXT M9410A/11A/15A/16A and EXM when used with Radio Heads/CIU” for more details.

Remote Command	`[:SENSe]:FEED:RF:PORT:OUTPut RFOut | RFIO1 | RFIO2 | RFIO3 | RFIO4 | RFHD | RFFD | A1 | A2 | A3 | B1 | B2 | B3 | IFIO1 | IFIO2 | GEN | TR | RRHhRFHDp | IFOutn | IFHDn | NONE`
	For details of each option, see "Port Options" on page 2207
	`[:SENSe]:FEED:RF:PORT:OUTPut?`

Example	Set output to RF Output:
	`:FEED:RF:PORT:OUTP RFO`
	Set output to Radio Head 1, RF Tx/Rx Port 2:
	`:FEED:RF:PORT:OUTP RRH1RFHD2`

Dependencies	Only appears in models that support multiple output ports. If the SCPI command is sent with unsupported parameters in any other model, an error is generated, -221, “Settings conflict; option not installed” `RFHD` and `RFFD` are only available on VXT. Option HDX is required to enable RFHD port. Option FDX is required to enable RFFD port For E7760B: Ports IFIO1 and IFIO2 are available if Option RF2 is installed. Ports A1, A2, A3, B1, B2, B3 are available if Option RF3 is installed. Attempting to select a port for which the option is not present generates the error, -241, “Hardware missing; Output not available” A port cannot be selected as an Output while it is occupied as an Input. If the SCPI command is sent while the port is occupied, an error is generated, -221, “Settings conflict; Output Port is not available while occupied by Input” Additionally, the mmWave ports are divided into two banks: the A Bank and the B Bank. A port cannot be selected as an Output if any port on the *same* bank is occupied as an Input. If the SCPI command is sent for this situation, an error is generated, -221 “Settings conflict; Output Port is not available while

	port bank is occupied by Input" Lastly, if RF3 is present, and RF4 is absent, a mmWave port cannot be selected as an Output if the Input Port is occupied by wwWave Transceiver with a different frequency range. If the SCPI command is sent for this situation an error is generated, -221 "Settings conflict; Output Port is not available while occupied by Input of incompatible frequency" Ports `GEN` and `TR` are only available.in modular analyzers, and only when the M9470A module is installed, such as in M8920A. Option HDX is required to enable the T/R port When any output is selected in a measurement that does not support it, the "No result; Meas invalid with this output" error condition occurs, and the measurement returns invalid data when queried
Preset	Unaffected by **Mode Preset**, but set to default by **Source Preset** or **Restore System Defaults -> All**
State Saved	Saved in State
Backwards Compatibility SCPI	`:FEED:RF:PORT:OUTPut IFIO1` `IFIO1` is treated as `IFO1` and sets the IF output to be the port labeled **DUT IF Out** on the CIU rear panel. This is for compatibility with earlier implementations on EXM and VXT when using the E7770A Common Interface Unit

Port Options

Value	Notes
RF Output `RFOut`	On EXM with hardware M9430A, if RF Output is selected as RF Output Port, use the settings in the **Half Duplex Config** menu to determine which port (`RFIO3` or `RFIO4`) will be used On EXM with hardware M9431A, this setting is not supported. If the SCPI command is sent with this setting, an error is generated, -221, "Settings conflict; option not installed"
`RFHD`	RFHD port is exclusive for RF Input and RF Output. If HD Port is chosen as RF Input port, pressing this key, or sending SCPI to set it, generates error message: "-221, Settings conflict; RFHD is being used as RF Input Port" Option HDX is required to enable RFHD port
`RFFD`	Option FDX is required to enable RFFD port
`GEN`	Selects the Gen port on M8920A/20B
T/R `TR`	Selects the T/R port on M8920A/20B
`RRHhRFHDp`	Used to select a port on a Radio Head (such as the Keysight M1740A mmWave Transceiver) as an output `RRHhRFHDp` corresponds to **Head h**, port **RF Tx/Rx p**. For example, `RRH1RFHD2` = the port labeled **RF Tx/Rx 2** on **Head 1**

6.1.3 Half Duplex Output Port

Specifies whether `RFIO3` or `RFIO4` is the Half Duplex Output port.

Remote Command	`[:SENSe]:HDUPlex:PORT:OUTPut RFIO3 | RFIO4`

Example	`:HDUPlex:PORT:OUTPut RFIO3` `:HDUPlex:PORT:OUTPut?`
Dependencies	Only appears in EXM If `RFIO3` is selected as “Half Duplex Input Port”, then “Half Duplex Output Port” will be set to `RFIO4` automatically If `RFIO4` is selected as “Half Duplex Input Port”, then “Half Duplex Output Port” will be set to `RFIO3` automatically
Preset	`RFIO4`
State Saved	Saved in State

6.1.4 RF Power

Lets you control the amplitude of the Source output. Same as "RF Power" on page 2208 in **Amplitude Setup**.

Example	`:SOUR:POW -100 dBm`

6.1.5 T/R Port High Power Attenuator

Controls whether additional attenuation is added at the T/R Port. The T/R port has two output paths, one that provides a 16 dB attenuator, another that bypasses this attenuator. When this control is `ON`, the path includes the 16 dB attenuator, so the maximum output level for this path is 0 dBm. When this control is `OFF`, the 16 dB attenuator is bypassed, so the maximum output level for this path is +5 dBm.

Example	`:FEED:RF:PORT:TR:HPOW:ATT ON`

6.1.6 Amplitude Setup

Lets you access the **Amplitude Setup** panel.

Notes	This menu under this control is for independent mode, and has no effect on "List Sequencer" on page 2215. If **"Sequencer" on page 2216** is `ON`, the List Sequencer controls the source output, and this control is grayed-out on the front panel, to indicate out-of-scope. When you set **"Sequencer" on page 2216** to `OFF`, makes source leave List Sequencer and this control is blanked out

6.1.6.1 RF Power

Lets you adjust the power level of the source using the numeric keypad, step keys, or RPG. Pressing any digit, 0 through 9 on the numeric keypad displays the unit terminator.

Please refer to the "RF Power Range" on page 2209 table below for the valid ranges.

Remote Command	`:SOURce:POWer[:LEVel][:IMMediate][:AMPLitude] <ampl>` `:SOURce:POWer[:LEVel][:IMMediate][:AMPLitude]?`
Example	`:SOUR:POW -100 dBm`
Notes	Amplitude corrections can be specified for use with the source. In the event of amplitude corrections being applied, the valid ranges for the RF power do not change dependent on the current amplitude correction setting. If the combination of RF power + amplitude correction is higher or lower than the source output range, the Source Unleveled bit is set, and the “Source Unleveled” indicator will appear on status panel to indicate that the source cannot maintain the output power that has been requested When signal generator is unable to maintain the requested output level, the “Source Unleveled” indicator will appear on status panel. When the source output setting is restored to the normal range, the “Source Unleveled” is removed from status panel Internal source has list sequence mode, which comprises of several steps which contain separate output power, frequency and waveform etc. When the source list sequence playing is complete, the last step keeps playing, and user can use this command to change the list sequence last step’s output power For EXT, The multiport adapter RFIO TX ports and GPS ports cannot ensure power accuracy when power setting is lower than -130dBm, this power setting value is defined by the sum of RF Power setting and related amplitude correction value. But user settable value could be lower than this limit. When application detected there exists power setting lower than -130dBm on MPA RFIO TX ports, then popup warning message . When application detected there exists power setting lower than -130dBm on MPA GPS ports, then popup warning message . This is only warning message, and check is performed when RF is ON
Dependencies	The RF power is dependent on the RF output port and frequency, such that the current frequency and selected output port determine the valid range of power values
Couplings	For if AWGN State is ON and ARB State is ON, this setting is adjusted to the value to maintain the AWGN power relationship defined by Power Control Mode and other noise settings
Preset	-100 dBm
Min	The range of values depends on the current frequency and selected RF output port. See "RF Power Range" on page 2209 below for the valid ranges
Max	The range of values depends on the current frequency and selected RF output port. Refer to "RF Power Range" on page 2209 below for the valid ranges

RF Power Range

RF Output Port	Frequency Range	Min Output Power	Max Output Power
High Power RF Out	10 MHz ≤ f ≤ 6 GHz	–150 dBm	20 dBm
RFIO 1 & RFIO 2	10 MHz ≤ f ≤ 6 GHz	–150 dBm	0 dBm

Note: This is the UI power range, which is larger than the actual specification.

VXT model M9420A

RF Output Port	Frequency Range	Min Output Power	Max Output Power without Option “1EA”	Max Output Power with Option “1EA”
RF Output	60 MHz ≤ f ≤ 6 GHz	–150 dBm	10 dBm	25 dBm
RFHD	60 MHz ≤ f ≤ 6 GHz	–150 dBm	10 dBm	15 dBm
RFFD	60 MHz ≤ f ≤ 6 GHz	–150 dBm	0 dBm	0 dBm

Note 1: This is the UI power range, which is larger than the actual specification.

Note 2: Max output power with Option 1EA can be set to 25 dBm, but Meas Uncal (measurement uncalibrated) warning is given in the Status Bar in the lower right corner of the screen when output power set higher than 20 dBm.

VXT models M9410A/11A

Ports	Option LFE	Frequency Range	Min Output Power	Max Output Power without option “1EA”	Max Output Power with “1EA”
RF Output	With Option LFE	1 MHz ≤ f ≤ 60 MHz	–150 dBm	5 dBm	5 dBm
		60 MHz ≤ f ≤ 380MHz	–150 dBm	5 dBm	25 dBm
	Without Option LFE	380 MHz ≤ f ≤ 6 GHz	–150 dBm	5 dBm	25 dBm
RFHD		1 MHz ≤ f ≤ 6 GHz	–150 dBm	5 dBm	5 dBm

Note 1: Min Output Power is the UI power range, which is smaller than the actual specification.

Note 2: Max output power with Option 1EA can be set to 25 dBm for RF Output Port, but Meas Uncal (measurement uncalibrated) warning is given in the Status Bar in the lower right corner of the screen when the output power is set higher than 20 dBm.

Note 3: Option LFE provides Low Frequency Extension, which covers frequency from 1 MHz to 380 MHz.

VXT models M9415A/16A

RF Output Port	Frequency Range	Min Output Power	Max Output Power without Option “1EA”	Max Output Power with Option “1EA”
RF Output	380 MHz ≤ f ≤ 12.3 GHz	–150 dBm	5 dBm	25 dBm
RFHD	380 MHz ≤ f ≤ 12.3 GHz	–150 dBm	5 dBm	18 dBm

Note 1: For RF output port, the Max output power with Option 1EA can be set to 25 dBm for RF Output Port, but Meas Uncal (measurement uncalibrated) warning is given in the Status Bar in the lower right corner of the screen when the output power is set higher than 20 dBm.

Note 2: For RFHD port, the Max output power with Option 1EA can be set to 18 dBm for RF Output Port, but Meas Uncal (measurement uncalibrated) warning is given in the Status Bar in the lower right corner of the screen when the output power is set higher than 15 dBm.

M9410E/11E/15E/16E

Ports	Option LFE	Frequency Range	Min Output Power	Max Output Power
RF Output	With Option LFE	1 MHz ≤ f ≤ 380 MHz	-150 dBm	13 dBm
		380 MHz ≤ f ≤ 25.9 GHz	-150 dBm	25 dBm
	Without Option LFE	380 MHz ≤ f ≤ 25.9 GHz	-150 dBm	25 dBm
RFHD		1 MHz ≤ f ≤ 25.9 GHz	-150 dBm	5 dBm

VXT Models with Remote Radio Heads/CIU

RRH	Port	Frequency Range	Min Output Power	Max Output Power
M1742A	Head h RFHD p	10 GHz ≤ f ≤ 32 GHz	–150 dBm	10 dBm

M8920A/20B

RF Output Port	Frequency Range	Min Output Power	Max Output Power
Gen	100 kHz ≤ f ≤ 6 GHz	–150 dBm	without option 1EA: 3 dBm with option 1EA: 15 dBm
T/R	100 kHz ≤ f ≤ 6 GHz	–150 dBm	T/R port high power attenuator On: -15 dBm T/R port high power attenuator Off: 3 dBm

Note: This is the UI power range, which is larger than the actual specification.

6.1.6.2 Set Reference Power

Turns the power reference state to ON, sets the reference power value to the current RF output power, maintains this power at the RF output, and sets the displayed power to 0.00 dB. All subsequent RF power values entered under **Source**, **Amplitude**, **RF Power** are interpreted as being relative to this reference power.

When you use a power reference, the signal generator outputs an RF power that is set relative to the reference power by the value entered under **Source**, **Amplitude**, **RF Power** as follows:

Output power = reference power – entered power

Where:

- reference power equals the original RF Power entered under **Source>Amplitude>RF Power** and set as the reference power
- entered power equals a new value entered under **Source>Amplitude>Amptd Offset**

In addition, the displayed power value is the same as a new value entered under **Source**, **Amplitude**, **RF Power**.

NOTE If Power Ref is ON with a reference value set, entering a value under **Source**, **Amplitude**, **RF Power** and pressing **Set Reference Power** adds that value to the existing Power Ref value.

If you wish to change the reference power value to a new value entered under **Source**, **Amplitude**, **RF Power**, first set Power Ref to OFF, then press **Set Reference Power**.

Dependencies	Unavailable, and grayed-out, when "List Sequencer" on page 2215 is ON

6.1.6.3 Power Ref

Lets you toggle the state of the power reference. When you use a power reference, the signal generator outputs an RF power that is set relative to the reference power by the value entered under **Source>Amplitude>RF Power** as follows:

Output power = reference power + entered power

Where:

- reference power equals the original RF Power entered under **Source>Amplitude>RF Power** and set as the reference power
- entered power equals a new value entered under **Source>Amplitude>Amptd Offset**

For more information on Reference Frequency, see "Set Reference Power" on page 2212.

Remote Command	`:SOURce:POWer:REFerence <ampl>` `:SOURce:POWer:REFerence?`
Example	`:SOUR:POW:REF 0.00 dBm`
Dependencies	Unavailable and grayed-out when "List Sequencer" on page 2215 is ON
Couplings	Coupled to "Set Reference Power" on page 2212, such that pressing **Set Reference Power** updates the reference power with the current output power
Preset	0.00 dBm
Min	-125.00 dBm
Max	10.00 dBm

Auto Function

Remote Command	`:SOURce:POWer:REFerence:STATe OFF | ON | 0 | 1` `:SOURce:POWer:REFerence:STATe?`
Example	`:SOUR:POW:REF:STATe ON`
Preset	`OFF`

6.1.6.4 Power Unit

Modifies the units for RF Power and Power Ref. The change is immediate and does not force a restart.

Remote Command	`:SOURce:POWer[:LEVel][:IMMediate][:AMPLitude]:UNIT DBM | W | V | DBUV` `:SOURce:POWer[:LEVel][:IMMediate][:AMPLitude]:UNIT?`
Example	Set the RF Power units to volts:

	:SOUR:POW:UNIT V
Couplings	RF Power and Power Ref units are modified by Power Unit
Preset	dBm
State Saved	Saved in Instrument State

6.1.6.5 Amptd Offset

Lets you specify the RF output power offset value.

When the amplitude offset is set to zero (0) and you set a new offset value (positive or negative), the displayed amplitude value changes as follows, and the RF output power does not change:

Displayed value = output power + offset value

Where:

– output power equals the original RF Power entered under **Source, Amplitude, RF Power**

– offset value equals the value entered under **Source, Amplitude, Amptd Offset**

When the amplitude offset is set to a value other than zero (0) and you enter a new RF power value under **Source, Amplitude, RF Power**, the displayed power will be the same as the value entered and the RF output power will be equal to the value entered minus the offset value as follows:

Output power = entered power – offset power

Displayed Power = output power + offset power

Displayed power = entered power

Where:

– entered power equals the amplitude entered under **Source, Amplitude, RF Power**

– offset power equals the value previously entered and set under **Source, Amplitude, Amptd Offset**

Remote Command	:SOURce:POWer[:LEVel][:IMMediate]:OFFSet <rel_ampl> :SOURce:POWer[:LEVel][:IMMediate]:OFFSet?
Example	:SOUR:POW:OFFS 0.00 dB
Notes	The amplitude Offset unit follows the units set in Power Unit
Dependencies	Unavailable, and grayed-out, when List Sequencer is ON
Preset	0.00 dB

Min	-200.00 dB
Max	200.00 dB

6.1.6.6 Amplitude Increment

Changes the step size for the RF Power function. Once an increment size has been selected and the RF Amplitude function is active, the step keys (and the UP|DOWN parameters for RF Power from remote commands) change the RF Power by the set value. This feature exists in EXG and MXG.

Remote Command	`:SOURce:POWer:STEP[:INCRement] <ampl>` `:SOURce:POWer:STEP[:INCRement]?`
Example	`:SOUR:POW:STEP 1`
Notes	The Amplitude Increment unit follows the units set in Power Unit
Couplings	Coupled to the Step size of the RF Power function
Preset	1 dB
Min	0.1 dB
Max	10 dB

6.1.7 Frequency

Lets you control the frequency of the Source. Same as "Frequency" on page 2240 under "Frequency Setup" on page 2240.

Example	`:SOUR:FREQ 1.00 GHz`

6.1.8 List Sequencer

Accesses sub-menus for configuring the **List Sequencer**.

List sequences allow you to enter frequencies and amplitudes at unequal intervals in nonlinear ascending, descending or random order. Each step within the list can also include its own waveform file for playback, step duration, trigger event and trigger output.

The complexities involved in configuring the **List Sequencer** do not lend themselves to manual configuration; hence the manual configuration for this feature is limited. For easier configuration of the List Sequencer, it is recommended that you use either SCPI, or load a tab-delimited file containing the setup parameters in a tabular form. The details of the SCPI for configuring the List Sequencer can be found in "Step Configuration (Remote Command Only)" on page 2231.

Once the **List Sequencer** has been configured using the front panel, SCPI, or by loading a tab-delimited file, the sequence must be initiated using the front panel **Initiate Sequence** key, or the corresponding SCPI command.

Dependencies	Not available in E7760B

6.1.8.1 Sequencer

Sets the state of "List Sequencer" on page 2215

- When **List Sequencer** is ON, the source outputs the sequence defined by the sequencer
- When **List Sequencer** is OFF, the source outputs a single waveform segment or sequence (independent mode) at a single frequency and amplitude

Remote Command	`:SOURce:LIST[:STATe] ON | OFF | 1 | 0` `:SOURce:LIST[:STATe]?`
Example	`:SOUR:LIST OFF`
Notes	When the sequencer is ON, the List Sequencer controls the output of the source
Dependencies	Not available in E7760B
Couplings	When in Sequence Analyzer Mode, and the List Sequencer state is OFF, **Include Source** is forced to NO, and the **Include Source** key is grayed-out When in Sequence Analyzer Mode, and the List Sequencer state is ON, **Include Source** is available to set, and an ARB memory related operation such as load or delete will be rejected
Preset	OFF
Range	ON | OFF

6.1.8.2 Initiate Sequence

Arms the sequence for single execution. Once the sequence is armed, the source begins the sequence as soon as the trigger is received. If trigger is set to **Free Run**, the sequence starts immediately.

Remote Command	`:SOURce:LIST:TRIGger[:IMMediate]`
Example	`:SOUR:LIST:TRIG`
Notes	When in Sequence Analyzer Mode, and **Include Source** is ON, the Initiate List Sequencer operation is rejected, and the key is grayed-outIf the file needed by the sequencer is not already in ARB memory, the sequence cannot be initiated, and an error is generated There is a blocking SCPI query that can be used to check whether source list sequence was initiated successfully (see "Remote Software Trigger (Remote command Only)" on page 2240)
Dependencies	In Sequence Analyzer Mode, if **Meas Setup, Include Source** is set to YES, **Source, List Sequencer, Initiate Sequence** is disabled Not available in E7760B

6.1.8.3 Repetition

Accesses a sub-menu to select the repetition type for the List Sequencer globally. It cannot be changed between different sequence steps.

In **Single**, the Source list plays one time after initiation. In **Continuous**, the Source list plays continuously after initiation.

This setting is available on EXM.

Remote Command	`:SOURce:LIST:REPetition:TYPE SINGle | CONTinuous`
Example	`:SOUR:LIST:REP:TYPE SING` `:SOUR:LIST:REP:TYPE?`
Dependencies	Available on EXM Not available in E7760B
Preset	`SINGle`
Range	`SINGle | CONTinuous`

6.1.8.4 Trig Out Type

Accesses a sub-menu to select the output trigger type for the List Sequencer globally. It cannot be changed between different sequence steps. It sets the output trigger type for the whole source sequence.

Remote Command	`:SOURce:LIST:TRIGger:OUTPut:TYPE STEP | MARKer` `:SOURce:LIST:TRIGger:OUTPut:TYPE?`
Notes	`STEP` = Start of Step `MARKer` = Data Marker
Dependencies	Available on EXM Not available in E7760B
Preset	`STEP`
Backwards Compatibility SCPI	`:SOURce:LIST:TRIGgerout:TYPe BEGinningofstep | DATamarker`

6.1.8.5 Select Data Marker

When "Trig Out Type" on page 2217 is set to Data `MARKer`, specifies which marker to route.

Remote Command	`:SOURce:LIST:TRIGger:OUTPut:TYPE:MARKer M1 | … | M4` `:SOURce:LIST:TRIGger:OUTPut:TYPE:MARKer?`

Backwards Compatibility SCPI	`:SOURce:LIST:TRIGgerout:TYPe:Marker`

6.1.8.6 Manual Trigger Now

Provides a software trigger event to the List Sequencer. During execution of a sequence, if the sequencer is halted on any step that has been configured with a “Manual” step trigger, then this keypress causes the sequencer to continue and execute the step.

Notes	No remote command, front panel only

6.1.8.7 List Sequencer Setup

Accesses the List Sequencer setup menus.

Number of Steps

Lets you specify the number of steps within the list sequence.

Remote Command	`:SOURce:LIST:NUMBer:STEPs <integer>` `:SOURce:LIST:NUMBer:STEPs?`
Example	`:SOUR:LIST:NUMB:STEP 1`
Notes	Increasing the number of steps creates additional steps at the end of the list, with all the settings within the steps set to their default values Decreasing the number of steps removes steps from the end of the list. The settings within the removed steps are not reset. This means that increasing the number of steps again would allow you to retrieve these steps
Dependencies	The Step Count parameter is increased or decreased when you insert or delete a point from within the GUI interface to the sequencer Not available in E7760B
Preset	1
Min	1
Max	1000

Go To Step

Lets you select the step number you wish to view or edit.

Preset	1

Min	1
Max	Step Count

Insert Step Before

Inserts a new step, with default values, before the currently selected step. Inserting a step automatically increases the Step Count parameter by 1. If a sequence has already reached the upper limit of 1000 steps, then this operation is rejected, and error -221, “Setting Conflict; Cannot insert more steps, maximum number of steps reached” is displayed.

Notes	If the list already contains the maximum limit (1000 steps), pressing this control has no effect

Delete Step

Deletes the current step. Deleting a step automatically decreases the Step Count parameter by 1. If the sequence only has one step left, then this operation is rejected, and error -221, “Setting conflict; Cannot delete current step, minimum number of steps reached” is displayed

Notes	If the list already contains the minimum limit of 1 step, pressing this control has no effect

Clear List

Clears the list. Clearing the list sets the number of steps to the default value (1) and sets the parameters for the only step to their default values.

Step Trigger

Lets you select the trigger input for the current step.

Remote Command	`:SOURce:LIST:STEP[1]|2|…|1000:SETup:INPut:TRIGger IMMediate | INTernal | EXTernal2 | KEY | BUS | EXTernal4`
	For details of options, see "More Information" on page 2220
	`:SOURce:LIST:STEP[1]|2|…|1000:SETup:INPut:TRIGger?`

Example	`:SOUR:LIST:STEP2:SET:INP:TRIG BUS` `:SOUR:LIST:STEP2:SET:INP:TRIG?`
Notes	SCPI is supported after A.09.40
Dependencies	Not available in E7760B
Preset	`IMMediate`
Range	`IMMediate|INTernal|EXTernal2|KEY|BUS|EXTernal4`

More Information

Parameter	SCPI	Notes
Free Run	`IMM`	Sets the trigger input for the current step to Free Run
Internal	`INT`	Sets the trigger input for the current step to Internal
Manual (Trigger Key)	`KEY`	Sets the trigger input for the current step to Manual (Trigger Key). Any step in the sequence set to Manual will cause the sequence execution to stop until the manual trigger key is pressed. Sending the Bus Trigger SCPI command will have no effect. At any point in the sequence where the List Sequencer is paused waiting for a software trigger, a pop-up dialog is displayed until the trigger event occurs
Bus	`BUS`	Sets the trigger input for the current step to Bus. Any step in the sequence set to Bus will cause the sequence execution to stop until the Bus Trigger command is sent. Pressing the manual trigger key has no effect. At any point in the sequence where the List Sequencer is paused waiting for a software trigger, a pop-up dialog is displayed until the trigger event occurs
External 2	`EXT2`	Sets the trigger input for the current step to External 2 Note: When on EXM, trigger 2 is a bi-directional trigger port. So, when trigger 2 has been configured as OUTPUT type, choosing External 2 as the input trigger for the current step will generate error

Transition Time

Lets you specify the transition time for the current step.

The following table lists recommended values for appropriate settling times to allow for changes within the source.

Value Changed	Recommended Transition Time
Frequency	500 µs
Amplitude	100 µs to within 0.1 dB 20 µs to within 1.0 dB

If the Transition Time value is shorter than the time necessary for the hardware to settle and a List Sequence is initiated, a **warning** is generated.If the Transition Time value is longer than the Step Duration, an error is generated when initiating a source list sequence. For source list sequence, transition time is included in the step duration length. If the Transition Time value is longer than the Step Duration Time, the real step duration length is extended to equal the transition time and cause a timing shift.

Remote Command	`:SOURce:LIST:STEP[1]|2|…|1000:SETup:TRANsition:TIME <time>` `:SOURce:LIST:STEP[1]|2|…|1000:SETup:TRANsition:TIME?`
Example	`:SOUR:LIST:STEP2:SET:TRAN:TIME 1ms`

	:SOUR:LIST:STEP2:SET:TRAN:TIME?
Notes	SCPI is supported after A.09.40
Dependencies	Not available in E7760B
Preset	1.0 ms
Min	0.0 ms
Max	4.0 ks

Band

Lets you select the radio band for use in the current step.

Remote Command	:SOURce:LIST:STEP[1]|2|…|1000:SETup:RADio:BAND <band> where <band> is one of: NONE | PGSM | EGSM | RGSM | DCS1800 | PCS1900 | GSM450 | GSM480 | GSM700 | GSM850 | TGSM810 | USCELL | USPCS | JAPAN | KOREAN | NMT | IMT2K | UPPER | SECOND | PAMR400 | PAMR800 | IMTEXT | PCS1DOT9G | AWS | US2DOT5G | PUBLIC | LOWER | BANDI | BANDII | BANDIII | BANDIV | BANDV | BANDVI | BANDVII | BANDVIII | BANDIX | BANDX | BANDXI | BANDXII | BANDXIII | BANDXIV | BANDXIX | BAND1 | BAND2 | BAND3 | BAND4 | BAND5 | BAND6 | BAND7 | BAND8 | BAND9 | BAND10 | BAND11 | BAND12 | BAND13 | BAND14 | BAND17 | BAND18 | BAND19 | BAND20 | BAND21 | BAND24 | BAND25 | BAND26 | BAND27 | BAND28 | BAND29 | BAND30 | BAND31 | BAND65 | BAND66 | BAND67 | BAND68 | BAND71 | BAND252 | BAND255 | BAND33 | BAND34 | BAND35 | BAND36 | BAND37 | BAND38 | BAND39 | BAND40 | BAND41 | BAND42 | BAND43 | BAND44 | BAND45 | BAND46 | BANDA | BANDB | BANDC | BANDD | BANDE | BANDF | N1 | N2 | N3 | N5 | N7 | N8 | N12 | N20 | N25 | N28 | N34 | N38 | N39 | N40 | N41 | N50 | N51 | N66 | N70 | N71 | N74 | N75 | N76 | N77 | N78 | N79 | N80 | N81 | N82 | N83 | N84 | N86 | N257 | N258 | N260 | N261 :SOURce:LIST:STEP[1]|2|…|1000:SETup:RADio:BAND?
Example	:SOUR:LIST:STEP2:SET:RAD:BAND PGSM :SOUR:LIST:STEP2:SET:RAD:BAND?
Notes	SCPI is supported after A.09.40
Dependencies	Not available in E7760B

Here are the Radio Standards for each Band, and a SCPI example for each (Step 2 is assumed):

Band	Standard	SCPI Example
None	None	:SOUR:LIST:STEP2:SET:RAD:BAND NONE
P-GSM	GSM/EDGE	:SOUR:LIST:STEP2:SET:RAD:BAND PGSM
E-GSM	GSM/EDGE	:SOUR:LIST:STEP2:SET:RAD:BAND EGSM
R-GSM	GSM/EDGE	:SOUR:LIST:STEP2:SET:RAD:BAND RGSM
DCS 1800	GSM/EDGE	:SOUR:LIST:STEP2:SET:RAD:BAND DCS1800

Band	Standard	SCPI Example
PCS 1900	GSM/EDGE	:SOUR:LIST:STEP2:SET:RAD:BAND PCS1900
GSM 450	GSM/EDGE	:SOUR:LIST:STEP2:SET:RAD:BAND GSM450
GSM 480	GSM/EDGE	:SOUR:LIST:STEP2:SET:RAD:BAND GSM480
GSM 700	GSM/EDGE	:SOUR:LIST:STEP2:SET:RAD:BAND GSM700
GSM 850	GSM/EDGE	:SOUR:LIST:STEP2:SET:RAD:BAND GSM850
T-GSM 810	GSM/EDGE	:SOUR:LIST:STEP2:SET:RAD:BAND T-GSM810
US Cell	CDMA 2000	:SOUR:LIST:STEP2:SET:RAD:BAND USCELL
US PCS	CDMA 2000	:SOUR:LIST:STEP2:SET:RAD:BAND PCS
Japan Cell	CDMA 2000	:SOUR:LIST:STEP2:SET:RAD:BAND JAPAN
Korean PCS	CDMA 2000	:SOUR:LIST:STEP2:SET:RAD:BAND KOREAN
NMT 450	CDMA 2000	:SOUR:LIST:STEP2:SET:RAD:BAND NMT
IMT 2000	CDMA 2000	:SOUR:LIST:STEP2:SET:RAD:BAND IMT2K
Upper 700	CDMA 2000	:SOUR:LIST:STEP2:SET:RAD:BAND UPPER
Secondary 800	CDMA 2000	:SOUR:LIST:STEP2:SET:RAD:BAND SECOND
400 Euro PAMR	CDMA 2000	:SOUR:LIST:STEP2:SET:RAD:BAND PAMR400
800 PAMR	CDMA 2000	:SOUR:LIST:STEP2:SET:RAD:BAND PAMR800
2.5 GHz IMT EXT	CDMA 2000	:SOUR:LIST:STEP2:SET:RAD:BAND IMTEXT
US PCS 1.9 GHz	CDMA 2000	:SOUR:LIST:STEP2:SET:RAD:BAND PCS1DOT9G
AWS	CDMA 2000	:SOUR:LIST:STEP2:SET:RAD:BAND AWS
US 2.5 GHz	CDMA 2000	:SOUR:LIST:STEP2:SET:RAD:BAND US2DOT5G
700 Public Safety	CDMA 2000	:SOUR:LIST:STEP2:SET:RAD:BAND PUBLIC
C2K Lower 700	CDMA 2000	:SOUR:LIST:STEP2:SET:RAD:BAND LOWER
Band I	W-CDMA	:SOUR:LIST:STEP2:SET:RAD:BAND BANDI
Band II	W-CDMA	:SOUR:LIST:STEP2:SET:RAD:BAND BANDII
Band III	W-CDMA	:SOUR:LIST:STEP2:SET:RAD:BAND BANDIII
Band IV	W-CDMA	:SOUR:LIST:STEP2:SET:RAD:BAND BANDIV
Band V	W-CDMA	:SOUR:LIST:STEP2:SET:RAD:BAND BANDV
Band VI	W-CDMA	:SOUR:LIST:STEP2:SET:RAD:BAND BANDVI
Band VII	W-CDMA	:SOUR:LIST:STEP2:SET:RAD:BAND BANDVII
Band VIII	W-CDMA	:SOUR:LIST:STEP2:SET:RAD:BAND BANDVIII
Band IX	W-CDMA	:SOUR:LIST:STEP2:SET:RAD:BAND BANDIX
Band X	W-CDMA	:SOUR:LIST:STEP2:SET:RAD:BAND BANDX
Band XI	W-CDMA	:SOUR:LIST:STEP2:SET:RAD:BAND BANDXI
Band XII	W-CDMA	:SOUR:LIST:STEP2:SET:RAD:BAND BANDXII
Band XIII	W-CDMA	:SOUR:LIST:STEP2:SET:RAD:BAND BANDXIII
Band XIV	W-CDMA	:SOUR:LIST:STEP2:SET:RAD:BAND BANDXIV

Band	Standard	SCPI Example
Band XIX	W-CDMA	:SOUR:LIST:STEP2:SET:RAD:BAND BANDXIX
Band 1	LTE FDD	:SOUR:LIST:STEP2:SET:RAD:BAND BAND1
Band 2	LTE FDD	:SOUR:LIST:STEP2:SET:RAD:BAND BAND2
Band 3	LTE FDD	:SOUR:LIST:STEP2:SET:RAD:BAND BAND3
Band 4	LTE FDD	:SOUR:LIST:STEP2:SET:RAD:BAND BAND4
Band 5	LTE FDD	:SOUR:LIST:STEP2:SET:RAD:BAND BAND5
Band 6	LTE FDD	:SOUR:LIST:STEP2:SET:RAD:BAND BAND6
Band 7	LTE FDD	:SOUR:LIST:STEP2:SET:RAD:BAND BAND7
Band 8	LTE FDD	:SOUR:LIST:STEP2:SET:RAD:BAND BAND8
Band 9	LTE FDD	:SOUR:LIST:STEP2:SET:RAD:BAND BAND9
Band 10	LTE FDD	:SOUR:LIST:STEP2:SET:RAD:BAND BAND10
Band 11	LTE FDD	:SOUR:LIST:STEP2:SET:RAD:BAND BAND11
Band 12	LTE FDD	:SOUR:LIST:STEP2:SET:RAD:BAND BAND12
Band 13	LTE FDD	:SOUR:LIST:STEP2:SET:RAD:BAND BAND13
Band 14	LTE FDD	:SOUR:LIST:STEP2:SET:RAD:BAND BAND14
Band 17	LTE FDD	:SOUR:LIST:STEP2:SET:RAD:BAND BAND17
Band 18	LTE FDD	:SOUR:LIST:STEP2:SET:RAD:BAND BAND18
Band 19	LTE FDD	:SOUR:LIST:STEP2:SET:RAD:BAND BAND19
Band 20	LTE FDD	:SOUR:LIST:STEP2:SET:RAD:BAND BAND20
Band 21	LTE FDD	:SOUR:LIST:STEP2:SET:RAD:BAND BAND21
Band 24	LTE FDD	:SOUR:LIST:STEP2:SET:RAD:BAND BAND24
Band 25	LTE FDD	:SOUR:LIST:STEP2:SET:RAD:BAND BAND25
Band 26	LTE FDD	:SOUR:LIST:STEP2:SET:RAD:BAND BAND26
Band 27	LTE FDD	:SOUR:LIST:STEP2:SET:RAD:BAND BAND27
Band 28	LTE FDD	:SOUR:LIST:STEP2:SET:RAD:BAND BAND28
Band 29	LTE FDD	:SOUR:LIST:STEP2:SET:RAD:BAND BAND29
Band 30	LTE FDD	:SOUR:LIST:STEP2:SET:RAD:BAND BAND30
Band 31	LTE FDD	:SOUR:LIST:STEP2:SET:RAD:BAND BAND31
Band 65	LTE FDD	:SOUR:LIST:STEP2:SET:RAD:BAND BAND65
Band 66	LTE FDD	:SOUR:LIST:STEP2:SET:RAD:BAND BAND66
Band 67	LTE FDD	:SOUR:LIST:STEP2:SET:RAD:BAND BAND67
Band 68	LTE FDD	:SOUR:LIST:STEP2:SET:RAD:BAND BAND68
Band 71	LTE FDD	:SOUR:LIST:STEP2:SET:RAD:BAND BAND71
Band 252	LTE FDD	:SOUR:LIST:STEP2:SET:RAD:BAND BAND252
Band 255	LTE FDD	:SOUR:LIST:STEP2:SET:RAD:BAND BAND255
Band 33	LTE TDD	:SOUR:LIST:STEP2:SET:RAD:BAND BAND33

Band	Standard	SCPI Example
Band 34	LTE TDD	:SOUR:LIST:STEP2:SET:RAD:BAND BAND34
Band 35	LTE TDD	:SOUR:LIST:STEP2:SET:RAD:BAND BAND35
Band 36	LTE TDD	:SOUR:LIST:STEP2:SET:RAD:BAND BAND36
Band 37	LTE TDD	:SOUR:LIST:STEP2:SET:RAD:BAND BAND37
Band 38	LTE TDD	:SOUR:LIST:STEP2:SET:RAD:BAND BAND38
Band 39	LTE TDD	:SOUR:LIST:STEP2:SET:RAD:BAND BAND39
Band 40	LTE TDD	:SOUR:LIST:STEP2:SET:RAD:BAND BAND40
Band 41	LTE TDD	:SOUR:LIST:STEP2:SET:RAD:BAND BAND41
Band 42	LTE TDD	:SOUR:LIST:STEP2:SET:RAD:BAND BAND42
Band 43	LTE TDD	:SOUR:LIST:STEP2:SET:RAD:BAND BAND43
Band 44	LTE TDD	:SOUR:LIST:STEP2:SET:RAD:BAND BAND44
Band 45	LTE TDD	:SOUR:LIST:STEP2:SET:RAD:BAND BAND45
Band 46	LTE TDD	:SOUR:LIST:STEP2:SET:RAD:BAND BAND46
Band A	TD-SCDMA	:SOUR:LIST:STEP2:SET:RAD:BAND BANDA
Band B	TD-SCDMA	:SOUR:LIST:STEP2:SET:RAD:BAND BANDB
Band C	TD-SCDMA	:SOUR:LIST:STEP2:SET:RAD:BAND BANDC
Band D	TD-SCDMA	:SOUR:LIST:STEP2:SET:RAD:BAND BANDD
Band E	TD-SCDMA	:SOUR:LIST:STEP2:SET:RAD:BAND BANDE
Band F	TD-SCDMA	:SOUR:LIST:STEP2:SET:RAD:BAND BANDF
N 1	5G NR	:SOUR:LIST:STEP2:SET:RAD:BAND N1
N 2	5G NR	:SOUR:LIST:STEP2:SET:RAD:BAND N2
N 3	5G NR	:SOUR:LIST:STEP2:SET:RAD:BAND N3
N 5	5G NR	:SOUR:LIST:STEP2:SET:RAD:BAND N5
N 7	5G NR	:SOUR:LIST:STEP2:SET:RAD:BAND N7
N 8	5G NR	:SOUR:LIST:STEP2:SET:RAD:BAND N8
N 12	5G NR	:SOUR:LIST:STEP2:SET:RAD:BAND N12
N 20	5G NR	:SOUR:LIST:STEP2:SET:RAD:BAND N20
N 25	5G NR	:SOUR:LIST:STEP2:SET:RAD:BAND N25
N 28	5G NR	:SOUR:LIST:STEP2:SET:RAD:BAND N28
N 34	5G NR	:SOUR:LIST:STEP2:SET:RAD:BAND N34
N 38	5G NR	:SOUR:LIST:STEP2:SET:RAD:BAND N38
N 39	5G NR	:SOUR:LIST:STEP2:SET:RAD:BAND N39
N 40	5G NR	:SOUR:LIST:STEP2:SET:RAD:BAND N40
N 41	5G NR	:SOUR:LIST:STEP2:SET:RAD:BAND N41
N 50	5G NR	:SOUR:LIST:STEP2:SET:RAD:BAND N50
N 51	5G NR	:SOUR:LIST:STEP2:SET:RAD:BAND N51

Band	Standard	SCPI Example
N 66	5G NR	:SOUR:LIST:STEP2:SET:RAD:BAND N66
N 70	5G NR	:SOUR:LIST:STEP2:SET:RAD:BAND N70
N 71	5G NR	:SOUR:LIST:STEP2:SET:RAD:BAND N71
N 74	5G NR	:SOUR:LIST:STEP2:SET:RAD:BAND N74
N 75	5G NR	:SOUR:LIST:STEP2:SET:RAD:BAND N75
N 76	5G NR	:SOUR:LIST:STEP2:SET:RAD:BAND N76
N 77	5G NR	:SOUR:LIST:STEP2:SET:RAD:BAND N77
N 78	5G NR	:SOUR:LIST:STEP2:SET:RAD:BAND N78
N 79	5G NR	:SOUR:LIST:STEP2:SET:RAD:BAND N79
N 80	5G NR	:SOUR:LIST:STEP2:SET:RAD:BAND N80
N 81	5G NR	:SOUR:LIST:STEP2:SET:RAD:BAND N81
N 82	5G NR	:SOUR:LIST:STEP2:SET:RAD:BAND N82
N 83	5G NR	:SOUR:LIST:STEP2:SET:RAD:BAND N83
N 84	5G NR	:SOUR:LIST:STEP2:SET:RAD:BAND N84
N 86	5G NR	:SOUR:LIST:STEP2:SET:RAD:BAND N86
N 257	5G NR	:SOUR:LIST:STEP2:SET:RAD:BAND N257
N 258	5G NR	:SOUR:LIST:STEP2:SET:RAD:BAND N258
N 260	5G NR	:SOUR:LIST:STEP2:SET:RAD:BAND N260
N 261	5G NR	:SOUR:LIST:STEP2:SET:RAD:BAND N261

Device

Lets you specify the radio band link direction for the steps within the list sequence. The link is used in conjunction with the channel band and channel number to determine the output frequency.

Setting	Option	Description
Uplink	UP	The source calculates the uplink frequency according to an uplink formula together with selected channel band and channel number
Downlink	DOWN	The source calculates the downlink frequency according to a downlink formula together with selected channel band and channel number

Remote Command	:SOURce:LIST:STEP[1]|2|…|1000:SETup:RADio:BAND:LINK DOWN | UP :SOURce:LIST:STEP[1]|2|…|1000:SETup:RADio:BAND:LINK?
Example	:SOUR:LIST:STEP2:SET:RAD:BAND:LINK UP :SOUR:LIST:STEP2:SET:RAD:BAND:LINK?
Notes	SCPI is supported after A.09.40

Dependencies	Not available in E7760B
Preset	DOWN
Range	DOWN | UP

Freq/Chan

Lets you select the frequency or channel value for the current step. If the Band selection for the current row is NONE, you enter a frequency. Otherwise, enter a channel, which causes the frequency to be automatically selected, based on the Band selection.

Entering a Frequency

If the Band selection for the current row is NONE, enter a Frequency. This field in the table allows you to select the frequency value for the current step.

Remote Command	`:SOURce:LIST:STEP[1]|2|…|1000:SETup:CNFRequency <double>` `:SOURce:LIST:STEP[1]|2|…|1000:SETup:CNFRequency?`
Example	`:SOUR:LIST:STEP2:SET:CNFR 1GHz` `:SOUR:LIST:STEP2:SET:CNFR?`
Notes	SCPI is supported after A.09.40 Used to setup channel number or frequency setting, according to the current Radio Band setting. If Radio Band is NONE, then the value is frequency. If Radio Band is not NONE, then the value is channel number
Dependencies	Not available in E7760B
Couplings	The frequency value is coupled to the channel band and number for the step, such that updates to the radio band and channel number will update the frequency value to the corresponding absolute frequency. The reverse is also true, changing the frequency value causes the value of the channel number to be updated
Preset	1.00 GHz
Min	10.00 MHz
Max	Hardware Dependent:

Option 503	3.6 GHz
Option 504	3.9 GHz
Option 506	6.00 GHz
Option F06	6.08 GHz
Option F06 & EP6	6.60 GHz

Entering a Channel

If the Band selection for the current row is not NONE, enter a Channel Number. This field in the table allows you to select the channel value for the current step. The frequency is selected automatically, based on the Band.

Example	`:SOUR:LIST:STEP2:SET:CNFR 124` `:SOUR:LIST:STEP2:SET:CNFR?`
Notes	SCPI is supported after A.09.40 Used to setup channel number or frequency setting, according to current Radio Band setting. If Radio Band is NONE, then the value is a frequency. If Radio Band is not NONE, then the value is a channel number
Dependencies	Not available in E7760B
Couplings	The channel number is coupled to the step frequency value. When the step frequency value is changed, the channel number increases or decreases to match the new step frequency. If the step frequency is not at an exact match for a channel number, the nearest channel number is displayed, along with a greater-than or less-than sign, to indicate the frequency is above or below the channel number
Preset	1
Min/Max	0/10838 (See "Channel" on page 2243 for valid ranges)

Power

Lets you specify the power value for the current step.

Remote Command	`:SOURce:LIST:STEP[1]|2|…|1000:SETup:AMPLitude <double>` `:SOURce:LIST:STEP[1]|2|…|1000:SETup:AMPLitude?`
Example	`:SOUR:LIST:STEP2:SET:AMPL -50dBm` `:SOUR:LIST:STEP2:SET:AMPL?`
Dependencies	The RF power is dependent on the RF output port and frequency, such that the current frequency and selected output port determine the valid range of power values Not available in E7760B
Preset	-100 dBm
Min/Max	The range of values depends on the current frequency and selected RF output port See "RF Power" on page 2208 and the RF Power Range table for valid ranges

Waveform

Lets you select the waveform to be played back during the current step. Options are: CW, a Waveform file, Continue the previous step's waveform, or Off.

Remote Command	`:SOURce:LIST:STEP[1]|2|…|1000:SETup:WAVeform <string>`

	where `<string>` is one of: "CW", "waveform name", "Cont", "Off" For full details of options, see "More Information" on page 2228 `:SOURce:LIST:STEP[1]|2|…|1000:SETup:WAVeform?`
Example	`:SOUR:LIST:STEP2:SET:WAV "CW"` `:SOUR:LIST:STEP2:SET:WAV?`
Notes	SCPI is supported after A.09.40
Dependencies	Not available in E7760B For VXT models M9410A/11A/16A, if the Waveform is not Continue Previous, there is always a time gap between the current step and the previous step
Preset	`CW`
Range	`"CW", "waveform name", "Cont", "Off"`

More Information

Parameter	SCPI	Notes
CW	`"CW"`	Sets the current step to output a CW tone
Selected Waveform	`"waveform name"`	Inserts a waveform from the Select Waveform dialog as the waveform for playback during the current step If the selected waveform contains header (which contains ARB play parameters), source list sequence will automatically apply header settings of the selected waveform in that step
Continue Previous	`"Cont"`	Sets the current step to continue with playback of the waveform from the previous step. When continuing the previous waveform, the ARB playback will not pause while the source retunes to the new frequency or amplitude that may be defined for the new step
Off	`"Off"`	Disable RF output of the current step

Waveform File

Pressing the slide-aside field of this column (>) opens the "Select Waveform" on page 2284 screen, which lets you select a waveform in ARB memory to playback during the current step. When you select a waveform, and press **OK**, it returns to the List Sequencer Setup screen with that file name in the table.

Step Duration

Lets you select the duration of play for the current step.

The duration can be set to be either the number of times for the ARB file associated with the sequence to play, or a specific time value, or continuous. If the step is set to play a CW tone, the step duration cannot be set to a play count.

Remote Command	`:SOURce:LIST:STEP[1]|2|…|1000:SETup:DURation:TYPE TIME | COUNt | CONTinuous | CABort`
	See "Option Details" on page 2229
	`:SOURce:LIST:STEP[1]|2|…|1000:SETup:DURation:TYPE?`

Example	`:SOUR:LIST:STEP2:SET:DUR:TYPE TIME` `:SOUR:LIST:STEP2:SET:DUR:TYPE?`
Dependencies	Not available in E7760B If in VXT models M9410A/11A/16A, **Step Duration** is `TIME` or Play `COUNt`, only **Free Run** is available for the next step. Otherwise, an error message is generated: "Parameter error; only Free Run is available as step trigger on step<n>"
Range	`TIME|COUNt|CONTinuous|CABort`

Option Details

Parameter	SCPI	Notes
Time	`TIME`	Sets the duration of the current step to be a time value for the length of time the step will play When `TIME` is selected, the Time may be set using the second field under **Step Duration** and/or by the "Duration Time" on page 2229 command
Count	`COUNt`	Sets the duration of the current step to be an integer value for the number of times (play count) the ARB file is selected for playback during this step. For example, a 5 second ARB will be set to play 5 times during the step When `COUNt` is selected, the Count may be set using the second field under **Step Duration** and/or by the "Play Count" on page 2230 command
Continuous	`CONTinuous`	Sets the current step to be played continuously until the next step starts. The waveform will always play completely before transitioning to the next step
Continuous Abort	`CABort`	Sets the current step to be played continuously or until the trigger event of the next step is detected. When a trigger event is received, the waveform play will be aborted after the interval specified by the Duration Time parameter and it will then transition to the next step When Continuous Abort is selected, the Duration Time may be set using the second field under Step Duration and/or by the "Duration Time" on page 2229 command

Duration Time

Lets you specify the length of time the current step will play when "Step Duration" on page 2228 is Time.

When "Step Duration" on page 2228 is Continuous Abort, this parameter specifies the maximum duration that the waveform will continue to play after a step trigger is received before the transition to the next waveform will occur. Duration is limited to a maximum of 20 seconds.

If the Transition Time value is longer than the Step Duration Time, an error is generated when initiating a source list sequence. For source list sequence, transition time is included in the step duration length (not occupy additional time). If the Transition Time value is longer than the Step Duration Time, the real step duration length is extended to equal the transition time and cause a timing shift.

Remote Command	`:SOURce:LIST:STEP[1]|2|…|1000:SETup:DURation:TCOunt <double>` `:SOURce:LIST:STEP[1]|2|…|1000:SETup:DURation:TCOunt?`
Example	`:SOUR:LIST:STEP2:SET:DUR:TCO 1s` `:SOUR:LIST:STEP2:SET:DUR:TCO?`
Notes	When Repetition is **Single**, the last step continues playing after the sequence is completed. In this extended playing time, `:STAT:OPER:COND?` returns 0 for the Source Sweeping Status Bit (bit 9) SCPI is supported after A.09.40 If current **Duration Type** is **Continuous**, then error -221, "Settings conflict; Cannot accept time or count input when step duration type is Continuous on step #" is displayed
Dependencies	Not available in E7760B
Preset	VXT models M9410A/11A/16A: 2.0 ms All others: 1.00 ms
Min	For VXT models M9410A/11A/16A, the minimum duration time for first step is 1.2 ms. If the Waveform is “waveform name”, the minimum duration time is 1.2 ms All others: 100 µs
Max	1800 s

Play Count

Lets you specify the number of times the current ARB waveform file will play during a step when "Step Duration" on page 2228 is Count.

"Duration Time" on page 2229

Remote Command	`:SOURce:LIST:STEP[1]|2|…|1000:SETup:DURation:TCOunt <double>` `:SOURce:LIST:STEP[1]|2|…|1000:SETup:DURation:TCOunt?`
Example	`:SOUR:LIST:STEP2:SET:DUR:TCO 10` `:SOUR:LIST:STEP2:SET:DUR:TCO?`
Notes	SCPI is supported after A.09.40 This command is reused by **Play Count** and **Duration Time** if **Duration Type** is set to **Play Count** or **Duration Time** If **Duration Type** is **Continuous**, then error -221, "Settings conflict; Cannot accept time or count input

	when step duration type is Continuous on step #" is displayed If **Play Count** is set for the last step, the last step of ARB keeps playing as if set to **Continuous** after play count setting is reached
Dependencies	Not available in E7760B
Preset	1
Min	1
Max	65536

Trig Out

Lets you specify the trigger output for the current step. The trigger output signal is sent at the start of the step.

When this is ON, a trigger event occurs on both Internal and External2 paths. Selecting OFF turns off trigger output.

Remote Command	`:SOURce:LIST:STEP[1]|2|…|1000:SETup:OUTPut:TRIGger ON | OFF | 1 | 0` `:SOURce:LIST:STEP[1]|2|…|1000:SETup:OUTPut:TRIGger?`
Example	`:SOUR:LIST:STEP2:SET:OUTP:TRIG ON` `:SOUR:LIST:STEP2:SET:OUTP:TRIG?`
Notes	SCPI is supported after A.09.40
Dependencies	Not available in E7760B
Preset	OFF
Range	ON|OFF

Step Configuration (Remote Command Only)

Used to configure the List Sequencer, as detailed in the table below. The command is defined such that you send one command per step, with the step number being specified as a subopcode of the SCPI command. Each command includes all the parameter settings for the step. As a step is set up, the values entered are run through several levels of validation.

Remote Command	`:SOURce:LIST:STEP[1]|2|…|1000:SETup <step_trigger>, <trans_time>, <band>, <link_type>, <freq_chan>, <power>, <waveform>, <duration>, <time_count>, <trig_state>`
	For details of each option, see "Step Configuration Parameters" on page 2232 below
	`:SOURce:LIST:STEP[1]|2|…|1000:SETup?`

Example	`:SOUR:LIST:STEP1:SET INT, 1ms, PGSM, DOWN, 10, -25 dBm, "GSM_Test1.bin", TIME, 10ms, OFF`
Dependencies	The range of subopcode values is 1 to 1000, and the value you enter is determined by the number of

steps you have configured. For details see "Number of Steps" on page 2218

If you attempt to remotely set or query a subopcode that is out of range, an error is generated

Step Configuration Parameters

There are 10 parameters for each step, which must be in the following order in the command:

1	Step Trigger `<step_trigger>`	Data Type: enum Specifies the input trigger for the step. For further details, see "Step Trigger" on page 2219
2	Transition Time `<trans_time>`	Data Type: enum Specifies the transition time for the step, in seconds. For further details, see "Transition Time" on page 2220
3	Radio Band `<band>`	Data Type: enum Specifies the radio band for the step, as any one of: `NONE | PGSM | EGSM | RGSM | DCS1800 | PCS1900 | TGSM810 | GSM450 | GSM480 | GSM700 | GSM850 | BANDI | BANDII | BANDIII | BANDIV | BANDV | BANDVI | BANDVII | BANDVIII | BANDIX | BANDX | BANDXI | BANDXII | BANDXIII | BANDXIV | BANDXIX | USCELL | USPCS | JAPAN | KOREAN | NMT | IMT2K | UPPER | SECOND | PAMR400 | PAMR800 | IMTEXT | PCS1DOT9G | AWS | US2DOT5G | PUBLIC | LOWER | NONE | BAND1 | BAND2 | BAND3 | BAND4 | BAND5 | BAND6 | BAND7 | BAND8 | BAND10 | BAND11 | BAND12 | BAND13 | BAND14 | BAND17 | BAND18 | BAND19 | BAND20 | BAND21 | BAND24 | BAND25 | BAND26 | BAND33 | BAND34 | BAND35 | BAND36 | BAND37 | BAND38 | BAND39 | BAND40 | BAND41 | BAND42 | BAND43 | BANDA | BANDB | BANDC | BANDD | BANDE | BANDF | N1 | N2 | N3 | N5 | N7 | N8 | N12 | N20 | N25 | N28 | N34 | N38 | N39 | N40 | N41 | N50 | N51 | N66 | N70 | N71 | N74 | N75 | N76 | N77 | N78 | N79 | N80 | N81 | N82 | N83 | N84 | N86 | N257 | N258 | N260 | N261` For further details, see "Band" on page 2221
4	Radio Band Link `<link_type>`	Data Type: enum Specifies the radio band link direction for the step, as either of: `DOWN|UP` For further details, see "Device" on page 2225 The old **Device** BTS|MS is obsolete, but is still supported, acting as an alias for the **Link** parameter
5	Frequency/Channel Number `<freq_chan>`	Data Type: freq/chan num Specifies the frequency in Hz or the channel number for the step. The channel number and frequency are combined as one parameter that represents the frequency or channel number depending on the radio band setting. If the radio band is set to `NONE`, this value is interpreted as a frequency value in Hz. If the radio band is set to a valid band, this value is interpreted as a channel number For further details, see "Freq/Chan" on page 2226

6	Power <power>	Data Type: ampl Specifies the output power for the step in dBm. For details of the valid ranges see "Power" on page 2227
7	Waveform <waveform>	Data Type: string Specifies the waveform for playback during the step. The step can output either a new ARB waveform, continue playback of the previous waveform, or output a CW tone. The options for specifying these are: <filename> — Plays the specified waveform from the start. The filename value is the name of the file within ARB playback memory, it is does not include the windows path to the file on the HDD. If you enter a filename for a waveform that does not reside within ARB playback memory, an error is generated CONT — Continues playback of the ARB file from the previous step CW — Outputs a CW tone OFF — Disables RF output For further details, see "Waveform" on page 2227 and "Waveform File" on page 2228
8	Step Duration <duration>	Data Type: enum Specifies the duration of the step, as one of: TIME|COUNt|CONTinuous The duration can be specified to be either time, or play count of the ARB file associated with the step, or continuous. If Waveform is set to CW, this value cannot be set to Play Count and an error will be generated. If CONTinuous is selected, the following Time or Count value is ignored. For further details, see "Step Duration" on page 2228
9	Time or Count <time_count>	Data Type: time/int Specifies time duration in seconds, or play count of the ARB file associated with the step For further details, see "Play Count" on page 2230
10	Output Trigger <trig_state>	Data Type: boolean Specifies the output trigger state for the step, as one of: ON|OFF|1|0 For further details, see "Trig Out" on page 2231

–

Step Configuration of Step Trigger parameter list (Remote Command Only)

Configures the “Step Trigger” parameter array of the whole List Sequencer at one time. The number of arrays is the same as the step number defined in "Number of

Steps" on page 2218. As a step is setup, the value entered runs through several levels of validation.

Remote Command	`:SOURce:LIST:SETup:INPut:TRIGger <enum>, <enum>, <enum>, …` `:SOURce:LIST:SETup:INPut:TRIGger?`
Example	`:SOUR:LIST:SET:INP:TRIG IMM,INT,EXT2` `:SOUR:LIST:SET:INP:TRIG?`
Notes	The command is to setup below parameter array of whole list sequence Step Trigger <**enum**> - specifies the input trigger for the step. For details of the valid types of step trigger see "Step Trigger" on page 2219 If input parameter number exceeds the step number defined by "Number of Steps" on page 2218, then error -221 "Settings conflict; The number of input parameters is too large and is truncated to current list step number" is generated, and only those parameters whose index number falls in number of steps will be updated
Dependencies	The range is 1 to 1000, which is determined by the number of steps you have configured. For details see "Number of Steps" on page 2218

Step Configuration of Transition Time parameter list (Remote Command Only)

Configures the “Transition Time” parameter array of the whole List Sequencer at once. The array size is the same as step number defined in "Number of Steps" on page 2218. As a step is setup, the value entered runs through several levels of validation.

Remote Command	`:SOURce:LIST:SETup:TRANsition:TIME <time>, <time>, <time>, …` `:SOURce:LIST:SETup:TRANsition:TIME?`
Example	`:SOUR:LIST:SET:TRAN:TIME 1ms,1ms,1ms` `:SOUR:LIST:SET:TRAN:TIME?`
Notes	The command is to setup below parameter array of whole list sequence Transition Time <**time**> - specifies the transition time for the step in seconds. For details of the valid ranges for the transition time see "Transition Time" on page 2220 If input parameter number exceeds the step number defined by "Number of Steps" on page 2218, then the error -221, "Settings conflict; The number of input parameters is too large and is truncated to current list step number" is generated, and only those parameters whose index number falls in number of steps will be updated
Dependencies	The range is 1 to 1000 which is determined by the number of steps you have configured. For details see "Number of Steps" on page 2218

Step Configuration of Radio Band parameter list (Remote Command Only)

Configures the **Radio Band** parameter array of the whole List Sequencer at once. The size of the array is the same as the step number defined in "Number of Steps" on page 2218. As a step is set up, the value entered runs through several levels of validation.

Remote Command	`:SOURce:LIST:SETup:RADio:BAND <enum>, <enum>, <enum>, …` `:SOURce:LIST:SETup:RADio:BAND?`
Example	`:SOUR:LIST:SET:RAD:BAND PGSM, EGSM, RGSM` `:SOUR:LIST:SET:RAD:BAND?`
Notes	The command sets up the parameter array of whole list sequence Radio Band <**enum**> - specifies the radio band for the step. For available options, see "Band" on page 2221 If the input parameter number exceeds the step number defined by "Number of Steps" on page 2218, then error -221, "Settings conflict; The number of input parameters is too large and is truncated to current list step number" is generated, and only those parameters whose index number falls within the number of steps will be updated
Dependencies	The range is 1 to 1000, which is determined by the number of steps you have configured. For details see "Number of Steps" on page 2218

Step Configuration of Radio Band Link parameter list (Remote Command Only)

Configures the **Radio Band Link** parameter array of the whole List Sequencer at one time. The number of arrays is same as step number defined in "Number of Steps" on page 2218. As a step is set up, the value entered runs through several levels of validation.

Remote Command	`:SOURce:LIST:SETup:RADio:BAND:LINK <enum>, <enum>, <enum>, …` `:SOURce:LIST:SETup:RADio:BAND:LINK?`
Example	`:SOUR:LIST:SET:RAD:BAND:LINK DOWN,UP,UP` `:SOUR:LIST:SET:RAD:BAND:LINK?`
Notes	The command sets up the parameter array of whole list sequence Radio Band Link <**enum**> - specifies the radio band link direction for the step. Options are: `DOWN|UP` If input parameter number exceeds the step number defined by "Number of Steps" on page 2218, then error -221, "Settings conflict; The number of input parameters is too large and is truncated to current list step number" is generated, and only those parameters whose index number falls within the number of steps will be updated
Dependencies	The range is 1 to 1000, which is determined by the number of steps you have configured. For details see "Number of Steps" on page 2218

Step Configuration of Frequency/Channel Number parameter list (Remote Command Only)

Configures the **Frequency** or **Channel Number** parameter array of the whole List Sequencer at one time. The number of arrays is same as step number defined in "Number of Steps" on page 2218. As a step is set up, the value entered runs through several levels of validation.

Remote Command	`:SOURce:LIST:SETup:CNFRequency <double>, <double>, <double>, …` `:SOURce:LIST:SETup:CNFRequency?`

Example	`:SOUR:LIST:SET:CNFR 1GHz,100MHz,100MHz`
	`:SOUR:LIST:SET:CNFR?`
	`:SOUR:LIST:SET:CNFR 124,124,124`
	`:SOUR:LIST:SET:CNFR?`

Notes	The command sets up the parameter array of whole list sequence Frequency/Channel Number <freq>/<chan num> - specifies the frequency in Hz or the channel number for the step. The channel number and frequency are combined as one parameter that represents the frequency or channel number depending on the radio band setting. If the radio band is set to `NONE`, this value is interpreted as a frequency value in Hz. If the radio band is set to a valid band, this value is interpreted as a channel number. For details of the valid ranges for frequency and channel numbers, see "Freq/Chan" on page 2226 and "Freq/Chan" on page 2226 This command is used to setup/query channel number or frequency setting, according to current Radio Band setting of that step. If Radio Band is `NONE`, then it is frequency. If Radio Band is not `NONE`, then it is channel number If input parameter number exceeds the step number defined by "Number of Steps" on page 2218, then generate error -221, "Settings conflict; The number of input parameters is too large and is truncated to current list step number", and only those parameters whose index number falls in legal step number will be updated
Dependencies	The range is 1 to 1000, which is determined by the number of steps you have configured. For details see "Number of Steps" on page 2218

Step Configuration of Power parameter list (Remote Command Only)

Configures the **Power** parameter array of the whole List Sequencer at one time. The number of arrays is the same as step number defined in "Number of Steps" on page 2218. As a step is set up, the value entered runs through several levels of validation.

Remote Command	`:SOURce:LIST:SETup:AMPLitude <ampl>, <ampl>, <ampl>, …` `:SOURce:LIST:SETup:AMPLitude?`
Example	`:SOUR:LIST:SET:AMPL -50dBm,-40dBm,-30dBm` `:SOUR:LIST:SET:AMPL?`
Notes	The command sets up the parameter array of whole list sequence

	Power <**ampl**> - specifies the output power for the step in dBm. For details of the valid ranges, see "Power" on page 2227 If input parameter number exceeds the step number defined by "Number of Steps" on page 2218, then error -221, "Settings conflict; The number of input parameters is too large and is truncated to current list step number" is generated, and only those parameters whose index number falls within legal step number will be updated
Dependencies	The range is 1 to 1000, which is determined by the number of steps you have configured. For details see "Number of Steps" on page 2218

Step Configuration of Waveform parameter list (Remote Command Only)

Configures the **Waveform** parameter array of the whole List Sequencer at one time. The number of arrays is same as step number defined in "Number of Steps" on page 2218. As a step is set up, the value entered runs through several levels of validation.

Remote Command	`:SOURce:LIST:SETup:WAVeform <string>, <string>, <string>, …` `:SOURce:LIST:SETup:WAVeform?`
Example	`:SOUR:LIST:SET:WAV "CW","Off","CONT"` `:SOUR:LIST:SET:WAV?`
Notes	Sets up or queries the parameter array of whole list sequence Waveform <**string**> - specifies the waveform for playback during the step. The step can output either a new ARB waveform, continue playback of the previous waveform, or output a CW tone. The options for specifying these are: `<filename>`: Plays the specified waveform from the start. The filename value is the name of the file within ARB playback memory, it is does not include the windows path to the file on the HDD. If you enter a filename for a waveform that does not reside within ARB playback memory, an error is generated `CONT`: Continues playback of the ARB file from the previous step `CW`: Outputs a CW tone `OFF`: Disables the RF output If input parameter number exceeds the step number defined by "Number of Steps" on page 2218, then error -221, "Settings conflict; The number of input parameters is too large and is truncated to current list step number" is generated, and only those parameters whose index number falls within number of steps will be updated
Dependencies	The range is 1 to 1000 which is determined by the number of steps you have configured. For details see "Number of Steps" on page 2218
Range	`"filename" | "CW" | "Off" | "CONT"`

Step Configuration of Step Duration parameter list (Remote Command Only)

Configures the **Step Duration** parameter array of the whole List Sequencer at one time. The number of arrays is same as step number defined in "Number of Steps" on page 2218. As a step is set up, the value entered runs through several levels of validation.

Remote Command	`:SOURce:LIST:SETup:DURation:TYPE <enum>, <enum>, <enum>, …` `:SOURce:LIST:SETup:DURation:TYPE?`
Example	`:SOUR:LIST:SET:DUR:TYPE COUN,TIME,CONT` `:SOUR:LIST:SET:DUR:TYPE?`
Notes	Sets up or queries the parameter array of whole list sequence Step Duration <**enum**> - specifies the duration of the step. The duration can be specified to be either time, or play count of the ARB file associated with the step, or continuous. If Waveform is set to "CW", this value cannot be set to Play Count and an error will be generated. If continuous is selected, the following Time or Count value is ignored. For further details of this setting, see "Step Duration" on page 2228 Options are: `TIME | COUNt | CONTinuous` If input parameter number exceeds the step number defined by "Number of Steps" on page 2218, then error -221, "Settings conflict; The number of input parameters is too large and is truncated to current list step number" is generated, and only those parameters whose index number falls within number of steps will be updated
Dependencies	The range is 1 to 1000, which is determined by the number of steps you have configured. For details see "Number of Steps" on page 2218

Step Configuration of Duration Time or Play Count parameter list (Remote Command Only)

Configures the **Duration Time** or **Play Count** parameter array of the whole List Sequencer at one time. The number of arrays is same as step number defined in "Number of Steps" on page 2218. As a step is set up, the value entered runs through several levels of validation.

Remote Command	`:SOURce:LIST:SETup:TOCount <time/int>, <time/int>, <time/int>, …` `:SOURce:LIST:SETup:TOCount?`

Example	`:SOUR:LIST:SET:TOC 1s,2s,3s`
	`:SOUR:LIST:SET:TOC?`
	`:SOUR:LIST:SET:TOC 5,6,7`
	`:SOUR:LIST:SET:TOC?`

Notes	Sets up or queries the parameter array of whole list sequence

	Time or Count <time/int> - specifies time duration in seconds or play count of the ARB file associated with the step If input parameter number exceeds the step number defined by "Number of Steps" on page 2218, then an error is generated, and only those parameters whose index number falls within number of steps will be updated If current "Step Duration" on page 2228 is "Continuous", then error -221, "Settings conflict; Cannot accept time or count input when step duration type is Continuous on step #" is generated
Dependencies	The range is 1 to 1000, which is determined by the number of steps you have configured. For details see "Number of Steps" on page 2218

Step Configuration of Output Trigger parameter list (Remote Command Only)

Configures the **Output Trigger** parameter array of the whole List Sequencer at one time. The number of arrays is same as step number defined in "Number of Steps" on page 2218. As a step is set up, the value entered runs through several levels of validation.

Remote Command	`:SOURce:LIST:SETup:OUTPut:TRIGger <bool>, <bool>, <bool>, …` `:SOURce:LIST:SETup:OUTPut:TRIGger?`
Example	`:SOUR:LIST:SET:OUTP:TRIG ON,OFF,ON` `:SOUR:LIST:SET:OUTP:TRIG?`
Notes	Sets up or queries the parameter array of whole list sequence Output Trigger <Boolean> - specifies the output trigger for the step. Options are: `ON|OFF|1|0` If input parameter number exceeds the step number defined by "Number of Steps" on page 2218, then error -221,"Settings conflict; The number of input parameters is too large and is truncated to current list step number" is generated, and only those parameters whose index number falls within legal step number are updated
Dependencies	The range is 1 to 1000, which is determined by the number of steps you have configured. For details see "Number of Steps" on page 2218

Clear List (Remote Command Only)

The SCPI equivalent of the Clear List UI feature described in "Clear List" on page 2219.

Remote Command	`:SOURce:LIST:SETup:CLEar`
Example	`:SOUR:LIST:SETup:CLE`
Dependencies	Not available in E7760B

6.1.8.8 Remote Software Trigger (Remote command Only)

During execution of a list sequence, the sequence halts and waits at any step that has Step Trigger set to “Bus”. Sending this command triggers the step and continues the sequence.

Remote Command	`:SOURce:LIST:TRIGger:INITiate[:IMMediate]`
Example	`:SOUR:LIST:TRIG:INIT`
Dependencies	Not available in E7760B

6.1.8.9 Query List Sequence Initiation Armed Status (Remote Query Only)

This is a blocking SCPI query to determine whether a source list sequence has been initiated successfully.

Remote Command	`:SOURce:LIST:INITiation:ARMed?`
Example	`:SOUR:LIST:INIT:ARMed?`
Notes	Returns “1” if list sequence has been initiated successfully, or “0” if not. If the response is “0”, use `:SYST:ERR?` to query the actual error Like `*OPC?`, this command can be blocked until event/status “IsSourceSweeping” occurs, and then returns. Doing so can help a script query the armed status only once during the time interval of the initiation. As an ancillary to the existing `:SOUR:LIST:TRIGger[:IMMediate]` (see "Initiate Sequence" on page 2216), send this query after `:SOUR:LIST:TRIG`. Otherwise, this query will return “1” immediately The return data is in the following format: Integer There is an alias: `:SOURce:LIST:TRIGger:INITiation:ARMed?`
Dependencies	Not available in E7760B

6.1.9 Frequency Setup

Lets you access the Frequency Setup sub-menu panel.

Notes	The menu under this control is for independent mode and has no effect on the "List Sequencer" on page 2215. If "Sequencer" on page 2216 is `ON`, the List Sequencer controls the source output and this key is grayed-out, to indicate out-of-scope. When "Sequencer" on page 2216 is `OFF`, source leaves List Sequencer and this button is blanked out

6.1.9.1 Frequency

Lets you set the RF Output Frequency. You can adjust the frequency of the source using the numeric keypad, step keys, or RPG. Pressing any digit (0 through 9) on the numeric keypad displays the unit terminator.

<table>
<tr><td>Remote Command</td><td><code>:SOURce:FREQuency[:CW] <freq></code>
<code>:SOURce:FREQuency[:CW]?</code></td></tr>
<tr><td>Example</td><td><code>:SOUR:FREQ 1.00 GHz</code></td></tr>
<tr><td>Notes</td><td>Internal source has list sequence mode, which comprises of several steps that contain separate output power, frequency and waveform etc. When the source list sequence playing is complete, the last step keeps playing, and you can use this command to change the list sequence last step’s output frequency</td></tr>
<tr><td>Couplings</td><td>The frequency value is coupled to the current channel band and number, such that updates to the band and number will update the frequency value to the corresponding absolute frequency</td></tr>
<tr><td>Preset</td><td><table>
<tr><td>E7760B</td><td>Depends on port selected</td></tr>
<tr><td>EXM, with license F1A or 5WC</td><td>2.412 GHz</td></tr>
<tr><td>VXT Models with Radio Heads/CIU</td><td>See "VXT Models with Remote Radio Heads/CIU" on page 2242</td></tr>
<tr><td>M941xE(VXT Models with M9471A)</td><td>See "M941xE(VXT Models with M9471A)" on page 2242</td></tr>
<tr><td>All other models</td><td>1.00 GHz</td></tr>
</table></td></tr>
<tr><td>Min</td><td><table>
<tr><td>E7760B</td><td>Depends on port selected</td></tr>
<tr><td>VXT model M9420A</td><td>60 MHz</td></tr>
<tr><td>VXT models M9410A/11A/15A/16A</td><td>380 MHz</td></tr>
<tr><td>VXT model M9411A with Option LFE</td><td>1 MHz</td></tr>
<tr><td>VXT Models with Radio Heads/CIU</td><td>See "VXT Models with Remote Radio Heads/CIU" on page 2242</td></tr>
<tr><td>M941xE(VXT Models with M9471A)</td><td>See "M941xE(VXT Models with M9471A)" on page 2242</td></tr>
<tr><td>All other models</td><td>10.00 MHz</td></tr>
</table></td></tr>
<tr><td>Max</td><td>Hardware Dependent:<table>
<tr><td>Option 503</td><td>3.6 GHz</td></tr>
<tr><td>Option 504</td><td>3.8 GHz</td></tr>
<tr><td>Option 506</td><td>6.00 GHz</td></tr>
<tr><td>Option F06</td><td>6.00 GHz</td></tr>
</table>
Parameters for "VXT models M9415A/16A" on page 2242
Parameters for "VXT Models with Remote Radio Heads/CIU" on page 2242
Parameters for "M941xE(VXT Models with M9471A)" on page 2242
For E7760B: Depends on port selected
For EXM, if license 5WC is present, the frequency range should be limited to: 1.1GHz-1.7GHz, 2.4GHz-2.5GHz, 4.8GHz-6.0GHz. If the user-defined frequency is outside of range, reports error message “Settings conflict; Frequency is outside available range”</td></tr>
</table>

VXT models M9410A/11A

RF Output Port	Preset	Min Without Option "LFE"	Min With Option "LFE"	Max
RF Output	1 GHz	380 MHz	1 MHz	6 GHz
RFHD	1 GHz	380 MHz	1 MHz	6 GHz

VXT models M9415A/16A

Freq Option	Preset	Min	Max
F06	1 GHz	380 MHz	6.0 GHz
F08	1 GHz	380 MHz	8.0 GHz
F12	1 GHz	380 MHz	12.3 GHz

E7760B

RF Output Port	Preset	Min	Max
IFIO	16 GHz	2 GHz	18 GHz
M1650A	58.32 GHz	55 GHz	69 GHz
M1720A	28 GHz	25 GHz	29 GHz

VXT Models with Remote Radio Heads/CIU

Products with Radio Heads/CIU	Preset	Min frequency	Max frequency
VXT + CIU	6 GHz	5.9 GHz	12 GHz
VXT + CIU + RRH	28 GHz	24.25 GHz	43.5 GHz
VXT + M1742A RRH	28 GHz	10 GHz	32 GHz

M941xE(VXT Models with M9471A)

Products with M9471A	Preset	Minimum settable frequency	Minimum frequency with Spec	Maximum settable frequency
M941xE without LFE option	1 GHz	330 MHz	380MHz	26.5GHz
M941xE with LFE option (LFE option in M9411A or M9471A)	1 GHz	750 kHz	1MHz	26.5GHz

NOTE The minimum spec frequency is 380 MHz, minimum settable center frequency is 330 MHz.

With Option LFE in M9411A or in M9471A, the minimum settable frequency is 750 kHz, but Spec to customer only ensure down to 1 MHz.

6.1.9.2 Channel

The frequency of the source can be specified by a channel number of a given frequency band. This control allows you to specify the current channel number. For the appropriate range of channel numbers for a given frequency band, see the following tables: "GSM/EDGE Channel Number Ranges" on page 2243, "W-CDMA Channel Number Ranges" on page 2244, "LTE FDD Channel Number Ranges" on page 2245, and "LTE TDD Channel Number Ranges" on page 2247.

Channel is not available on E7760B.

Remote Command	:SOURce:FREQuency:CHANnels:NUMBer <int> :SOURce:FREQuency:CHANnels:NUMBer?
Example	:SOUR:LIST:STEP2:SET:RAD:NUMB 1
Notes	Grayed-out when the "Radio Standard/Radio Band" on page 2248 is set to NONE
Couplings	The channel number is coupled to the frequency value when "Radio Standard/Radio Band" on page 2248 is not set to NONE When the frequency value is changed, the channel number increases or decreases to match the new frequency. If the frequency is not at an exact match for a channel number, the nearest channel number is displayed, with > or < indicating whether the frequency is above or below the channel number
Preset	1
Min/Max	See "GSM/EDGE Channel Number Ranges" on page 2243, "W-CDMA Channel Number Ranges" on page 2244, "LTE FDD Channel Number Ranges" on page 2245, and "LTE TDD Channel Number Ranges" on page 2247

GSM/EDGE Channel Number Ranges

Band	Link (Device)	Range	Frequency (MHz)
P-GSM	Uplink (MS)	1 £ n £ 124	890.0 + 0.2*n
	Downlink (BS)	1 £ n £ 124	935.0 + 0.2*n
E-GSM	Uplink (MS)	0 £ n £ 124	890.0 + 0.2*n
		975 £ n £ 1023	890.0 + 0.2*(n-1024)
	Downlink (BS)	0 £ n £ 124	935.0 + 0.2*n
		975 £ n £ 1023	935.0 + 0.2*(n-1024)
DCS 1800	Uplink (MS)	512 £ n £ 885	1710.200 + 0.20*(n-512)
	Downlink (BS)	512 £ n £ 885	1805.200 + 0.20*(n-512)
PCS 1900	Uplink (MS)	512 £ n £ 810	1850.200 + 0.2*(n-512)
	Downlink (BS)	512 £ n £ 810	1930.200 + 0.2*(n-512)
R-GSM	Uplink (MS)	0 £ n £ 124	890.0 + 0.2*n
		955 £ n £ 1023	890.0 + 0.2*(n-1024)
	Downlink (BS)	0 £ n £ 124	935.0 + 0.2*n

Band	Link (Device)	Range	Frequency (MHz)
		955 £ n £ 1023	935.0 + 0.2*(n-1024)
GSM 450	Uplink (MS)	256 £ n £ 293	450.6 + 0.2*(n-259)
	Downlink (BS)	256 £ n £ 293	460.6 + 0.2*(n-259)
GSM 480	Uplink (MS)	306 £ n £ 340	479.000 + 0.20*(n-306)
	Downlink (BS)	306 £ n £ 340	489.000 + 0.20*(n-306)
GSM 850	Uplink (MS)	128 £ n £ 251	824.200 + 0.20*(n-128)
	Downlink (BS)	128 £ n £ 251	869.200 + 0.20*(n-128)
GSM 700	Uplink (MS)	438 £ n £ 516	777.200 + 0.20*(n-438)
	Downlink (BS)	438 £ n £ 516	747.200 + 0.20*(n-438)
T-GSM810	Uplink (MS)	350 £ n £ 425	806.0 + 0.20*(n-350)
	Downlink (BS)	350 £ n £ 425	851.0 + 0.20*(n-350)

W-CDMA Channel Number Ranges

Band	Link (Device)	Range	Frequency (MHz)
Band I	Downlink	10562 £ n £ 10838	n÷5
	Uplink	9612 £ n £ 9888	n÷5
Band II	Downlink	412 £n £687	n÷5 + 1850.1
		9662 £n £9938	n÷5
	Uplink	12 £n £287	n÷5 + 1850.1
		350 £n £425	n÷5
Band III	Downlink	1162 ≤n £1513	n÷5 + 1575
	Uplink	937 ≤n £1288	n÷5 + 1525
Band IV	Downlink	537 ≤n ≤1738	n÷5 + 1805
		1887 ≤n ≤2087	n÷5 + 1735.1
	Uplink	1312 ≤n ≤1513	n÷5 + 1450
		1662 ≤n ≤1862	n÷5 + 1380.1
Band V	Downlink	1007 ≤n ≤1087	n÷5 + 670.1
		4357 ≤n ≤4458	n÷5
	Uplink	782 ≤n ≤862	n÷5 + 670.1
		4132 ≤n ≤4233	n÷5
Band VI	Downlink	1037 ≤n ≤1062	n÷5 + 670.1
		4387 ≤n ≤4413	n÷5
	Uplink	812 ≤n ≤837	n÷5 + 670.1
		4162 ≤n ≤4188	n÷5
Band VII	Downlink	2237 ≤n ≤2563	n÷5 + 2175
		2587 ≤n ≤2912	n÷5 + 2105.1

Band	Link (Device)	Range	Frequency (MHz)
	Uplink	2012 ≤n ≤2338	n÷5 + 2100
		2362 ≤n ≤2687	n÷5 + 2030.1
Band VIII	Downlink	2937 ≤n ≤3088	n÷5 + 340
	Uplink	2712 ≤n ≤2863	n÷5 + 340
Band IX	Downlink	9237 ≤n ≤9387	n÷5
	Uplink	8762 ≤n ≤8912	n÷5
Band X	Downlink	3112 ≤n ≤3388	n÷5 + 1490
		3412 ≤n ≤3687	n÷5 + 1430.1
	Uplink	2887 ≤n ≤3163	n÷5 + 1135
		3187 ≤n ≤3462	n÷5 + 1075.1
Band XI	Downlink	3712 ≤n ≤3812	n÷5 + 736
	Uplink	3487 ≤n ≤3587	n÷5 + 733
Band XII	Downlink	3837 ≤n ≤3903	n÷5 – 37
		3927 ≤n ≤3992	n÷5 – 54.9
	Uplink	3612 ≤n ≤3678	n÷5 – 22
		3702 ≤n ≤3767	n÷5 – 39.9
Band XIII	Downlink	4017 ≤n ≤4043	n÷5 – 55
		4067 ≤n ≤4092	n÷5 – 64.9
	Uplink	3792 ≤n ≤3818	n÷5 + 21
		3702 ≤n ≤3767	n÷5 – 39.9
Band XIV	Downlink	4117 ≤n ≤4143	n÷5 – 63
		4167 ≤n ≤4192	n÷5 – 72.9
	Uplink	3892 ≤n ≤3918	n÷5 + 12
		3942 ≤n ≤3967	n÷5 + 2.1
Band XIX	Downlink	712 £ n £ 763	n÷5 + 735
		787 £ n £ 837	n÷5 + 720.1
	Uplink	312 £ n £ 363	n÷5 + 770
		387 £ n £ 437	n÷5 + 755.1

LTE FDD Channel Number Ranges

The carrier frequency in the uplink and downlink is designated by the E-UTRA Absolute Radio Frequency Channel Number (EARFCN) in the range 0 - 65535. The relation between EARFCN and the carrier frequency in MHz for the downlink is given by the following equation, where F_{DL_low} and $N_{Offs\text{-}DL}$ are given in table 5.4.4-1 and N_{DL} is the downlink EARFCN.

$$F_{DL} = F_{DL\_low} + 0.1(N_{DL} – N_{Offs\text{-}DL})$$

The relation between EARFCN and the carrier frequency in MHz for the uplink is given by the following equation where F_{UL_low} and $N_{Offs-UL}$ are given in table 5.4.4-1 and N_{UL} is the uplink EARFCN.

$F_{UL} = F_{UL\_low} + 0.1(N_{UL} – N_{Offs-UL})$

Band	Downlink			Uplink		
	F_{DL_low} (MHz)	$N_{Offs-DL}$	Range of N_{DL}	F_{UL_low} (MHz)	$N_{Offs-UL}$	Range of N_{UL}
1	2110	0	0 – 599	1920	18000	18000 – 18599
2	1930	600	600 – 1199	1850	18600	18600 – 19199
3	1805	1200	1200 – 1949	1710	19200	19200 – 19949
4	2110	1950	1950 – 2399	1710	19950	19950 – 20399
5	869	2400	2400 – 2649	824	20400	20400 – 20649
6	875	2650	2650 – 2749	830	20650	20650 – 20749
7	2620	2750	2750 – 3449	2500	20750	20750 – 20449
8	925	3450	3450 – 3799	880	21450	21450 – 21799
9	1844.9	3800	3800 – 4149	1749.9	21800	21800 – 22149
10	2110	4150	4150 – 4749	1710	22150	22150 – 22749
11	1475.9	4750	4750 – 4949	1427.9	22750	22750 – 22949
12	729	5010	5010 – 5179	699	23010	23010 – 23179
13	746	5180	5180 – 5279	777	23180	23180 – 23279
14	758	5280	5280 – 5379	788	23280	23280 – 23379
...						
17	734	5730	5730 – 5849	704	23730	23730 – 23849
18	860	5850	5850 – 5999	815	23850	23850 – 23999
19	875	6000	6000 – 6149	830	24000	24000 – 24149
20	791	6150	6150 – 6449	832	24150	24150 – 24449
21	1495.9	6450	6450 – 6599	1447.9	24450	24450 – 24599
...						
24	1525	7700	7700 - 8039	1626.5	25700	25700 – 26039
25	1930	8040	8040 - 8689	1850	26040	26040 - 26689
26	859	8690	8690 - 9039	814	26690	26690 - 27039
...						

Note: The channel numbers that designate carrier frequencies so close to the operating band edges that the carrier extends beyond the operating band edge shall not be used. This implies that the first 7, 15, 25, 50, 75 and 100 channel numbers at the lower operating band edge and the last 6, 14, 24, 49, 74 and 99 channel numbers at the upper operating band edge shall not be used for channel bandwidths of 1.4, 3, 5, 10, 15 and 20 MHz respectively.

LTE TDD Channel Number Ranges

The carrier frequency in the uplink and downlink is designated by the E-UTRA Absolute Radio Frequency Channel Number (EARFCN) in the range 0 - 65535. The relation between EARFCN and the carrier frequency in MHz for the downlink is given by the following equation, where F_{DL_low} and $N_{Offs\text{-}DL}$ are given in table 5.4.4-1 and N_{DL} is the downlink EARFCN.

$F_{DL} = F_{DL\_low} + 0.1(N_{DL} – N_{Offs\text{-}DL})$

The relation between EARFCN and the carrier frequency in MHz for the uplink is given by the following equation where F_{UL_low} and $N_{Offs\text{-}UL}$ are given in table 5.4.4-1 and N_{UL} is the uplink EARFCN.

$F_{UL} = F_{UL\_low} + 0.1(N_{UL} – N_{Offs\text{-}UL})$

Band	Downlink			Uplink		
	F_{DL_low} (MHz)	$N_{Offs\text{-}DL}$	Range of N_{DL}	F_{UL_low} (MHz)	$N_{Offs\text{-}UL}$	Range of N_{UL}
33	1900	36000	36000 –36199	1900	36000	36000 – 36199
34	2010	36200	36200 –36349	2010	36200	36200 – 36349
35	1850	36350	36350 –36949	1850	36350	36350 – 36949
36	1930	36950	36950 –37549	1930	36950	36950 – 37549
37	1910	37550	37550 –37749	1910	37550	37550 – 37749
38	2570	37750	37750 –38249	2570	37750	37750 – 38249
39	1880	38250	38250 –38649	1880	38250	38250 – 38649
40	2300	38650	38650 –39649	2300	38650	38650 – 39649
41	2496	39650	39650 - 41589	2496	39650	39650 - 41589
42	3400	41590	41590 – 43589	3400	41590	41590 – 43589
43	3600	43590	43590 – 45589	3600	43590	43590 – 45589

Note: The channel numbers that designate carrier frequencies so close to the operating band edges that the carrier extends beyond the operating band edge shall not be used. This implies that the first 7, 15, 25, 50, 75 and 100 channel numbers at the lower operating band edge and the last 6, 14, 24, 49, 74 and 99 channel numbers at the upper operating band edge shall not be used for channel bandwidths of 1.4, 3, 5, 10, 15 and 20 MHz respectively.

6.1.9.3 Radio Setup

Lets you select the radio standard and associated radio band. You can also set the Radio Band Link to Uplink or Downlink.

Radio Standard/Radio Band

Lets you select the radio standard and associated radio band. The first column in the dialog lets you set the Radio Standard; for each standard, and the second column in the dialog changes to show you the available bands.

Once you have selected the radio standard, you can then set an active channel band. The radio standard and the active channel band allow you to use the "Channel" on page 2243 control to set Channel numbers, thus setting "Frequency" on page 2240 automatically.

Remote Command	`:SOURce:FREQuency:CHANnels:BAND <band>` where `<band>` is one of: `NONE | PGSM | EGSM | RGSM | DCS1800 | PCS1900 | GSM450 | GSM480 | GSM700 | GSM850 | TGSM810 | USCELL | USPCS | JAPAN | KOREAN | NMT | IMT2K | UPPER | SECOND | PAMR400 | PAMR800 | IMTEXT | PCS1DOT9G | AWS | US2DOT5G | PUBLIC | LOWER | BANDI | BANDII | BANDIII | BANDIV | BANDV | BANDVI | BANDVII | BANDVIII | BANDIX | BANDX | BANDXI | BANDXII | BANDXIII | BANDXIV | BANDXIX | BAND1 | BAND2 | BAND3 | BAND4 | BAND5 | BAND6 | BAND7 | BAND8 | BAND9 | BAND10 | BAND11 | BAND12 | BAND13 | BAND14 | BAND17 | BAND18 | BAND19 | BAND20 | BAND21 | BAND24 | BAND25 | BAND26 | BAND27 | BAND28 | BAND29 | BAND30 | BAND31 | BAND65 | BAND66 | BAND67 | BAND68 | BAND71 | BAND252 | BAND255 | BAND33 | BAND34 | BAND35 | BAND36 | BAND37 | BAND38 | BAND39 | BAND40 | BAND41 | BAND42 | BAND43 | BAND44 | BAND45 | BAND46 | BANDA | BANDB | BANDC | BANDD | BANDE | BANDF | N1 | N2 | N3 | N5 | N7 | N8 | N12 | N20 | N25 | N28 | N34 | N38 | N39 | N40 | N41 | N50 | N51 | N66 | N70 | N71 | N74 | N75 | N76 | N77 | N78 | N79 | N80 | N81 | N82 | N83 | N84 | N86 | N257 | N258 | N260 | N261` `:SOURce:FREQuency:CHANnels:BAND?`
Example	`:SOUR:LIST:STEP2:SET:RAD:BAND PGSM`
Notes	Setting this to NONE grays-out "Channel" on page 2243 under **Frequency Setup**

Here are the members of each group in Radio Standard and a SCPI example for each:

None – no Radio Standard

None	`:SOUR:FREQ:CHAN:BAND NONE`

GSM

Sets GSM/EDGE as the radio standard for use and accesses the GSM/EDGE specific channel band sub-menus.

P-GSM	`:SOUR:FREQ:CHAN:BAND PGSM`
E-GSM	`:SOUR:FREQ:CHAN:BAND EGSM`
R-GSM	`:SOUR:FREQ:CHAN:BAND RGSM`
DCS 1800	`:SOUR:FREQ:CHAN:BAND DCS1800`

PCS 1900	`:SOUR:FREQ:CHAN:BAND PCS1900`
GSM 450	`:SOUR:FREQ:CHAN:BAND GSM450`
GSM 480	`:SOUR:FREQ:CHAN:BAND GSM480`
GSM 700	`:SOUR:FREQ:CHAN:BAND GSM700`
GSM 850	`:SOUR:FREQ:CHAN:BAND GSM850`
T-GSM 810	`:SOUR:FREQ:CHAN:BAND T-GSM810`

W-CDMA

Sets WCDMA as the radio standard for use and accesses the W-CDMA specific channel band sub-menus.

Band I	`:SOUR:FREQ:CHAN:BAND BANDI`
Band II	`:SOUR:FREQ:CHAN:BAND BANDII`
Band III	`:SOUR:FREQ:CHAN:BAND BANDIII`
Band IV	`:SOUR:FREQ:CHAN:BAND BANDIV`
Band V	`:SOUR:FREQ:CHAN:BAND BANDV`
Band VI	`:SOUR:FREQ:CHAN:BAND BANDVI`
Band VII	`:SOUR:FREQ:CHAN:BAND BANDVII`
Band VIII	`:SOUR:FREQ:CHAN:BAND BANDVIII`
Band IX	`:SOUR:FREQ:CHAN:BAND BANDIX`
Band X	`:SOUR:FREQ:CHAN:BAND BANDX`
Band XI	`:SOUR:FREQ:CHAN:BAND BANDXI`
Band XII	`:SOUR:FREQ:CHAN:BAND BANDXII`
Band XIII	`:SOUR:FREQ:CHAN:BAND BANDXIII`
Band XIV	`:SOUR:FREQ:CHAN:BAND BANDXIV`
Band XIX	`:SOUR:FREQ:CHAN:BAND BANDXIX`

LTE

Sets LTE FDD as the radio standard for use and accesses the LTE FDD specific channel band sub-menus.

Band 1	`:SOUR:FREQ:CHAN:BAND BAND1`
Band 2	`:SOUR:FREQ:CHAN:BAND BAND2`
Band 3	`:SOUR:FREQ:CHAN:BAND BAND3`
Band 4	`:SOUR:FREQ:CHAN:BAND BAND4`
Band 5	`:SOUR:FREQ:CHAN:BAND BAND5`
Band 6	`:SOUR:FREQ:CHAN:BAND BAND6`
Band 7	`:SOUR:FREQ:CHAN:BAND BAND7`
Band 8	`:SOUR:FREQ:CHAN:BAND BAND8`

Band 9	`:SOUR:FREQ:CHAN:BAND BAND9`
Band 10	`:SOUR:FREQ:CHAN:BAND BAND10`
Band 11	`:SOUR:FREQ:CHAN:BAND BAND11`
Band 12	`:SOUR:FREQ:CHAN:BAND BAND12`
Band 13	`:SOUR:FREQ:CHAN:BAND BAND13`
Band 14	`:SOUR:FREQ:CHAN:BAND BAND14`
Band 17	`:SOUR:FREQ:CHAN:BAND BAND17`
Band 18	`:SOUR:FREQ:CHAN:BAND BAND18`
Band 19	`:SOUR:FREQ:CHAN:BAND BAND19`
Band 20	`:SOUR:FREQ:CHAN:BAND BAND20`
Band 21	`:SOUR:FREQ:CHAN:BAND BAND21`
Band 24	`:SOUR:FREQ:CHAN:BAND BAND24`
Band 25	`:SOUR:FREQ:CHAN:BAND BAND25`
Band 26	`:SOUR:FREQ:CHAN:BAND BAND26`
Band 27	`:SOUR:FREQ:CHAN:BAND BAND27`
Band 28	`:SOUR:FREQ:CHAN:BAND BAND28`
Band 29	`:SOUR:FREQ:CHAN:BAND BAND29`
Band 30	`:SOUR:FREQ:CHAN:BAND BAND30`
Band 31	`:SOUR:FREQ:CHAN:BAND BAND31`
Band 65	`:SOUR:FREQ:CHAN:BAND BAND65`
Band 66	`:SOUR:FREQ:CHAN:BAND BAND66`
Band 67	`:SOUR:FREQ:CHAN:BAND BAND67`
Band 68	`:SOUR:FREQ:CHAN:BAND BAND68`
Band 71	`:SOUR:FREQ:CHAN:BAND BAND71`
Band 252	`:SOUR:FREQ:CHAN:BAND BAND252`
Band 255	`:SOUR:FREQ:CHAN:BAND BAND255`

LTE TDD

Sets LTE TDD as the radio standard for use and accesses the LTE TDD specific channel band sub-menus.

Band 33	`:SOUR:FREQ:CHAN:BAND BAND33`
Band 34	`:SOUR:FREQ:CHAN:BAND BAND34`
Band 35	`:SOUR:FREQ:CHAN:BAND BAND35`
Band 36	`:SOUR:FREQ:CHAN:BAND BAND36`
Band 37	`:SOUR:FREQ:CHAN:BAND BAND37`
Band 38	`:SOUR:FREQ:CHAN:BAND BAND38`
Band 39	`:SOUR:FREQ:CHAN:BAND BAND39`

Band 40	`:SOUR:FREQ:CHAN:BAND BAND40`
Band 41	`:SOUR:FREQ:CHAN:BAND BAND41`
Band 42	`:SOUR:FREQ:CHAN:BAND BAND42`
Band 43	`:SOUR:FREQ:CHAN:BAND BAND43`
Band 44	`:SOUR:FREQ:CHAN:BAND BAND44`
Band 45	`:SOUR:FREQ:CHAN:BAND BAND45`
Band 46	`:SOUR:FREQ:CHAN:BAND BAND46`

5GNR

Sets 5G NR as the radio standard for use and accesses the 5G NR specific channel band sub-menus.

N 1	`:SOUR:FREQ:CHAN:BAND N1`
N 2	`:SOUR:FREQ:CHAN:BAND N2`
N 3	`:SOUR:FREQ:CHAN:BAND N3`
N 5	`:SOUR:FREQ:CHAN:BAND N5`
N 7	`:SOUR:FREQ:CHAN:BAND N7`
N 8	`:SOUR:FREQ:CHAN:BAND N8`
N 12	`:SOUR:FREQ:CHAN:BAND N12`
N 20	`:SOUR:FREQ:CHAN:BAND N20`
N 25	`:SOUR:FREQ:CHAN:BAND N25`
N 28	`:SOUR:FREQ:CHAN:BAND N28`
N 34	`:SOUR:FREQ:CHAN:BAND N34`
N 38	`:SOUR:FREQ:CHAN:BAND N38`
N 39	`:SOUR:FREQ:CHAN:BAND N39`
N 40	`:SOUR:FREQ:CHAN:BAND N40`
N 41	`:SOUR:FREQ:CHAN:BAND N41`
N 50	`:SOUR:FREQ:CHAN:BAND N50`
N 51	`:SOUR:FREQ:CHAN:BAND N51`
N 66	`:SOUR:FREQ:CHAN:BAND N66`
N 70	`:SOUR:FREQ:CHAN:BAND N70`
N 71	`:SOUR:FREQ:CHAN:BAND N71`
N 74	`:SOUR:FREQ:CHAN:BAND N74`
N 75	`:SOUR:FREQ:CHAN:BAND N75`
N 76	`:SOUR:FREQ:CHAN:BAND N76`
N 77	`:SOUR:FREQ:CHAN:BAND N77`
N 78	`:SOUR:FREQ:CHAN:BAND N78`
N 79	`:SOUR:FREQ:CHAN:BAND N79`
N 80	`:SOUR:FREQ:CHAN:BAND N80`

N 81	:SOUR:FREQ:CHAN:BAND N81
N 82	:SOUR:FREQ:CHAN:BAND N82
N 83	:SOUR:FREQ:CHAN:BAND N83
N 84	:SOUR:FREQ:CHAN:BAND N84
N 86	:SOUR:FREQ:CHAN:BAND N86
N 257	:SOUR:FREQ:CHAN:BAND N257
N 258	:SOUR:FREQ:CHAN:BAND N258
N 260	:SOUR:FREQ:CHAN:BAND N260
N 261	:SOUR:FREQ:CHAN:BAND N261

Radio Band Link

Lets you specify the channel band type as either uplink or downlink link direction. This value is used in conjunction with the channel band and channel number to determine the absolute frequency output by the source.

- When set to **Uplink** (UP), the source calculates the uplink frequency using an uplink formula together with the selected channel band and channel number
- When set to **Downlink** (DOWN) the source calculates the downlink frequency using a downlink formula together with the selected channel band and channel number

Remote Command	:SOURce:RADio:BAND:LINK DOWN | UP :SOURce:RADio:BAND:LINK?
Example	:SOUR:RAD:BAND:LINK UP
Preset	DOWN
Range	DOWN | UP
Backwards Compatibility SCPI	:SOURce:RADio:DEVice BTS | MS :SOURce:RADio:DEVice?
Backwards Compatibility Notes	DOWN = BTS UP = MS

6.1.9.4 Set Reference Frequency

Lets you set the frequency reference. Pressing this control turns the frequency reference state to ON, sets the reference frequency value to the current frequency, maintains this frequency at the RF output, and sets the displayed frequency to 0.00 Hz. All subsequent frequencies entered under Source>Frequency>Frequency are interpreted as being relative to this reference frequency.

When you use a frequency reference, the signal generator outputs a frequency that is set relative to the reference frequency by the value entered under **Source**, **Frequency**, **Frequency** as follows:

Output frequency = reference frequency – entered frequency

Where:

– reference frequency equals the original RF frequency entered under Source>Frequency>Frequency and set as the reference frequency

– entered frequency equals a new value entered under **Source**, **Frequency**, **Frequency**

In addition, the displayed frequency value will be the same as the value entered under Source>Frequency>Frequency.

NOTE

If Freq Reference is ON with a reference value set, entering a value under **Source**, **Frequency**, **Frequency** and pressing **Set Frequency Reference** adds that value to the existing Freq Reference value.

If you wish to change the reference frequency value to the new value entered under **Source**, **Frequency**, **Frequency**, first set Freq Reference OFF then press **Set Frequency Reference**.

Remote Command	`:SOURce:FREQuency:REFerence:SET`
Example	`:SOUR:FREQ:REF:SET`
Dependencies	Unavailable, and grayed-out, when List Sequencer is ON

6.1.9.5 Freq Reference

Lets you toggle the state of the frequency reference. When the frequency reference state is ON, an annunciator is displayed on the main source view to indicate this state to the user.

When you use a frequency reference, the signal generator outputs a frequency that is set relative to the reference frequency by the value entered under **Source**, **Frequency**, **Frequency** as follows:

Output frequency = reference frequency + entered frequency

Where:

– reference frequency equals the original RF frequency entered under **Source**, **Frequency**, **Frequency** and set as the reference frequency

– entered frequency equals a new value entered under **Source**, **Frequency**, **Frequency**

For more information on Reference Frequency, see "Set Reference Frequency" on page 2252.

Remote Command	`:SOURce:FREQuency:REFerence <freq>` `:SOURce:FREQuency:REFerence?`
Example	`:SOUR:FREQ:REF 0.00 Hz`
Dependencies	Unavailable, and grayed-out, when List Sequencer is ON
Couplings	The frequency reference state is coupled to the frequency reference set immediate action. When the reference set immediate action key is pressed, or the SCPI command issued, it turns the frequency reference state ON
Preset	0.00 Hz
Min	0.00 Hz
Max	Hardware Dependent: Option 503: 3.6 GHz Option 504: 3.8 GHz Option 506: 6.00 GHz For E7760B: Dependent on port selected

Auto Function

Remote Command	`:SOURce:FREQuency:REFerence:STATe OFF | ON | 0 | 1` `:SOURce:FREQuency:REFerence:STATe?`
Example	`:SOUR:FREQ:REF:STATe ON`
Preset	OFF

6.1.9.6 Freq Offset

Lets you specify the frequency offset value. When the frequency offset state is ON, an annunciator is displayed on the main source view to indicate this state.

When the frequency offset is set to zero (0) and you set a new offset value, the displayed frequency value changes as follows, and the RF output frequency does not change:

Displayed value = output frequency + offset value

Where:

- output frequency equals the original frequency entered under **Source**, **Frequency**, **Frequency**
- offset value equals the value entered under **Source**, **Frequency**, **Freq Offset**

When the frequency offset is set to a value other than zero (0) and you enter a new frequency value under **Source**, **Frequency**, **Frequency**, the displayed frequency will be the same as the value entered and the RF output frequency will be equal to the value entered minus the offset value as follows:

Output frequency = entered frequency – offset frequency

Displayed frequency = output frequency + offset frequency

Displayed frequency = entered frequency

Where:

– entered frequency equals the frequency entered under **Source**, **Frequency**, **Frequency**

– offset frequency equals the value previously entered and set under **Source**, **Frequency**, **Freq Offset**

Remote Command	`:SOURce:FREQuency:OFFSet <freq>` `:SOURce:FREQuency:OFFSet?`
Example	`:SOUR:FREQ:OFFS 0 Hz`
Dependencies	Unavailable, and grayed-out, when List Sequencer is ON
Preset	0 Hz
Min/Max	–/+100.00 GHz

6.1.9.7 Freq Increment

Changes the step size for the RF Output Frequency function. Once an increment size has been selected and the RF Output Frequency function is active, the step keys (and the UP|DOWN parameters for RF Frequency from remote commands) change the RF Output Frequency by the increment set value.

This feature exists in EXG and MXG.

Remote Command	`:SOURce:FREQuency:STEP[:INCRement] <freq>` `:SOURce:FREQuency:STEP[:INCRement]?`
Example	`:SOUR:FREQ:STEP 1.0 kHz`
Couplings	Coupled to the Step size of the RF Frequency function
Preset	Hardware Dependent. 10% of the span preset value
Min	1 Hz
Max	Hardware Dependent: Option 503: 3.6 GHz Option 504: 3.8 GHz

Option 506	6.00 GHz

For E7760B: Dependent on port selected

For EXM, if license 5WC is present, the frequency range should be limited to: 1.1GHz-1.7GHz, 2.4GHz-2.5GHz, 4.8GHz-6.0GHz. If the user-defined frequency is outside of range, reports error message “Settings conflict; Frequency is outside available range”

6.1.9.8 Rx/Tx Coupling

Allows coupling between the frequency of the Internal Source, RF Output Frequency, and the instrument Center Frequency. For all settings except NONE, this parameter couples the **Center Frequency** of the instrument to the RF Output Frequency of the source. Valid setting changes result in the Analyzer CF and RF Output Frequency parameters being set to the same value, plus the "Rx/Tx Offset" on page 2257.

The four states for coupling are:

SOURce	Source follows Analyzer Coupling is in one direction only. Changes to the Center Frequency will result in the RF Output Frequency being set to the same value, with any Rx/Tx Frequency Offset applied. Changes to the RF Output Frequency will not change the Center Frequency and will change Rx/Tx Frequency Coupling to None
ANALyzer	Analyzer follows Source Coupling is in one direction only. Changes to the RF Output Frequency will result in the Center Frequency being set to the same value, with any Rx/Tx Frequency Offset applied. Changes to the Center Frequency will not change the RF Output Frequency and will change Rx/Tx Frequency Coupling to None
BOTH	Analyzer/Source Coupled Coupling is bi-directional. Changes to the Center Frequency will result in the RF Output Frequency being set to the same value, with any Rx/Tx Frequency Offset applied. Changes to the RF Output Frequency will result in the Center Frequency being set to the same value, with any Rx/Tx Frequency Offset applied
NONE	None RF Output Frequency and CF Frequency are independently controlled

Remote Command	`:SOURce:FREQuency:COUPling NONE | BOTH | SOURce | ANALyzer` `:SOURce:FREQuency:COUPling?`
Example	`:SOUR:FREQ:COUP BOTH`
Dependencies	Only appears in Radio Test Mode
Preset	NONE Input/Output Preset
State Saved	Yes

6.1.9.9 Rx/Tx Offset

Lets you offset the RF Output Frequency of the source from the **Center Frequency** of the instrument. See "Rx/Tx Coupling" on page 2256 for coupling behavior.

Remote Command	`:SOURce:FREQuency:COUPling:OFFSet <freq>` `:SOURce:FREQuency:COUPling:OFFSet?`
Example	`:SOUR:FREQ:COUP:OFF 100 kHz`
Dependencies	Grayed-out when "Rx/Tx Coupling" on page 2256 is set to `NONE`. If the grayed-out control is selected, the following message appears: “The parameter cannot be changed when Rx/Tx Coupling is Off” Only appears in Radio Test Mode
Preset	0 Hz (Input/Output Preset)
Min	-6 GHz
Max	Hardware Dependent: Option 503: 3.6 GHz Option 504: 3.8 GHz Option 506: 6.00 GHz For E7760B: Dependent on port selected For E6640A, if license 5WC is present, the frequency range should be limited to: 1.1GHz-1.7GHz, 2.4GHz-2.5GHz, 4.8GHz-6.0GHz. If the user-defined frequency is outside of range, UI reports an error message: “Settings conflict; Frequency is outside available range”

6.1.10 Modulation

Lets you toggle the state of modulation.

Remote Command	`:OUTPut:MODulation[:STATe] ON | OFF | 1 | 0` `:OUTPut:MODulation[:STATe]?`
Example	`:OUTP:MOD OFF`
Notes	This setting is for independent mode and has no effect on the "List Sequencer" on page 2215. If **Sequencer** is `ON`, the List Sequencer controls the source output, and this key is grayed-out When **Sequencer** is `OFF`, source leaves List Sequencer, and this setting is blanked out, taking effect immediately When Modulation is `ON`, the “MOD” annunciator is displayed in the system settings panel. When Modulation is `OFF`, the “MOD” annunciator is cleared If **Sequencer** is `ON`, the “MOD” annunciator will be replaced by “SEQ” in the system settings panel, indicating that the output is controlled by List Sequencer

Preset	OFF
Range	ON|OFF

6.1.11 Modulation Setup

Allows access to the menus for setting up the available modulation types.

Not available in E7760B.

AM/FM/PM are not available for VXT models M9415A/16A and M9415E/16E .

6.1.11.1 AM

Enables or disables amplitude modulation.

Turning AMON when another modulation format is already on results in the previous modulation format being turned off, and generates an error.

Remote Command	:SOURce:AM:STATe ON | OFF | 1 | 0 :SOURce:AM:STATe?
Example	:SOUR:AM:STAT OFF
Dependencies	Not available in E7760B
Preset	OFF
Range	ON|OFF

6.1.11.2 AM Mod Depth

Lets you set the amplitude modulation depth in percent.

Remote Command	:SOURce:AM[:DEPTh][:LINear] <real> :SOURce:AM[:DEPTh][:LINear]?
Example	:SOUR:AM 0.1
Dependencies	Not available in E7760B
Preset	0.1 %
Min	0.1 %
Max	95.0 %

6.1.11.3 AM Rate

Lets you set the internal amplitude modulation rate.

Remote Command	`:SOURce:AM:INTernal:FREQuency <freq>` `:SOURce:AM:INTernal:FREQuency?`
Example	`:SOUR:AM:INT:FREQ 40.0 Hz`
Dependencies	Not available in E7760B
Preset	400.0 Hz
Min	10 Hz
Max	40 kHz

6.1.11.4 AM Rate Increment

Changes the step size for "AM Rate" on page 2258. Once an increment size has been selected and **AM Rate** is active, the step keys (and the `UP|DOWN` parameters for **AM Rate** from remote commands) change **AM Rate** by the increment value.

Remote Command	`:SOURce:AM:INTernal:FREQuency:STEP[:INCRement] <freq>` `:SOURce:AM:INTernal:FREQuency:STEP[:INCRement]?`
Example	`:SOUR:AM:INT:FREQ:STEP 100 Hz` `:SOUR:AM:INT:FREQ:STEP?`
Couplings	Coupled to the increment size of **AM Rate**
Preset	10 Hz
State Saved	Yes
Min	1 Hz
Max	40 kHz

6.1.11.5 FM

Enables or disables frequency modulation.

Turning `FMON` when another modulation format is already on results in the previous modulation format being turned off and the generation of an error.

Remote Command	`:SOURce:FM:STATe ON | OFF | 1 | 0` `:SOURce:FM:STATe?`
Example	`:SOUR:FM:STAT OFF`
Dependencies	Not available in E7760B
Preset	`OFF`
Range	`ON|OFF`

6.1.11.6 FM Deviation

Lets you set the frequency modulation deviation.

Remote Command	`:SOURce:FM[:DEViation] <freq>` `:SOURce:FM[:DEViation]?`
Example	`:SOUR:FM 1.00 kHz`
Dependencies	Not available in E7760B
Preset	1.00 Hz
Min	1.00 Hz
Max	100.00 kHz

6.1.11.7 FM Rate

Lets you set the internal frequency modulation rate.

Remote Command	`:SOURce:FM:INTernal:FREQuency <freq>` `:SOURce:FM:INTernal:FREQuency?`
Example	`:SOUR:FM:INT:FREQ 40.0 Hz`
Dependencies	Not available in E7760B
Preset	400.0 Hz
Min	10 Hz
Max	40 kHz

6.1.11.8 FM Rate Increment

Changes the step size for "FM Rate" on page 2260. Once an increment size has been selected and **FM Rate** is active, the step keys (and the `UP|DOWN` parameters for **FM Rate** from remote commands) change **FM Rate** by the increment value.

Remote Command	`:SOURce:FM:INTernal:FREQuency:STEP[:INCRement] <freq>` `:SOURce:FM:INTernal:FREQuency:STEP[:INCRement]?`
Example	`:SOUR:FM:INT:FREQ:STEP 100 Hz` `:SOUR:FM:INT:FREQ:STEP?`
Couplings	Coupled to the increment size of **FM Rate**
Preset	10 Hz
State Saved	Yes
Min	1 Hz
Max	40 kHz

6.1.11.9 PM

Enables or disables phase modulation.

Turning PMON when another modulation format is already on results in the previous modulation format being turned OFF and the generation of an error.

Remote Command	`:SOURce:PM:STATe ON | OFF | 1 | 0` `:SOURce:PM:STATe?`
Example	`:SOUR:PM:STAT OFF`
Dependencies	Not available in E7760B
Preset	OFF
Range	ON|OFF

6.1.11.10 PM Deviation

Lets you set the phase modulation deviation in radian.

<table>
<tr><td>Remote Command</td><td><code>:SOURce:PM[:DEViation] <real></code>
<code>:SOURce:PM[:DEViation]?</code></td></tr>
<tr><td>Example</td><td><code>:SOUR:PM 1.00</code></td></tr>
<tr><td>Dependencies</td><td>Not available in E7760B</td></tr>
<tr><td>Preset</td><td>0.1 rad</td></tr>
<tr><td>Min</td><td>0.1 rad</td></tr>
<tr><td>Max</td><td><table><tr><th>Instrument Type</th><th>Value</th></tr><tr><td>M9410A/11A</td><td>10.0 rad</td></tr><tr><td>All Others</td><td>20.0 rad</td></tr></table></td></tr>
</table>

6.1.11.11 PM Rate

Lets you set the internal phase modulation rate.

Remote Command	`:SOURce:PM:INTernal:FREQuency <freq>` `:SOURce:PM:INTernal:FREQuency?`
Example	`:SOUR:PM:INT:FREQ 40.0 Hz`
Dependencies	Not available in E7760B
Preset	400.0 Hz

Min	10 Hz
Max	40 kHz

6.1.11.12 PM Rate Increment

Changes the step size for "PM Rate" on page 2261. Once an increment size has been selected and **PM Rate** is active, the step keys (and the `UP|DOWN` parameters for **PM Rate** from remote commands) change **PM Rate** by the increment value.

Remote Command	`:SOURce:PM:INTernal:FREQuency:STEP[:INCRement] <freq>` `:SOURce:PM:INTernal:FREQuency:STEP[:INCRement]?`
Example	`:SOUR:PM:INT:FREQ:STEP 100 Hz` `:SOUR:PM:INT:FREQ:STEP?`
Couplings	Coupled to the increment size of PM Rate
Preset	10 Hz
State Saved	Yes
Min	1 Hz
Max	40 kHz

6.1.11.13 ARB Setup

Accesses menus for setting up the Arbitrary Waveform Generator.

Basic Control

Lets you set up the basic ARB parameters and select a waveform to play.

ARB State

Lets you toggle the state of the ARB function. When the ARB is `ON`, a “MOD” annunciator is displayed in the system settings panel. When the ARB is `OFF`, the MOD annunciator is cleared

Remote Command	`:SOURce:RADio:ARB[:STATe] ON | OFF | 1 | 0` `:SOURce:RADio:ARB[:STATe]?`
Example	`:SOUR:RAD:ARB OFF` `:SOUR:RAD:ARB?`
Notes	If ARB is `ON`, and you then load or delete another file to ARB memory, the playing waveform segment may not keep phase continuity during the ARB memory operation. The waveform will be replayed after the ARB operation is finished

Dependencies	This setting is for the independent mode, and has no effect on "List Sequencer" on page 2215. If **Sequencer** is ON, this will make the source enter List Sequencer mode, and even if ARB state is ON, the ARB file will not be played. When **Sequencer** is OFF, source leaves List Sequencer and this setting takes effect immediately The ARB can only be turned on when there is a waveform file selected for playback. On the GUI, If no waveform is selected, this key is grayed out. If you send the SCPI command to turn the ARB on with no waveform selected for playback, the ARB state remains OFF and an error is generated -If you try to recall a certain set of states in which the selected waveform is not in ARB memory and the ARB state is ON, errors are reported
Preset	`OFF`
Range	`ON|OFF`

Sample Rate

Lets you set the ARB waveform playback sample rate.

See "More Information" on page 2264

Remote Command	`:SOURce:RADio:ARB:SCLock:RATE <freq>` `:SOURce:RADio:ARB:SCLock:RATE?`
Example	`:SOUR:RAD:ARB:SCL:RATE 48.00 MHz`
Notes	If there is a sample rate specified in the header of the waveform file, changing that sample rate is not recommended, as it may cause problems with burst timing For E7760B, the Sample Rate is fixed. If this control is attempted to be set the error -221, “Settings conflict; Sample Rate is fixed” is generated
Dependencies	When a new waveform is selected for playback the settings contained within the associated waveform header file are applied to the ARB. The sample rate is one of the values stored within the header file. If the newly selected waveform file has an associated header file, the sample rate is updated with the value from the header file. The sample rate will remain unchanged if the newly selected waveform does not have an associated header file
Preset	

E7760B	2.64 GHz
Option B40	50 MHz
Option B85	100 MHz
Option B1X	200 MHz
Option B3X	375 MHz
Option B6X	750 MHz
Option B4X	500 MHz
Option B8X	1.0 GHz
Option B12	1.5 GHz

Min	E7760B: 2.64 GHz All Others: 1.00 kHz
Max	Hardware Dependent:

E7760B		2.64 GHz
VXT model M9420A	Option B40	50 MHz
	Option B85	100 MHz
	Option B1X	200 MHz
VXT models M9410A/11A and M9410E/11E	Option B40	50 MHz
	Option B3X	375 MHz
	Option B6X	750 MHz
	Option B12	1.5 GHz
VXT models M9415A/16A and M9415E/16E	Option B4X	500 MHz
	Option B8X	1.0 GHz
	Option B12	1.5 GHz

For VXT models M9410A/11A/15A/16A, M9410E/11E/15E/16E and E6680A/81A, the sample rate is only limited by the option, but the IF BW is limited by center frequency in addition to options. See "More Information" on page 2264. Performance is guaranteed only when the bandwidth of the selected waveform is smaller than the Max IF BW

More Information

Although the range of Sample Rate only depends on the installed option, the Maximum IF BW depends on options as well as the Center Frequency.

VXT models M9410A/11A, E6680A and E6681A

Option Limitation:

Option	Maximum IF BW
B40	40 MHz
B3X	300 MHz
B6X	600 MHz
B12	1200 MHz

Center Frequency Limitation:

Center Frequency	Maximum IF BW
6.5 kHz ~ 9 kHz (Option LFE)	(CF – 6.5 kHz) * 2
9 kHz ~ 100 kHz (Option LFE)	5 kHz

Center Frequency	Maximum IF BW
100 kHz ~ 1 MHz (Option LFE)	50 kHz
1 MHz ~ 10 MHz (Option LFE)	500 kHz
10 MHz ~ 20 MHz (Option LFE)	5 MHz
20 MHz ~ 60 MHz (Option LFE)	10 MHz
60 MHz ~ 80 MHz (Option LFE)	20 MHz
80 MHz ~ 380 MHz (Option LFE)	40 MHz
330 MHz ~ 380 MHz (without Option LFE)	(CF – 330 MHz) * 2
380 MHz ~ 550 MHz	100 MHz
550 MHz ~ 1310 MHz	200 MHz
1310 MHz ~ 2000 MHz (without Option EP6)	600 MHz
2000 MHz ~ 5480 MHz (without Option EP6)	1200 MHz
5480 MHz ~ 6080 MHz (without Option EP6)	(6080 MHz – CF) * 2
1310 MHz ~ 1900 MHz (Option EP6)	600 MHz
1900 MHz ~ 6000 MHz (Option EP6)	1200 MHz
6000 MHz ~ 6600 MHz (Option EP6)	(6600 MHz – CF) * 2

VXT models M9415A/16A

Option Limitation:

Option	Maximum IF BW
B4X	400 MHz
B8X	800 MHz
B12	1200 MHz

Center Frequency Limitation:

Center Frequency	Maximum IF BW
330 MHz ~ 380 MHz	(CF – 330 MHz) * 2
380 MHz ~ 550 MHz	100 MHz
550 MHz ~ 1310 MHz	200 MHz
1310 MHz ~ 2000 MHz	600 MHz
2000 MHz ~ 12300 MHz	1200 MHz
12300 MHz ~ 12900 MHz	(12900 MHz – CF) * 2

M9410E/11E

Option Limitation:

Option	Maximum IF BW
B40	40 MHz
B3X	300 MHz
B6X	600 MHz
B12	1200 MHz

Center Frequency Limitation:

Center Frequency	Maximum IF BW
1 MHz ~ 10 MHz (Option LFE)	500 kHz
10 MHz ~ 20 MHz (Option LFE)	5 MHz
20 MHz ~ 60 MHz (Option LFE)	10 MHz
60 MHz ~ 80 MHz (Option LFE)	20 MHz
80 MHz ~ 380 MHz (Option LFE)	40 MHz
330 MHz ~ 380 MHz (without Option LFE)	(CF – 330 MHz) * 2
380 MHz ~ 550 MHz	100 MHz
550 MHz ~ 1310 MHz	200 MHz
1310 MHz ~ 2000 MHz (without Option EP6)	600 MHz
2000 MHz ~ 25.9 GHz (without Option EP6)	1200 MHz
1310 MHz ~ 1900 MHz (Option EP6)	600 MHz
1900 MHz ~ 25.9 GHz (Option EP6)	1200 MHz
25.9 GHz ~ 26.5 GHz	Min(Max BW by option, 2*(26.5 GHz-Center Freq))

M9415E/16E

Option Limitation:

Option	Maximum IF BW
B4X	400 MHz
B8X	800 MHz
B12	1200 MHz

Center Frequency Limitation:

Center Frequency	Maximum IF BW
1 MHz ~ 10 MHz (Option LFE)	500 kHz
10 MHz ~ 20 MHz (Option LFE)	5 MHz
20 MHz ~ 60 MHz (Option LFE)	10 MHz
60 MHz ~ 80 MHz (Option LFE)	20 MHz
80 MHz ~ 380 MHz (Option LFE)	40 MHz

Center Frequency	Maximum IF BW
330 MHz ~ 380 MHz (without Option LFE)	(CF – 330 MHz) * 2
380 MHz ~ 550 MHz	100 MHz
550 MHz ~ 1310 MHz	200 MHz
1310 MHz ~ 2000 MHz	600 MHz
2000 MHz ~ 25.9 GHz	1200 MHz
25.9 GHz ~ 26.5 GHz	Min(Max BW by option, 2*(26.5 GHz-Center Freq))

Run-Time Scaling

Lets you adjust the run-time scaling value. The run-time scaling value is applied in real-time while the waveform is playing.

Remote Command	`:SOURce:RADio:ARB:RSCaling <real>` `:SOURce:RADio:ARB:RSCaling?`
Example	`:SOUR:RAD:ARB:RSC 100.00`
Notes	Cannot be set in EXM and VXT. Grayed-out in menu, and the value is fixed at 70.00%
Dependencies	When a new waveform is selected for playback the settings contained within the associated waveform header file are applied to the ARB. The run-time scaling is one of the values stored within the header file. If the newly selected waveform file has an associated header file, the run-time scaling is updated with the value from the header file. The run-time scaling will remain unchanged if the newly selected waveform does not have an associated header file
Preset	70.00 %
Min	1.00 %
Max	100.00 %

Baseband Freq Offs

Lets you adjust the value by which the baseband frequency is offset relative to the carrier.

Remote Command	`:SOURce:RADio:ARB:BASeband:FREQuency:OFFSet <freq>` `:SOURce:RADio:ARB:BASeband:FREQuency:OFFSet?`
Example	`:SOUR:RAD:ARB:BAS:FREQ:OFFS 0.00 Hz`
Dependencies	When a new waveform is selected for playback the settings contained within the associated waveform header file are applied to the ARB. The baseband frequency offset is one of the values stored within the header file. If the newly selected waveform file has an associated header file, the baseband frequency offset is updated with the value from the header file. The baseband frequency offset will remain unchanged if the newly selected waveform does not have an associated header file Not available in E7760B

Preset	0.00 Hz
Min	-50.00 MHz
Max	50.00 MHz

Baseband Power

Lets you quickly control the power of the modulator prior to up-conversion to the RF carrier.

Remote Command	`:SOURce:RADio:ARB:BASeband:POWer <ampl>` `:SOURce:RADio:ARB:BASeband:POWer?`
Example	`:SOUR:RAD:ARB:BAS:POW -10 dB`
Notes	The Source Power level equals RF Power plus Baseband Power. For example, if the RF Power is set to -10 dBm and the Baseband Power is set to -4 dB, the actual Source Power level is -14 dBm Can be used to change the output level very quickly compared to the RF Power
Dependencies	Only appears in VXT models M9410A/11A/15A/16A and M9410E/11E/15E/16E
Preset	0 dB
Min	-50 dB
Max	20 dB

Mkr 1-4 Polarity

Lets you set the polarity of markers 1 through 4 respectively.

Remote Command	`:SOURce:RADio:ARB:MPOLarity:MARKer1|…|4 POSitive | NEGative` `:SOURce:RADio:ARB:MPOLarity:MARKer1|…|4?`
Example	`:SOUR:RAD:ARB:MPOL:MARK1 NEG`
Dependencies	When a new waveform is selected for playback the settings contained within the associated waveform header file are applied to the ARB. The marker polarity is one of the values stored within the header file. If the newly selected waveform file has an associated header file, the marker polarity is updated with the value from the header file. The marker polarity will remain unchanged if the newly selected waveform does not have an associated header file Not available in E7760B
Preset	`POSitive`
Range	`POSitive|NEGative`

Pulse/RF Blank

Lets you select which marker is used for **Pulse/RF Blank** . This function blanks the RF when the marker signal goes low. The marker polarity determines when the marker signal is high. For a positive polarity, this is during the marker points. For a negative polarity, this is when there are no marker points.

Marker points should be set before using this function. Enabling this function without setting maker points may create a continuous low or high signal, dependent on the marker polarity. This causes either no RF output, or a continuous RF output.

Remote Command	`:SOURce:RADio:ARB:MDEStination:PULSe NONE | M1 | M2 | M3 | M4`
	For option details, see "More Information" on page 2269
	`:SOURce:RADio:ARB:MDEStination:PULSe?`

Example	`:SOUR:RAD:ARB:MDES:PULS NONE`
Dependencies	When a new waveform is selected for playback the settings contained within the associated waveform header file are applied to the ARB. The **Pulse/RF Blank** setting is one of the values stored within the header file. If the newly selected waveform file has an associated header file, the **Pulse/RF Blank** setting is updated with the value from the header file. The **Pulse/RF Blank** setting remains unchanged if the newly selected waveform does not have an associated header file
Range	`NONE | M1 | M2 | M3 | M4`

More Information

Parameter	SCPI	Notes
None	`NONE`	Sets no marker to be used for **Pulse/RF Blank** function, essentially turning the RF blanking function off
Marker 1	`M1`	Sets marker 1 to be used for **Pulse/RF Blank**
Marker 2	`M2`	Sets marker 2 to be used for **Pulse/RF Blank**
Marker 3	`M3`	Sets marker 3 to be used for **Pulse/RF Blank**
Marker 4	`M4`	Sets marker 4 to be used for **Pulse/RF Blank**

ALC Hold

Lets you specify which marker is routed for use within **ALC Hold**. This function holds the ALC circuitry at the average value of the sample points set by the marker.

ALC Hold operates during the low periods of the marker signal. The marker polarity determines when the marker signal is high. For positive polarity, this is during the marker points. For a negative polarity, this is when there are no maker points.

Remote Command	`:SOURce:RADio:ARB:MDEStination:ALCHold NONE | M1 | M2 | M3 | M4`
	For option details, see "Option Details" on page 2270
	`:SOURce:RADio:ARB:MDEStination:ALCHold?`

Example	`:SOUR:RAD:ARB:MDES:ALCH NONE`
Dependencies	When a new waveform is selected for playback the settings contained within the associated waveform header file are applied to the ARB. The **ALC Hold** setting is one of the values stored within the header file. If the newly selected waveform file has an associated header file, the **ALC Hold** setting is updated

	with the value from the header file. The **ALC Hold** setting remains unchanged if the newly selected waveform does not have an associated header file Not available in E7760B, and VXT models M9410A/11A/15A/16A and M9410E/11E/15E/16E
Range	`NONE | M1 | M2 | M3 | M4`

Option Details

Parameter	SCPI	Notes
None	`NONE`	Use no marker for **ALC Hold**, essentially turning **ALC Hold** off
Marker 1	`M1`	Use marker 1 for **ALC Hold**
Marker 2	`M2`	Use marker 2 for **ALC Hold**
Marker 3	`M3`	Use marker 3 for **ALC Hold**
Marker 4	`M4`	Use marker 4 for **ALC Hold**

Trigger Type

Determines the behavior of the waveform when it plays.

Remote Command	`:SOURce:RADio:ARB:TRIGger:TYPE CONTinuous | SINGle | SADVance` `:SOURce:RADio:ARB:TRIGger:TYPE?`
Example	`:SOUR:RAD:ARB:TRIG:TYPE CONT` `:SOUR:RAD:ARB:TRIG:TYPE?`
Preset	`CONTinuous`
Range	Continuous | Single | Seg Adv

Continuous trigger

Sets the active trigger type to **Continuous**. If **Continuous** is already selected as the active trigger type, pressing this control allows access to the **Continuous trigger** type setup menu. In **Continuous** trigger mode, the waveform repeats continuously.

Remote Command	`:SOURce:RADio:ARB:TRIGger:TYPE:CONTinuous[:TYPE] FREE | TRIGger | RESet`
	See "Option Details" on page 2271
	`:SOURce:RADio:ARB:TRIGger:TYPE:CONTinuous[:TYPE]?`

Example	`:SOUR:RAD:ARB:TRIG:TYPE:CONT FREE`
Preset	`FREE`
Range	Free Run | Trigger + Run | Reset + Run

Option Details

Parameter	SCPI	Notes
Free Run	FREE	Sets the waveform generator to play a waveform sequence or segment continuously, without waiting for a trigger. In this mode, the waveform generator does not respond to triggers
Trigger + Run	TRIGger	Sets the waveform generator to play a waveform sequence or segment continuously when the first trigger is received, and to ignore any subsequent triggers
Reset + Run	RESet	Sets the waveform generator to play a waveform sequence or segment continuously when the first trigger is received. Subsequent triggers reset the waveform sequence or segment to the start, and then play it continuously

Single trigger

Sets the active trigger type to **Single**. If **Single** is already selected as the active trigger type, pressing this control allows access to the single trigger type setup menu. In **Single** trigger mode, the waveform plays once.

Remote Command	`:SOURce:RADio:ARB:RETRigger ON | OFF | IMMediate`
	See "Option Details" on page 2271
	`:SOURce:RADio:ARB:RETRigger?`

Example	`:SOUR:RAD:ARB:RETR OFF`
Notes	`ON`: Buffered Trigger `OFF`: No Retrigger `IMMediate`: Restart on Trigger This is defined as an enumerated SCPI command, with `ON|OFF` being considered as enumerated types rather than Boolean. This means the query returns `OFF` instead of 0, and `ON` instead of 1
Preset	`ON`

Option Details

Parameter	SCPI	Notes
No Retrigger	OFF	Sets the waveform generator to play a waveform sequence or segment once when a trigger is received. Any triggers then received during playback are ignored
Buffered Trigger	ON	Sets the waveform generator to play a waveform sequence or segment once when a trigger is received. If a trigger is received during playback, the waveform generator plays the sequence or segment to the end, then plays the sequence or segment once more
Restart on Trigger	IMMediate	Sets the waveform generator to play a waveform sequence or segment once when a trigger is received. If a trigger is received during playback, the waveform generator resets and plays the sequence or segment from the start

Segment Advance trigger

Sets the active trigger type to **Segment Advance**. If **Segment Advance** is already selected as the active trigger type, pressing this control allows access to the segment advance trigger type setup menu.

Segment Advance triggering allows you to control the playback of waveform segments within a waveform sequence. When a trigger is received the ARB advances to the next waveform segment within the waveform sequence. This type of triggering ignores the repetition count for the waveform segment within the waveform sequence. For example, if a waveform segment has a repetition count of 10 and you select single segment advance triggering mode, the waveform segment will only play once.

Segment Advance triggering can also be used for waveform segments only. In this situation, the same waveform segment is played again when a trigger is received.

Remote Command	`:SOURce:RADio:ARB:TRIGger:TYPE:SADVance[:TYPE] SINGle | CONTinuous`
	See "Option Details" on page 2272
	`:SOURce:RADio:ARB:TRIGger:TYPE:SADVance[:TYPE]?`

Example	`:SOUR:RAD:ARB:TRIG:TYPE:SADV SING`
Dependencies	Not available in E7760B
Preset	`CONTinuous`
Range	`SINGle|CONTinuous`

Option Details

Parameter	SCPI	Notes
Single	`SINGle`	Once a trigger is received a segment is played once. If a trigger is received during playback of a segment, the segment plays to completion and the next segment is played once
Continuous	`CONTinuous`	Once a trigger is received a segment is played continuously. When subsequent triggers are received, the currently playing segment plays to completion and then the next segment is played continuously
Trigger Initiate	Front panel only	If "Trigger Source" on page 2272 is set to `KEY`, initiates an immediate trigger event

Trigger Source

Determines how the source receives the trigger that starts the waveform playing. Grayed-out if "Trigger Type" on page 2270 is free run, since free run triggers immediately with no trigger source required.

Remote Command	`:SOURce:RADio:ARB:TRIGger[:SOURce] KEY | BUS | EXTernal1 | EXTernal2 | PXI`
	See "Option Details" on page 2273
	`:SOURce:RADio:ARB:TRIGger[:SOURce]?`

Example	`:SOUR:RAD:ARB:TRIG KEY`
Notes	For E7760B, the available selections are KEY|BUS
Dependencies	Grayed-out if **Trigger Type** is Continuous, Free Run
Preset	EXTernal2 For E7760B: BUS
Range	Key | Bus | External1 | External 2 | PXI

Option Details

Parameter	SCPI	Notes
Key	KEY	The waveform is triggered when you press the front panel **Trigger** key
Bus	BUS	Enables triggering over GPIB, LAN, or USB using: `:SOURce:RADio:ARB:TRIGger:INITiate`
External 1	EXTernal1	Enables triggering a waveform by an externally-applied signal
External 2	EXTernal2	Enables triggering a waveform by an externally-applied signal Note: in EXM, trigger 2 is a bi-directional trigger port, so when trigger 2 has been configured as OUTPUT type, selecting External 2 as the input trigger for the current step generates an error Note 2: in VXT model M9420A, triggers on an externally connected trigger source marked **Trigger 1** on the front panel
PXI	PXI	Enables triggering a waveform by a PXI backplane Line applied signal

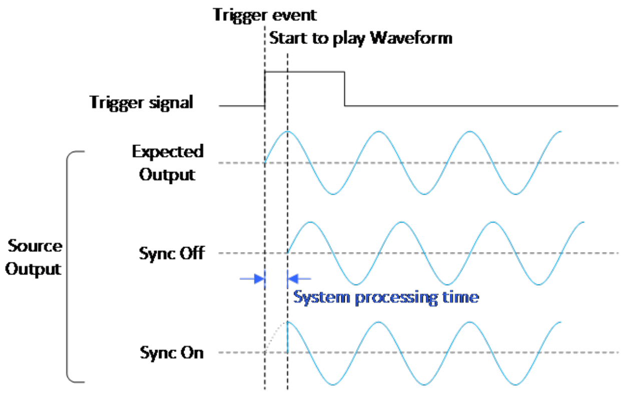
Bus Trigger Command (Remote Command Only)

Used to initiate an immediate trigger event if "Trigger Source" on page 2272 is set to BUS.

Remote Command	`:SOURce:RADio:ARB:TRIGger:INITiate`
Example	`:SOUR:RAD:ARB:TRIG:INIT`

Sync to Trigger Source

There is a time interval (system processing time) between the trigger event and the beginning of playing waveform. Turn on this control to compensate the system latency at the cost of cutting off the beginning of the ARB. The figure below shows the turn-on and turn-off behavior of the control.



Remote Command	`:SOURce:RADio:ARB:TRIGger:SYNC[:STATe] ON | OFF | 1 | 0` `:SOURce:RADio:ARB:TRIGger:SYNC[:STATe]?`
Example	`:SOUR:RAD:ARB:TRIG:SYNC ON` `:SOUR:RAD:ARB:TRIG:SYNC?`
Notes	Compensates for the instrument internal latency. The negative trigger delay compensates the external latency (that is, heads and cables). See "External Trigger Delay" on page 2274 and "PXI Trigger Delay" on page 2277 The first PerARB trigger is cut off if **Sync to Trigger Source** is `ON`
Dependencies	Only available when "Trigger Source" on page 2272 is `EXTernal1`, `EXTernal2`, or `PXI`
Preset	`OFF`
Range	`ON|OFF`

External Trigger Delay

Lets you toggle the state and value of external trigger delay. The value you enter sets a delay time between when an external trigger is received and when it is applied to the waveform. Only active if "Trigger Source" on page 2272 is `EXTernal1` or `EXTernal2`.

Negative trigger delay is only supported by VXT models M9410A/11A/15A/16A and M9410E/11E/15E/16E (see "More Information" on page 2275).

Remote Command	`:SOURce:RADio:ARB:TRIGger[:SOURce]:EXTernal:DELay <time>` `:SOURce:RADio:ARB:TRIGger[:SOURce]:EXTernal:DELay?`

Example	:SOUR:RAD:ARB:TRIG:EXT:DEL 100ns :SOUR:RAD:ARB:TRIG:EXT:DEL?
Notes	External trigger delay time set by users will be rounded to the nearest integer multiple of the resolution
Dependencies	Unavailable and grayed-out when **Trigger Source** is not set to EXTernal1 or EXTernal2 Not available in E7760B
Preset	1 ms
Min	VXT models M9410A/11A/15A/16A and M9410E/11E/15E/16E: -10 s All others: 0 s
Max	(see table below)

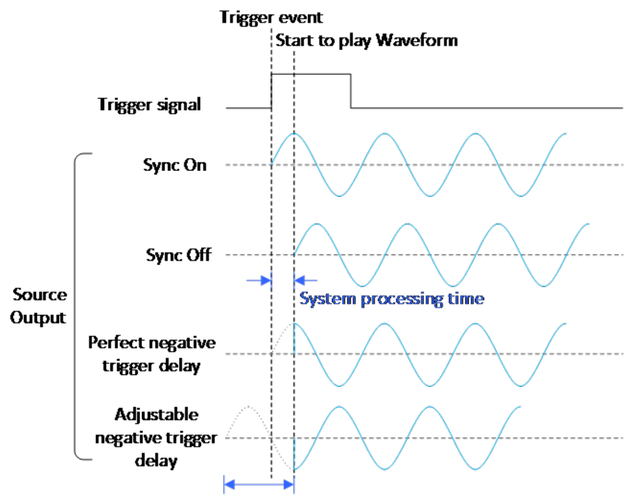
Instrument/Condition	Value	Derivation
VXT models M9410A/11A/15A/16A	11.45324612 s	2.666667ns *(2^32-1)
M9410E/11E/15E/16E	11.45324612 s	2.666667ns *(2^32-1)
Continuous – Trigger + Run	11.45324612 s	2.666667ns *(2^32-1)
Other trigger conditions	17.17986918 s	4 ns *(2^32-1)
All others	8.589934588 s	4ns * (2^31 – 1) = 8589934588 ns

Auto Function

Remote Command	:SOURce:RADio:ARB:TRIGger[:SOURce]:EXTernal:DELay:STATe OFF | ON | 0 | 1 :SOURce:RADio:ARB:TRIGger[:SOURce]:EXTernal:DELay:STATe?
Example	:SOUR:RAD:ARB:TRIG:EXT:DEL:STAT ON :SOUR:RAD:ARB:TRIG:EXT:DEL:STAT?
Preset	OFF

More Information

There is a time interval (system processing time) between the trigger event and the beginning of playing waveform. The figure below shows you the behavior. The negative trigger delay allows you to specify the beginning of a waveform.



Note: the first PerArb trigger signal will be missed when the trigger delay is negative.

External Trigger Polarity

Sets the polarity of the external trigger. When `POSitive` is selected, trigger event happens on a rising edge of the external trigger in signal. When `NEGative` is selected, trigger event happens on a falling edge of the external trigger in signal.

Active only if "Trigger Source" on page 2272 is `EXTernal1` or `EXTernal2`.

Remote Command	`:SOURce:RADio:ARB:TRIGger[:SOURce]:EXTernal:SLOPe POSitive | NEGative` `:SOURce:RADio:ARB:TRIGger[:SOURce]:EXTernal:SLOPe?`
Example	`:SOUR:RAD:ARB:TRIG:EXT:SLOP POS` `:SOUR:RAD:ARB:TRIG:EXT:SLOP?`
Dependencies	Unavailable and grayed-out when "Trigger Source" on page 2272 is not `EXTernal1` or `EXTernal2` Not available in E7760B
Preset	`POSitive`
Range	`POSitive|NEGative`

Select PXI Line

Controls which PXI_TRIG[0..7] backplane line is used for the trigger source.

Only appears in modular analyzer products.

Remote Command	:SOURce:RADio:ARB:TRIGger[:SOURce]:PXI:LINE <line> :SOURce:RADio:ARB:TRIGger[:SOURce]:PXI:LINE?
Example	:SOUR:RAD:ARB:TRIG:PXI:LINE 2
Dependencies	Unavailable and grayed-out when "Trigger Source" on page 2272 is not set to PXI Not available in E7760B
Preset	0
State Saved	Saved in instrument state
Range	[0,7]

PXI Trigger Delay

Lets you toggle the state and value of PXI trigger delay. The value you enter sets a delay time between when an PXI trigger is received and when it is applied to the waveform.

Only active if "Trigger Source" on page 2272 is PXI.

Remote Command	:SOURce:RADio:ARB:TRIGger[:SOURce]:PXI:DELay <time> :SOURce:RADio:ARB:TRIGger[:SOURce]:PXI:DELay?
Example	:SOUR:RAD:ARB:TRIG:PXI:DEL 100ns :SOUR:RAD:ARB:TRIG:PXI:DEL?
Notes	PXI trigger delay time set by users will be rounded to the nearest integer multiple of the resolution
Dependencies	Unavailable and grayed-out when "Trigger Source" on page 2272 is not PXI Not available in E7760B
Preset	1 ms
Min	VXT models M9410A/11A/15A/16A and M9410E/11E/15E/16E: -10 s
Max	

Instrument/Condition	Value	Derivation
VXT models M9410A/11A/15A/16A	11.45324612 s	2.666667ns * (2^32-1)
M9410E/11E/15E/16E	11.45324612 s	2.666667ns * (2^32-1)
Continuous – Trigger + Run" trigger	11.45324612 s	2.666667ns * (2^32-1)
Other trigger conditions	17.17986918 s	4 ns *(2^32-1)
All Others	8.589934588 s	4ns * (2^31 – 1)

Auto Function

Remote Command	:SOURce:RADio:ARB:TRIGger[:SOURce]:PXI:DELay:STATe OFF | ON | 0 | 1 :SOURce:RADio:ARB:TRIGger[:SOURce]:PXI:DELay:STATe?
Example	:SOUR:RAD:ARB:TRIG:PXI:DEL:STAT ON :SOUR:RAD:ARB:TRIG:PXI:DEL:STAT?
Preset	OFF

PXI Trigger Polarity

Sets the polarity of the PXI trigger:

- When POSitive is selected, trigger event happens on a rising edge of the PXI trigger in signal
- When NEGative is selected, trigger event happens on a falling edge of the PXI trigger in signal

Active only if "Trigger Source" on page 2272 is PXI.

Remote Command	:SOURce:RADio:ARB:TRIGger[:SOURce]:PXI:SLOPe POSitive | NEGative :SOURce:RADio:ARB:TRIGger[:SOURce]:PXI:SLOPe?
Example	:SOUR:RAD:ARB:TRIG:PXI:SLOP POS :SOUR:RAD:ARB:TRIG:PXI:SLOP?
Dependencies	Unavailable and grayed-out when "Trigger Source" on page 2272 is PXI Not available in E7760B
Preset	POSitive
Range	POSitive|NEGative

I/Q Adjustments

Enables or disables the I/Q adjustments.

Remote Command	:SOURce:RADio:ARB:IQADjustment:[STATe] OFF | ON | 0 | 1 :SOURce:RADio:ARB:IQADjustment:[STATe]?
Example	:SOUR:RAD:ARB:IQAD ON :SOUR:RAD:ARB:IQAD?
Dependencies	Not available in E7760B
Preset	OFF

I/Q Gain

Lets you adjust the ratio of I to Q while preserving the composite, vector magnitude. Adding Gain (+x dB) to the signal increases the I component and decreases the Q component proportionally. Reducing Gain (-x dB) decreases the I component and increases the Q component proportionally.

Remote Command	`:SOURce:RADio:ARB:IQADjustment:GAIN <value><unit>` `:SOURce:RADio:ARB:IQADjustment:GAIN?`
Example	`:SOUR:RAD:ARB:IQAD:GAIN 0.5` `:SOUR:RAD:ARB:IQAD:GAIN?`
Notes	Effective only if the I/Q adjustment function is ON
Dependencies	Unavailable and grayed-out when the ARB state is OFF Not available in E7760B
Preset	+0.00000000E+000
Min	-1 dB
Max	1 dB

I/Q Delay

Lets you change the absolute phase of both I and Q with respect to triggers and markers. A positive value delays I and Q. This value affects both the external I/Q out signals and the baseband signal modulated on the RF output. This adjustment does not affect external I/Q inputs.

Remote Command	`:SOURce:RADio:ARB:IQADjustment:DELay <value><unit>` `:SOURce:RADio:ARB:IQADjustment:DELay?`
Example	`:SOUR:RAD:ARB:IQAD:DEL 10ps` `:SOUR:RAD:ARB:IQAD:DEL?`
Notes	User-set IQ delay time values are rounded to the nearest integer multiple of the resolution
Dependencies	Unavailable and grayed-out when the ARB state is off Not available in E7760B
Preset	+0.00000000E+000
Min/Max	see table below

Instrument Type	Min	Max
M9410A/11A/15A/16A	-80ns	80ns
All Others	-250ns	250ns

RMS

Lets you directly specify current RMS value used to playback currently selected waveform.

For EXM, note that an incorrect RMS value may cause inaccurate power output that is sensitive to RMS value.

This setting is also updated by RMS in waveform header or updated when invoking RMS calculation operation.

This setting can be saved to the header of currently selected waveform by "Save Header" on page 2300.

Remote Command	`:SOURce:RADio:ARB:RMS <float>` `:SOURce:RADio:ARB:RMS?`
Example	`:SOUR:RAD:ARB:HEAD:RMS 0.7` `:SOUR:RAD:ARB:HEAD:RMS?`
Notes	The valid range for this setting is 0 to 1.414 (linear). Values outside the range are clipped to the closest boundary This value does not affect Source List Sequencer, which always uses the RMS value included in each ARB header. If this setting is to take effect in List Sequencer, use "Save Header" on page 2300 to save the current RMS value to the header, then play the ARB in Source List Sequencer
Dependencies	When a new waveform is selected for playback this setting is updated by the RMS value included in the associated waveform header file. If the selected waveform has no associated header file or the header file does not include the RMS value then the instrument will try to calculate the value automatically based on the RMS Calculation Mode setting Pressing **Calculate** also updates this setting
Preset	0
Range	0 ~ 1.414

RMS Calculation Mode

Lets you specify the mode to calculate the current RMS.

Remote Command	`:SOURce:RADio:ARB:RMS:CALCulation:MODE AUTO | M1 | M2 | M3 | M4`
	See "Option Details" on page 2281
	`:SOURce:RADio:ARB:RMS:CALCulation:MODE?`

Example	`:SOUR:RAD:ARB:RMS:CALC:MODE AUTO`
Notes	If no waveform is selected, or selected waveform is waveform sequence, the key is grayed-out
Preset	AUTO
Range	AUTO | M1 | M2 | M3 | M4

Option Details

Parameter	SCPI	Notes
Auto	AUTO	In Auto, RMS is calculated based on the whole sample range of the currently selected waveform
Marker 1	M1	Marker 1 designates the sample range for RMS calculation
Marker 2	M2	Marker 2 designates the sample range for RMS calculation
Marker 3	M3	Marker 3 designates the sample range for RMS calculation
Marker 4	M4	Marker 4 designates the sample range for RMS calculation

Calculate

Lets you calculate current RMS based on mode selected. Updates the setting in the "RMS" on page 2280 control.

Remote Command	:SOURce:RADio:ARB:RMS:CALCulate
Example	:SOUR:RAD:ARB:RMS:CALC
Notes	If no waveform is selected, invoking this operation generates error “-221 Setting conflict; No waveform is selected for RMS operation” Grayed-out if no waveform is selected, or selected waveform is waveform sequence If selected waveform does not contain marker data, but "RMS Calculation Mode" on page 2280 is set to marker, invoking a calculation operation generates error “-221 Setting conflict; There is no marker for currently selected waveform, auto RMS calculation mode is used instead”, and "RMS Calculation Mode" on page 2280 is coupled to **Auto** mode automatically RMS calculation is not suitable for waveform sequence. If selected waveform is waveform sequence file, invoking this operation generates error “-221 Setting conflict; RMS calculation does not apply to waveform sequence” You can still edit current RMS as play parameter, and save current RMS to waveform sequence header for later use

Use Header RMS

Lets you quickly set RMS to value in ARB header. Updates the setting in the "RMS" on page 2280 control.

Notes	Grayed-out if no waveform is selected If no waveform is selected, invoking this operation generates error “-221 Setting conflict; No waveform is selected for RMS operation”

Real-Time 5G NR Compensation

Phase compensation is a new concept introduced into 5G NR baseband signal generation in TS38.211 as below, to address a typical 5G scenario that Tx and Rx frequencies may not be the same. In that case, without properly compensating the phase, receiver would not be able to correctly demodulate the received signal.

Modulation and up-conversion to the carrier frequency f_0 of the complex-valued OFDM baseband signal for antenna port p, subcarrier spacing configuration μ, and OFDM symbol l in a subframe assumed to start at t = 0 is given by the following equation for all channels and signals except PRACH:

$$Re\left\{s_l^{(p,\mu)}(t)\cdot e^{j2\pi f_0\left(t-t_{start,l}^{\mu}-N_{CP,l}^{\mu}T_C\right)}\right\}$$

$$Re\left\{s_l^{(p,\mu)}(t)\cdot e^{j2\pi f_0\left(t-t_{start,l}^{\mu}-N_{CP,l}^{\mu}T_C\right)}\right\}$$

From the 3GPP specification equation above, it can be observed that phase compensation is performed for a specific transmission frequency f_0. So that means, even if a same signal configuration needs to be transmitted at multiple frequencies, we'll have to generate a different waveform for each frequency point. As a result, the number of test waveforms will increase significantly along with the frequency number. This would be a big challenge for test engineers, considering the complexity of 5G NR signal configurations - they have to maintain a large waveform library and identify each waveform carefully with its "frequency tag".

Real-Time 5G NR Phase Compensation allows you to play the same 5G NR waveform while performing phase compensation along with transmission frequency change automatically. This control allows you to turn on or off the real-time phase compensation for 5G NR waveform.

Remote Command	`:SOURce:RADio:ARB:NR5G:PHASe[:STATe] ON | OFF | 1 | 0` `:SOURce:RADio:ARB:NR5G:PHASe[:STATe]?`
Example	`:SOUR:RAD:ARB:NR5G:PHAS ON` `:SOUR:RAD:ARB:NR5G:PHAS?`
Dependencies	Only appears when Option RPC is present If the waveform is not for 5G NR, there may be error message and the output signal may be incorrect To ensure that you do *not* compensate for phase twice, once at waveform generation and again during playback, turn off this control if you had turned on phase compensation while generating the waveform
Preset	`OFF`
Range	`ON|OFF`

SCS

Sets the SCS for real-time 5G NR phase compensation.

Remote Command	:SOURce:RADio:ARB:NR5G:PHASe:SCS SCS15K | SCS30K | SCS60K | SCS60KECP | SCS120K | SCS240K | SCS480K :SOURce:RADio:ARB:NR5G:PHASe:SCS?
Example	:SOUR:RAD:ARB:NR5G:PHAS:SCS SCS15K :SOUR:RAD:ARB:NR5G:PHAS:SCS?
Preset	SCS30K
Range	

μ	CP	Value
0		15 kHz
1		30 kHz
2	Normal	60 kHz
	Extended	60 kHz
3		120 kHz
4		240 kHz
5		480 kHz

Filter

Sets the state of Filter usage after real-time 5G NR phase compensation.

Remote Command	:SOURce:RADio:ARB:NR5G:PHASe:FILTer[:STATe] ON | OFF | 1 | 0 :SOURce:RADio:ARB:NR5G:PHASe:FILTer[:STATe]?
Example	:SOUR:RAD:ARB:NR5G:PHAS:FILT ON :SOUR:RAD:ARB:NR5G:PHAS:FILT?
Preset	OFF
Range	ON|OFF

Filter Bandwidth

Sets the Filter Bandwidth if Filter is used.

By searching <FilterBandwidth> node in the *.scp file, you can get the correct filter bandwidth value for phase compensation.

Remote	:SOURce:RADio:ARB:NR5G:PHASe:FILTer:BANDwidth <freq>

Command	:SOURce:RADio:ARB:NR5G:PHASe:FILTer:BANDwidth?
Example	:SOUR:RAD:ARB:NR5G:PHAS:FILT:BAND 99MHz :SOUR:RAD:ARB:NR5G:PHAS:FILT:BAND?
Preset	100 MHz
Min	10 Hz
Max	1200 MHz

Select Waveform

Lets you select a waveform segment or sequence to be played by the ARB player. Presents you with a list of waveform segments files and waveform sequence files. The list of waveform segment files and waveform sequence files contains the names of all the waveform segments and waveform sequence files currently loaded into ARB playback memory.

Waveform sequences are not available in E7760B.

Waveforms formatted as `*.mat`, `*.csv` and `*.txt` are supported by models with a built-in source, such as VXT and EXM.

NOTE **To load a file from the hard drive into ARB memory, go to the Recall, Waveform dialog**

NOTE **Selecting a waveform file does not result in automatic adjustments to burst timing; that adjustment occurs only when a waveform is loaded to ARB memory.**

Remote Command	:SOURce:RADio:ARB:WAVeform <string> :SOURce:RADio:ARB:WAVeform?
Example	:SOUR:RAD:ARB:WAV "test_waveform.bin"
Notes	If the intended waveform is not in the memory yet, then issuing this command invokes ARB loading operation first, which involves a delay of unpredictable length, so this command should be followed by *OPC?, which holds off subsequent commands until the loading operation is complete <string> - specifies the name of the waveform segment or waveform sequence to be played by the ARB Sequence Analyzer Mode only: – If Include Source is Yes, and you attempt to play a waveform sequence but not all the required waveform segments are in the ARB playback memory, the application rejects the loading operation and an error is generated – If Include Source is No, and you attempt to play a waveform sequence but not all the required waveform segments are contained in the ARB playback memory, the application attempts to load the required segments from either the default directory or the current directory. If the ARB memory

does not have enough space for all the waveform segments to be loaded, an error is generated and none of the waveform segments is loaded

If ARB is ON, and you attempt to play a waveform sequence but not all the waveform segments within the sequence could be found to be loaded into ARB memory, an error is generated. The selected waveform keeps the previous value and ARB state remains On

If you specify a waveform segment via SCPI but the waveform segment is not present within ARB playback memory, and cannot be found for auto loading within the current directory or the default directory, an error is generatedand the file selection remains unchanged

If you select a waveform for playback and the waveform requires a license that is not installed on the instrument, an error is generated

.

If ARB is ON and you load a file to ARB memory or delete a file from ARB memory, the playing waveform segment may not keep phase continuity during the ARB memory operation. The waveform will be replayed after the ARB operation is finished

Segments in ARB Memory

Shows you which files are loaded into the ARB memory and lets you select a file for playback.

Recall Waveform

This is the same as **Recall From File** in the **Recall**, **Waveform** dialog.

Delete Segment From ARB Mem

This is the same as **Delete Segment From ARB Mem** in the **Recall**, **Waveform** dialog.

Delete All From ARB Memory

This is the same as **Delete All From ARB Memory** in the **Recall**, **Waveform** dialog.

Query ARB Memory File List (Remote Query Only)

Queries the test set for the list of waveform segments in the ARB memory.

NOTE **Returns a string for waveform segment names in ARB memory. If you require a string list of waveform segments in the ARB memory, use** "Query ARB Memory Full File List (Remote Query Only)" on page 2286

Remote Command	`:SOURce:RADio:ARB:CATalog?`
Example	`:SOUR:RAD:ARB:CAT?`
Notes	The return data is in the following format:

`<integer>`	Memory used, in kB
`<integer>`	Memory free, in kB
`<string> …`	Comma-separated list of waveform segments within ARB memory

Query ARB Memory Full File List (Remote Query Only)

Queries the test set for the string list of waveform segments in the ARB memory. Returns a string list for waveform segment names in the ARB memory.

Remote Command	`:SOURce:RADio:ARB:FCATalog?`
Example	`:SOUR:RAD:ARB:FCAT?`
Notes	The return data is in the following format:

`<integer>`	Memory used, in kB
`<integer>`	Memory free, in kB
`<integer>`	File count in ARB memory
`<string>,<string>, … <string>`	Comma-separated string list of waveform segments within ARB memory

EXT returns: 27499,2069653,3,"c2k.wfm","gsm.wfm","wcdma.wfm"

Waveform Sequences

Not available in E7760B.

Lets you build new sequences or edit existing sequences. The Sequences table displayed in this dialog shows you the sequences in the current directory. You may build a new sequence or select one of the sequences in the table and tap **Edit Selected Sequence**. The default current directory is `C:\NVARB`. Tapping any element of this path lets you select an alternate route. Tapping the **Computer** arrow lets you select a different drive. Tapping the **Back** arrow navigates to the previously selected directory.

Build New Sequence

Lets you build a new sequence of waveform segments. When you build a sequence you are building the "current sequence", and the next time you press "Build New

Sequence” the sequence you have been building will still be there, allowing you to add or remove segments from it.

Segment

Shows the segment number assigned to this row.

Waveform

Shows the file name for the waveform inserted into this row. Use "Insert Waveform" on page 2288 to insert a waveform.

Repetitions

Lets you specify the number of times the currently selected waveform is played within the sequence.

Preset	1
Min	1
Max	65535

Marker 1 – Marker 4

Lets you enable or disable Marker 1, 2, 3, or 4 for the currently selected waveform. For a waveform sequence, you can enable and disable markers on a per-segment basis, allowing you to output markers from some waveform segments within the sequence, but not for others.

Preset	Enabled
Range	Enabled | Disabled

Sync Seq File

Enables or disables the saving of secondary modules’ waveform sequence files based on the current primary module segment’s waveform settings.

Remote Command	`:SOURce:RADio:ARB:SEQuence:SYNC ON | OFF` `:SOURce:RADio:ARB:SEQuence:SYNC?`
Example	`:SOUR:RAD:ARB:SEQ:SYNC OFF`
Notes	Available only on primary modules If this setting is ON, when Sync Config is not NONE, the responding secondary module’s waveform

	sequence file will be saved accordingly when save sequence... on the primary module, and the primary sequence file name should end with `xxx0.seq`, so the secondary module will be named according to the "Naming Rule" on page 2288 Waveform names in sequence files should also follow the **Naming Rule**
Dependencies	Not available in E7760B
Preset	`OFF`
Range	`ON|OFF`

Naming Rule

If Sync Config is not 2x2 +2x2 or 1x1+1x1, the waveform files to be used should follow this naming convention: the waveform file for the primary source should end in 0; the waveform files for the controlled sources should end in 1, 2, or 3 (reflecting the order of the TRXs). For example, for DL 11AC80 3X3 MIMO, sequence file names for TRX1,TRX2 and TRX3 should be xxx0.xx, xxx1.xx and xxx2.xx

If Sync Config is 2x2+2x2, the waveform files to be used should follow this naming convention: the waveform file for the primary source of first 2x2 should end in 0_0; the waveform files for the secondary source of first 2x2 should end in 0_1; the waveform files for the primary source of second 2x2 should end in 1_0; the waveform files for the secondary source of second 2x2 should end in 1_1. For example, for DL 11AC80 2x2 + 2x2 MIMO, waveform file names for TRX1,TRX2,TRX3 and TRX4 should be xxx0_0.xx, xxx0_1.xx, xxx1_0.xx and xxx1_1.xx

If Sync Config is 1x1+1x1, the waveform files to be used should follow this naming convention: the waveform file for the first source should end in 0_0; the waveform files for the second source should end in 1_0. For example, for DL 11AC80 1x1 + 1x1 MIMO, waveform file names for TRX1 and TRX2 should be xxx0_0.xx and xxx1_0.xx

Insert Waveform

Lets you select a waveform segment to be added to the sequence.

NOTE To load a file from the hard drive into ARB memory, go to the **Recall**, **Waveform** dialog

Segments in ARB Memory

Shows you which files are loaded into the ARB memory and lets you select a file for inclusion in the sequence.

Delete Segment From ARB Mem

This is the same as **Delete Segment From ARB Mem** in the **Recall**, **Waveform** dialog.

Delete All From ARB Memory

This is the same as **Delete All From ARB Memory** in the **Recall**, **Waveform** dialog.

Delete Segment

Lets you delete the selected segment from the waveform sequence.

Save Sequence

Lets you save the newly built Waveform Sequence to the disk drive.

Sequence files have the extension `.seq`. The default filename is `WfmSequence_0000.seq`, where the 4-digit number is the lowest number that does not conflict with any filename in the current directory. Use “File Name” and “File Type’ to specify your waveform sequence. The newly build sequence will be stored in the current directory.

Build New Sequence (Remote Command Only)

This is the SCPI equivalent of the waveform sequence creation features described in "Build New Sequence" on page 2286.

Writes a waveform sequence file to the hard disk. You must specify the waveform sequence file path and filename which will be saved on the hard disk, and the waveform segment file path and name which will be nested into the waveform sequence file. You can utilize mass storage unit specifier (MSUS) “NVWFM” or use a real full path representation. See the example below. MSUS “NVWFM” is mapped to D:\NVARB directory on test set hard disk.

Any number of segments, up to a segment count limit of 64, can be used to create a sequence. Repeated segments are included in the count limit.

Each waveform segment name string length upper limit is 128 chars. Do not attempt to insert a waveform with a name string that exceeds 128 chars.

The internal source does not support nesting one waveform sequence file into another waveform sequence file.

Remote	`:SOURce:RADio:ARB:SEQuence[:MWAVeform] <filename>, <waveform1>, <reps>, NONE`

Command	`| M1 | M2 | M3 | M4 | M1M2 | M1M3 | M1M4 | M2M3 | M2M4 | M3M4 | M1M2M3 | M1M2M4 | M1M3M4 | M2M3M4 | M1M2M3M4 | ALL, \{<waveform2>, <reps>, NONE | M1 | M2 | M3 | M4 | M1M2 | M1M3 | M1M4 | M2M3 | M2M4 | M3M4 | M1M2M3 | M1M2M4 | M1M3M4 | M2M3M4 | M1M2M3M4 | ALL,\} …`
	For additional description of each item, see "For Setup SCPI" on page 2290 below
	`:SOURce:RADio:ARB:SEQuence[:MWAVeform]? <filename>`
	For additional description of each item, see "For Query SCPI" on page 2291 below

Example	For setup:
	`:SOUR:RAD:ARB:SEQ "NVWFM:testSeq1.seq", "NVWFM:wfmSegment1.wfm",10, M2M3M4, "NVWFM:wfmSegment2.wfm", 20, M1M3`
	Or
	`:SOUR:RAD:ARB:SEQ "D:\NVARB\testSeq1.seq", "D:\NVARB\wfmSegment1.wfm",10, M2M3M4, "D:\NVARB\wfmSegment2.wfm", 20, M1M3`
	For query, must specify which waveform sequence file to query
	`:SOUR:RAD:ARB:SEQ? "NVWFM:testSeq1.seq"`
	Or
	`:SOUR:RAD:ARB:SEQ? "D:\NVARB\testSeq1.seq"`

For Setup SCPI

For the Setup SCPI command, the parameters are:

`<filename>` - String Type

This variable specifies the path and name for the waveform sequence file. The path supports MSUS (NVWFM) or a real full path representation. See example.

`<waveform1>` - String Type

This variable specifies the path and name of the first existing waveform segment. The path supports MSUS (NVWFM) or a real full path representation. See example.

The segment file must reside within ARB playback memory before it can be played by the ARB player.

`<reps>` - Integer Type

This variable specifies the number of times a segment or sequence plays before moving on to the next segment or sequence.

`<marker>` - Enum Type

NONE – This choice disables all four markers for the waveform. Disabling markers means that the waveform sequence ignores the segments or sequence marker settings.

`M1, M2, M3, M4` – these choices, either individually or a combination of them, enable the markers for the waveform segment or sequence. Markers not specified are ignored for that segment or sequence.

`ALL` – This choice enables all four markers in the waveform segment or sequence.

`<waveform2>` - String type.

This variable specifies the name of a second existing waveform segment. The path supports MSUS (NVWFM) and real full path representation both. See example.

The segment file must reside within ARB playback memory before it can be played by the ARB player.

`<reps>` same as above, for the 2nd waveform segment.

`<marker>` same as above, for the 2nd waveform segment.

You can insert several waveform segments into a waveform sequence file. Just repeat inserting waveform segments as described above.

Error Checks for Setup SCPI command:

If you do not specify a filename, or you use an unsupported MSUS (that is, not NVWFM), or have an error in the waveform sequence file path, an error is generated. If the specified waveform sequence file name suffix is not ".seq", error is generated.

If you use an unsupported MSUS (that is, not NVWFM), or have an error in the waveform segment file path, an error is generated.

If the first specified waveform file cannot be found, an error is generated.

If you nest one waveform sequence file into another waveform sequence file, an error is generated.

If the specified repetition value is larger than 65535 or smaller than 1, an error is generated.

If the specified marker type is unrecognized, an error is generated.

For Query SCPI

For the Query the parameters are:

`<filename>` - String type.

This variable specifies the path and name of the waveform sequence file being queried. The path supports MSUS (NVWFM) or a real full path representation. See example.

The return value is a `<string>`, which includes each waveform segment file name, repetitions, and marker type. For example:

```
>:SOUR:RAD:ARB:SEQ? "NVWFM:testSeq1.seq",
<"wfmSegment1. wfm, 10, ALL, wfmSegment2.wfm, 20, M1M3",
```

Error Checks for Query SCPI command:

If you do not specify a filename, an error is generated.

If the waveform sequence file name is empty, an error is generated.If the specified waveform sequence file cannot be found, an error is generated.

Edit Selected Sequence

This dialog lets you edit an existing sequence of waveform segments. A table of the segments in the currently selected sequence displays, allowing you to insert waveform segments or edit the characteristics of each segment.

Segment

This field in the table shows the segment number assigned to this row.

Waveform

This field in the table shows the file name for the waveform inserted into this row. Use "Insert Waveform" on page 2288 to insert a waveform.

Repetitions

Lets you specify the number of times the currently selected waveform is played within the sequence.

Preset	1
Min	1

Marker 1 – Marker 4

Lets you enable or disable Marker 1, 2, 3, or 4 for the currently selected waveform. For a waveform sequence, you can enable and disable markers on a per-segment basis, allowing you to output markers from some waveform segments within the sequence, but not for others.

Notes	No remote command, front panel only
Preset	Enabled
Range	Enabled | Disabled

Sync Seq File

Change this setting to enable/disable the function of saving secondary modules' waveform sequence files based on the current primary segment's waveform settings.

Remote Command	See "Sync Seq File" on page 2287
Notes	Available only on primary modules If this setting is ON, when Sync Config is not NONE, the responding secondary module's waveform sequence file will be saved accordingly when save sequence... on the primary module, and the primary sequence file name should end with `xxx0.seq`, so the secondary module will be named according to the "Naming Rule" on page 2293 Waveform names in sequence files should also follow the Naming Rule
Dependencies	Not available in E7760B
Preset	OFF
Range	ON|OFF

Naming Rule

If Sync Config is not 2x2 +2x2 or 1x1+1x1, the waveform files to be used should follow this naming convention: the waveform file for the primary source should end in 0; the waveform files for the controlled sources should end in 1, 2, or 3 (reflecting the order of the TRXs). For example, for DL 11AC80 3X3 MIMO, sequence file names for TRX1,TRX2 and TRX3 should be xxx0.xx, xxx1.xx and xxx2.xx

If Sync Config is 2x2+2x2, the waveform files to be used should follow this naming convention: the waveform file for the primary source of first 2x2 should end in 0_0; the waveform files for the secondary source of first 2x2 should end in 0_1; the waveform files for the primary source of second 2x2 should end in 1_0; the waveform files for the secondary source of second 2x2 should end in 1_1. For example, for DL 11AC80 2x2 + 2x2 MIMO, waveform file names for TRX1,TRX2,TRX3 and TRX4 should be xxx0_0.xx, xxx0_1.xx, xxx1_0.xx and xxx1_1.xx

If Sync Config is 1x1+1x1, the waveform files to be used should follow this naming convention: the waveform file for the first source should end in 0_0; the waveform files for the second source should end in 1_0. For example, for DL 11AC80 1x1 + 1x1 MIMO, waveform file names for TRX1 and TRX2 should be xxx0_0.xx and xxx1_0.xx

Insert Waveform

This dialog p select a waveform segment to be added to the sequence.

NOTE **To load a file from the hard drive into ARB memory, go to the Recall, Waveform dialog**

Segments in ARB Memory

This table shows you which files are loaded into the ARB memory and lets you select a file for inclusion in the sequence.

Delete Segment From ARB Mem

Deletes a segment from ARB memory. This is the same as **Delete Segment From ARB Mem** in the **Recall**, **Waveform** dialog.

Delete All From ARB Memory

Removes all segments from ARB memory. This is the same as **Delete All From ARB Memory** in the **Recall**, **Waveform** dialog.

Delete Segment

Lets you delete the current segment from the waveform sequence.

Notes	No remote command, front panel only

Waveform Utilities

Not available in E7760B.

Only appears if there is at least one Multi-pack license installed in the instrument.

On modular instruments, such as EXM , multi-pack license operations are only allowed on the default module, that is, “TRX1” module for EXM.

For EXM, if access multi-pack license sub-menu from modules other than “TRX1”, an advisory message like “Please go to “TRX1” to operate multi-pack license” will display.

Add Waveform

Use this dialog to select and add waveforms. Pressing **OK** in this dialog adds the currently highlighted waveform to the next available slot, and returns you to the "Waveform Utilities" on page 2294 dialog.

Remote Command	`:SYSTem:LKEY:WAVeform:ADD <string>`
	or
	`:SYSTem:LICense[:FPACk]:WAVeform:ADD <string>`

Example	`:SYST:LKEY:WAV:ADD "mywaveform.wfm"`
	or
	`:SYST:LIC:WAV:ADD "mywaveform.wfm"`

Notes	The second form, `:SYSTem:LICense[:FPACk]:WAVeform:ADD`, is provided for consistency with Keysight signal sources. You can use either form Since adding a waveform segment to a Multi-Pack license causes the license slot to enter the trial period of only 48 hours, pressing this key causes a confirmation dialog to be displayed to ensure you do want to add the waveform segment to the Multi-Pack If you attempt to license a waveform that is already licensed using another slot an error is generated For EXM, if current module is not “TRX1” module, the key is grayed-out, and error message is generated “-221 Setting conflict; Not allowed on current module. Go to “TRX1” to operate multi-pack license” when invoking SCPI
Dependencies	Only available if the currently selected file is a secure waveform requiring a license, and there is at least one slot available within at least one multi-pack license. Unavailable if the waveform highlighted is a secure waveform, but is already licensed

Replace Selected Waveform

Lets you replace the waveform in the currently selected slot with the waveform currently selected in the Multi-Pack License Waveform Add view. Pressing **OK** in this dialog replaces the waveform in the currently selected slot with that currently highlighted, and returns you to the "Waveform Utilities" on page 2294 dialog.

Remote Command	`:SYSTem:LKEY:WAVeform:REPLace <int>, <string>`
	or
	`:SYSTem:LICense[:FPACk]:WAVeform:REPLace <int>, <string>`

Example	`:SYST:LKEY:WAV:REPL 1, "myotherwaveform.wfm"`
	or
	`:SYST:LIC:WAV:REPL 1, "myotherwaveform.wfm"`

Notes	The second command form, `:SYSTem:LICense[:FPACk]:WAVeform:REPLace` is provided for consistency with Keysight signal sources. You can use either form If you attempt to license a waveform that is already licensed using another slot an error is generated Waveform slot number <int> is positive. If you attempt to input a slot number less than or equals 0, an error is generated For EXM, if current module is not “TRX1” module, the key is grayed-out, and error message is generated “-221 Setting conflict; Not allowed on current module. Go to “TRX1” to operate multi-pack license” when invoking SCPI

Clear Waveform from Slot

Lets you clear the waveform from the selected slot.

Remote Command	`:SYSTem:LKEY:WAVeform:CLEar <int>`
	or
	`:SYSTem:LICense[:FPACk]:WAVeform:CLEar <int>`

Example	`:SYST:LKEY:WAV:CLE 1`
	or
	`:SYST:LIC:WAV:CLE 1`

Notes	The second form: `:SYSTem:LICense[:FPACk]:WAVeform:CLEar` is provided for consistency with the style of Keysight signal sources. You can use either form Waveform slot number `<int>` is positive. If you attempt to input a slot number less than or equal to 0, an error is generated For EXM, if current module is not "TRX1" module, the key is grayed-out, and error message is generated "-221 Setting conflict; Not allowed on current module. Go to "TRX1" to operate multi-pack license" when invoking SCPI
Dependencies	Only available if the currently selected slot is in the trial state

Lock Waveform in Slot

If the selected slot is in the trial state or the lock required state, the waveform that occupies the slot is locked and permanently licensed.

Remote Command	`:SYSTem:LKEY:WAVeform:LOCK <int>`
	or
	`:SYSTem:LICense[:FPACk]:WAVeform:LOCK <int>`

Example	`:SYST:LKEY:WAV:LOCK 1`
	or
	`:SYST:LIC:WAV:LOCK 1`

Notes	The command form `:SYSTem:LICense[:FPACk]:WAVeform:LOCK` is provided for consistency with Keysight signal sources. You can use either form Waveform slot number `<int>` is positive. If you attempt to input a slot number less than or equal to 0, an error is generated For EXM, if current module is not "TRX1" module, the key is grayed-out, and error message is generated "-221 Setting conflict; Not allowed on current module. Go to "TRX1" to operate multi-pack license" when invoking SCPI
Dependencies	Only available if the currently selected slot is in the trial state, or the lock required state

Slot Status Query (Remote Command Only)

Returns the status of the specified slot.

Remote Command	`:SYSTem:LKEY:WAVeform:STATus? <int>`
	or
	`:SYSTem:LICense[:FPACk]:WAVeform:STATus? <int>`

Example	`:SYST:LKEY:WAV:STAT? 1`
	<"Locked"
	or
	`:SYST:LIC:WAV:STAT? 1`
	<"Locked"

Notes	The command form `:SYSTem:LICense[:FPACk]:WAVeform:STATus` is provided for consistency with Keysight signal sources. You can use either form Waveform slot number `<int>` is positive. If you attempt to input a slot number less than or equal to 0, an error is generated Result type is string. If input slot number exceeds total available slot numbers, “Nonexistent” is returned
Range	"Locked" | "Available" | “Trail” | “LockRequired” | “Nonexistent”

Slots Free Query (Remote Query Only)

Returns the number of license slots free.

Remote Command	`:SYSTem:LKEY:WAVeform:FREE?`
	or
	`:SYSTem:LICense[:FPACk]:WAVeform:FREE?`

Example	`:SYST:LKEY:WAV:FREE?`
	or
	`:SYST:LIC:WAV:FREE?`

Notes	The second form: `:SYSTem:LICense[:FPACk]:WAVeform:FREE` is provided for consistency with the style of Keysight signal sources. You can use either one

Slots Used Query (Remote Query Only)

Returns the number of license slots used.

Remote Command	`:SYSTem:LKEY:WAVeform:USED?`
	or
	`:SYSTem:LICense[:FPACk]:WAVeform:USED?`

Example	:SYST:LKEY:WAV:USED? or :SYST:LIC:WAV:USED?
Notes	The second form: SCPI :SYSTem:LICense[:FPACk]:WAVeform:USED is provided for consistency with the style of Keysight signal sources. You can use either form

Slot Waveform Name Query (Remote Command Only)

Returns the waveform name of the specified slot.

Remote Command	:SYSTem:LKEY:WAVeform:NAME? <int> or :SYSTem:LICense[:FPACk]:WAVeform:NAME? <int>
Example	:SYST:LKEY:WAV:NAME? 1 <"CDMA2K_22.wfm" or :SYST:LIC:WAV:NAME? 1 <"CDMA2K_22.wfm"
Notes	Waveform slot number <int> is positive. If you attempt to input a slot number less than or equal to 0, an error is generated Result type is string. If input slot number exceeds total available slot numbers, “Nonexistent” is returned If no waveform stored in the specified slot, then empty string is returned

Slot Waveform Unique ID Query (Remote Command Only)

Returns the waveform unique ID of the specified slot.

Remote Command	:SYSTem:LKEY:WAVeform:UID? <int> or :SYSTem:LICense[:FPACk]:WAVeform:UID? <int>
Example	:SYST:LKEY:WAV:UID? 2 <"1346752140" or :SYST:LIC:WAV:UID? 2 <"1346752140"
Notes	Waveform slot number <int> is positive. If you attempt to input a slot number less than or equal to 0, an error is generated Result type is string. If input slot number exceeds total available slot numbers, “Nonexistent” is returned

	Only Signal Studio waveform has a unique ID, which is a positive number. User-generated waveforms have no unique ID. If no waveform is stored in the specified slot, returns "0"

Locked Waveform Name List Query (Remote Query Only)

Returns the waveform name list of locked.

Remote Command	`:SOURce:RADio:ARB:MPLicensed:NAME:LOCKed?`
Example	`:SOUR:RAD:ARB:MPL:NAME:LOCKed?` < "CDMA2K_27.wfm","GSM_MCS1.WFM","c2kWfm.wfm"

Locked Waveform Unique ID List Query (Remote Query Only)

Returns the waveform unique id list of locked.

Remote Command	`:SOURce:RADio:ARB:MPLicensed:UID:LOCKed?`
Example	`:SOUR:RAD:ARB:MPL:UID:LOCKed?` < "2996927136","3812603511","3710986266"
Notes	Each Signal Studio waveform has a unique id recorded in header. If the unique ids are same, that means they are the same waveform. For this reason, in addition to the locked waveform name list query , there is also a locked waveform unique id list query

Multi-Pack License multi-module control state (Remote Command Only)

When `ON`, multi-pack license operations (such as adding/locking/replacinwaveform etc.) from TRXs other than TRX1 are allowed. If `OFF`, only TRX1 is allowed to operate multi-pack license, while other TRXs are only able to show the related multi-pack license information.

Remote Command	`:SERVice[:PRODuction]:SOURce:MCONtrol:MPLicense[:STATe] ON | OFF | 1 | 0` `:SERVice[:PRODuction]:SOURce:MCONtrol:MPLicense[:STATe]?`
Example	`:SERV:SOUR:MCON:MPL OFF`
Notes	Only effective in modular-based OBTs, such as EXM
Preset	`OFF`
Range	`ON|OFF`

Header Utilities

If there is currently a waveform selected for playback, this table shows you the header information for the file. You can clear the header information out or edit it and save it.

Dependencies	Only available if there is currently a waveform selected for playback. Grayed-out if no waveform is selected

Clear Header

Lets you clear the header information from the file header associated with the currently selected waveform.

Remote Command	`:SOURce:RADio:ARB:HEADer:CLEar`
Example	`:SOUR:RAD:ARB:HEAD:CLE`
Notes	Attempting to clear the header details via SCPI when no waveform was selected for playback generates an error

Save Header

Lets you save new file header information details to the file.

Remote Command	`:SOURce:RADio:ARB:HEADer:SAVE`
Example	`:SOUR:RAD:ARB:HEAD:SAVE`
Notes	Attempting to save the header details via SCPI when no waveform was selected for playback generates an error

Query Waveform Unique ID (Remote Query Only)

Each Signal Studio waveform contains a unique waveform ID, which recorded in the header. This command allows you to query the unique waveform ID from the header.

Remote Command	`:MMEMory:HEADer:ID? "<file name>"`

Example	Query the waveform already loaded into the ARB memory:
	`:MMEM:HEAD:ID? "test.wfm"`
	Query the waveform on the hard disk by absolute path:
	`:MMEM:HEAD:ID? "D:\NVARB\test.wfm"`

	Query the waveform on the hard disk by MSUS: `:MMEM:HEAD:ID? "NVWFM:test.wfm"`
Notes	The queried waveform file can be in ARB memory, or on hard disk. If want to query ARB in ARB memory, then give out the file name directly. If want to query ARB on the hard disk, then absolute file path or MSUS should be given along with the file name. The valid MSUS is `NVWFM`, which is mapped to `D:\NVARB` on the hard disk If the file cannot be found in ARB memory or on hard disk, an error is generated and value -1 is returned

Query Selected Waveform Header info (Remote Query Only)

Returns a listing of the current selected ARB header info. If no ARB selected, then empty string is returned.

Remote Command	`:SOURce:RADio:ARB:HEADer:INFormation?`
Example	`:SOUR:RAD:ARB:HEAD:INF?`
Notes	After each colon of field title string, related header info string is appended The field title string in “Range” part cannot change, for Sequence Studio needs to accurately match those string character to know which header info field it is Below are the abbreviation descriptions:

`DESC`	Description
`SR`	Sample Rate
`RTS`	Run Time Scaling
`RMS`	Root Mean Square
`M1P`	Marker 1 Polarity
`M2P`	Marker 2 Polarity
`M3P`	Marker 3 Polarity
`M4P`	Marker 4 Polarity
`ALCHR`	ALC Hold Routing
`RFBR`	RF Blank Routing
`FOFF`	Frequency Offset
`AWGNST`	AWGN State
`AWGNCN`	AWGN C/N Ratio
`AWGNCBW`	AWGN Carrier Bandwidth
`AWGNNBW`	AWGN Noise Bandwidth
`AWGNCRMS`	AWGN Carrier RMS
`ORP`	DAC Over Range Protection

	UID	Unique ID
	LICSTS	License Status
Range	"DESC:", "SR:", "RTS:", "RMS:", "M1P:", "M2P:", "M3P:", "M4P:", "ALCHR:", "RFBR:", "FOFF:", "AWGNST:", "AWGNCN:", "AWGNCBW:", "AWGNNBW:", "AWGNCRMS:", "ORP:", "UID:", "LICSTS"	

6.1.12 Trigger Initiate

Initiates an immediate trigger event if the trigger source (under ARB Setup) is set to KEY.

Dependencies	Grayed-out unless Trigger Source is set to KEY and an ARB waveform is configured

6.1.13 Source Sync

Accesses a menu for setting up Source Synchronization for multiple models.

Only appears in modular products such as VXT, and only when the instrument is configured for MIMO analysis.

6.1.13.1 Sync Config

Lets you config MIMO type for source.

Grayed-out when Primary and Secondary modules are in Sync State.

Remote Command	:SOURce:SYNC:CONFig NONE | TWO | THRee | FOUR | SIX | EIGHt | DONE | DTWO | DTHR | DFOU See "Option Details" on page 2303 :SOURce:SYNC:CONFig?	
Example	:SOUR:SYNC:CONF TWO	
Dependencies	EXM	2x2 and 1x1+1x1 MIMO are supported when license E6640A-M22 is enabled
		2x2 and 3x3 MIMO are supported when license E6640A-M33 is enabled
		2x2, 3x3, 4x4 and 2x2+2x2 MIMO are supported when license E6640A-M44 is enabled
	VXT models M9410A/11A	No-Across chassis MIMO is supported when license M941xA-MMO is enabled
		Across chassis MIMO is supported when license M941xA-MTS is enabled

	VXT models M9415A/16A	No-Across chassis MIMO is supported when license M941xA-MMO is enabled
Range	NONE|TWO|THRee|FOUR|SIX|EIGHt|DONE|DTWO|DTHR|DFOU	

Option Details

Parameter	SCPI	Notes
None	NONE	Sets MIMO Config type as None
2x2	TWO	Sets 2x2 as MIMO Config Type. 2 models are configured to Sync
3x3	THRee	Sets 3x3 as MIMO Config Type. 3 models are configured to Sync
4x4	FOUR	Sets 4x4 as MIMO Config Type. 4 models are configured to Sync
6x6	SIX	Sets 6x6 as MIMO Config Type. 6 models are configured to Sync
8x8	EIGHt	Sets 8x8 as MIMO Config Type. 8 models are configured to Sync
1x1+1x1	DONE	Sets 1x1+1x1 as MIMO Config Type. 2 models are configured to Sync with different center frequency. Use Segment 2 Setup to config the second model
2x2+2x2	DTWO	Sets 2x2+2x2 as MIMO Config Type. 2 groups of 2x2 MIMO. First group consists of Primary and TRX1. Second group consists of TRX2 and TRX3. Segment 2 Setup allows you to config the second group
3x3+3x3	DTHR	Sets 3x3+3x3 as MIMO Config Type. 2 groups of 3x3 MIMO. First group consists of Primary, TRX1 and TRX2. Second group consists of TRX3, TRX4 and TRX5. Segment 2 Setup allows you to config the second group
4x4+4x4	DFOU	Sets 4x4+4x4 as MIMO Config Type. 2 groups of 4x4 MIMO. First group consists of Primary, TRX1, TRX2 and TRX3. Second group consists of TRX4, TRX5, TRX6 and TRX7. Segment 2 Setup allows you to config the second group

6.1.13.2 Sync Type

Grayed-out when models are in Sync State.

Remote Command	`:SOURce:SYNC:TYPE PRIMary | SECondary | OFF`
	For details of parameter options, see "Options" on page 2304
	`:SOURce:SYNC:TYPE?`

Example	`:SOUR:SYNC:TYPE PRIM`
Preset	OFF
Range	PRIMary|SECondary|OFF

Options

Parameter	Notes
OFF	This model is not listed in the Secondary module List
SECondary	Use :SOURce:SYNC:CONNected:NAME? to obtain the Primary's name in Sync State
PRIMary	Sync Setup is only available for Primary

6.1.13.3 Sync Settings

Grayed-out when Primary and Secondary are in Sync State.

Dependencies	Grayed-out when Sync Type is set to OFF or Secondary

Secondary Module List

Lists the parameters of Secondary modules. The Selected checkbox in each row allows you to select the Secondary module when the Sync Type is set to Primary.

- When Sync Config is set to NxN, use this control to enable N-1 Secondary modules
- When Sync Config is set to NxN+NxN, use this control to enable 2N-1 Secondary modules

See "More Information" on page 2304

Remote Command	:SOURce:SYNC:REMote:SECondary<integer> ON | OFF | 1 | 0 :SOURce:SYNC:REMote:SEC<integer>?
Example	:SOUR:SYNC:REM:SEC1 ON :SOUR:SYNC:REM:SEC2 OFF
Notes	<integer> Secondary module number in Available Models
Preset	OFF

More Information

Parameter	SCPI Example	Notes
Available Secondary modules	:SOUR:SYNC:REM:SEC:List?	All the available Secondary models are listed
IP Address	:SOUR:SYNC:REM:SEC1:ADDR?	Refer to Remote Chassis to add the IP Address for remote chassis

Parameter	SCPI Example	Notes
		“Local Host” indicates that the Primary and Secondary modules share the same chassis
Slot Number	:SOUR:SYNC:REM:SEC2:SLOT?	Indicates the slot number of available models
Socket Port	:SOUR:SYNC:REM:SEC2:SPOR?	Indicates the socket port of available models
Secondary module Order		Shows you the models to be Secondary devices Use Selected to choose from available Secondary models

Sync Settings

Lets you apply the source settings of the Primary module to its Secondary modules.

Remote Command	`:SOURce:SYNC:SETTings:ENABle ON | OFF | 1 | 0` `:SOURce:SYNC:SETTings:ENABle?`
Example	`:SOUR:SYNC:SETT:ENAB ON` `:SOUR:SYNC:SETT:ENAB?`
Notes	When Sync Settings is ON, the source settings of Primary are applied to Secondary modules. The supported settings are Amplitude, Frequency, Trigger Source, Trigger Type, RF Output and waveform related information When Sync Segment 2 is switched ON, this Toggle is set ON simultaneously
Dependencies	Waveform files naming convention: For NxN MIMO: – xxx0.wfm for Primary – xxx[n].wfm for TRX[n] For example, in 3x3 MIMO: – xxx0.wfm for Primary – xxx1.wfm for TRX1 – xxx2.wfm for TRX2 For NxN+NxN MIMO, in the first group: – xxx0_0.wfm for Primary – xxx0_n.wfm for TRX[n] in the second group: – xxx1_n.wfm for TRX[n+N] For example, in 3x3+3x3 MIMO: – xxx0_0 for Primary

	– xxx0_1.wfm for TRX1 – xxx0_2.wfm for TRX2 – xxx1_0.wfm for TRX3 – xxx1_1.wfm for TRX4 xxx1_2.wfm for TRX5
Preset	OFF
Range	ON|OFF

Sync Segment 2

Lets you config the models in the second group of NxN+NxN MIMO.

Remote Command	:SOURce:SYNC:SETTings:SEGMent2:ENABle ON | OFF | 1 | 0 :SOURce:SYNC:SETTings:SEGMent2:ENABle?
Example	:SOUR:SYNC:SETT:SEGM2:ENAB ON :SOUR:SYNC:SETT:SEGM2:ENAB?
Notes	Only Frequency in settings is supported
Dependencies	When this setting is ON, Sync Settings will be turned on accordingly
Preset	OFF
Range	ON|OFF

Segment 2 Frequency

When Sync Segment 2 is ON, allows you to set the frequency of models in the second group of NxN+NxN MIMO.

Remote Command	:SOURce:SYNC:SETTings:SEGMent2:FREQuency <freq> :SOURce:SYNC:SETTings:SEGMent2:FREQuency?
Example	:SOUR:SYNC:SETT:SEGM2:FREQ 1.00 GHz :SOUR:SYNC:SETT:SEGM2:FREQ?
Preset	1.00 GHz
Min	VXT models M9410A/11A/15A/16A: 380 MHz
Max	Hardware Dependent VXT models M9410A/11A/15A/16A: – Option F06 = 6.0 GHz

IP Address

Sets up the controller's IP address of Remote Secondary models.

Remote Command	`:SOURce:SYNC:REMote:ADDRess <string>`
Example	`:SOUR:SYNC:REM:ADDR "192.168.1.2"`
Notes	`<string>` - IP Address

SCPI Socket Port

Sets up the controller's SCPI socket port of Remote Secondary models.

Remote Command	`:SOURce:SYNC:REMote:IPPort <integer>`
Example	`:SOUR:SYNC:REM:IPP 5025`
Notes	`<integer>` - Port

Add Secondary Module

Lets you connect the remote chassis specified by IP Address and Socket Port.

Remote Command	`:SOURce:SYNC:REMote:ADDRess:ADD`
Example	`:SOUR:SYNC:REM:ADDR:ADD`

Notes	Example of how to add a remote chassis:
	`:SOUR:SYNC:REM:ADDR "192.168.1.2"`
	`:SOUR:SYNC:REM:IPP 5025`
	`:SOUR:SYNC:REM:ADDR:ADD`
	Once a remote chassis is connected, the "Secondary Module List" on page 2304 shows you the available Secondary modules

Delete Secondary Module

Lets you delete a selected remote chassis IP Address from the "Secondary Module List" on page 2304 .

Remote Command	`:SOURce:SYNC:REMote:ADDRess:DELete`
Example	`:SOUR:SYNC:REM:ADDR:DEL`
Notes	Example of how to delete a remote chassis: `:SOUR:SYNC:REM:ADDR "192.168.1.2"`

	:SOUR:SYNC:REM:ADDR:DEL

Sync Runtime Settings (Remote Command Only)

Lets you Sync runtime settings to the Secondary modules without restarting Sync.

Remote Command	:SOURce:SYNC:RTSetting:STATe ON | OFF | 1 | 0 :SOURce:SYNC:RTSetting:STATe?
Example	:SOUR:SYNC:RTS:STAT ON :SOUR:SYNC:RTS:STAT?
Notes	When OFF, Sync is interrupted when changing frequency or power settings on the Primary module. After applying the new settings to the Secondary modules, Sync will restart When ON, setting changes on the Primary module are applied to the Secondary modules immediately without interrupting Sync status. This is the default behavior. The supported settings are **Amplitude** and **Frequency**
Preset	ON
Range	ON|OFF

6.1.13.4 Sync Start

Lets you start synchronizing Primary and Secondary modules to play Arb synchronously.

When the Sync connection is built successfully, Primary and Secondary modules are in the Sync State.

Sync Start and Sync Config menu are grayed-out when Primary and Secondary modules are in Sync State.

Remote Command	:SOURce:SYNC:STARt
Example	:SOUR:SYNC:STAR
Notes	If you change the source settings during Sync State, an error message appears in the status bar: "Settings conflict; Sync connection is already established" and the change will not be applied until Sync Stop

6.1.13.5 Sync Stop

Stops the synchronization.

When Sync Stops, Sync Config menu and Sync Start will be available.

Remote Command	:SOURce:SYNC:STOP
Example	:SOUR:SYNC:STOP

6.1.13.6 Sync Connected (Remote Query Only)

Lets you query the state of synchronization.

Remote Command	`:SOURce:SYNC:CONNected?`
Example	`:SOUR:SYNC:CONN?` Returns: 1 when synchronization is established, 0 when synchronization is stopped

6.1.14 Source Preset

Lets you preset the source settings to their default values.

Remote Command	`:SOURce:PRESet`
Example	`:SOUR:PRES`

6.2 Input

The controls on this tab let you select and configure the instrument's inputs.

6.2.1 Select Input

Lets you choose which signal input you want to analyze:

- "RF Input" on page 2312
- "External Mixer" on page 2312
- "I/Q" on page 2315

See also:

- "External Mixer Setup" on page 2337
- "I/Q Setup" on page 2357

Remote Command	`[:SENSe]:FEED RF | AIQ | EMIXer` `[:SENSe]:FEED?`

Example	Select the RF Input:
	`:FEED RF`
	Select External Mixing:
	`:FEED EMIX`
	Select BBIQ:
	`:FEED AIQ`

Dependencies	I/Q only appears when Option BBA present Ext Mix only appears when Option EXM present
Couplings	Connecting a U7227A USB Preamplifier to one of the instrument's USB ports causes the Input to automatically switch to the RF Input. If the RF Calibrator is on, it is turned off. Subsequently disconnecting the USB Preamp from USB does not change the Input selection, nor restore the previous selection `[:SENSe]:FEED RF` turns the calibrator `OFF`
Preset	Unaffected by Preset or power cycle. Survives a Mode Preset and mode changes Set to `RF` by **Restore Input/Output Defaults** or **Restore System Defaults->All**
State Saved	Saved in instrument state
Annotation	Displayed in the Meas Bar as "Input::" followed by: RF or Ext Mix or I/Q depending on which input is selected

Backwards Compatibility SCPI	`[:SENSe]:FEED AREFerence`
	In the PSA the calibrator was one of the inputs and selected using the AREF parameter to the same :FEED command that switched the inputs. In the X-Series, it is controlled in a separate menu and overrides the input selection. For code compatibility, `[:SENSe]:FEED AREFerence` is provided, and is aliased to `[SENSe]:FEED:AREF REF50`, which causes the input to be switched to the 50 MHz calibrator. `[:SENSe]:FEED RF` switches the input back to the RF port and turns the calibrator `OFF`, thus providing full compatibility with the PSA calibrator function
	Note that after sending this, `[:SENSe]:FEED?` does *not* return "AREF" but instead the currently selected input:
	`[:SENSe]:FEED IQ | IONLy | QONLy`
	`[:SENSe]:FEED?`
	The parameters `IQ | IONLy | QONLy` are supported for backwards compatibility with the E44406A
	`[:SENSe]:FEED IQ aliases to [:SENSe]:FEED: IQ:TYPE IQ`
	`[:SENSe]:FEED IONLy aliases to [:SENSe]:FEED:IQ:TYPE IONLy`
	`[:SENSe]:FEED QONLy aliases to [:SENSe]:FEED:IQ:TYPE QONLy`
	`[:SENSe]:FEED? always returns AIQ, whatever type of legacy parameter IQ | IONLy | QONLy has been used`

Backwards Compatibility Notes	Most of the settings in the X-Series Input/Output system, including External Gain, Amplitude Corrections settings and data, etc., are shared by all modes and are not changed by a mode switch. Furthermore, most variables under the **Input/Output** menu are not affected by Mode Preset. Both of these behaviors represent a departure from legacy behavior In X-Series. Input/Output settings are reset by using **Restore Input/Output Defaults**. They can also be reset to their default values by **System**->**Restore System Defaults**-> **In/Out Config**, or by **System** ->**Restore System Defaults** -> **All** (and corresponding SCPI) While this matches most use cases better, it does create some code compatibility issues. For example, Amplitude Corrections are no longer turned off by Mode Preset, but instead by **Restore Input/Output Defaults** Although Input/Output settings are not part of each Mode's State, they are saved in Save State files, so that all of the instrument settings can be recalled with **Recall**, **State**, as in legacy instruments
Notes	In legacy analyzers you choose between the Internal mixer or an External Mixer. In X-Series, the External Mixer is one of the choices for the Input and is selected using the `FEED` command (`:SENSe:FEED EXTMixer`) For compatibility, the `:INPut:MIXer EXTernal|INTernal` legacy command is mapped as follows: 1. When `:INPut:MIXer EXTernal` is received, `:SENSe:FEED EMIXer` is executed 2. When `:INPut:MIXer INTernal` is received, `:SENSe:FEED RF` is executed 3. When `:INPut:MIXer?` is received, the response is `INT` if any input other than the external mixer is selected, and `EXT` if the external mixer is selected
Preset	`INT`

Backwards Compatibility SCPI	`:INPut:MIXer EXTernal | INTernal` `:INPut:MIXer?`

Backwards Compatibility Notes	PSA supports the following SCPI Command :
	`:INPut:MIXer:TYPE PRESelected | UNPReselect`
	`:INPut:MIXer:TYPE?`
	PXA does not support the `:INPut:MIXer:TYPE` command

RF Input

Selects the front-panel RF input port to be the instrument signal input. If RF is already selected, pressing this key accesses the RF input setup functions.

External Mixer

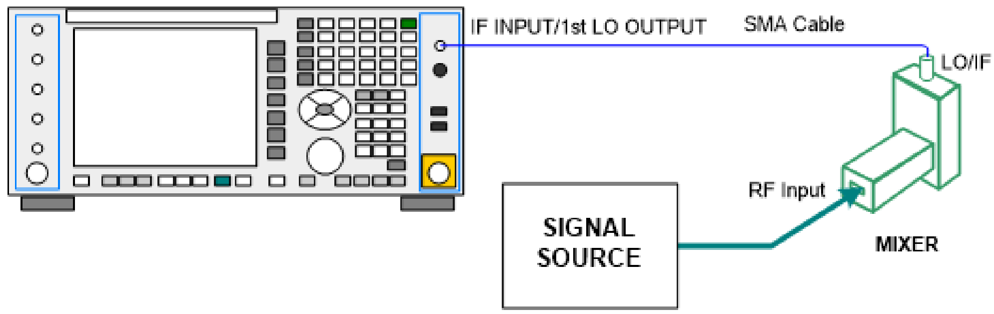
Lets you select an External Mixer through which to apply signal input to the instrument. When selected, the LO/IF port becomes the input to the instrument.

External Mixing requires option EXM. The External Mixer key will not appear unless option EXM is installed. The presence of the LO/IF connector alone does not indicate that you have Option EXM licensed. To verify that option EXM is installed, press **System, Show, System.**

When External Mixer is selected, the **Center Freq** key controls the setting of the Center Freq in external mixing, which is separate from the settings of Center Freq for the RF Input or BBIQ. Each input retains its unique settings for Center Freq. A unique SCPI command is provided solely for the external mixing Center Freq (see the **Center Freq** key description), which only affects the External Mixer CF, although sending the generic Center Freq command while External Mixer is selected also controls the External Mixer CF.

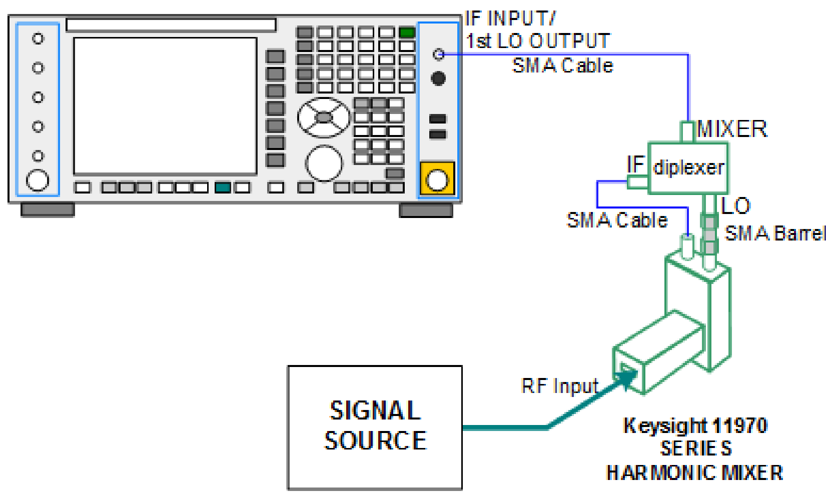
Unless option EXM is present, the External Mixer key is blanked, and all SCPI commands associated with menus accessed by this key return an error
Manual FFT mode is available with external mixing, but not with Signal ID. All settings under this key, and all Frequency settings, are remembered when you go out of External Mixer, so that when **External Mixer** is chosen again, all the external mixer functions will retain their previous settings, with the exception of Signal ID which is set to OFF (Signal ID is also set to Off unless External Mixer is the selected Input). Note that this differs from ESA and PSA, in which all external mixer settings including Center Frequency are lost when you turn off External Mixing or Preset the instrument.

X-series instruments have a combined LO Out/IF In connection, whereas earlier instruments used separate ports for the LO Out and the IF in. Internal diplexers in the instrument and the mixer simplify the connection for users – only a single SMA cable is required.



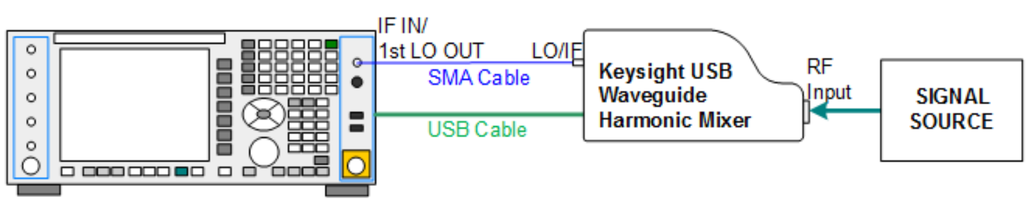
Legacy HP/Agilent and some third-party mixers have separate LO In and IF out connections. This requires you to use an external diplexer to connect these mixers. A diplexer can easily be purchased for this purpose (for example, Diplexer Model # DPL.26 or # DPL.313B from OML Inc., Morgan Hill, California, USA).

The connection diagram for such a legacy mixer is:



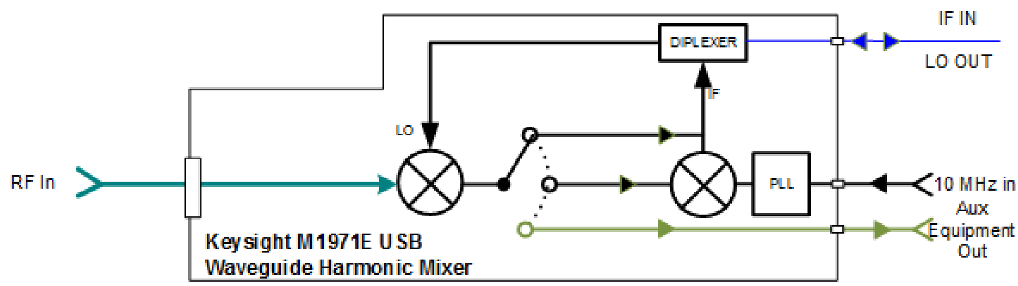
In addition, External Mixing in the X-Series supports the new Keysight M1970 series of Harmonic Mixers, which provide a USB connection for download of calibration data and additional control.

The connection diagram for one of the Keysight USB mixers is:

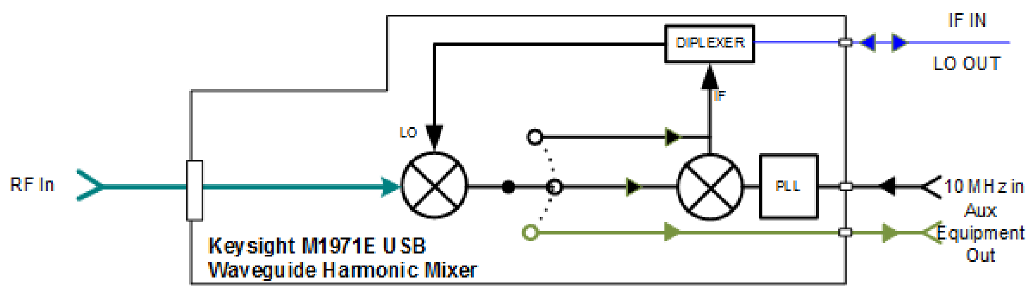


Also available in the M197x series are the M1971 series USB Mixers, which provide additional inputs and outputs for special functionality as described below. These mixers have multiple signal paths which allow them to function in three different states:

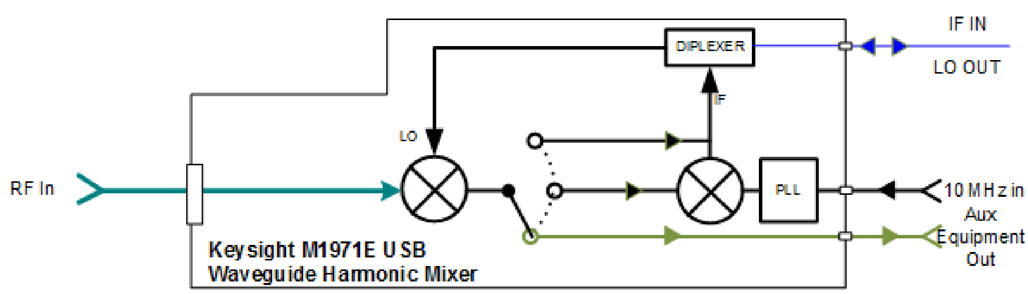
- Normal, in which the mixer functions as a classic external mixer with a single conversion:



- Dual Conversion, which gives you a wider image-free range. In Dual Conversion, the first conversion is to a higher IF frequency and you provide a 10 MHz signal to which an internal PLL is locked, to effect a second downconversion:



- Aux Equipment, wherein the first mixer output drives an output connector on the mixer and the instrument is out of the circuit:



External Mixing is only supported in certain Modes and Measurements in the X-Series, as shown in the table below. When External Mixer is selected in a measurement that does not support it, the "No result; Meas invalid with Ext Mixing" error condition occurs:

Mode	Measurements	Sig ID (Image Suppress only)
Spectrum Analyzer	Swept SA	Y*
	TOI	Y
	Harmonics	N
	Spurious Emissions	Y
	Channel Power	Y
	Occupied BW	Y
	ACP	Y
	Spectrum Emissions Mask	Y
	CCDF	N
	Burst Power	N
	List Sweep	N
Phase Noise	Monitor Spectrum	Y
	Log Plot	Y
	Spot Frequency	N
	Waveform	N
I/Q Analyzer	Complex Spectrum	N
	Waveform	N
Vector Signal Analyzer	Vector Analysis	N
	Analog Demod	N
	Digital Demod	N
Analog Demod	AM	N
	FM	N
	PM	N
	FM Stereo	N

* the Swept SA measurement also supports Image Shift

I/Q

Selects the front-panel I/Q input ports to be the instrument signal input. If I/Q is already selected, pressing this key accesses the I/Q setup menu.

The Baseband I/Q functionality is a hardware option. It is option BBA. If the option is not installed, none of the I/Q functionality is enabled.

The Baseband I/Q has four input ports and one output port. The input ports are I, I-bar, Q, and Q-bar. The I and I-bar together compose the I channel, and the Q and Q-bar together compose the Q channel. Each channel has two modes of operation, Single-Ended (also called "unbalanced") and Differential Input (also called "balanced"). When in Single-Ended operation, only the main port (I or Q) is used, and the complementary port (I-bar or Q-bar) is ignored. When in Differential Input mode, both main and complementary ports are used.

The input settings (range, attenuation, skew, impedance, external gain) apply to the channels, not the individual ports.

The system supports a variety of 1 MΩ input passive probes as well as the Keysight 113x Series active differential probes using the Infinimax probe interface.

The Keysight 113x Series active probes can be used for both single ended and differential measurements. In either case a single connection is made for each channel (on either the I or Q input). The input is automatically configured to 50 Ω single ended and the probe power is supplied through the Infinimax interface. The probe can be configured for a variety of input coupling and low frequency rejection modes. In addition, a wide range of offset voltages and probe attenuation accessories are supported at the probe interface. The active probe has the advantage that it does not significantly load the circuit under test, even with unity gain probing.

With passive 1 MΩ probes, the probe will introduce a capacitive load on the circuit, unless higher attenuation is used at the probe interface. Higher attenuation reduces the signal level and degrades the signal-to-noise-ratio of the measurement. Passive probes are available with a variety of attenuation values for a moderate cost. Most Keysight passive probes can be automatically identified by the system, setting the input impedance setting required as well as the nominal attenuation. For single ended measurements a single probe is used for each channel. Other passive probes can be used, with the attenuation and impedance settings configured manually.

For full differential measurements, the system supports probes on each of the four inputs. The attenuation of the probes should be the same for good common mode rejection and channel match.

Both active and passive probes in single ended and differential configurations can be calibrated. This calibration uses the Cal Out BNC connection and a probe connection accessory. The calibration achieves excellent absolute gain flatness in a probed measurement. It matches both the gain and frequency response of the I and Q channels as well as any delay skew, resulting in high accuracy in derived measurements such as Error Vector Magnitude (EVM).

When a probe is connected a status message will be displayed. The message will indicate if calibration data is available or not. Calibration data is saved for each type of probe (including "none") for each port and will be reapplied whenever that type of probe is re-connected to the same port. For probes with EEPROM identification, the calibration data will be stored based on the unique probe identifier and will reapply data for that particular probe if it is available. The data will not follow a probe from one port to another. For probes without EEPROM identification, the instrument cannot distinguish between different probes of the same type, and it will use the data from the last calibration for that probe type on that port.

When in differential mode, both the main and complementary probes are expected to be of the same type.

In some situations, the I and Q channels should be configured identically. In other situations, it is convenient to control them independently. Some menus have a "Q Same as I" setting that will cause the Q channel configuration to mirror the I channel configuration, avoiding the overhead of double data entry when the channels should be the same.

The output port is for calibrating the I/Q input ports, although it can also be manually controlled.

There are two types of calibrations available: cable calibration and probe calibration. The cable calibration will guide the user through connecting each input port in turn. All ports must be calibrated together. The probe calibration is done for a specific channel (I or Q). If in Single-Ended mode, only the main port is calibrated. When in Differential Input mode, the user is guided through calibrating both main and complementary ports.

The front panel I/Q port LEDs indicate the current state of that port. On (green) indicates it is active, and off (dark) indicates it is not in use. For example, the Cal Out port LED is on if and only if there is signal coming out of that port.

The input is a context, and some parameters have separate values for each context. The SCPI for these parameters has an optional "[:RF|IQ]" node. If the specific context is omitted, the command acts on the current input context's value. Here are the parameters that are input context sensitive:

- Center Frequency
- Trigger Source

It is important to distinguish between the I and Q input ports and the displayed I and Q data values. The I and Q input ports feed into a digital receiver that does digital tuning and filtering. The I and Q data seen by the user (either on the display or through SCPI) corresponds to the real ("I") and the imaginary ("Q") output from the digital receiver. When the input path is I+jQ or I Only and the center frequency is 0 Hz the I input ends up in as the real output from the receiver and appears as "I" data. Likewise, when the input path is I+jQ and the center frequency is 0 Hz, the Q input ends up as the imaginary output from the receiver and appears as "Q" data. However, when the input path is Q Only, the Q input is sent to the receiver as Q+j0, so the receiver output has the Q input coming out on the real output, and so in Q Only, the signal from the Q input port appears as the "I" data. Another situation where the I and Q data do not necessarily correspond directly to the I and Q inputs is when the center frequency is non-zero. The digital processing involved in the tuning is a complex operation. This will result in I Only data appearing as both "I" and "Q" data, the same as that signal would appear if seen through the RF input port.

BBIQ is only supported in certain Modes and Measurements in the X-Series. When I/Q is selected in a measurement that does not support it, the “No Result; Meas invalid with I/Q inputs” message appears. This is error 135

Baseband I/Q Remote Language Compatibility

For the Agilent E4406A VSA Series Transmitter Tester, Option B7C provided baseband I/Q inputs. Code compatibility has been provided to allow many of the commands for Option B7C to function properly with X-Series. X-Series has hardware differences and additional capabilities (for example, E4406A does not have independent settings of I & Q, nor does it provide for probe calibrations), which make 100% compatibility impossible.

The following commands are supported:

```
:CALibration:IQ:FLATness
```

```
:INPut:IMPedance:IQ U50 | B50 | U1M | B1M
```

```
:INPut:IMPedance:REFerence <integer>
```

`[:SENSe]:FEED RF|IQ|IONLy|QONLy|AREFerence|IFALign` supports all parameters except `IFALign`. The `FEED?` query returns only `RF|AIQ|AREF`.

The following commands are not supported:

```
:CALibration:GIQ
```

```
:CALibration:IQ:CMR
```

```
:INPut:IQ:ALIGn OFF | ON | 0 | 1
```

The Rohde & Schwarz FSQ-B71 also provides baseband I/Q inputs. A certain amount of code compatibility is provided in X-Series, but hardware differences make this a somewhat limited set.

Supported:

The "<1|2>" is supported as "[1]".

```
INPut<1|2>:IQ:BALanced[:STATe] ON | OFF
```

```
INPut<1|2>:IQ:TYPE I | Q | IQ
```

```
INPut<1|2>:IQ:IMPedance LOW | HIGH
```

Not Supported:

```
DIAGnostic<1|2>:SERVice:IQ:CALibration:DC 0 | 0.1 | 0.178 | 0.316 | 0.562 | 1.0
```

```
DIAGnostic<1|2>:SERVice:IQ:CALibration:DESTination IHIGh | ILOW | QHIGh | QLOW
```

```
DIAGnostic<1|2>:SERVice:IQ:CALibration:PULSe: PRATe 10 kHz | … | 4 MHz
```

```
DIAGnostic<1|2>:SERVice:IQ:INPut IQ | GND | CALDc | CALPulse
```

`INPut<1|2>:SELect AIQ | RF`

`TRACe<1|2>:IQ:DATA:FORMat COMPatible | IQBLock | IQPair>`

`TRACe<1|2>:IQ:DATA:MEMory? <offset samples>,<# of samples>`

`TRACe<1|2>:IQ:DATA?`

`TRACe<1|2>:IQ:SET <filter type>,<rbw>,<sample rate>,<trigger source>,<trigger slope>, <pretrigger samples>, <# of samples>`

`TRACe<1|2>:IQ:SRATe 10.0kHz to 81.6MHz`

`TRACe<1|2>:IQ[:STATe] ON | OFF`

The Rohde & Schwarz FMU has the following SCPI, which is *not* supported (these commands start/abort the probe calibration procedure, which is manually interactive from the front panel):

`CALibration:ABORt`

`CALibration:PROBe[:STARt]`

6.2.2 RF Input Port

Specifies the RF input port used. Only appears on units with multiple RF inputs, and lets you switch between the inputs.

Instruments that include multiple RF Input ports include:

- N9041B
- N9000B (CXA)
- N9048B (PXE)
- VXT, M941xE and EXM
- M8920A/20B
- E7760B

NOTE	Switching input ports may change the receiver performance of the instrument.

See "Instruments with 2 Inputs" on page 2321

Remote Command	`[:SENSe]:FEED[:RF]:PORT[:INPut] <port>` For instrument-specific definitions of `<port>`, see: "Parameters for UXA/PXA/MXA/EXA/CXA/MXE/PXE/NFA" on page 2321 "Parameters for EXT, EXF and EXM Wireless Test Sets" on page 2322

	"Parameters for VXT M9410A/11A/15A16A, M9410E/11E/15E/16E and M9420A Vector Transceivers" on page 2322 "Parameters for VXT M9410A/11A/15A/16A and EXM when used with Radio Heads/CIU" on page 2324 "Parameters for E7760B Wideband Transceiver" on page 2327 "Parameters for M8920A/20B Radio Test Set" on page 2328 "Parameters for UXM Wireless Test Set" on page 2328 `[:SENSe]:FEED[:RF]:PORT[:INPut]?`

Example	Use the port labeled RF Input when the selected input is RF:
	`:FEED:RF:PORT RFIN`
	Use the port labeled RF Input 2 when the selected input is RF:
	`:FEED:RF:PORT RFIN2`

Dependencies	Only appears when RF Input is selected as the Input Only appears in models that support multiple inputs. If the SCPI command is sent with unsupported parameters in any other model, an error is generated, -221, “Settings conflict; option not installed” When any input is selected in a measurement that does not support it, the "No result; Meas invalid with this input" error condition occurs, and the measurement returns invalid data when queried
Couplings	When switching between inputs, you may find the new input has a different frequency range than the current input. This means the frequency at the new input may be limited, depending on where you were tuned When you switch from an input whose maximum frequency is greater than the input to which you are switching: 1. If the current Stop Freq is below the Max Freq for the new input, then neither Stop Freq or Start Freq needs to change 2. But if the current Stop Freq is above the Max Freq for the new input, Stop Freq must change; so, it is set to the Max Freq for the new input 3. If the Stop Freq is forced to change then, if possible, the Span is preserved with the new Stop Freq; however, the Start Freq can’t go below zero Example: Input 2 has a Max Freq of 110 GHz and Input 1 has a Max Freq of 52 GHz Case 1: Input 2 is selected and Start Freq=40 GHz, Stop Freq=60 GHz. Change to Input 1. Stop Freq changes to 52 GHz so, to preserve Span, Start Freq is set to 32 GHz Case 2: Input 2 is selected and Start Freq=40 GHz, Stop Freq=110 GHz. Change to Input 1. Stop Freq changes to 52 GHz. Span was 70 GHz, but new Span maximum is 52 GHz so Start Freq is set to 0 Hz Case 3: Input 2 is selected and Start Freq=10 GHz, Stop Freq=20 GHz. Change to Input 1. No change is necessary, Start Freq and Stop Freq don’t change
Preset	Unaffected by Mode Preset, but set to `RFIN` on **Restore Input/Output Defaults** or **Restore System Defaults -> All**, unless noted in the platform-specific sections below
State Saved	Saved in instrument state
Annotation	Annotation in the Meas Bar reads as follows: When input is RF In: Input: RF

	When input is RF In 2: Input: RF2

Backwards Compatibility SCPI	`:INPut<1|2>:TYPE INPUT1 | INPUT2`
	`:INPut<1|2>:TYPE?`
	Included for R&S ESU compatibility. In MXE, the INPUT1 parameter is aliased to RFIN and the INPUT2 parameter is aliased to RFIN2

Instruments with 2 Inputs

In models with two inputs, the second input usually has a different maximum frequency than the first input. For your convenience, the actual “Max Freq” value is allowed to go slightly higher than the nominal Max Freq for the second input, just as is the case with the first input.

Model	Nominal Input 2 Max Freq	Absolute Input 2 Max Freq	Transition rule for switching from Input 1 to Input 2
N9038A	1 GHz	1.000025 GHz	If Stop Freq is above 1.000025 GHz, it is set to 1.000025 GHz, otherwise it does not change If Start Freq is above 1.000024990 Hz, Start Freq is set to 1.000024990 Hz and Span to 10 Hz, otherwise nothing changes
N9000A with option C75	1.5 GHz	1.58 GHz	If Stop Freq is above 1.58 GHz, it is set to 1.58 GHz, otherwise it does not change If Start Freq is above 1.579999990 GHz, Start Freq is set to 1.579999990 GHz and Span to 10 Hz, otherwise nothing changes

Parameters for UXA/PXA/MXA/EXA/CXA/MXE/PXE/NFA

<port>	Input
`RFIN`	RF Input
`RFIN2`	RF Input 2
`ERFIN`	External RF

Example	Set the RF input to be RF Input:
	`:FEED:RF:PORT RFIN`
	Set the RF input to be RF Input 2 if that port exists:
	`:FEED:RF:PORT RFIN2`
	Set the RF input to be External RF if the V3050A unit is connected:
	`:FEED:RF:PORT ERFIN`

Dependencies	If the command is sent with `RFIN2` or `ERFIN` and that port does not exist, an error is generated, -221, “Settings conflict; option not installed” `ERFIN` requires option “EXW”

Couplings	Connecting a V3050A changes the Preset to `ERFIN` and automatically switches the input to `ERFIN`. Disconnecting the V3050A changes the Preset back to `RFIN` and automatically switches the input to `RFIN`
Preset	`ERFIN` when V3050A is connected, otherwise `RFIN`
Annotation	Annotation in the Meas Bar reads as follows: – When input is RFIN: Input: RF – When input is RFIN2: Input: RF2 – When input is ERFIN: Input: Ext RF

Parameters for EXT, EXF and EXM Wireless Test Sets

<port>	Input
`RFIO1`	RFIO 1
`RFIO2`	RFIO 2
`RFIO3`	RF3 I|O
`RFIO4`	RF4 I|O

See also "Parameters for VXT M9410A/11A/15A/16A and EXM when used with Radio Heads/CIU" on page 2324

Example	Set the RF input to RFIO 1: `:FEED:RF:PORT RFIO1`
Dependencies	In EXF, or in EXM with hardware M9430A, if RF Input is selected as RF Input Port, you need to choose the settings in the Half Duplex Config menu to determine which port (RFIO3 or RFIO4) will be used In EXM with hardware M9431A, this setting is not supported. If the SCPI command is sent with this setting, an error is generated, -221, "Settings conflict; option not installed"
Preset	`RFIO1`
Annotation	Annotation in the Meas Bar reads as follows: – When input is RFIO1: Input: RFIO1 – When input is RFIO2: Input: RFIO2 – When input is RFIO3: Input: RFIO3 – When input is RFIO4: Input: RFIO4

Parameters for VXT M9410A/11A/15A16A, M9410E/11E/15E/16E and M9420A Vector Transceivers

<port>	Input
`RFIN`	RF Input

<port>	Input
RFFD	RFIO FD
RFHD	RFIO HD, Half Duplex

Example

```
:FEED:RF:PORT RFIN
:FEED:RF:PORT RFFD
:FEED:RF:PORT RFHD
:FEED:RF:PORT NONE
```

Notes

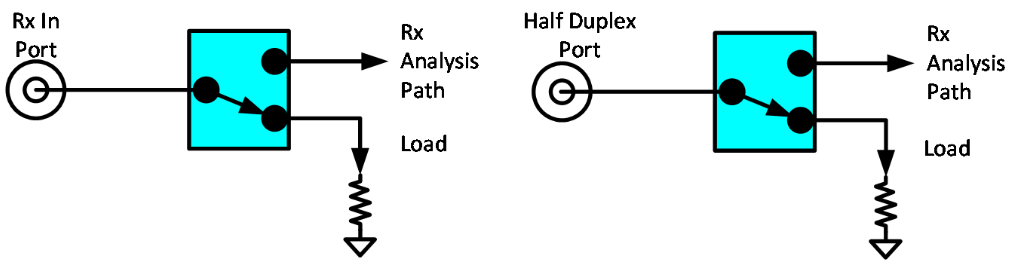
RFIN sets the RF input to be the RF Input port, labeled RF Input

RFFD sets the RF input to be the full duplex port, labeled RFIO FD. Note that Option “FDX” is required to enable this port

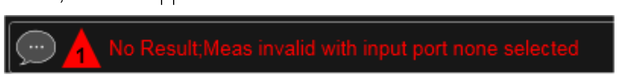
RFHD sets the RF input to be the half duplex port, labeled Half Duplex (M9410A/11A/15A/16A) or RFIO HD (M9420A)

M9410E/11E/15E/16E also has HD port, which is the HD port on M9471A module

NONE sets the RF In port and Half Duplex port (if HD Port is not set to RF Output) to connect to 50Ω load, as shown below:



When using Source only, set RF Input to NONE to provide better isolation. When the input port is set to NONE, an error appears in the status area:



Dependencies

Option HDX is required to enable the Half Duplex (RFIO HD) port

You cannot set this port to be the input if it is already set to be the output. Attempting to do so generates error message: “-221, Settings conflict; RF Input cannot be set to RFIO HD when RF Output is RFIO HD”

NONE is not available in VXT model M9420A

Preset

RFIN

Annotation

Annotation in the Meas Bar reads as follows:

When input is RF Input: Input: RF

When input is RFIO FD: Input: RFFD

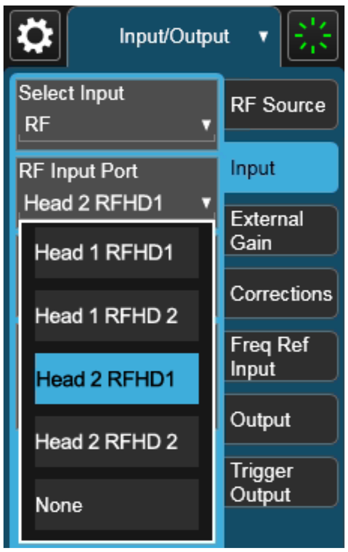
When input is RFIO HD or Half Duplex: Input: RFHD

When input is None: Input: NONE

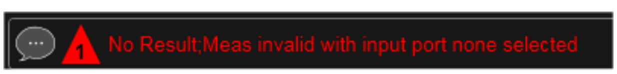
Parameters for VXT M9410A/11A/15A/16A and EXM when used with Radio Heads/CIU

<port>	Input
`RRH`*h*`RFHD`*p*	Head *h*, RF Tx/Rx *p*, for example `RRH1RFHD2` = Head 1, RF Tx/Rx 2
`IFIN`*n*	DUT IF IN for Channel *n*, for example `IFIN1` = DUT IF IN for Channel 1
`IFHD`*n*	DUT IF In/Out for Channel *n*, for example `IFHD1` = DUT IF In/Out for Channel 1

When using a Remote Radio Head (RRH), such as the Keysight M1740A mmWave Transceiver for 5G, with the VXT or EXM, the choices in the dropdown are dependent on which heads are installed. For example, in the case where two M1740As are present, each with two ports, the dropdown will look like this:

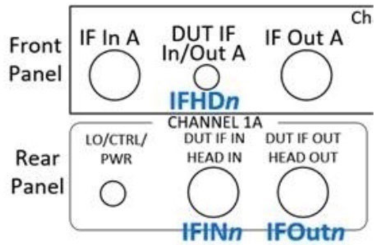


Note the inclusion of the **None** choice, which allows the input port to become unassigned, and thus allows any Output port to be assigned without concern about an Input port conflict. When the input port is unassigned, an error appears in the status area:



The user interface parameter RFHD p corresponds to the port labeled RF Tx/Rx p; for example, RFHD 2 means the port labeled RF Tx/Rx 2 on the M1740A.

When using a E7770A Common Interface Unit, you may make connections to the half-duplex port on the front of the CIU labeled DUT IF In/Out, and/or to ports on the rear of the CIU labeled DUT IF IN and DUT IF OUT. For example, if your DUT has an IF Output you will usually connect it to one of the DUT IF IN ports on the rear panel of the CIU. The user interface parameter IFIN n corresponds to the DUT IF IN port for Channel n on the CIU, so you would choose IFIN 1 in the dropdown to connect to the DUT IF IN port for Channel 1, and the corresponding SCPI parameter would be IFIN1. See the figure below:

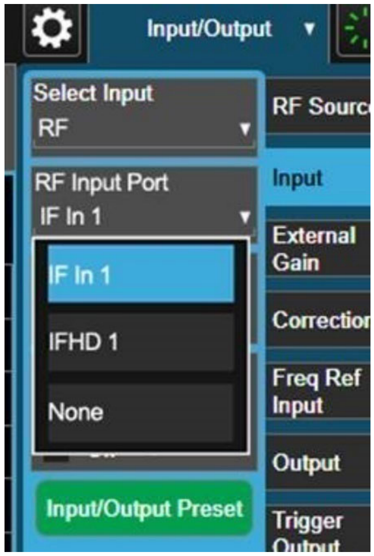


The following table lists the GUI parameter for each input or output on the CIU, and the SCPI parameter for the RF Input Port command (`[:SENSe]:FEED[:RF]:PORT [:INPut]`) and the RF Output Port command (`[:SENSe]:FEED:RF:PORT:OUTPut`):

Port	Port name on CIU	Name displayed in GUI	SCPI parameter for RF Input Port and Output Port commands
IF input port	DUT IF IN	IF In n	`IFINn`, for example `IFIN1`
IF output port	DUT IF OUT	IF Out n	`IFOutn`, for example `IFO1`
IF port, half duplex	DUT IF In/Out	IFHD n	`IFHDn`, for example, `IFHD1`

NOTE The value of n for each port, in the multiple-port use case, may vary according to your system configuration. For the value of n for your use case, consult the Startup Guide for your particular system (for example S9100A).

An example of the GUI for the CIU ports appears below:



Example	Set the RF input to be the port labeled RF Tx/Rx 2 on Head 1:
	`:FEED:RF:PORT RRH1RFHD2`
	Set the RF input to be the Channel 1 port labeled DUT IF IN on the CIU:
	`:FEED:RF:PORT IFIN1`

Notes	Parameter `RRHhRFHDp` corresponds to **Head h**, port **RF Tx/Rx p**; for example, `RRH1RFHD2` = the port labeled **RF Tx/Rx 2** on **Head 1** For the CIU, the parameter `IFINc` corresponds to the **DUT IF IN** for channel c. For example, IFIN1 would connect to the **DUT IF IN** port for Channel 1
Dependencies	The Radio Head and CIU parameters only appear when a Remote Radio Head or CIU is connected to the instrument. If these parameters are sent at any other time, an error is generated, “-221, Settings conflict; option not installed”
Preset	`RRH1RFHD1`
Annotation	Annotation in the Meas Bar reads as follows: Input:Hd *h* RFHD *p* For example, in the case above, with RFHD 2 on Head 1 selected: Input:Hd 1 RFHD 1 When using the CIU: – When input is IFIN1: Input: IFIN 1 – When input is IFIN2: Input: IFIN 2 – When input is IFIN3: Input: IFIN 3 – When input is IFIN4: Input: IFIN 4
Backwards	`:FEED:RF:PORT A1`

Compatibility SCPI	A1 is treated as RRH1RFHD1 and sets the RF input to be the port labeled RF Tx/Rx 1 on Head 1
	`:FEED:RF:PORT B1`
	B1 is treated as RRH1RFHD2 and sets the RF input to be the port labeled RF Tx/Rx 2 on Head 1
	`:FEED:RF:PORT IFIO2`
	IFIO2 is treated as IFIN1, and sets the IF input to be the port labeled "DUT IF In/Out" on the CIU rear panel

Parameters for E7760B Wideband Transceiver

<port>	Input
A*n*	Bank A, Channel *n*, for example A1
B*n*	Bank B, Channel *n*, for example B1
IFIO*n*	IF In/Out for Channel *n*, for example IFIO1

Example	Set the RF input to A1:
	`:FEED:RF:PORT A1`
	Set the RF input to B3:
	`:FEED:RF:PORT B3`
	Set the RF input to IFIO1:
	`:FEED:RF:PORT IFIO1`

Dependencies	Ports A1, A2, A3, B1, B2, and B3 are available if Option RF3 is installed. Ports IFIO1 and IFIO2 are available if option RF2 is installed Note that for E7760B: – Attempting to select a port for which the option is not present will generate the error, -241, "Hardware missing; Input not available" – A port cannot be selected as an Input while it is occupied as an Output. Sending such a command while the port is occupied generates error: -221, "Settings conflict; Input Port is not available while occupied by Output" – The mmWave ports are divided into two banks; the A Bank and the B Bank. A port cannot be selected as an Input if any port on the same bank is occupied as an Output. Sending a command for this situation generates error: -221 "Settings conflict; Input Port is not available while port bank is occupied by Output" If RF3 is present and RF4 is absent, a mmWave port cannot be selected as an Input if the Output Port is occupied by wwWave Transceiver with a different frequency range. Sending a command for this situation generates error: -221 "Settings conflict; Input Port is not available while occupied by Output of incompatible frequency"
Preset	E7760B with Option RF2: IFIO1 E7760B without Option RF2: the first port with mmWave Transceiver attached. If no mmWave Transceiver attached: NONE
Annotation	Annotation in the Meas Bar reads as follows:

- When input is A1: Input: A1
- When input is A2: Input: A2
- When input is A3: Input: A3
- When input is B1: Input: B2
- When input is B2: Input: B2
- When input is B3: Input: B3
- When input is IFIO1: Input: IFIO1
- When input is IFIO2: Input: IFIO2

Parameters for M8920A/20B Radio Test Set

<port>	Input
ANT	Ant
TR	T/R

Example	Set the RF input to be the Antenna port on M9470A, labeled **Ant**:
	`:FEED:RF:PORT ANT`
	Set the RF input to be the T/R port on M9470A and M8920A/20B, labeled **T/R**. Note that Option HDX is required to enable the T/R port:
	`:FEED:RF:PORT TR`

Dependencies	ANT and TR are only available in modular analyzers, and only when the M9470A module is installed, such as in M8920A. Option HDX is required to enable the T/R port
Preset	ANT
Annotation	Annotation in the Meas Bar reads as follows: – When input is Ant: Input: Ant – When input is T/R: Input: T/R

Parameters for UXM Wireless Test Set

<port>	Input
RFIN	RF Input
RFIO1	RFIO 1
RFIO2	RFIO 2

Example	Set the RF input to RFIO 2: `:FEED:RF:PORT RFIO2`
Preset	RFIN

6.2.3 SA Frequency Extender Firmware Update (Front Panel Only)

When a Frequency Extender device (for example, V3050A) is connected and selected, if a firmware update is available for that device, this control will be visible. Because the measurement will be stopped for the duration of the firmware update, and because the update cannot be un-done, a confirmation dialog will be presented before proceeding with the firmware update. The update can take some time, so while in process, a modal dialog will be shown indicating that the update is in process and warning not to disconnect the device or turn off power. Typically, the update will take about a minute, but time can vary with the model of the Frequency Extender. When complete, the modal dialog will be dismissed, and a pop-up message will be shown for a few seconds indicating the success or failure of the update.

See "Error Messages" on page 2329

Notes	Measurement is stopped while the update is in process
Dependencies	Not available unless an External RF device is connected, External RF is the selected RF Input Port, and there is a firmware update available for the device

Error Messages

Update Already in Process Error

If a firmware update is already in process, the following message is displayed:

```
Another external device FW update is already in process. Only one update is allowed at a time
```

If received, wait until the current FW update is complete and then try again if still needed.

Unknown Assembly Error

When updating the firmware, the target hardware assembly needs to be identified. If for some reason the assembly cannot be identified, the firmware will not be able to initiate the update, and this error message will be displayed:

```
Error updating FW for external device model <model number>' serial number <serial number>
```

```
Could not find HW assembly, cannot perform FW update
```

The `<model number>` and `<serial number>` contain the actual numbers for the device.

This is a failure that warrants investigation, so you should contact Keysight Customer Support for service.

Error During Firmware Update Process

If there is an execution problem during the FW update, the specific error message(s) is written to the SA Event Log and this error message is displayed:

`Error updating FW for external device model <model number>' serial number <serial number>`

`Error during FW update. See windows event log for more details`

The `<model number>` and `<serial number>` contain the actual numbers for the device.

6.2.4 SA Frequency Extender Cable Correction

An SA Frequency Extender, such as V3050A, is attached to the instrument with several cables. Keysight provides several cables for purchase with the frequency extender. Typically, these are 1-, 2-, or 3-meter cables for the RF and IF connections. Keysight has characterized these cables and can correct for their loss. This control allows you to specify which cable is being used.

If you are using another type of cable, the instrument *cannot* automatically correct for it, so this function must be set to `OFF`. In this case, you can use RCal to characterize the corrections.

Remote Command	`:INPut:FEXTender:CABLe:CORRection OFF | V3050A1M | V3050A2M | V3050A3M`
Example	`:INP:FEXT:CABL:CORR V3050A1M`
Notes	The RF Input Port selections that support an SA Frequency Extender (such as V3050A) are: N9042B: External RF No other instruments support an SA Frequency Extender
Dependencies	An SA Frequency Extender must be attached, and the frequency extender's port must be the selected input for this control to be visible – If the instrument does not support frequency extenders, the SCPI command returns error -241, "Hardware missing; option not available" – If the instrument does support frequency extenders, but a frequency extender is not attached, the SCPI command returns error -241, "Hardware missing; Cable selection only available when supporting frequency extender attached" When a frequency extender is attached, the control is not visible unless the frequency extender's port is the selected RF input, but the command will still be available. Setting the cable selection when the frequency extender's port is not active has no effect until the port is selected
Preset	Unaffected by **Mode Preset** but set to preset value by **Restore Input/Output Defaults** or **Restore System Defaults -> All**
State Saved	Saved in instrument state

6.2.5 Half Duplex Input Port

Specify whether `RFIO3` or `RFIO4` is the Half Duplex Input port.

Remote Command	`[:SENSe]:HDUPlex:PORT:INPut RFIO3 | RFIO4`
Example	`:HDUPlex:PORT:INPut RFIO3` `:HDUPlex:PORT:INPut?`
Dependencies	Only appears in EXM If `RFIO3` is selected as "Half Duplex Output Port", then "Half Duplex Input Port" will be set to `RFIO4` automatically. If `RFIO4` is selected as "Half Duplex Output Port", then "Half Duplex Input Port" will be set to `RFIO3` automatically
Preset	`RFIO3`
State Saved	Saved in State

6.2.6 Port Information (Remote Command Only)

Provides information about an instrument port. The return information consists of two comma-separated fields:

- Field 1: the connection status (0 or 1)
- Field 2: a string of port information

The return information is device-dependent.

Remote Command	`[:SENSe]:FEED[:RF]:PORT:INFormation? RFIN | RFIN2 | RFFD | RFHD | A1 | A2 | A3 | B1 | B2 | B3 | IFIO1 | IFIO2 | ANT | TR`
Example	`:FEED:PORT:INF? A1` example = `1,"US56160060"` where `1` is the connection status and `"US56160060"` is the port information
Notes	For E7760B: The connection status (first field in the return value) indicates: 0 – the port is either not licensed for use or is not connected to a mmWave Transceiver 1 – the port is licensed; and for the case of mmWave ports, the port is connected to a mmWave Transceiver The port information (second field in the return value) contains: "" (empty string) – no applicable information Serial Number – the serial number of the connected mmWave Transceiver If you send an incompatible parameter, the return values are: 0,""
Dependencies	Only valid for E7760B

6.2.7 RF Preselector

In models that support the RF Preselector, such as PXE (N9048B), allows you to turn the preselector on or off.

NOTE When using the RF Preselector, if your measurement starts below 3.6 GHz and finishes above 3.6 GHz, the preselector bypass switch will have to switch in and out for every measurement. When this is the case, you will hear a clicking sound from the instrument and a warning message will be displayed: “Settings Alert: Mechanical switch cycling”. You are advised to *avoid* such setups as much as possible, to minimize switch wear. Pressing **Mode Preset** resets Stop Freq to 3.6 GHz, to exit this state, or you can manually set Stop Freq to be below 3.6 GHz.

Remote Command	`[:SENSe]:POWer[:RF]:RFPSelector[:STATe] 1 | 0 | ON | OFF` `[:SENSe]:POWer[:RF]:RFPSelector[:STATe]?`
Example	`:POW:RFPS 1` `:INP:PRES:STAT ON`

Notes	Set full compliance measurement:
	`[:SENSe]:POWer[:RF]:RFPSelector[:STATe] 1 | ON`
	Set pre-compliance measurement:
	`[:SENSe]:POWer[:RF]:RFPSelector[:STATe] 0 | OFF`

Dependencies	Only appears when RF Input is selected as the Input Only appears in MXE and PXE The RF Preselector is not available in all measurements. The key is grayed out in measurements that do not support it, unless you are in a Mode in which no measurements support it, in which case the key does not appear at all. If the preselector is unavailable, it is forced to Off. Attempting to turn it on or off in measurements that do not support it generates the error message: -221, Settings conflict; Feature not supported for this measurement The RF Preselector is not available when FFT Sweep Type is manually selected. Attempting to turn it on or off when this is the case generates an error message: -221, Settings conflict; RF Presel unavailable when Sweep Type=Manual FFT Only appears in Modes that support the RF Preselector, in other Modes, sending the SCPI command or query generates an error In Frequency Scan measurement, this key is grayed-out when final measurement is running. Warning message “Function not available while measurement is running” appears if the grayed-out key is pressed
Preset	`ON`
Annotation	When RF Preselector=On, “RF PRESEL” is displayed on the Settings Panel

Backwards Compatibility SCPI	`:INPut<1|2>:PRESelection[:STATe] ON | OFF`
	`:INPut<1|2>:PRESelection[:STATe]?`
	Included for R&S ESU compatibility

6.2.8 Notch Filter

In some models that support the RF Preselector, such as PXE, there is also a notch filter to suppress signals in the frequency band from 2.4 GHz to 2.5 GHz. This control allows you to turn the notch filter on or off.

Remote Command	`[:SENSe]:POWer[:RF]:RFPSelector:NFILter[:STATe] OFF | ON | 0 | 1` `[:SENSe]:POWer[:RF]:RFPSelector:NFILter[:STATe]?`
Example	`:POW:RFPS:NFIL 1` `:POW:RFPS:NFIL?`
Dependencies	Only appears when RF Input is selected as the Input Only appears in models that support the notch filter, such as PXE. Attempting to turn it on or off via SCPI in models that do not support it generates error message: -241 Hardware missing; Not available for this model number Only appears in measurements that support the Notch Filter, such as EMI Receiver measurements. Attempting to turn it on or off via SCPI in measurements that do not support it generates error message: -221, Settings conflict; Feature not supported for this measurement In Frequency Scan measurement, this control is grayed-out when final measurement is running, aligned with the **RF Preselector** key. The warning message "Function not available while measurement is running" appears if the grayed-out control is pressed
Preset	`OFF`
State Saved	Saved in instrument state
Range	`OFF|ON`
Annotation	Due to limited space in the Measurement Bar, Notch Filter annotation is shown as part of the RF Presel state – `RF Presel: On, NF`, when both RF Presel and Notch Filter are turned on – `RF Presel: On`, when RF Presel = on and Notch Filter= off – `RF Presel: Off`, when RF Presel = off
Backwards Compatibility SCPI	`:INPut<1|2>:PRESelection:FILTer:NOTCh[:STATe] ON | OFF` `:INPut<1|2>:PRESelection:FILTer:NOTCh[:STATe]?`

6.2.9 RF Calibrator

Lets you choose a calibrator signal to look at or turns the calibrator off.

Remote Command	`[:SENSe]:FEED:AREFerence REF50 | REF4800 | OFF` `[:SENSe]:FEED:AREFerence?`
Example	Select the 50 MHz amplitude reference as the signal input: `:FEED:AREF REF50`

	Select the 4.8 GHz amplitude reference as the signal input:
	`:FEED:AREF REF4800`
	Turn the calibrator "off" (switches back to the selected input - RF or I/Q):
	`:FEED:AREF OFF`

Dependencies	Only appears when RF Input is selected as the Input Selecting an input (RF, Ext Mix or I/Q) turns the Calibrator `OFF`. This is true whether the input is selected using the menu panel or `[:SENSe]:FEED` The 4.8 GHz internal reference is only available in some models and frequency range options. If the 4.8 GHz reference is not present, the **4.8 GHz** choice does not show, and if the REF4800 parameter is sent, the instrument generates an error
Couplings	When one of the calibrator signals is selected, the instrument routes that signal (an internal amplitude reference) to the instrument, and changes the main input selection to RF so the calibrator signal can be seen. When you turn the calibrator off it does not switch back to the previously selected input
Preset	`OFF`
State Saved	Saved in instrument state
Annunciation	An advisory message is sent, indicating that the input is set to internal

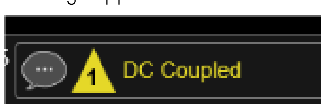
Backwards Compatibility SCPI

Notes	For ESA backwards compatibility In the ESA the calibrator was a separate output which you connected to the input and switched on with this command In X-Series, the `ON` parameter is aliased to `[:SENSe]:FEED:AREF REF50` and the `OFF` parameter is aliased to `[:SENSe]:FEED:AREF OFF` When `:CALibration:SOURce:STATe?` is received, 1 is returned if any of the references is selected, or 0 if the Calibrator is `OFF`
Preset	`OFF`
Backwards Compatibility SCPI	`:CALibration:SOURce:STATe OFF | ON | 0 | 1` `:CALibration:SOURce:STATe?`

6.2.10 RF Coupling

Specifies alternating current (AC) or direct current (DC) coupling at the instrument RF input port. Selecting AC coupling switches in a blocking capacitor that blocks any DC voltage present at the instrument input. This decreases the input frequency range of the instrument, but prevents damage to the input circuitry of the instrument if there is a DC voltage present at the RF input.

NOTE **When operating in DC coupled mode, ensure protection of the instrument input circuitry by limiting the DC part of the input level to within 200 mV of 0 Vdc. In AC or DC coupling, limit the input RF power to +30 dBm (1 Watt).**

Remote Command	`:INPut:COUPling AC | DC` `:INPut:COUPling?`
Example	`:INP:COUP DC`
Dependencies	Only appears when RF Input is selected as the Input Does not appear in models that are always AC coupled. When the SCPI command to set DC coupling is sent to these models, it generates the error “Illegal parameter value; This model is always AC coupled” In these models, `:INP:COUP?` always returns AC Does not appear in models that are always DC coupled. When the SCPI command to set AC coupling is sent to these models, it generates the error “Illegal parameter value; This instrument is always DC coupled” In these models, `:INP:COUP?` always returns DC
Preset	AC on models that support AC coupling On models that are always DC coupled, such as millimeter wave models (frequency ranges 30 GHz and above), the preset is DC
State Saved	Saved in instrument state
Annunciation	When the RF Input is selected, and AC coupling is selected, annunciators appear in the Meas Bar to that effect:  appears in the settings panel (the row of annunciators across the top of the display) to that effect, as shown below: When the RF Input is selected, and DC coupling is in effect, the annunciator changes as shown below:  Note the amber color, which indicates that you should exercise caution when applying a signal to any DC coupled input (see note above this table for the specific cautions) On models that support both AC and DC coupling: when DC coupling is selected, a warning condition message appears in the status line "DC coupled" as shown below:  On models that support both AC and DC coupling: when AC coupling is selected, and any part of the displayed frequency range is below 10 MHz, a warning condition message appears in the status line: "AC: Accy unspec’d below 10 MHz"

In AC coupling mode, you can view signals below the corner frequency of the DC block, but below a certain frequency the amplitude accuracy is not specified.

The lowest frequency for which specifications apply is:

X-Series Model	Lowest Freq for meeting specs when AC coupled	Lowest Freq for meeting specs when DC coupled
CXA-503/507	100 kHz	n/a

X-Series Model	Lowest Freq for meeting specs when AC coupled	Lowest Freq for meeting specs when DC coupled
CXA-C75 Input 2	1 MHz	n/a
CXA-513/526	10 MHz	9 kHz
CXA-m	10 MHz	9 kHz
EXA	10 MHz	9 kHz
MXA	10 MHz	20 Hz
PXA	10 MHz	3 Hz
UXA	10 MHz	3 Hz

Some amplitude specifications apply only when coupling is set to DC. Refer to the appropriate amplitude specifications and characteristics for your instrument.

6.2.11 Input Z Correction

Sets the input impedance for unit conversions. This affects the results when the y-axis unit is voltage or current units (dBmV, dBµV, dBµA, V, A), but not when it is power units (dBm, W). The impedance you select is for computational purposes only, since the actual impedance is set by internal hardware to 50 ohms. Setting the computational input impedance to 75 ohms is useful when using a 75 ohm to 50-ohm adapter to measure a 75-ohm device on an instrument with a 50-ohm input impedance.

There are a variety way to make 50-to-75-ohm transitions, such as impedance transformers or minimum loss pads. The choice of the solution that is best for your measurement situation requires balancing the amount of loss that you can tolerate with the amount of measurement frequency range that you need. If you are using one of these pads/adaptors with the **Input Z Corr** function, you might also want to use the **Ext Gain** key. This function is used to set a correction value to compensate for the gain (loss) through your pad. This correction factor is applied to the displayed measurement values.

Remote Command	`[:SENSe]:CORRection:IMPedance[:INPut][:MAGNitude] 50 | 75` `[:SENSe]:CORRection:IMPedance[:INPut][:MAGNitude]?`
Example	Set the input impedance correction to 75 ohms: `:CORR:IMP 75`
Couplings	In CXA option C75, when RF Input 2 is selected, the Input Z Correction automatically changes to 75 ohms. You may then change it to whatever is desired. When the main RF Input is selected, the Input Z Correction automatically changes to 50 ohms. You may then change it to whatever is desired
Preset	Unaffected by Preset, but set to 50 ohms by **Restore Input/Output Defaults** or **Restore System Defaults->All** Some instruments/options may have 75 ohms available
State Saved	Saved in instrument state

6.2.12 All Screens Use Same Input

If ON, then all Screens share the same Input settings. This is the default state.

If OFF, then certain settings are allowed to be local to each Screen, meaning one Screen can have them set one way and another can have them set another way.

The Input settings that become local to each Screen when **All Screens Use Same Input** is OFF are:

Input Tab:

- Selected Input (RF, Ext Mix, BBIQ)
- RF Input Port (only appears in instruments with multiple RF ports, such as N9041B, MXE, and CXA)
- RF Coupling (AC/DC)
- Input Z Correction

External Gain Tab:

- External Preamp
- MS
- BTS

Corrections Tab:

- For each Correction, whether it is on or off

Note that if **All Screens Use Same Input** is OFF and you press the **+** control to create a new Screen, the new Screen contains a copy of the old Screen's state, including all its Input/Output variables.

Remote Command	`:INSTrument:COUPle:SCReen:INPut ON | OFF | 1 | 0` `:INSTrument:COUPle:SCReen:INPut?`
Example	`:INST:COUP:SCR:INP OFF`
Preset	ON Not affected by **Input/Output Preset**, but set to ON by **Restore Input/Output Defaults**

6.2.13 External Mixer Setup

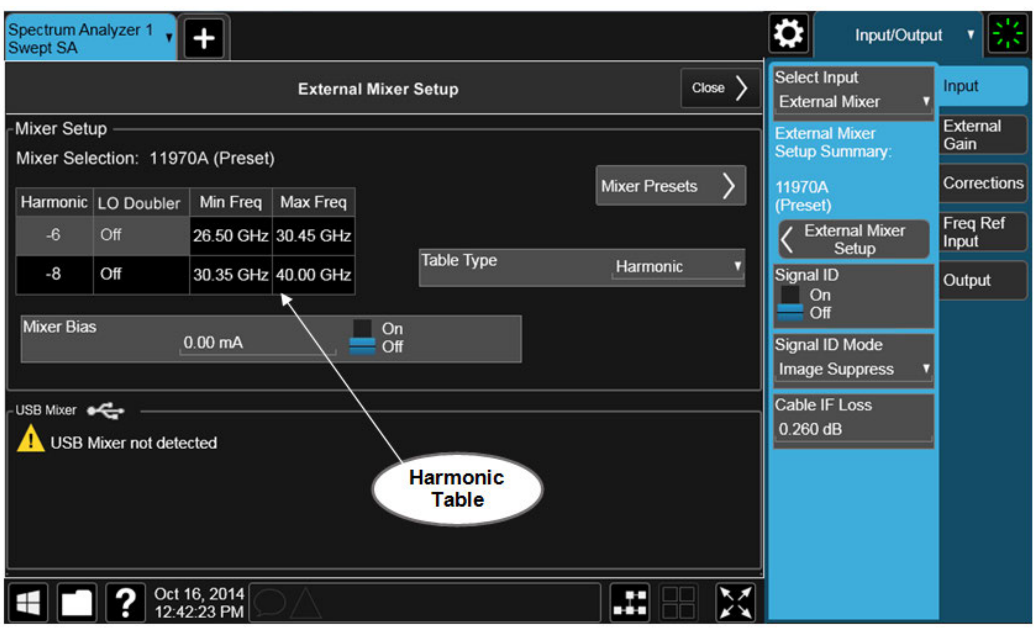
Lets you select the mixer type, and lets you configure your mixer (if necessary). The first page of the dialog shows you the current settings for the selected mixer. These settings may be dependent on which IF path is currently in use, whether a + or – harmonic is currently selected, etc.

To apply any amplitude correction factors needed to correct mixer flatness, you enter values into one of the Correction tables (under **Input/Output**, **Corrections**). The correction conversion loss values can be extracted from data supplied with the mixer or from manual measurements you make to determine the conversion loss. Note that the correction applied by the Correction tables is global to the instrument; therefore, you should make sure to turn off the External Mixer corrections when you are not using the External Mixer input.

NOTE **Keysight USB Mixers automatically supply their flatness data to the instrument, and the correction is applied internally. No correction needs be entered, and the correction does not appear in the user-accessible Corrections tables. You are free to enter additional corrections into the Correction tables under Input/Output, Corrections.**

Notes	The setup summary on the menu panel appears just above this control, showing the current external mixer setup
Dependencies	Only appears when External Mixer is selected as the Input
State Saved	All settings in the External Mixer Setup dialog are part of the Input/Output system, and hence are saved whenever State is saved

The **External Mixer Setup** screen looks like this:



The current Mixer selection (the current or most recently connected USB Mixer, or the most recent Mixer Preset, or **Custom** if you have modified the setup) reads out at the top of this screen as **Mixer Selection**

The Harmonic Table currently being used reads out below the Mixer Selection. It shows each range being used for the current mixer. Note that a band may be made up of up to 3 ranges. Each range represents a choice of mixer harmonic and doubler state. When you select a Mixer Preset, it sets the instrument Start and Stop frequency to the values shown in the Harmonic Table; Start Freq is set to the Min Freq for the bottom range, and Stop Freq is set to the Max Freq for the top range. In many cases you can exceed these nominal values; the absolute maximum and minimum frequency for each preset are shown in the tables that accompany the control descriptions for the Mixer Presets.

NOTE If the current measurement has a limited Span available to it and cannot achieve the Span shown in the table (Span = Stop Freq – Start Freq), the instrument uses the maximum Span the measurement allows, and sets **Center Frequency** to the midpoint of the Start and Stop Freq values in the Harmonic Table.

You may edit some of the Harmonic and LO Doubler fields in the Harmonic Table, as shown by the gray backgrounds of these fields. When you edit the Harmonic Table, the Mixer Selection changes to **Custom**. To change it back you must go back into the Mixer Presets menu and select a Preset.

When you edit the Harmonic Table, the nominal Min Freq and Max Freq that are available will usually be different than the Preset you were using; and the absolute frequency limits will change as well. This may result in a change to your Start and/or Stop Freq, if the current values fall outside the new range, requiring you to retune your Center Freq to get your signal back in the center.

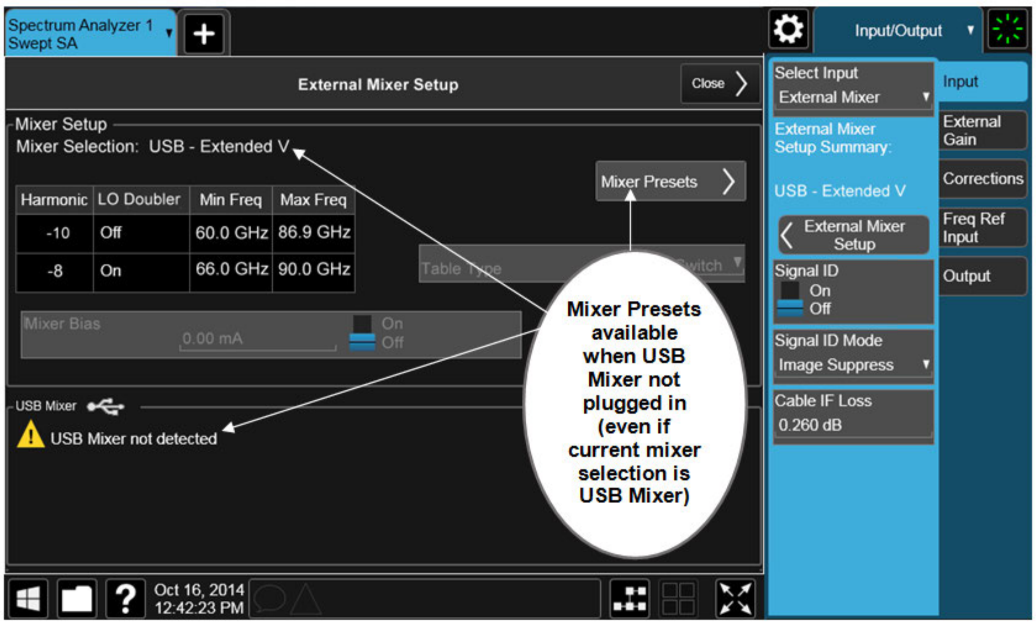
The instrument supports the Keysight M1970 Series Harmonic Mixers with USB connection. While in External Mixing, if one of these mixers is plugged in to a USB port, it is automatically detected and displayed in the “USB Mixer” area of the setup screen, including its model number and serial number.

The instrument assumes that if you plug a mixer into the USB you want to use that mixer, so:

1. If a USB mixer is connected to the USB port, the Mixer Presets button is grayed-out, as none of the presets make sense with a USB Mixer connected. Note that once the instrument has acquired the USB Mixer, the mixer selection will remain if it is subsequently unplugged from the USB, allowing you to plug it back in with no change to your settings. However, once you unplug it, the Mixer Presets control ceases to be grayed-out, allowing you to preset to a different mixer
2. When Restore Input/Output Defaults is performed, if a Keysight USB Mixer is plugged into the instrument’s USB port, the Mixer Selection remains unchanged

3. When recalling an instrument state, if a Keysight USB Mixer is plugged into the instrument's USB port, and the Mixer Selection in the recalled state is for a USB Mixer that does not match the mixer currently plugged in, you will have to unplug your mixer and then plug it back in to get the instrument to recognize your mixer

As long as the selection in Ext Mixer Setup shows one of the USB mixers, the **Mixer Bias** control is grayed-out and the Harmonic Table is no longer editable, as shown by the fact that the fields in the Harmonic Table are now black and the **Table Type** control is grayed-out.



Only one USB Mixer is supported at a time. To switch to a different USB Mixer, disconnect the one that is no longer being used prior to connecting a new one.

The **Mixer Selection** displayed and menu panel readback for the Keysight M1970 series mixers is:

Mixer Model	Mixer Selection display on Setup Screen	Readback
Keysight M1970E: Option 001: 60 to 90 GHz Waveguide Harmonic Mixer	**USB - M1970E-001 E-Band**	USB Mixer E-Band
Keysight M1971E: Option 001: 60 to 90 GHz Waveguide Harmonic Mixer	**USB - M1971E-001 E-Band**	USB Mixer E-Band
Keysight M1971E: Option 003: 55 to 90	**USB - M1971E-003 Extended E-Band**	USB Mixer

Mixer Model	Mixer Selection display on Setup Screen	Readback
GHz Waveguide Harmonic Mixer		Extended E
Keysight M1971V: Option 001: 50 to 75 GHz Waveguide Harmonic Mixer	**USB - M1971E-001 V-Band**	USB Mixer V-Band
Keysight M1971W: Option 001:75 to 110 GHz Waveguide Harmonic Mixer	**USB - M1971E-001 W-Band**	USB Mixer W-Band
Keysight M1970V Option 001: 50 to 75 GHz Waveguide Harmonic Mixer	**USB - M1970V-001 V-Band**	USB Mixer V-Band
Keysight M1970V Option 002: 50 to 80 GHz Waveguide Harmonic Mixer	**USB - M1970V-002 Extended V-Band**	USB Mixer Extended V
Keysight M1970W Option 001: 75 to 110 GHz Waveguide Harmonic Mixer	**USB - M1970W-001 W-Band**	USB Mixer W-Band

The Keysight USB mixer essentially acts as a “remote front end” and is fully calibrated over the specified frequency range, without requiring any user interaction. This is particularly useful at high mm-wave frequencies, where cable loss is typically quite large, and it is desirable to bring the front end right up to the device under test, rather than bringing the mm-wave signal to the instrument using a lossy and uncalibrated cable or waveguide connection.

Connecting the mixer to the USB port on the instrument switches you to External Mixing, aborts the current measurement, and initiates an alignment of the mixer. A popup message, “USB Mixer connected” appears on the display. When a USB mixer and the LO/IF cable are connected the alignment is performed. When the alignment begins, an “Aligning” popup replaces the previous message on the display. When the alignment completes, the current measurement restarts.

6.2.13.1 Mixer Presets

Presets the mixer setup for the particular type of mixer that you are using.

These presets are divided into four groups:

- One for legacy HP/Agilent/Keysight mixers (11970)
- Three for general purpose mixers:

- presets that use a single harmonic and no doubling
- presets that use a single harmonic but double the LO
- presets that use multiple harmonics

Note that the IF/LO port provides a 3.8-14 GHz LO in two bands: 3.8-8.7 (LO fundamental), and 8.6-14 GHz (doubled LO).

In most cases, once you have executed the preset, you will not need to adjust any further settings.

Remote Command	`[:SENSe]:MIXer:BAND A | Q | U | V | W | NA | ND | NE | NF | NG | NJ | NK | NQ | NU | NV | NW | NY | NEXT | DD | DF | DG | DJ | DK | DQ | DV | DW | DY | DEXT | MA | ME | MU | MCOAX | USB | VDIWR6PT5M4` `[:SENSe]:MIXer:BAND?`
Example	`:MIX:BAND A` `:MIX:BAND?`
Notes	A|Q|U|V|W select HP/Agilent/Keysight 11970 mixer presets NA|ND|NE|NF|NG|NJ|NK|NQ|NU|NV|NW|NY|NEXT select single harmonic, non-doubled LO presets DD|DF|DG|DJ|DK|DQ|DV|DW|DY|DEXT select single harmonic, doubled LO presets MA|ME|MU|MCOAX select multiple harmonic presets VDIWR6PT5M4 selects presets for the VDI WR6.5CCD-M4 external mixer (a Compact Down-Converter in the Keysight N9029ACST Series) VDIWR6PT5M4 requires Model N9042B with the EXW option. To use this selection, you must connect cables from the external mixer to the High LO Out and High IF In ports (not the Ext Mixer port) of the N9042B All these presets are detailed in their respective control descriptions The query returns the most recent preset, *unless* the harmonic table has been edited after the preset was executed. If the harmonic table has been edited, returns CUSTOM The command USB refreshes the USB mixer connection and automatically detects the mixer band. The query returns the following if a Keysight USB Mixer is plugged into the instrument's USB port: USBE — Keysight E-Band USB Mixer USBV — Keysight V-Band USB Mixer USBVEXT — Keysight Extended V-Band USB Mixer USBW — Keysight W-Band USB Mixer Note that the parameters CUSTOM, USBV, USBVEXT, and USBW are query responses only, and cannot be sent *to* the instrument The following cross-reference matches the mixer band designators used by Keysight to the EIA waveguide designations:

	EIA	Keysight	Freq Range
	WR-28	A	26.5 - 40 GHz
	WR-22	Q	33 - 50 GHz
	WR-19	U	40 - 60 GHz
	WR-15	V	50 - 75 GHz
	WR-12	E	60 - 90 GHz
	WR-10	W	75 - 110 GHz
	WR-8	F	90 - 140 GHz
	WR-6	D	110 - 170 GHz
	WR-5	G	140 - 220 GHz
	WR-3	J	220 - 325 GHz
Preset	When **Restore Input/Output Defaults** is performed, an "A" mixer preset is also issued (11970A band), unless a Keysight USB Mixer is plugged into the instrument's USB port, in which case the Mixer Selection remains unchanged When using Keysight USB Mixers, if **Restore All Defaults** (`:SYSTem:DEFault`) has been performed, either remove and reinsert the USB cable or press the **Refresh USB Mixer Connection** control		

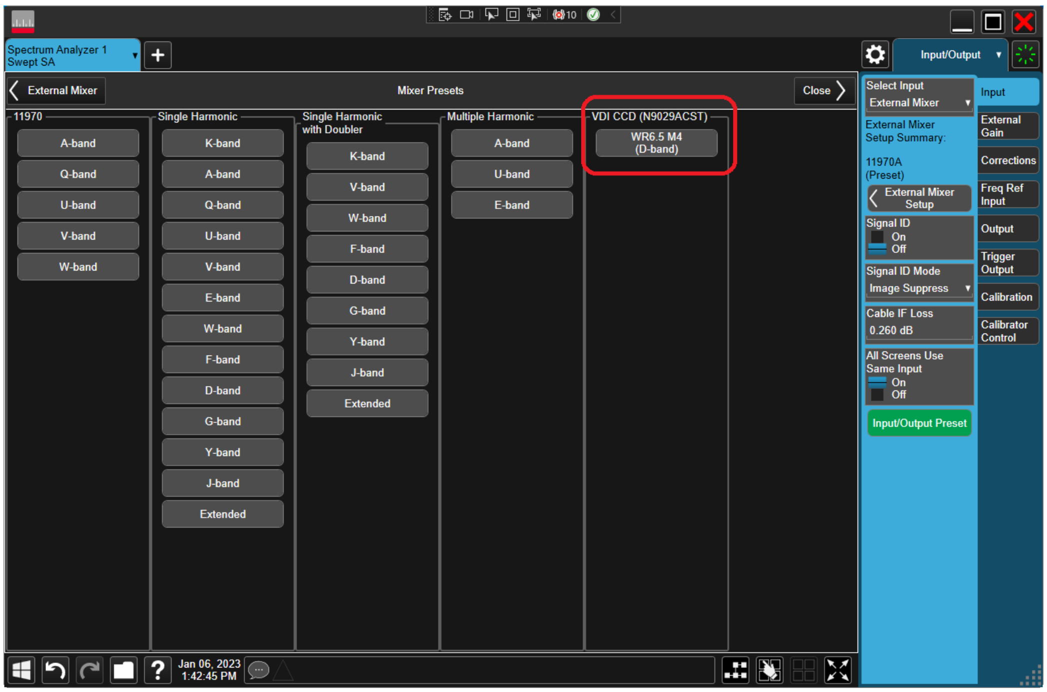
VDI CCD (N9029)

These presets select a setup that uses a single harmonic and no LO doubling.

This setup is used with an external mixer in the series VDI CCD (N9029ACST). The currently supported example is the D-band mixer VDI WR6.5CCD-M4.

Mixer	Readout on setup dialog and menu panel	Harm #	RF start	RF stop	RF center
WR6.5 M4 (D-band)	**VDI WR6.5CCD-M4**	-4	110	170	140

This mixer setup is enabled only for model N9042B with the EXW option You must connect cables from this external mixer to the High LO Out and High IF In ports (not the Ext Mixer port) of the N9042B, as illustrated below:



11970

Lets you preset for a model in the HP/Agilent/Keysight 11970 series.

Because the X-Series has an LO range of 3.8 - 14 GHz, and older analyzers had an LO range of 3.0 - 6.8 GHz, the harmonic numbers used in the X-Series may differ from those used on older analyzers for the same mixers. Additionally, some of the 11970 mixers cannot be operated over their full range with the X-Series without switching harmonics. Consequently, you will find that some of the bands (A-Band, for example) are broken into two ranges for use with the X-Series.

Below are the 11970A presets. The 11970U and the 11970W use a single harmonic. The other three switch harmonics mid-band. Both harmonic ranges are shown in the table. None of these mixers use LO doubling.

The 11970 K-band mixer and the 11974 preselected mixer series are not supported.

Preset	Readout on setup dialog and menu panel	Range	Harm #	RF start	RF stop	RF center
A-band	11970A	1	-6	26.5	30.45	28.475
		2	-8	30.35	40	35.175
Q-band	11970Q	1	-8	33	40.8	36.9
		2	-10	39.8	50	44.9
U-band	11970U	..	-10	40	60	50
V-band	11970V	1	-12	50	66	58
		2	-14	53	75	64
W-band	11970W	..	-18	75	110	92.5

Single Harmonic

These presets select a setup that uses a single harmonic and no doubling for the LO.

Mixer	Readout on setup dialog and menu panel	Harm #	RF start	RF stop	RF center
K-band	K-band Single Harmonic, no doubler	-4	18	26.5	22.25
A-band	A-band Single Harmonic, no doubler	-6	26.5	40	33.25
D-band	D-band Single Harmonic, no doubler	-20	110	170	140
E-band	E-band Single Harmonic, no doubler	-12	60	90	75
F-band	F-band Single Harmonic, no doubler	-18	90	140	115
Q-band	Q-band Single Harmonic, no doubler	-6	33	50	41.5
U-band	U-band Single Harmonic, no doubler	-8	40	60	50
V-band	V-band Single Harmonic, no doubler	-10	50	75	62.5
W-band	W-band Single Harmonic, no doubler	-14	75	110	92.5
G-band	G-band Single Harmonic, no doubler	-26	140	220	180
Y-band	Y-band Single Harmonic, no doubler	-30	170	260	215
J -band	J-band Single Harmonic, no doubler	-38	220	325	272.5
Extended	Extended Single Harmonic, no doubler	-40	155	345	250

Single Harmonic with doubler

These presets select a setup that uses a single harmonic and doubling for the LO.

Mixer	Readout on setup dialog and menu panel	Harm #	RF start	RF stop	RF center
D-band	D-band Single Harmonic w/doubler	-14	110	170	140
F-band	F-band Single Harmonic w/doubler	-10	90	140	115
G-band	G-band Single Harmonic w/doubler	-16	140	220	180
J-band	J-band Single Harmonic w/doubler	-24	220	325	272.5
K-band	K-band Single Harmonic w/doubler	-2	18	26.5	22.25
Q-band	Q-band Single Harmonic w/doubler	-4	33	50	41.5
V-band	V-band Single Harmonic w/doubler	-6	50	75	62.5
W-band	W-band Single Harmonic w/doubler	-8	75	110	92.5
Y-band	Y-band Single Harmonic w/doubler	-20	170	260	215
Extended	Extended Single Harmonic w/doubler	-28	245	390	317.5

Multiple Harmonics

These presets select a setup that uses multiple harmonics and may or may not use doubling for the LO.

Mixer	Readout on setup dialog and menu panel	Range	Harm #	Dblr?	RF start	RF stop	RF Center
A-band	A-band Multiple Harmonic	1	-4	N	26.5	34.1	30.3
		2	-4	Y	33.1	40	36.55
E-band	E-band Multiple Harmonic	1	-6	Y	60	83	71.5
		2	-8	Y	65	90	77.5
U-band	U-band Multiple Harmonic	1	-6	N	40	51.5	45.75
		2	-6	Y	49.5	60	54.75
Coaxial	Coaxial Multiple Harmonic	1	-4	N	26.5	34	30.25
		2	-4	Y	32.5	55	43.75
		3	-6	Y	50	70	60

6.2.13.2 Mixer Bias

Adjusts an internal bias source for use with external mixers. The bias signal is present on the center conductor of the IF input connector on the front panel. The shunt current range is from -10 mA to 10 mA, and it can be set whether Mixer Bias state is On or Off, but it will only be applied if it is On.

The bias remains as set if you switch to another input (for example, the RF Input).

Remote Command	`[:SENSe]:MIXer:BIAS <real>` `[:SENSe]:MIXer:BIAS?`

Example	`:MIX:BIAS 0` `:MIX:BIAS?`
Preset	Unaffected by Preset, but set to `OFF` (0) by **Restore Input/Output Defaults**
State Saved	Saved in instrument state
Min	-10 mA
Max	10 mA
Annunciation	When the bias is turned on this (together with the bias polarity) is indicated in the Meas Bar with a plus or minus sign:  otherwise, it reads "Off"

Auto Function

Remote Command	`[:SENSe]:MIXer:BIAS:STATe OFF | ON | 0 | 1` `[:SENSe]:MIXer:BIAS:STATe?`
Example	`:MIX:BIAS:STAT 0` `:MIX:BIAS:STAT?`
Preset	`OFF`

6.2.13.3 Table Type

Determines the Custom Mixer configuration type. You can choose: Single Row, Harmonic Switching, or Doubler Switching. For details, see "Available Types" on page 2347.

The Harmonic Table can be configured as:

- A single row (meaning only one harmonic number is used and the LO Doubler is either on or off)
- Two rows where the harmonic number switches between the first row and the second
- Two rows where the LO Doubler state switches between the first row and the second

Available Types

Table Type	Behavior
Single Row	The External Mixer always stays in the same Harmonic Number and the LO Doubler is either on or off and does not change state during a sweep. You may change the Harmonic Number and you may change the state of the Doubler
Harmonic	The External Mixer switches the Harmonic Number in the middle of the sweep. The LO Doubler may be on

Table Type	Behavior
Switching	or off, but it is the same for both Harmonic Numbers. You can set the initial Harmonic Number, and when it switches it decrements by two when the harmonic is negative and increments by two when the harmonic is positive For example, if you set the initial number to -6, when it switches it will go to -8. If you set the harmonic number to 8, when it switches it will go to 10
Doubler Switching	The External Mixer switches the doubler from Off to On in the middle of the sweep. You can set the Harmonic Number, but it stays the same for the Doubler Off state as for the Doubler On state. The LO Doubler control is grayed-out in this table type

Editable Fields

Table Type	Fields you can edit
Single Row	Harmonic and LO Doubler cells
Harmonic Switching	Harmonic and LO Doubler cells (only the first row)
Doubler Switching	Harmonics cell (only the first row)

Note that you cannot add or delete rows from the table; you can only modify the rows that are already there.

Remote Command	`[:SENSe]:MIXer:TTYPe SINGle | HARMonic | DOUBler` `[:SENSe]:MIXer:TTYPE?`
Example	`:MIX:TTYP SING`
Couplings	When you change the Table Type, the Mixer Selection changes to **Custom**
Preset	Depends on the current Mixer Preset. Unaffected by **Mode Preset**, but **Restore Input/Output Defaults** presets the Mixer to 11970A, for which the Table Type is Harmonic Switching
State Saved	Saved in instrument state

6.2.13.4 Select VDI CCD Correction

Selects the appropriate VDI CCD Correction data by mixer Serial Number.

Remote Command	`[:SENSe]:VCORrection:SELect NONE | <serialNumber>` `[:SENSe]:VCORrection:SELect?`
Example	`:VCOR:SEL NONE` `:VCOR:SEL 123123`
Dependencies	Requires EXW (External Mixing Wide Bandwidth) and Ampcor (Amplitude Correction) licenses
Couplings	When the External Mixer Model or VDI CCD Corrections data changes, this field checks whether VDI CCD corrections are stored for the currently-selected External Mixer Model, and automatically selects the first serial number found, or NONE if no matching corrections are found When setting this parameter via SCPI, if no match is found for the given serial number, the parameter

	is set to NONE. If the correction should be automatically selected, this can be done by setting the value via SCPI to **Any** (see "External Mixer Setup" on page 2337)
State Saved	Saved in instrument state

6.2.13.5 Delete All VDI CCD Corrections

Erases all stored VDI CCD corrections.

Remote Command	`[:SENSe]:VCORrection:DELete`
Example	`:VCOR:DEL`
Dependencies	Requires EXW (External Mixing Wide Bandwidth) and Ampcor (Amplitude Correction) licenses
Couplings	When the VDI CCD corrections are deleted from memory, "Select VDI CCD Correction" on page 2348 is set to NONE

6.2.13.6 Harmonic

Lets you enter the **Harmonic** value with its associated sign (mixing mode). Only the first row of the table is editable. When you edit a value or change "Table Type" on page 2347, the Mixer Selection changes to **Custom**.

In **Custom** mode, the maximum start and stop frequencies are strictly set by the LO range and the harmonic number you have chosen. The undoubled LO range is approximately 3.8 - 8.7 GHz , and (for LOs that support doubling) the doubled range is approximately 8.0 – 14.0 GHz. That range times the harmonic you have selected determines the tuning range. If your frequency is currently outside that range when you edit the Harmonic Table, the frequency will be changed to fall at the edge of the range. To change it back, go to the **Mixer Presets** menu and select a Preset.

The harmonic number is a signed integer, where the sign distinguishes between positive and negative mixing products. Desired mixing products occur at an IF frequency that equals the difference between the RF frequency (f_{RF}) and the LO frequency (Nf_{LO}). When this difference is positive, we can say $f_{IF} = f_{RF} – Nf_{LO}$. When this difference is negative, we can say $f_{IF} = Nf_{LO} – f_{RF}$. Thus, a negative harmonic means the instrument will be tuned such that the harmonic of the LO is higher than the indicated frequency by the frequency of the first IF. A positive harmonic means the instrument will be tuned such that the harmonic of the LO is lower than the indicated frequency by the frequency of the first IF.

Remote Command	`[:SENSe]:MIXer:HARMonic <integer>` `[:SENSe]:MIXer:HARMonic?`
Example	`:MIX:HARM -28` `:MIX:HARM?`
Notes	The query returns the harmonic value of the first row of the harmonic table

Couplings	When you set a value for **Harmonic** via SCPI, the Mixer Selection changes to **Custom**
Preset	Unaffected by **Mode Prese**t, but **Restore Input/Output Defaults** turns editing off, the Harmonic Table returns to normal, and the Mixer is preset to 11970A, which has -6 in the first row of its Harmonic Table
State Saved	Saved in instrument state
Min	-400
Max	400

6.2.13.7 LO Doubler

Lets you specify whether the Doubler is on or off. Only the first row of the table is editable, and the LO Doubler field is only editable in Single Row and Harmonic Switching table types. When you edit a value or change the Table Type, the Mixer Selection changes to **Custom**.

The LO Doubler setting controls the choice of the LO doubler state for LO's that support doubled operation. In Single Row mode it is either on or off for the one row in the table. In Harmonic Switching mode it is on for both rows or off for both rows. In Doubler switching it is off for row 1 and on for row 2, so it is not editable.

In LOs that support doubling, the fundamental band is approximately 3.8 – 8.7 GHz, and the doubled band is approximately 8.0 – 14 GHz. The higher LO frequency can result in a lower mixer harmonic and reduced mixer conversion loss.

Remote Command	`[:SENSe]:MIXer:LODoubler ON | OFF | 0 | 1` `[:SENSe]:MIXer:LODoubler?`
Example	`:MIX:LOD 0` `:MIX:LOD?`
Notes	The query returns the doubler value of the first row of the harmonic table
Dependencies	Grayed-out and set to `OFF` when "Table Type" on page 2347 is set to Doubler Switching Grayout message: "-221 Settings conflict; Function unavailable while Table Type=Doubler Switching"
Couplings	When you set a value via SCPI, the Mixer Selection changes to **Custom**
Preset	Unaffected by **Mode Preset**, but **Restore Input/Output Defaults** turns off editing, the Harmonic Table returns to normal, and the Mixer is preset to 11970A, which has the doubler Off in the first row of its Harmonic Table
State Saved	Saved in instrument state

6.2.13.8 Refresh USB Mixer Connection

Re-reads the USB devices and refreshes connection to Keysight USB mixers. This operation is the same as physically removing and reinserting the mixer's USB connection.

Example	`:MIX:BAND USB`
Notes	When using Keysight USB Mixers, if **Restore All Defaults** (`:SYSTem:DEFault`) has been performed, either remove and reinsert the USB cable or press **Refresh USB Mixer Connection**

6.2.14 Mixer Path

Determines which path you wish to use when using M1971 series USB mixers:

- `NORMal`, in which they function as a classic external mixer with a single conversion
- `DUAL` Conversion, in which the first conversion is to a higher IF frequency (nominally 1.5 GHz) and you provide a 10 MHz signal to which an internal PLL is locked, to effect a second downconversion. The higher IF frequency used in Dual Conversion increases the image frequency offset, giving you a wider image-free conversion range. This reduces aliasing effects and improves the image suppress functionality for wideband signals
- `AUX` Equipment, wherein the first mixer output drives an output connector on the mixer and the instrument is out of the circuit. When you connect an M1971 Mixer to USB, the instrument will pull the IF and RF flatness data from the USB mixer and write this data to a user-accessible file in CSV format for your use when Aux Equipment is selected

Remote Command	`[:SENSe]:MIXer:MPATh NORMal | DUAL | AUX` `[:SENSe]:MIXer:MPATh?`
Example	`:MIX:MPAT NORM`
Dependencies	Only appears when an M1971 series Mixer is connected to the USB port of the instrument When `AUX` Equipment is the selection, Sig Id is turned off to avoid shifting the LO. It is *not* turned back on when a different path is selected When `AUX` Equipment is the selection, there is no valid result, so the instrument displays a “No Result; Meas invalid with Aux Equip” error condition message (error 135) `DUAL` Conversion is grayed-out unless in the Swept SA measurement. If grayed-out and the command is sent, generates error:”-221, Settings Conflict; Dual Conversion mixer path is only available in Swept SA" If in `DUAL` Conversion and you exit Swept SA, reverts to `NORMal` setting. If you subsequently return to Swept SA, does *not* automatically return to `DUAL` Conversion When `DUAL` Conversion is selected, if no signal is sensed at the 10 MHz input port, an error condition is generated, “Ref missing or out of range; M1971” (error 521). This also lights the Error LED on the mixer itself
Couplings	When `AUX` path is selected, the instrument switches to Zero Span
Preset	`NORMal`
State Saved	Saved in instrument state

Annotation	In the Meas Bar, if an M1971 series Mixer is connected to the USB port of the instrument, the field Mixer Path appears and says: – Normal for Normal – 2xConv for Dual Conversion – Aux for Aux Equipment

6.2.15 User IF Freq

Specifies the desired IF frequency when using the Aux Equipment path. This setting determines the LO frequency that the instrument will drive into the mixer to correspond to the specified center frequency. Note that the Aux Equipment path always uses "Negative Mixing", that is, the LO frequency is always higher than the RF frequency.

Remote Command	`[:SENSe]:MIXer:UIFFreq <real>` `[:SENSe]:MIXer:UIFFreq?`
Example	`:MIX:UIFF 300 MHz`
Dependencies	Only appears if an M1971 mixer is connected to USB and the Mixer Path is Aux Equipment
Preset	1.2 GHz
State Saved	Saved in Input/Output state
Min	0 GHz
Max	4 GHz

6.2.16 Signal ID On/Off

Toggles the Signal ID (signal identification) function On or Off. This function lets you identify multiple responses of a single input signal that are generated when using un-preselected external mixers. The use of mixers without pre-selecting filters offers the advantage of improved receiver sensitivity because of the absence of the filter insertion loss, but results in multiple responses due to images and undesired harmonic mixing products.

While in **Signal ID**, basic spectrum analyzer functions work normally (for example, you can change Span normally), but some functions are disabled (for example, some traces are unavailable).

There are two forms of **Signal ID**, Image Suppress and Image Shift. Choose the one most appropriate for your application. For Image Shift, an LO-shifted and an unshifted trace are taken in Trace 1 and Trace 2 and displayed together. Any peaks that are not the same in both traces are images. For Image Suppress, image cancellation is performed in the background using two hidden traces, and the result displayed in Trace 1, which shows only the valid signals.

When **Signal ID** is ON, this is indicated in the Meas Bar as Signal ID: On. The annotation is displayed in amber to alert you, because it can cause unexpected behavior if you are not aware that it is on.

Remote Command	`[:SENSe]:SIDentify[:STATe] OFF | ON | 0 | 1` `[:SENSe]:SIDentify[:STATe]?`
Example	`:SID 0` `:SID?`
Notes	**Signal ID** uses data from two successive sweeps. Therefore, if the instrument is in single sweep mode, two sweep triggers are used to generate the data needed for signal identification For the Log Plot measurement in the Phase Noise Mode, **Signal ID** works only in the segment of LO sweeping where the offsets are greater than the Rejection Offset setting. When turning it on, you may notice a discontinuity in the Phase Noise trace at the Rejection Offset setting frequency by a few dB due to the under response inherent to **Signal ID**
Dependencies	Only appears when External Mixer is selected as the Input Not available in some measurements. If **Signal ID** does not appear or is grayed-out while in your measurement, then it is not available Because **Signal ID** uses data from two successive sweeps, several trace and sweep functions are grayed-out in **Signal ID**. See the documentation for your measurement for details on which trace functions are grayed-out Not available with Signal Track, in which case **Signal ID** is grayed-out Turned off when External Mixer is turned off. **Signal ID** cannot be turned on when using internal mixing Rules for auto coupling of the Sweep and FFT controls are changed with **Signal ID**ON. For both the dynamic range case and the speed case, swept is chosen whenever any form of **Signal ID** is on. If Manual FFT is selected, **Signal ID** is grayed-out If **Signal ID** is selected in a measurement that does not support it, a warning message is generated
Couplings	The Auto Rules for detector selection select Normal for all active traces when **Signal ID** is turned ON
Preset	Unaffected by Preset, but set to OFF by **Restore Input/Output Defaults**
Annunciation	When Signal ID is on this is indicated in the Meas Bar as Signal ID: On. The annotation is displayed in amber color to alert you to the fact that Signal ID is on, as it can cause unexpected behavior if you are not aware that it is on

6.2.17 Signal ID Mode

Determines the **Signal ID** mode to use, either Image Suppress or Image Shift.

Image Suppress

Mathematically removes all image and multiple responses of signals present at the mixer input. Two hidden sweeps are taken in succession. The second sweep is offset in LO frequency by 2 * IF / N. For each point in each trace, the smaller amplitude from the two traces is taken and placed in that point in the selected trace. The Peak detector is auto-selected to improve the image suppression effectiveness. Responses of each trace that lie on top of one another will remain and are valid signals, others are images and are suppressed. The action of taking the smaller of the two traces will make the average noise level lower in all points that do not have an image, thus reducing the accuracy of the measurement of noise and noise-like signals.

NOTE **When changing from Image Shift to Image Suppress mode, Trace 2 is blanked, as it was used for Image Shift and contains data that you will probably not want to see in Image Suppress**

Image Shift

Like the Image Suppress mode, Image Shift is a two-sweep sequence. The data from the first sweep is placed in Trace 1 and the data from the second (LO frequency shifted by 2 * IF / N) sweep is placed in Trace 2. On alternate sweeps, the alternate trace (trace 2) is placed in front of trace 1. This way, you can see a signal at the same place on alternate sweeps, showing in yellow (trace1) and blue (trace2). Signal responses of Trace 1 and Trace 2 that have the same horizontal position are considered to be in the current band and therefore can be analyzed with the amplitude and frequency measurement systems of the SA. All other responses are invalid and should be ignored.

NOTE **This function takes control of and uses Trace 1 and Trace 2. Any data in these traces prior to activating Image Shift will be lost.**

Remote Command	`[:SENSe]:SIDentify:MODE ISUPpress | ISHift` `[:SENSe]:SIDentify:MODE?`

Example	`:SID:MODE ISUP`
	`:SID:MODE ISH`
	`:SID:MODE?`

Dependencies	Only appears when External Mixer is selected as the Input
Preset	Unaffected by Preset, but set to `ISUPpress` by **Restore Input/Output Defaults**
State Saved	Saved in instrument state

6.2.18 Cable IF Loss

The loss at the IF in the IF/LO cable can be compensated for with this function, by entering the loss in dB for your cable.

The cable loss will depend on the IF frequency. The IF frequency varies depending on which IF path your measurement is using. For best accuracy, characterize your cable's loss for the IF frequency or frequencies you will be using.

IF Frequencies

10 MHz path	322.5 MHz
25 MHz path	322.5 MHz
40 MHz path	250 MHz
140 MHz path	300 MHz

Remote Command	`[:SENSe]:MIXer:CIFLoss <rel_ampl>` `[:SENSe]:MIXer:CIFLoss?`
Example	`:MIX:CIFL 0.23 DB` `:MIX:CIFL?`
Dependencies	Only appears when External Mixer is selected as the Input
Preset	0.26 dB
State Saved	Saved in instrument state
Min	-100
Max	100

6.2.19 I/Q Path

Selects which I/Q input channels are active. The LED next to each I/Q input port will be on when that port is active.

The analysis bandwidth for each channel is the same as that of the instrument. For example, the base N9020A has a bandwidth of 10 MHz. With I/Q input the I and Q channels would each have an analysis bandwidth of 10 MHz, giving 20 MHz of bandwidth when the I/Q Path is I+jQ. With option B25, the available bandwidth becomes 25 MHz, giving 25 MHz each to I and Q and 50 MHz to I+jQ.

I/Q voltage to power conversion processing is dependent on the I/Q Path selected:

- With I+jQ input, we know that the input signal may not be symmetrical about 0 Hz, because it has a complex component. Therefore, above 0 Hz only the positive frequency information is displayed, and below 0 Hz only the negative frequency information is displayed
- With all other Input Path selections, the input signal has no complex component and therefore is always symmetrical about 0 Hz. In this case, by convention, the power conversion shows the combined voltage for both the positive and negative frequencies. The information displayed below 0 Hz is the mirror of the

information displayed above 0 Hz. This results in a power reading 6.02 dB higher (for both) than would be seen with only the positive frequency voltage. Note also that, in this case the real signal may have complex modulation embedded in it, but that must be recovered by further signal processing

Remote Command	`[:SENSe]:FEED:IQ:TYPE IQ | IONLy | QONLyFor option details, see More Information` `[:SENSe]:FEED:IQ:TYPE?`

Example	Set the input to be both the I and Q channels, combined as I + j * Q:
	`:FEED:IQ:TYPE IQ`
	Set the input to be only the I channel:
	`:FEED:IQ:TYPE IONL`
	Set the input to be only the Q channel:
	`:FEED:IQ:TYPE QONL`
	Turn on both I and Q channels and treat I as channel 1 and Q as channel 2:
	`:FEED:IQ:TYPE IND`

Dependencies	Only appears when I/Q is the selected input
Preset	`IQ`
State Saved	Yes Unaffected by Preset, but set to the default value by **Restore Input/Output Defaults** or **Restore System Defaults->All**

Backwards Compatibility SCPI

Notes	For R&S FSQ-B71 compatibility
Preset	`IQ`
Backwards Compatibility SCPI	`:INPut[1]:IQ:TYPE IQ | I | Q` `:INPut[1]:IQ:TYPE?`

More Information

I+jQ

Sets the signal input to be both the I and Q channels. The I and Q channel data will be combined as I + j * Q.

I Only

Sets the signal input to be only the I channel. The Q channel will be ignored. The data collected is still complex. When the center frequency is 0 the imaginary part will always be zero, but for any other center frequency both the real and imaginary parts will be significant.

Q Only

Sets the signal input to be only the Q channel. The I channel will be ignored. The Q channel will be sent to the digital receiver block as Q+j0. The receiver's output is still complex. When the center frequency is 0 the imaginary part will always be zero, but for any other center frequency both the real and imaginary parts will be significant. Note that since the receiver's real output is displayed as the "I" data, when the center frequency is 0, the Q Only input appears as the "I" data.

6.2.20 Reference Z

Sets the value of the impedance to be used in converting voltage to power for the I and Q channels. This does not change the hardware's path impedance (see "Input Z" on page 2358).

Remote Command	`:INPut:IMPedance:REFerence <integer>` `:INPut:IMPedance:REFerence?`
Example	Set the I/Q reference impedance to 50 Ω `:INP:IMP:REF 50`
Dependencies	Only appears when I/Q is the selected input
Preset	50 Ω
State Saved	Yes Unaffected by a Preset, but set to the default value by **Restore Input/Output Defaults** or **Restore System Defaults->All**
Min/Max	1 Ω - 1 MΩ

6.2.21 I/Q Setup

Lets you set up and calibrate various parameters for the I/Q inputs.

Dependencies	Only appears when I/Q is the selected input

6.2.21.1 I Setup

Accesses the channel setup parameters for the I channel.

Differential

Selects differential input on or off for the I channel. For differential input (also called balanced input), the instrument uses both main and complementary ports. When differential input is off (also called single-ended or unbalanced input), the instrument uses only the main port.

Remote Command	`:INPut:IQ[:I]:DIFFerential OFF | ON | 0 | 1` `:INPut:IQ[:I]:DIFFerential?`

Example	Put the I channel in Differential mode:
	`:INP:IQ:DIFF ON`
	Put the I channel in Single Ended mode:
	`:INP:IQ:DIFF OFF`

Notes	When I Differential Input = On, the instrument checks for attenuation mismatches between the I and I-bar ports. If the difference in attenuation values exceeds 0.5 dB, a Settings Alert error condition, error 159 is set When I Differential Input = On, and IQ Path is I+jQ, the Q Differential input must also be On. Similarly, when I Differential Input = Off, and IQ Path is I+jQ, the Q Differential input must also be Off. If the states of the two inputs do not match, an error condition message is generated, 159, Settings Alert; I/Q mismatch: Differential
Couplings	Some active probes include built-in differential capability. When one of these probes is sensed, this key is disabled. Since the differential capability is handled in the probe, the Instrument will use only the main port and the key will show that the Instrument's Differential Input mode is Off (indicating that the complementary port is not in use) When Q Same as I is On, the value set for I will also be copied to Q
Preset	`OFF` (Single Ended) Unaffected by Mode Preset, but set to the default value by **Restore Input/Output Defaults** or **Restore System Defaults->All**
State Saved	Yes
Annotation	The LED on the I-bar port indicates the Differential Input setting

Backwards Compatibility Command

Notes	For R&S FSQ-B71 compatibility, with no independent settings for the I and Q channels. Therefore, it is tied only to the I channel and does not provide an equivalent for the Q channel. For proper operation of the backwards compatibility command, Q Same as I should be `ON`
Preset	`OFF`
Backwards Compatibility SCPI	`:INPut[1]:IQ:BALanced[:STATe] OFF | ON | 0 | 1` `:INPut[1]:IQ:BALanced[:STATe]?`

Input Z

Selects the input impedance for the I channel. The impedance applies to both the I and I-bar ports.

The input impedance controls the hardware signal path impedance match. It is not used for converting voltage to power. The voltage to power conversion always uses the Reference Z parameter. The Reference Z parameter applies to both I and Q channels.

Remote Command	`:INPut[1]:IQ[:I]:IMPedance LOW | HIGH` `:INPut[1]:IQ[:I]:IMPedance?`

Example	Set the I channel input impedance to 1 MΩ:
	`:INP:IQ:IMP HIGH`
	Set the I channel input impedance to 50 Ω:
	`:INP:IQ:IMP LOW`

Notes	`LOW` = 50 Ω, `HIGH` = 1 MΩ When IQ Path is I+jQ, the I Input Z setting must be the same as the Q Input Z setting. If the settings of the two inputs do not match, an error condition message is generated, 159; Settings Alert; I/Q mismatch: Input Z
Couplings	Input impedance is a built-in characteristic of a probe. Therefore, whenever a probe is sensed, this key is disabled, and the value is set to match the probe When no probe is sensed on Q and Q Same as I is On, the value set for I will also be copied to Q
Preset	`LOW` Unaffected by Mode Preset, but set to the default value by **Restore Input/Output Defaults** or **Restore System Defaults->All**
State Saved	Yes
Annotation	"I:<I Input Z>" (examples, "I:50Ω" or "I:1MΩ") in the Measurement Bar. The annotation shows both the I and Q Input Z values

Skew

Sets the skew factor for the I channel. The skew will shift the channel's data in time. Use this to compensate for differences in the electrical lengths of the input paths due to cabling.

Remote Command	`[:SENSe]:CORRection:IQ[:I]:SKEW <seconds>` `[:SENSe]:CORRection:IQ[:I]:SKEW?`
Example	Delay the data for the I channel by 10 ns: `:CORR:IQ:SKEW 10 ns`
Preset	0
State Saved	Yes Unaffected by Mode Preset, but set to the default value by **Restore Input/Output Defaults** or **Restore System Defaults->All**
Range	0 s to 100 ns
Min	0 s
Max	+100 ns

Combined Differential/Input Z (Remote Command Only)

For backwards compatibility only. It combines the Differential Input and Input Z selections into a single command.

Notes	Provided for E4406A code compatibility The enum values translate as follows: `U50` — Differential Input = Off, Input Z = 50 Ω `B50` — Differential Input = On, Input Z = 50 Ω `U1M` — Differential Input = Off, Input Z = 1 MΩ `B1M` — Differential Input = On, Input Z = 1 MΩ Combines the Input Z (50 Ω or 1 M Ω) parameter with the Differential Input (Off = "Unbalanced", On = "Balanced") parameter into a single enumeration This backwards-compatibility command was for an instrument without independent settings for the I and Q channels. Therefore, it is tied only to the I channel and does not provide an equivalent for the Q channel. For proper operation of the backwards-compatibility command, Q Same as I should be set to `ON` Note also the subtle difference between this command and the backwards-compatibility command for Input Z. The Input Z SCPI has "`IQ`" before "`IMP`", while this command has that order reversed
Couplings	Does not have an independent parameter, but instead is tied to the Differential Input and Input Z parameters. The coupling for those parameters apply to this command too
Preset	`U50`
Backwards Compatibility SCPI	`:INPut:IMPedance:IQ U50 | B50 | U1M | B1M` `:INPut:IMPedance:IQ?`

6.2.21.2 I Probe

Access the probe setup parameters for the I channel.

Dependencies	Only appears when I/Q is the selected input

The set of I/Q probe setup parameters will change based on the type of probe that is sensed. All probe types have the Attenuation parameter, and all probe types can be calibrated. The remaining parameters are only available for some probe types and will not be shown when not available. The probe type is determined by and reported for only for the I and Q ports, never the I-bar or Q-bar ports. The menu title will be "<ch>: <probe id>", where "<ch>" is either "I" or "Q" and "<probe id>" is the type of probe. For example, for the I Probe setup with an Keysight 1130A probe connected to the I port, the title will be "I: 1130A".

Probe calibration data is stored for each probe type for each channel. When no probe is sensed, the probe type "Unknown" is used, and this is also treated like a probe type with its own calibration data. When a probe is changed, the calibration data for that probe type for that port is restored. An advisory message will be displayed showing the new probe type and the calibration status. The calibration data is stored permanently (survives a power cycle) and is not affected by a Preset or any of the Restore commands. When the probe has EEPROM identification (most newer Keysight probes have this), the calibration data is stored by probe serial number and port, so if you have two probes of the same type, the correct calibration data will be used for each. For probes that do not have EEPROM identification, the calibration data is stored by probe type and port and the instrument cannot distinguish between different probes of the same type. In all cases (with or without EEPROM identification), the calibration data is port specific, so it will not follow a specific probe from port to port if the probe is moved.

The "Unknown" probe type is used whenever no probe is sensed. When no calibration data exists for "Unknown" the latest cable calibration data is used.

Attenuation

The attenuation is part of the calibration data stored with the probe type and is initially the value that was returned by the last calibration. You can modify this value and any changes will be stored with the calibration data and will survive power cycles and presets. When a probe calibration is performed the attenuation value will be overwritten by the calibration.

Remote Command	`[:SENSe]:CORRection:IQ:I:ATTenuation:RATio <real>` `[:SENSe]:CORRection:IQ:I:ATTenuation:RATio?`
Example	Set the attenuation for the current I probe to 100.00:1: `:CORR:IQ:I:ATT:RAT 100`
Notes	Each probe type has its own attenuation setting. As probes are changed the attenuation value will reflect the new probe's setting. Changing the attenuation affects only the current probe type's setting and leaves all others unchanged When the IQ Path is I+jQ, the Q probe attenuation setting must match the I Probe attenuation setting within 1 dB. If this is not the case, an error condition message is generated, 159; Settings Alert; I/Q mismatch: Attenuation
Preset	1
State Saved	Saved with probe calibration data. Survives a power cycle and is not affected by Preset or Restore
Min/Max	0.001/10000

This is an alternate form of the SCPI command that allows input as a power instead of a ratio.

Remote Command	`[:SENSe]:CORRection:IQ:I:ATTenuation <rel_ampl>` `[:SENSe]:CORRection:IQ:I:ATTenuation?`

Example	Set the attenuation for the current I probe type to 100.00:1: `:CORR:IQ:I:ATT 20 dB`
Min/Max	-60 dB /+80 dB

Offset

Some active probes have DC offset capability. When one of these probes is connected, this control will be visible. The signal is adjusted for the DC offset before entering the instrument's port. This allows for removal of a DC offset before reaching the instrument's input port voltage limits. For example, a signal that varies 1 V peak-to-peak with a DC offset equal to the instrument's max input voltage would exceed the input limits of the instrument for half its cycle. Removing the DC offset allows the instrument to correctly process the entire signal.

Remote Command	`:INPut:OFFSet:I <voltage>` `:INPut:OFFSet:I?`
Example	Remove a DC offset of -0.5 V from the I channel input: `:INP:OFFS:I -0.5`
Notes	Only some probe types support **Offset**. For those that do, each probe type has its own **Offset** setting. As probes are changed, the **Offset** value will reflect the new probe's setting. Changing **Offset** affects only the current probe type's setting and leaves all others unchanged
Preset	0 V
State Saved	Saved with probe calibration data. Survives power cycle and is not affected by Preset or Restore
Min/Max	-18 V/+18 V

Coupling

Some probe types allow coupling to reject low frequencies. This filters out the DC component of a signal that is composed of a DC bias plus some AC signal. This control is visible only for probe types that have this capability.

Remote Command	`:INPut:COUPling:I DC | LFR1 | LFR2` `:INPut:COUPling:I?`

Example	Turn off low frequency rejection on the I channel, allowing signals down to DC:
	`:INP:COUP:I DC`
	Turn on low frequency rejection on the I channel for frequencies lower than 1.7 Hz:
	`:INP:COUP:I LFR1`
	Turn on low frequency rejection on the I channel for frequencies lower than 0.14 Hz:
	`:INP:COUP:I LFR2`

Notes	Only some probe types support **Coupling**. For those that do, each probe type has its own **Coupling** setting. As probes are changed, the **Coupling** value will reflect the new probe's setting. Changing

	Coupling affects only the current probe type's setting and leaves all others unchanged
Preset	DC
State Saved	Saved with probe calibration data. Survives a power cycle and is not affected by a Preset or Restore
Range	DC | AC 1.7 Hz LFR1 | AC 0.14 Hz LFR2

Clear Calibration

Clears the calibration data for the current port and probe. It does not clear the data for other probe types or other ports. If the sensed probe has EEPROM identification, only the data for that specific probe is cleared. After this command has completed, the probe calibration state will be the same as if no probe calibration had ever been performed for the specified channel and probe. The probe attenuation will be the default value for that probe type and the Cable Calibration frequency response corrections will be used. This command is dependent on the Differential Input state. When Differential Input is on, both the data for the probe attached to the main port and the data for the probe attached to the complementary port are cleared. When Differential Input is off, only data for the probe attached to the main port is cleared.

Remote Command	`:CALibration:IQ:PROBe:I:CLEar`
Example	Clear the calibration data for the I channel and the current probe (with EEPROM identification) or probe type (without EEPROM identification): `:CAL:IQ:PROBe:I:CLE`

6.2.21.3 Calibrate

Invokes the guided probe calibration. The guided probe calibration is context sensitive and depends on the channel (I or Q) and the Differential Input state. The calibration is only performed on the selected channel. When the Differential control is switched to Differential, both the probe attached to the main port and the probe attached to the complementary port are calibrated. When the Differential control is switched to Single Ended, only the probe attached to the main port is calibrated.

Calibrating the Baseband I/Q ports requires several steps and manual connections. The Guided Calibration will interactively step you through the required steps, displaying diagrams to help with the connections. The steps will vary depending on the setup.

In the Guided Calibration windows, the date and time of the last calibration are displayed. If any of the items listed are displayed in yellow, this indicates that the calibration for that item is inconsistent with the latest calibration, and you should complete the entire calibration process before you exit the calibration. For passive probes with Differential On, any calibration that is more than a day older than the most recent calibration will be displayed with the color amber.

The I/Q probe calibration creates correction data for one of the front panel I/Q channels. When the probe has EEPROM identification, the data is unique to that specific probe. When the probe does not have EEPROM identification, the data will be used for all probes of the same type. The data is also unique to the channel, so calibration data for the I channel will not be used for the Q channel and vice versa.

The guided calibration (front panel only) will show connection diagrams and guide you through the I/Q Isolation Calibration and through calibrating each port. The calibration data for each port is stored separately, so as soon as a port is calibrated that data is saved and will be used. If a user presses "Exit" to exit the calibration process, the data for the port already completed will still be used. It is recommended that a calibration be completed once started, or if exited, that it be properly done before the next use of the probe. The "Next" button will perform the calibration for the current port and then proceed to the next step in the calibration procedure. The "Back" button will return to the prior port in the procedure. Both softkeys and dialog buttons are supplied for ease of use. The dialog buttons are for mouse use and the softkeys for front panel use.

The calibration can also be done via SCPI, but no connection diagrams will be shown. You will need to make the correct connections before issuing each port calibration command. Again, it is recommended that all ports be calibrated at the same time.

For Active probes or when Differential is Off, only the main port is calibrated, otherwise both the main and complementary ports are calibrated.

The instrument state remains as it was prior to entering the calibration procedure except while a port is actually being calibrated. Once a port is calibrated it returns to the prior state. A port calibration is in process only from the time the "Next" button is pressed until the next screen is shown. For SCPI, this corresponds to the time from issuing the CAL:IQ:PROB:I|IB|Q|QB command until the operation is complete.

For example, if the prior instrument state is Cal Out = Off, Input = I+jQ, and Differential = Off, then up until the time the "Next" button is pressed the I Input and Q Input LEDs are on and the Cal Out, I-bar Input and Q-bar Input LEDs are off. Once the "Next" button is pressed for the I port calibration, only the Cal Out and I Input LEDs will be on, and the others will be off. When the screen progresses to the next step ("Next" button again enabled), the prior state is restored and only the I Input and Q Input LEDs are on (Cal Out is off again).

I/Q Isolation Calibration

I/Q Isolation Calibration must be run before calibrating any port with either the I/Q Cable Calibration or I/Q Probe Calibration. This calibration is performed with nothing connected to any of the front panel I/Q ports. This is the first step in both the I/Q Cable Calibration and the I/Q Probe Calibration. This dialog appears if the Calibration is being run for the first time. It can also be accessed by pressing Back from the I Input Cal, the Q Input Cal, or the I/Q Cable Cal. Pressing Next from this dialog runs the calibration

Remote Command	`:CALibration:IQ:ISOLation`
Example	`:CAL:IQ:ISOL`
Notes	All front panel I/Q ports must be unconnected
State Saved	No

I/Q Isolation Calibration Time (Remote Query Only)

Returns the last date and time that the I/Q Isolation Calibration was performed.

Remote Command	`:CALibration:IQ:ISOLation:TIME?`
Example	`:CAL:IQ:ISOL:TIME?`
Notes	Returns 6 integer values: year, month, day, hour, minute, second. When no calibration has been performed, all values are 0
Annunciation	Guided Calibration, Isolation Calibration, Last Calibration

I Port

The I port calibration is performed with the probe body attached to the front panel's I port, and the probe tip connected via an adapter to the Cal Out port. The guided calibration will show a diagram of the required connections.

Remote Command	`:CALibration:IQ:PROBe:I`
Example	`:CAL:IQ:PROB:I`
Notes	The I port must be connected to the Cal Out port before issuing the command The calibration data is saved as soon as the port is calibrated and will survive power cycles. It is not reset by any preset or restore data commands
State Saved	No

I Port Probe Calibration Time (Remote Query Only)

Return the last date and time that the I/Q Probe Calibration was performed for a specific port.

Remote Command	`:CALibration:IQ:PROBe:I|:TIME?`
Example	`:CAL:IQ:PROB:I:TIME?`

Notes	This returns 6 integer values: year, month, day, hour, minute, second. When no calibration has been performed, all values are 0. The value is specific to both the port and probe, so the value will change as probes are connected or disconnected

I-bar Port

The I-bar port calibration is performed with the probe body attached to the front panel's I-bar port and the probe tip connected via an adapter to the Cal Out port. The I-bar probe calibration is only available for passive probes with Differential On. The guided calibration will show a diagram of the required connections.

Remote Command	`:CALibration:IQ:PROBe:IBar`
Example	`:CAL:IQ:PROB:IB`
Notes	The I-bar port must be connected to the Cal Out port before issuing the command The calibration data is saved as soon as the port is calibrated and will survive power cycles. It is not reset by any preset or restore data commands
State Saved	No

I-bar Port Probe Calibration Time (Remote Query Only)

Return the last date and time that the I/Q Probe Calibration was performed for a specific port.

Remote Command	`:CALibration:IQ:PROBe:IBAR:TIME?`
Example	`:CAL:IQ:PROB:IBAR:TIME?`
Notes	Returns 6 integer values: year, month, day, hour, minute, second. When no calibration has been performed, all values are 0. The value is specific to both the port and probe, so the value will change as probes are connected or disconnected
Annunciation	Guided Calibration, Probe Calibration, Last Calibration

6.2.21.4 Q Setup

Access the channel setup parameters for the Q channel.

Dependencies	Only appears when I/Q is the selected input

Q Same as I

Many, but not all, usages require the I and Q channels have an identical setup. To simplify channel setup, the Q Same as I will cause the Q channel parameters to be mirrored from the I channel. That way you only need to set up one channel (the I channel). The I channel values are copied to the Q channel, so at the time Q Same as I is turned off the I and Q channel setups will be identical. This does not apply to Probe settings or to parameters that are determined by the probe.

Remote Command	`:INPut:IQ:MIRRored OFF | ON | 0 | 1` `:INPut:IQ:MIRRored?`
Example	Turn off the mirroring of parameters from I to Q: `:INP:IQ:MIRR OFF`
Couplings	Only displayed for the Q channel. When Yes, the I channel values for some parameters are mirrored (copied) to the Q channel. However, when a parameter is determined by the type of probe and a probe is sensed, the probe setting is always used and the I channel setting is ignored. The following parameters are mirrored: Differential Input (when not determined by probe) Input Z (when not determined by probe)
Preset	Unaffected by Preset, but set to the default value (Q Same as I set to ON) by **Restore Input/Output Defaults** or **Restore System Defaults->All**
State Saved	Saved in instrument state
Range	OFF | ON

Differential

Selects differential input on or off for the Q channel. For differential input (also called balanced input), the instrument uses both the Q and Q-bar ports. When differential input is off (also called single-ended or unbalanced input), the instrument uses only the Q port.

Remote Command	`:INPut:IQ:Q:DIFFerential OFF | ON | 0 | 1` `:INPut:IQ:Q:DIFFerential?`

Example	Put the Q channel in Differential mode:
	`:INP:IQ:Q:DIFF ON`
	Put the Q channel in Single Ended mode:
	`:INP:IQ:Q:DIFF OFF`

Notes	When Differential Input = ON, the instrument checks for attenuation mismatches between the Q and Q-bar ports. If the difference in attenuation values exceeds 0.5 dB a Settings Alert error condition, error 159 will be set When Q Differential Input = ON, and IQ Path is I+jQ, the I Differential input must also be ON. Similarly, when Q Differential Input = OFF, and IQ Path is I+jQ, the I Differential input must also be OFF. If the states of the two inputs do not match, an error condition message is generated, 159; Settings Alert; I/Q mismatch: Differential
Couplings	Some active probes include built-in differential capability. When one of these probes is sensed, this key is disabled. Since the differential capability is handled in the probe, the Instrument will use only the main port and the key will show that the Instrument's Differential Input mode is Off (indicating that the

	complementary port not in use) When a differential probe is not sensed and Q Same as I is On, the value set for I will be copied to Q. This key is disabled when Q Same as I is On
Preset	`OFF`
State Saved	Yes Unaffected by a Preset, but set to the default value by **Restore Input/Output Defaults** or **Restore System Defaults->All**
Range	`OFF | ON`
Annotation	The LED on the Q-bar port indicates the Differential Input setting

Input Z

Selects the input impedance for the Q channel. The impedance applies to both the Q and Q-bar ports.

The input impedance controls the hardware signal path impedance match. It is not used for converting voltage to power. The voltage to power conversion always uses the Reference Z parameter. The Reference Z parameter applies to both I and Q channels.

Remote Command	`:INPut[1]:IQ:Q:IMPedance LOW | HIGH` `:INPut[1]:IQ:Q:IMPedance?`

Example	Set the Q channel input impedance to 1 MΩ:
	`:INP:IQ:Q:IMP HIGH`
	Set the Q channel input impedance to 50 Ω:
	`:INP:IQ:Q:IMP LOW`

Notes	`LOW` = 50 Ω, `HIGH` = 1 MΩ When IQ Path is I+jQ, the I Input Z setting must be the same as the Q Input Z setting. If the settings of the two inputs do not match, an error condition message is generated, 159; Settings Alert; I/Q mismatch: Input Z
Couplings	Input impedance is a built-in characteristic of a probe. Therefore, whenever a probe is sensed, this key is disabled, and the value is set to match the probe When no probe is sensed and Q Same as I is On, the value set for I will also be copied to Q. This key is disabled when Q Same as I is On
Preset	`LOW`
State Saved	Yes Unaffected by a Preset, but set to the default value by **Restore Input/Output Defaults** or **Restore System Defaults->All**
Range	50 Ω | 1 MΩ
Annotation	"Q:<Q Input Z>" (examples, "Q:50Ω" or "Q:1MΩ") in the Measurement Bar. The annotation shows both the I and Q Input Z values

Skew

Sets the skew factor for the Q channel. The skew will shift the channel's data in time. Use this to compensate for differences in the electrical lengths of the input paths due to cabling and probes.

Remote Command	`[:SENSe]:CORRection:IQ:Q:SKEW <seconds>` `[:SENSe]:CORRection:IQ:Q:SKEW?`
Example	Delay the data for the Q channel by 10 ns `:CORR:IQ:Q:SKEW 10 ns`
Preset	0
State Saved	Yes Unaffected by a Preset, but set to the default value by **Restore Input/Output Defaults** or **Restore System Defaults->All**
Min/Max	0 s/ 100 ns

6.2.21.5 Q Probe

Accesses the probe setup parameters for the Q channel. See "Combined Differential/Input Z (Remote Command Only)" on page 2360.

Dependencies	Only appears when I/Q is the selected input

Attenuation

The attenuation is part of the calibration data stored with the probe type and is initially the value that was returned by the last calibration. You can modify this value and any changes will be stored with the calibration data and will survive power cycles and presets. When a probe calibration is performed the attenuation value will be overwritten by the calibration.

Remote Command	`[:SENSe]:CORRection:IQ:Q:ATTenuation:RATio <real>` `[:SENSe]:CORRection:IQ:Q:ATTenuation:RATio?`
Example	Set the attenuation for the current Q probe to 100.00:1: `:CORR:IQ:Q:ATT:RAT 100`
Notes	Each probe type has its own attenuation setting. As probes are changed the attenuation value will reflect the new probe's setting. Changing the attenuation affects only the current probe type's setting and leaves all others unchanged When the IQ Path is I+jQ, the Q probe attenuation setting must match the I Probe attenuation setting within 1 dB. If this is not the case, an error condition message is generated, 159; Settings Alert; I/Q mismatch: Attenuation

Preset	Each probe type has its own default. The default for the "Unknown" probe type is 1:1
State Saved	Saved with probe calibration data. Survives a power cycle and is not affected by Preset or Restore
Min/Max	0.001/10000

This is an alternate form of the SCPI command that allows input as a power instead of a ratio.

Remote Command	`[:SENSe]:CORRection:IQ:Q:ATTenuation <rel_ampl>` `[:SENSe]:CORRection:IQ:Q:ATTenuation?`
Example	Set the attenuation for the current Q probe type to 100.00:1: `:CORR:IQ:Q:ATT 20 dB`
Min/Max	-60 dB /+80 dB

Offset

Some active probes have DC offset capability. When one of these probes is connected this control will be visible. The signal is adjusted for the DC offset before entering the instrument's port. This allows for removal of a DC offset before reaching the instrument's input port voltage limits. For example, a signal that varies 1 V peak-to-peak with a DC offset equal to the instrument's max input voltage would exceed the input limits of the instrument for half its cycle. Removing the DC offset allows the instrument to correctly process the entire signal.

Remote Command	`:INPut:OFFSet:Q <voltage>` `:INPut:OFFSet:Q?`
Example	Remove a DC offset of -0.5 V from the Q channel input: `:INP:OFFS:Q -0.5`
Notes	Only some probe types support **Offset**. For those that do, each probe type has its own **Offset** setting. As probes are changed, the **Offset** value will reflect the new probe's setting. Changing **Offset** affects only the current probe type's setting and leaves all others unchanged
Preset	0 V
State Saved	Saved with probe calibration data. Survives power cycle and is not affected by Preset or Restore
Min/Max	-18 V/+18 V

Coupling

Some probe types allow coupling to reject low frequencies. This filters out the DC component of a signal that is composed of a DC bias plus some AC signal. This control is visible only for probe types that have this capability.

Remote Command	`:INPut:COUPling:Q DC | LFR1 | LFR2` `:INPut:COUPling:Q?`

Example	Turn off low frequency rejection on the Q channel, allowing signals down to DC:
	`:INP:COUP:Q DC`
	Turn on low frequency rejection on the Q channel for frequencies lower than 1.7 Hz:
	`:INP:COUP:Q LFR1`
	Turn on low frequency rejection on the Q channel for frequencies lower than 0.14 Hz:
	`:INP:COUP:Q LFR2`

Notes	Only some probe types support **Coupling**. For those that do, each probe type has its own **Coupling** setting. As probes are changed, the **Coupling** value will reflect the new probe's setting. Changing **Coupling** affects only the current probe type's setting and leaves all others unchanged
Preset	`DC`
State Saved	Saved with probe calibration data. Survives a power cycle and is not affected by a Preset or Restore
Range	DC | AC 1.7 Hz LFR1 | AC 0.14 Hz LFR2

Clear Calibration

Clears the calibration data for the current port and probe. It does not clear the data for other probe types or other ports. If the sensed probe has EEPROM identification, only the data for that specific probe is cleared. After this command has completed, the probe calibration state will be the same as if no probe calibration had ever been performed for the specified channel and probe. The probe attenuation will be the default value for that probe type and the Cable Calibration frequency response corrections will be used. This command is dependent on the Differential Input state. When Differential Input is on, both the data for the probe attached to the main port and the data for the probe attached to the complementary port are cleared. When Differential Input is off, only data for the probe attached to the main port is cleared.

Remote Command	`:CALibration:IQ:PROBe:Q:CLEar`
Example	Clear the calibration data for the Q channel and the current probe (with EEPROM identification) or probe type (without EEPROM identification): `:CAL:IQ:PROBe:I:CLE`

6.2.21.6 Calibrate

Invokes the guided probe calibration. The guided probe calibration is context sensitive and depends on the channel (I or Q) and the Differential Input state. The calibration is only performed on the selected channel. When the Differential control is switched to Differential, both the probe attached to the main port and the probe attached to the complementary port are calibrated. When the Differential control is switched to Single Ended, only the probe attached to the main port is calibrated.

The I/Q Isolation Calibration must be run before calibrating any port with either the I/Q Cable Calibration or I/Q Probe Calibration. See "I/Q Isolation Calibration" on page 2364

Q Port

The Q port calibration is performed with the probe body attached to the front panel's Q port and the probe tip connected via an adapter to the Cal Out port. The guided calibration will show a diagram of the required connections.

Remote Command	:CALibration:IQ:PROBe:Q
Example	:CAL:IQ:PROB:Q
Notes	The Q port must be connected to the Cal Out port before issuing the command The calibration data is saved as soon as the port is calibrated and survives power cycles. It is not reset by any preset or restore data commands
State Saved	No

Q Port Probe Calibration Time (Remote Query Only)

Return the last date and time that the I/Q Probe Calibration was performed for a specific port.

Remote Command	:CALibration:IQ:PROBe:Q:TIME?
Example	:CAL:IQ:PROB:Q:TIME?
Notes	Returns 6 integer values: year, month, day, hour, minute, second. When no calibration has been performed, all values are 0. The value is specific to both the port and probe, so the value will change as probes are connected or disconnected
Annunciation	Guided Calibration, Probe Calibration, Last Calibration

Q-bar Port

The Q-bar port calibration is performed with the probe body attached to the front panel's Q-bar port and the probe tip connected via an adapter to the Cal Out port. The Q-bar probe calibration is only available for passive probes with Differential On. The guided calibration will show a diagram of the required connections.

Remote Command	:CALibration:IQ:PROBe:QBar
Example	:CAL:IQ:PROB:QB
Notes	The Q-bar port must be connected to the Cal Out port before issuing the command

	The calibration data is saved as soon as the port is calibrated and will survive power cycles. It is not reset by any preset or restore data commands
State Saved	No

Q-bar Probe Calibration Time (Remote Query Only)

Return the last date and time that the I/Q Probe Calibration was performed for a specific port.

Remote Command	`:CALibration:IQ:PROBe:QBAR:TIME?`
Example	`:CAL:IQ:PROB:QBAR:TIME?`
Notes	Returns 6 integer values: year, month, day, hour, minute, second. When no calibration has been performed, all values are 0. The value is specific to both the port and probe, so the value will change as probes are connected or disconnected
Annunciation	Guided Calibration, Probe Calibration, Last Calibration

6.2.22 I/Q Cable Calibrate

The I/Q cable calibration creates correction data for each of the front panel I/Q ports. This calibration data is used whenever no probe specific calibration data is available. It is important that all ports are calibrated using the same short BNC cable so that the data is comparable from port to port.

The guided calibration (front panel only) will show connection diagrams and guide you through the isolation calibration and calibrating each port. The calibration data for each port is stored separately, so as soon as a port is calibrated that data is saved and will be used. If you press "Exit" to exit the calibration process, the data for the ports already completed will still be used. It is recommended that a calibration be completed once started, or if exited, that it be properly done before the next use of the I/Q ports. The "Next" button will perform the calibration for the current port and then proceed to the next step in the calibration procedure. The "Back" button will return to the prior port in the procedure. Both keys and dialog buttons are supplied for ease of use. The dialog buttons are for mouse use and the softkeys for front panel use.

The calibration can also be done via SCPI, but no connection diagrams will be shown. You will have to make the correct connections before issuing each port calibration command. Again, it is recommended that all ports be calibrated at the same time.

The instrument state remains as it was prior to entering the calibration procedure except while a port is actually being calibrated. Once a port is calibrated it returns to the prior state. A port calibration is in process only from the time the "Next" button is pressed until the next screen is shown. For SCPI, this corresponds to the time from issuing the CAL:IQ:FLAT:I|IB|Q|QB command until the operation is complete.

For example, if the prior instrument state is Cal Out = Off, Input = I+jQ, and Differential = Off, then up until the time the "Next" button is pressed the I Input and Q Input LEDs are on and the Cal Out, I-bar Input and Q-bar Input LEDs are off. Once the "Next" button is pressed for the I port calibration, only the Cal Out and I Input LEDs will be on and the others will be off. When the screen progresses to the next step ("Next" button again enabled), the prior state is restored and only the I Input and Q Input LEDs are on (Cal Out is off again).

The last calibration date and time for each port will be displayed. Any calibrations that are more than a day older than the most recent calibration will be displayed with the color amber.

The I/Q Isolation Calibration must be run before calibrating any port with either the I/Q Cable Calibration or I/Q Probe Calibration. See "I/Q Isolation Calibration" on page 2364

Dependencies	Only appears when I/Q is the selected input

6.2.22.1 I Port

The I port calibration is performed with the front panel's I port connected via a short BNC cable to the Cal Out port. The guided calibration will show a diagram of the required connections.

Remote Command	`:CALibration:IQ:FLATness:I`
Example	`:CAL:IQ:FLAT:I`
Notes	The recommended procedure is to use the same BNC cable to calibrate all I/Q ports. All I/Q ports should be calibrated sequentially during the procedure The calibration data is saved as soon as the port is calibrated and will survive power cycles. It is not reset by any preset or restore data commands The I port must be connected to the Cal Out port before issuing the command
State Saved	No

6.2.22.2 I-bar Port

The I-bar port calibration is performed with the front panel's I-bar port connected via a short BNC cable to the Cal Out port. The guided calibration will show a diagram of the required connections.

Remote Command	`:CALibration:IQ:FLATness:IBAR`

Example	`:CAL:IQ:FLAT:IBAR`
Notes	The recommended procedure is to use the same BNC cable to calibrate all I/Q ports. All I/Q ports should be calibrated sequentially during the procedure The calibration data is saved as soon as the port is calibrated and will survive power cycles. It is not reset by any preset or restore data commands The I-bar port must be connected to the Cal Out port before issuing the command
State Saved	No

6.2.22.3 Q Port

The Q port calibration is performed with the front panel's Q port connected via a short BNC cable to the Cal Out port. The guided calibration will show a diagram of the required connections.

Remote Command	`:CALibration:IQ:FLATness:Q`
Example	`:CAL:IQ:FLAT:Q`
Notes	The recommended procedure is to use the same BNC cable to calibrate all I/Q ports. All I/Q ports should be calibrated sequentially during the procedure The calibration data is saved as soon as the port is calibrated and will survive power cycles. It is not reset by any preset or restore data commands The Q port must be connected to the Cal Out port before issuing the command
State Saved	No

6.2.22.4 Q-bar Port

The Q-bar port calibration is performed with the front panel's Q-bar port connected via a short BNC cable to the Cal Out port. The guided calibration will show a diagram of the required connections.

Remote Command	`:CALibration:IQ:FLATness:QBAR`
Example	`:CAL:IQ:FLAT:QBAR`
Notes	The recommended procedure is to use the same BNC cable to calibrate all I/Q ports. All I/Q ports should be calibrated sequentially during the procedure The calibration data is saved as soon as the port is calibrated and will survive power cycles. It is not reset by any preset or restore data commands The Q-bar port must be connected to the Cal Out port before issuing the command
State Saved	No

6.2.22.5 I/Q Cable Calibration Time (Remote Query Only)

Returns the last date and time that the I/Q Cable Calibration was performed for a specific port.

Remote Command	`:CALibration:IQ:FLATness:I|IBAR|Q|QBAR:TIME?`
Example	`:CAL:IQ:FLAT:I:TIME?`
Notes	Returns 6 integer values: year, month, day, hour, minute, second. When no calibration has been performed, all values are 0
Annunciation	Guided Calibration, Cable Calibration, Last Calibration

6.2.23 Audio Input Channel

Determines which Audio Input to be used for audio measurements.

Remote Command	`[:SENSe]:FEED:AFINput:PORT CH1 | CH2` `[:SENSe]:FEED:AFINput:PORT?`
Example	`:FEED:AFIN CH1`
Dependencies	Only appears in Radio Test Mode Only appears in modular products, and only if an M9260A Audio Analyzer module is installed
Preset	Unaffected by Mode Preset, but set to Channel 1 by **Input/Output Preset**

6.2.24 Audio Calibrator

Lets you turn on the internal calibrator in the X-Series Audio board.

Remote Command	`[:SENSe]:FEED:AFALign OFF | REF10` `[:SENSe]:FEED:AFALign?`
Example	`:FEED:AFAL REF10`
Dependencies	Only appears in Measuring Receiver Mode's Audio Measurements when Option 107 is present
Preset	`OFF`

6.2.25 Audio Coupling

Lets you set AC or DC coupling for the currently selected audio input.

Remote Command	`[:SENSe]:AFINput[1]|2:COUPling AC | DC` `[:SENSe]:AFINput[1]|2:COUPling?`

Example	`:AFIN:COUP AC`
Dependencies	Only appears in Measuring Receiver Mode and Radio Test Mode In Measuring Receiver Mode, only appear in Audio Measurements, and only if Option 107 is present In Radio Test Mode, only appears in modular products, and only if an M9260A Audio Analyzer module is installed
Preset	`AC`

6.2.26 Audio Input Ground

Lets you float or ground the low side of the currently selected audio input channel. When you choose `FLOat`, the low side of the input is disconnected from ground.

Remote Command	`[:SENSe]:AFINput[1]|2:LOW FLOat | GROund` `[:SENSe]:AFINput[1]|2:LOW?`
Example	`:AFIN2:LOW FLO`
Dependencies	Only appears in Radio Test Mode Only appears in modular products, and only if an M9260A Audio Analyzer module is installed
Preset	Unaffected by Mode Preset, but set to `GROund` by **Input/Output Preset**

6.2.27 Audio In Impedance

Lets you set the Impedance of the currently selected audio input channel.

The value you enter is rounded up to the nearest allowed value.

Remote Command	`[:SENSe]:AFINput[1]|2:IMPedance 50 | 600 | 1000000` `[:SENSe]:AFINput[1]|2:IMPedance?`
Example	`:AFIN:IMP 50`
Dependencies	Only appears in Radio Test Mode Only appears in modular products, and only if an M9260A Audio Analyzer module is installed
Preset	Unaffected by Mode Preset, but set to 600 by **Input/Output Preset**

6.2.28 Input/Output Preset

Resets the group of settings and data associated with the **Input/Output** front-panel key to their default values. These settings are not affected by **Mode Preset** because they are generally associated with connections to the instrument, which you generally would not want to reset every time you press **Mode Preset**.

This is the same as the control in the **Preset** dropdown, and also the same as **Input/Output** button in the **Restore Defaults** menu under **System**.

All the variables set under the **Input/Output** front panel key are reset by **Input/Output Preset**, including Amplitude Corrections and Data (described in the **Corrections** section), with the exception of RF Source settings, which are unaffected.

By using **Input/Output Preset** and **Restore Mode Defaults**, a full preset of the current mode will be performed, with the caveat that since **Input/Output Preset** is a global function it will affect *all* Modes.

When **Input/Output Preset** is selected, a message appears saying:

“This will reset all of the Input/Output variables to their default state, including which input is selected, all Amplitude Correction settings and data, all External Mixing settings, all Frequency Reference settings and all Output settings.

It will not affect Alignment data or settings.

It will not affect RF Source settings.

This action cannot be undone. Do you want to proceed?”

Use the **OK** or **Cancel** buttons to affirm or cancel the operation.

Example	`:SYST:DEF INP` presets all Input/Output variables to their factory default values

6.3 External Gain

Contains controls that allow you to compensate for gain or loss in the measurement system outside the instrument. The External Gain is subtracted from the amplitude readout (or the loss is added to the amplitude readout). So, the displayed signal level represents the signal level at the output of the device-under-test, which can be the input of an external device that provides gain or loss.

Entering an External Gain value does not affect the Reference Level, therefore the trace position on screen changes, as do all of the values represented by the trace data. Thus, the values of exported trace data, queried trace data, marker amplitudes, trace data used in calculations such as N dB points, trace math, peak threshold, etc., are all affected by External Gain. Changing the External Gain, even on a trace that is not updating, immediately changes all of the above, without new data needing to be taken.

NOTE **Changing the External Gain causes the instrument to immediately stop the current sweep and prepare to begin a new sweep. The data will not change until the trace data updates because the offset is applied to the data as it is taken. If a trace is exported with a nonzero External Gain, the exported data will contain the trace data with the offset applied.**

In Spectrum Analyzer Mode, a Preamp is the common external device providing gain or loss. In a measurement application mode like GSM or W-CDMA, the gain or loss could be from a BTS (Base Transceiver Station) or an MS (Mobile Station). So, in the Spectrum Analyzer mode MS and BTS would be grayed out and the only choice would be Ext Preamp. Similarly, in some of the digital communications applications, Ext Preamp will be grayed out and you would have a choice of MS or BTS.

The Ext Preamp, MS, and BS controls may be grayed-out depending on which measurement is currently selected. If any of the grayed-out controls are pressed, or the equivalent SCPI command is sent, an advisory message is generated.

6.3.1 External Preamp

This function is similar to the reference level offset function. Both affect the displayed signal level. Ref Lvl Offset is a mathematical offset only, no instrument configuration is affected. Ext Preamp gain is used when determining the auto-coupled value of the Attenuator. The External Gain value and the Maximum Mixer Level settings are both part of the automatic setting equation for the RF attenuation setting. (10 dB of Attenuation is added for every 10 dB of External Gain.)

Note that the Ref Lvl Offset and Maximum Mixer Level are described in the Amplitude section. They are reset by Mode Preset. The External Preamp Gain is reset by the "Restore Input/Output Defaults" or "Restore System Defaults->All functions.

The Swept SA Measurement in SA Mode only supports the “Ext Preamp” function under External Gain. The other External Gain functions are grayed-out, and generate a settings conflict, if the SCPI for them is sent.

See "More Information" on page 2380

Remote Command	`[:SENSe]:CORRection:SA[:RF]:GAIN <rel_ampl>` `[:SENSe]:CORRection:SA[:RF]:GAIN?`

Example	Set the Ext Gain value to 10 dB:
	`:CORR:SA:GAIN 10`
	Set the Ext Gain value to -10 dB (that is, an attenuation of 10 dB):
	`:CORR:SA:GAIN -10`

Notes	Does not auto return This command is new in X-Series
Dependencies	The reference level limits are determined in part by the External Gain/Atten, Max Mixer Level, and RF Atten Grayed-out in Modes that do not support External Gain
Preset	Unaffected by Preset, but set to 0 dB by **Restore Input/Output Defaults** or **Restore System Defaults->All** 0.00 dB, Gain
State Saved	Saved in instrument state
Min	-120 dB
Max	120 dB
Annotation	Displayed in the Meas Bar as "Ext Gain <value>". When the gain is zero, no annotation is shown
Backwards Compatibility SCPI	`[:SENSe]:CORRection:OFFSet[:MAGNitude]` The legacy **Ext Preamp Gain** key is now called **Ext Gain** and the sub-menu has choices of Ext Preamp | MS | BTS for backwards compatibility The MS and BTS choices are unavailable in Swept SA and the Ext Preamp is unavailable in the cell comms measurements

More Information

The U7227A USB Preamplifier is an accessory for the X-Series Signal Analyzer that provides gain externally, and whose gain settings are automatically loaded into the instrument over USB whenever it is connected to one of the instrument’s USB ports.

While the USB Preamplifier is plugged into one of the instrument’s USB ports, the instrument will consider it to be in the signal path of the RF Input and will apply the calibration data from the USB Preamp to measurements taken at the RF Input (on 2 input boxes, it will be considered to be in the signal path of RF Input 1; it is not supported for RF Input 2).

The USB Preamplifier contains its own cal data. This includes a noise trace suitable for use with NFE, for those models which support NFE. The act of connecting the Preamp to USB will cause the cal data to be downloaded from the preamp. When this happens, an informational message is provided saying “Cal data loaded from USB Preamp”. The instrument will then automatically apply the calibration factors loaded from the Preamp in any measurement that supports the USB Preamp.

The External Preamp Gain setting may still be used, even though it is not required for the USB Preamp (since the USB Preamp supplies its own gain data to the instrument which is applied automatically). Connecting the USB Preamp does not change the External Preamp Gain setting, however unless you have another gain or attenuation element in the signal path, the appropriate setting for External Preamp Gain is 0 dB.

Overload detection and reporting will apply when the USB preamplifier is connected to USB. The USB Preamplifier has its own overload detector which reports overloads to the instrument over USB. This generates an error condition, “Input Overload; USB Preamp.”

If, while the USB Preamp is connected to USB, a measurement is selected that does not support the USB preamplifier, the "No result; Meas invalid with Preamp" error condition is generated.

6.3.2 External Gain - MS

Sets an external gain/attenuation value for MS (Mobile Station) tests.

Remote Command	`[:SENSe]:CORRection:MS[:RF]:GAIN <rel_ampl>` `[:SENSe]:CORRection:MS[:RF]:GAIN?`

Example	Set the Ext Gain value to 10 dB:
	`:CORR:MS:GAIN 10`
	Set the Ext Gain value to -10 dB (that is, a loss of 10 dB):
	`:CORR:MS:GAIN -10`

Notes	Does not auto return
Dependencies	The reference level limits are determined in part by the External Gain, Max Mixer Level, RF Atten Grayed-out in modes that do not support MS
Preset	Unaffected by Preset, but set to 0 dB by **Restore Input/Output Defaults** or **Restore System Defaults->All** 0.00 dB, Gain
State Saved	Saved in instrument state

Min	-100 dB
Max	100 dB

Backwards Compatibility SCPI

Example	Set the Ext Gain value to -10 dB, and subsequently querying :LOSS will give 10 dB:
	`:CORR:MS:LOSS 10`
	Set the Ext Gain value to 10 dB. Subsequently querying `:LOSS` will return -10 dB:
	`:CORR:MS:LOSS -10`

Notes	A positive value of `<rel_ampl>` in the above command means a loss and a negative value indicates a gain If `:LOSS` is set, `:GAIN` is set to the negative value of the parameter sent If `:LOSS` is queried, it returns the negative of `:GAIN`
Preset	Unaffected by Preset, but set to 0 dB by **Restore Input/Output Defaults** or **Restore System Defaults->All**
Min/Max	–/+100 dB
Backwards Compatibility SCPI	`[:SENSe]:CORRection:MS[:RF]:LOSS <rel_ampl>` `[:SENSe]:CORRection:MS[:RF]:LOSS?`

6.3.3 External Gain - BTS

Sets an external attenuation value for BTS (Base Transceiver Station) tests.

Remote Command	`[:SENSe]:CORRection:BTS[:RF]:GAIN <rel_ampl>` `[:SENSe]:CORRection:BTS[:RF]:GAIN?`

Example	Set the Ext Gain value to 10 dB:
	`:CORR:BTS:GAIN 10`
	Set the Ext Gain value to -10 dB (that is, a loss of 10 dB):
	`:CORR:BTS:GAIN -10`

Notes	Does not auto return
Dependencies	The reference level limits are determined in part by the External Gain, Max Mixer Level, RF Atten Grayed-out in modes that do not support BTS
Preset	Unaffected by Preset, but set to 0 dB by **Restore Input/Output Defaults** or **Restore System Defaults->All** 0.00 dB, Gain
State Saved	Saved in instrument state
Min	-100 dB
Max	100 dB

Backwards Compatibility SCPI

Example	Set the Ext Gain value to -10 dB, and subsequently querying :LOSS will give 10 dB:
	`:CORR:BTS:LOSS 10`
	Set the Ext Gain value to 10 dB. Subsequently querying `:LOSS` will return -10 dB:
	`:CORR:BTS:LOSS -10`

Notes	A positive value of `<rel_ampl>` in the above command means a loss and a negative value indicates a gain If `:LOSS` is set, `:GAIN` is set to the negative value of the parameter sent If `:LOSS` is queried, it returns the negative of `:GAIN`
Preset	Unaffected by Preset, but set to 0 dB by **Restore Input/Output Defaults** or **Restore System Defaults->All**
Min/Max	–/+100 dB
Backwards Compatibility SCPI	`[:SENSe]:CORRection:BTS[:RF]:LOSS <rel_ampl>` `[:SENSe]:CORRection:BTS[:RF]:LOSS?`

6.3.4 I Ext Gain

Affects the I channel input. However, when Q Gain in I+jQ is set to Same as I Gain, this value is applied to both I and Q channel inputs.

Remote Command	`[:SENSe]:CORRection:IQ:I:GAIN <rel_ampl>` `[:SENSe]:CORRection:IQ:I:GAIN?`

Example	Set the I Ext Gain to 10 dB:
	`:CORR:IQ:I:GAIN 10`
	Set the I Ext Gain to -10 dB (that is, a loss of 10 dB):
	`:CORR:IQ:I:GAIN -10`

Dependencies	Not available unless option BBA is installed Grayed-out when I/Q Path is Q Only
Preset	0 dB Unaffected by Preset, but set to 0 dB by **Restore Input/Output Defaults** or **Restore System Defaults->All**
State Saved	Yes
Min/Max	–/+100 dB
Annotation	Ext Gain: <I Ext Gain> dB No annotation is shown when Input is not I/Q. Also not shown when I Ext Gain is 0.00 dB. I Ext Gain is not shown for Input Path Q Only. When the Input Path is Independent I and Q and I Ext Gain is not the same as Q Ext Gain, both are shown. "Ext Gain: <I Ext Gain> dB, <Q Ext Gain> dB"

6.3.5 Q Ext Gain

Affects the Q channel input.

Remote Command	`[:SENSe]:CORRection:IQ:Q:GAIN <rel_ampl>` `[:SENSe]:CORRection:IQ:Q:GAIN?`

Example	Set the Q Ext Gain to 10 dB:
	`:CORR:IQ:Q:GAIN 10`
	Set the Q Ext Gain to -10 dB (that is, a loss of 10 dB):
	`:CORR:IQ:Q:GAIN -10`

Dependencies	Not available unless option BBA is installed Grayed-out when Q gain in I+jQ is set to Same as I Gain
Preset	0 dB Unaffected by Preset, but set to 0 dB by **Restore Input/Output Defaults** or **Restore System Defaults->All**
State Saved	Saved in instrument state
Min/Max	–/+100 dB
Annotation	Ext Gain: <Q Ext Gain> dB No annotation is shown when Input is not I/Q. Also not shown when Q Ext Gain is 0.00 dB. Q Ext Gain is not shown for Input Path I Only or I+jQ. When Input Path is Independent I and Q and when I and Q Ext Gain are both non-zero but are the same the annotation will be "Ext Gain: <Ext Gain> dB" and when I Ext Gain is not the same as Q Ext Gain, both are shown. "Ext Gain: <I Ext Gain> dB, <Q Ext Gain> dB"

6.3.6 Q Gain in I+jQ

When Same as I Gain (`ON`) is selected, I Ext Gain value is applied to both I and Q channel input if the Input Path is I+jQ.

When Independent (`OFF`) is selected, I and Q Ext Gain values are applied to I and Q channel input independently.

Remote Command	`[:SENSe]:CORRection:IQ:Q:GAIN:COUPle ON | OFF | 0 | 1` `[:SENSe]:CORRection:IQ:Q:GAIN:COUPle?`
Example	`:CORR:IQ:Q:GAIN:COUP ON` `:CORR:IQ:Q:GAIN:COUP?`
Preset	`ON`
State Saved	Yes
Range	Same as I Gain | Independent

6.4 Data Source

Contains controls that let you select the source of the data being fed to the instrument analysis engine.

The ability to Save and Record files of I/Q data is an important feature of some X-Series applications, and the Data Source controls allow you to switch back and forth from actual data at the instrument input and recorded data from a File.

In addition, some measurements allow you to retain a single measurement record in a Capture Buffer, and some measurements allow you to retain a specified length data record internally in a Recorded data area.

So, for measurements that support it, the controls on this tab allow you to select data from the instrument inputs, a recalled recording File, the Capture Buffer, or the Recorded data area. For measurements that do not support these features, the **Data Source** tab does not appear, and if `:FEED:DATA SCPI` is sent, an Undefined Header error is generated.

The available choices depend on which measurement you are running. All measurements support Input; Capture Buffer and File are only available in certain measurements, as shown in the table below. The choice of the internal Recorded data area is only available in Pulse Mode.

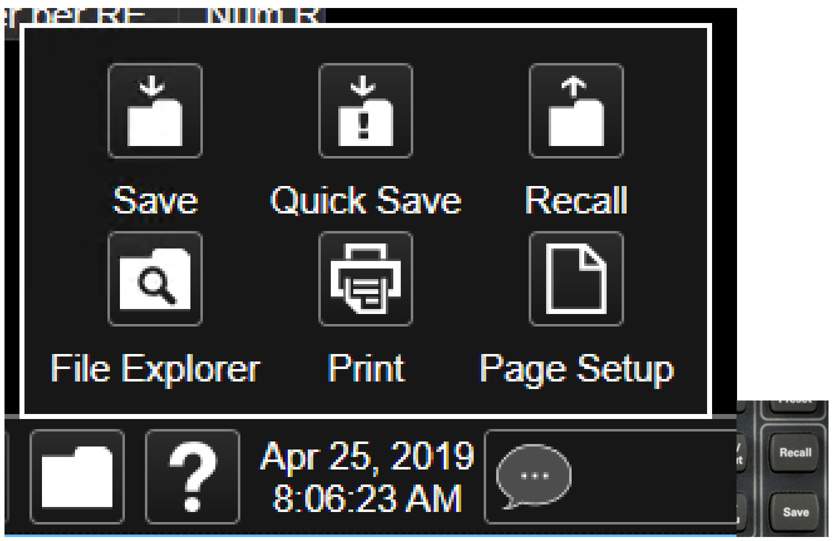
Measurement	Capture Buffer	File
WCDMA Code Domain	x	
WCDMA Mod Accuracy	x	
VMA Digital Demod		x
VMA Custom OFDM		x
5G NR Modulation Analysis		x
FDD LTE-A Modulation Analysis		x
TDD LTE-A Modulation Analysis		x
WLAN Modulation Analysis	x	x
WLAN Spectral Flatness		x
WLAN MIMO Modulation Analysis		x
Analog Demod AM		x
Analog Demod PM		x
Analog Demod FM		x
Analog Demod FM Stereo		x
Bluetooth Transmit Analysis	x	x
IoT & SRComms LoRa CSS Demod		x

How to Record and Playback I/Q Data

In several Demod measurements (and certain other measurements), it is possible to record I/Q data to files on your hard drive or network, and then recall these files for subsequent playback. These are the measurements shown in the table above with an “x” in the **File** column.

The Recording and Playback of signal data files is a multi-step process which involves controls in several menus (listed below).

Menus involved in Record/Playback:

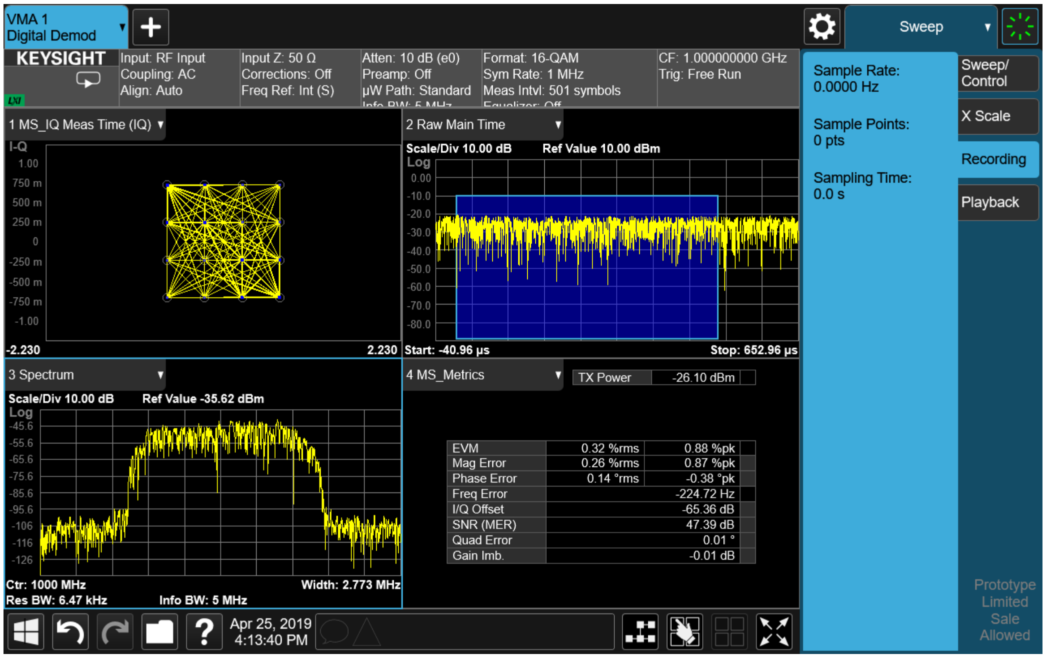


- **Save**, **Recording** (under the **Save** hardkey or the **Save** icon in the **File** panel)
- **Recall**, **Recording** (under the **Recall** hardkey or the **Recall** icon in the **File** panel)
- **Sweep**, **Recording** tab
- **Sweep**, **Playback** tab
- **Input/Output**, **Data Source** tab (this tab)

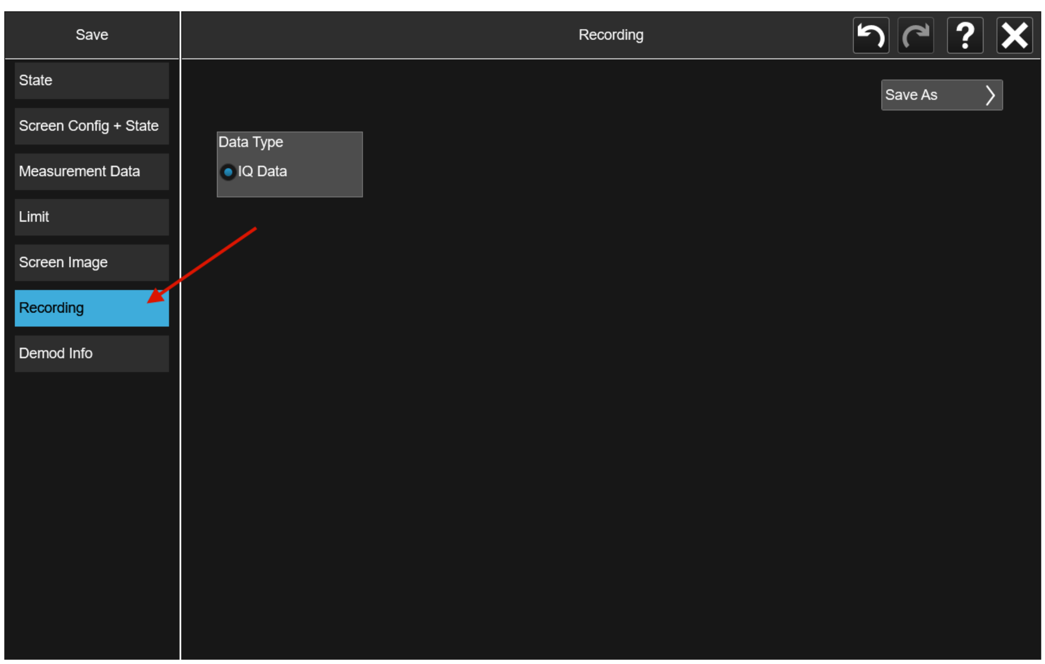
Saving a Recording

When you save a recording, a certain number of measurement records are saved to a Recording file. The amount of data that is saved varies depending on the measurement and measurement settings. The following example uses VMA Digital Demod to illustrate the process.

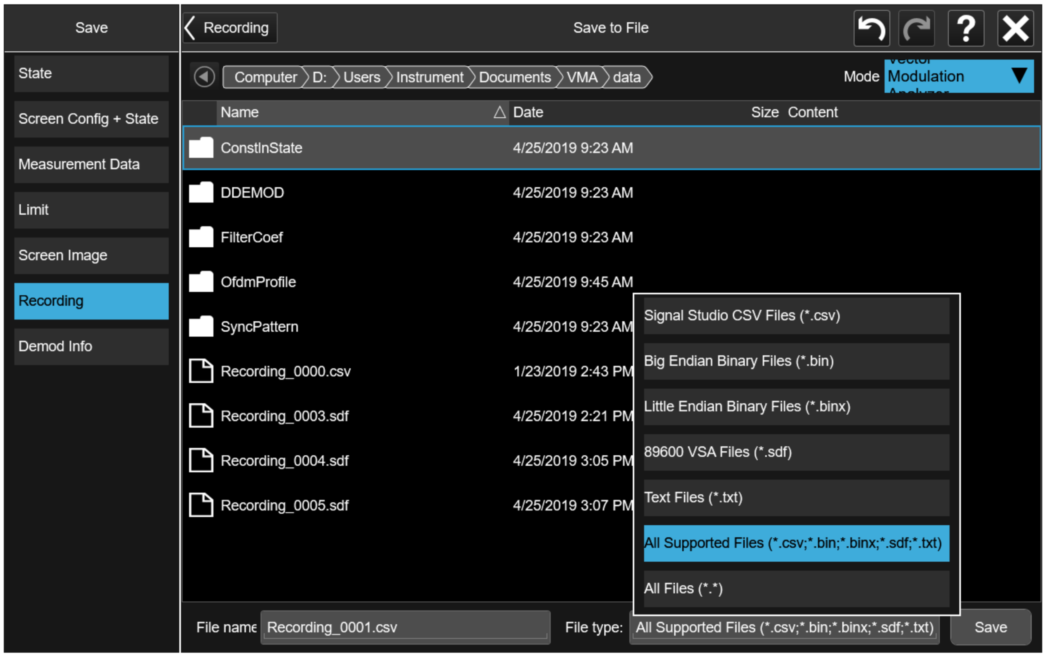
If you press the **Recording** tab in the **Sweep** menu, you will see a certain number of parameters displayed on the menu panel. Before you save a Recording, these parameters are all 0, as shown below:



To save the data for the current measurement, press the **Save** hardkey (or the **Save** icon in the **File** panel) and press the **Recording** tab on the left side of the **Save** panel:

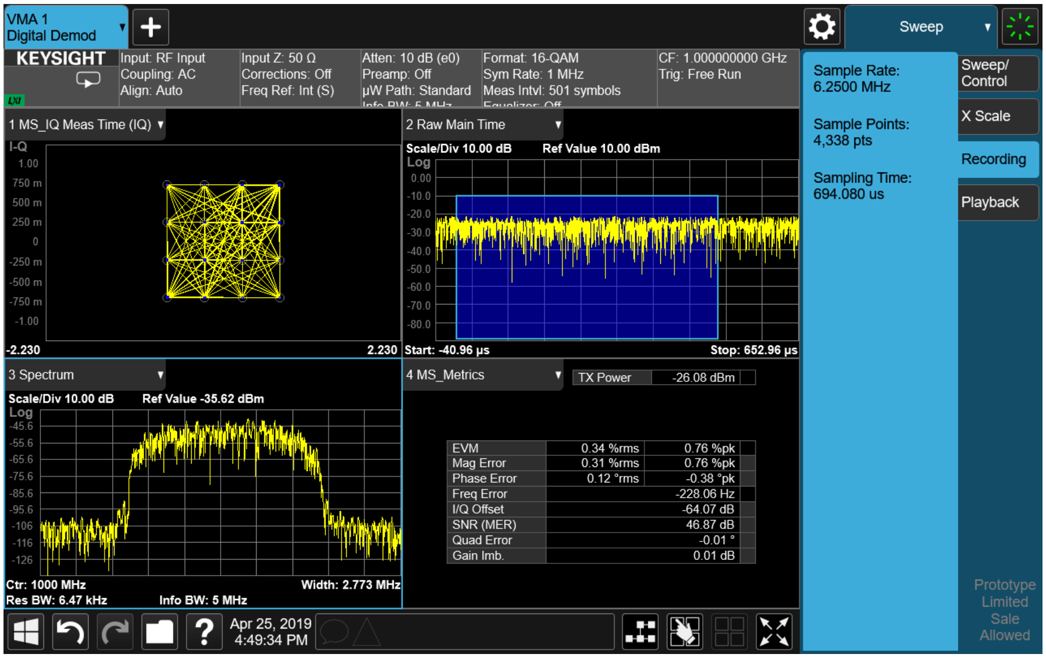


Then press **Save As** and choose the file type you would like to use for the Save (`CSV`, `SDF`, `TXT`, `BIN`, `BINX`). You can find details of the file formats in **Save > Recording**.



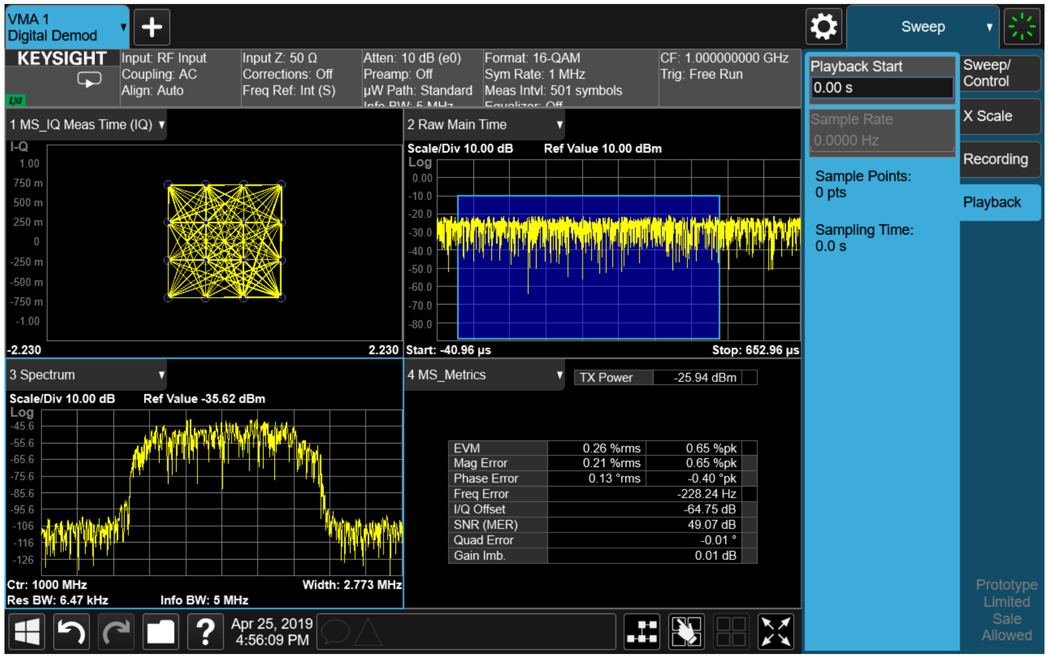
Then press **Save** to save the raw I/Q data of the current measurement.

After the Save, you will see that the data on the Recording panel has changed to describe the data in the file you just saved. You should note this data in case you need to refer to it when you recall the file, particularly as not all file formats include the Sample Rate that was used to save the data. In particular, `BIN` and `BINX` files do not include sampling rate information inside the file, so after recalling one of these file types, you will need to set the Sample Rate manually in the **Sweep**, **Playback** menu.



Step 2: Recalling a Recording

If you press the **Playback** tab in the **Sweep** menu, you will see a certain number of parameters displayed on the menu panel. Before you recall a Recording, these parameters are all 0, as shown below:



To recall a Recording, press the **Recall** hardkey (or the **Recall** icon in the **File** panel) and press the **Recording** tab on the left side of the **Recall** panel. Then press **Recall From** and choose the file you would like to recall. This will read the raw I/Q data from the specified file and feed it to the current measurement.

After the Recall, you will see that the data on the Recording panel has changed to describe the data in the file you just recalled:

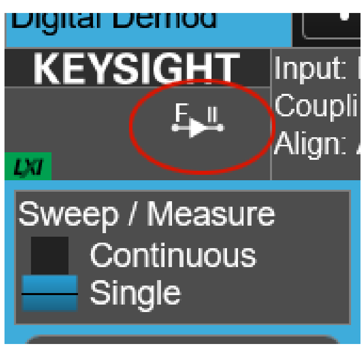
Note that the **Sample Rate** key is grayed out if the file type you loaded contains Sample Rate information. `BIN` and `BINX` files do not include sampling rate information inside the file, so after recalling one of these file types, you will need to set the Sample Rate. You should have noted the Sample Rate that was displayed on the **Sweep**, **Recording** menu panel after you saved the file.

After the recall is performed, you will also see that the **Data Source** control has switched to **File**. You can see this on the **Data Source** menu panel, and also on the dropdown from the Measurement Bar on the far-left side of the instrument:

You can also see that the control indicator on the measurement bar has an “F” in it and the playback symbol (right facing triangle) displayed:

This indicates that the instrument is in **Continuous Playback** mode and is using data from a File.

If you select **Single** in the control dropdown, the indicator will change to show that it is in **Single Pause** mode as below:



You can now examine data in the recorded file which you loaded. How you do this depends on whether you are in **Continuous Playback** mode or **Single Pause** mode.

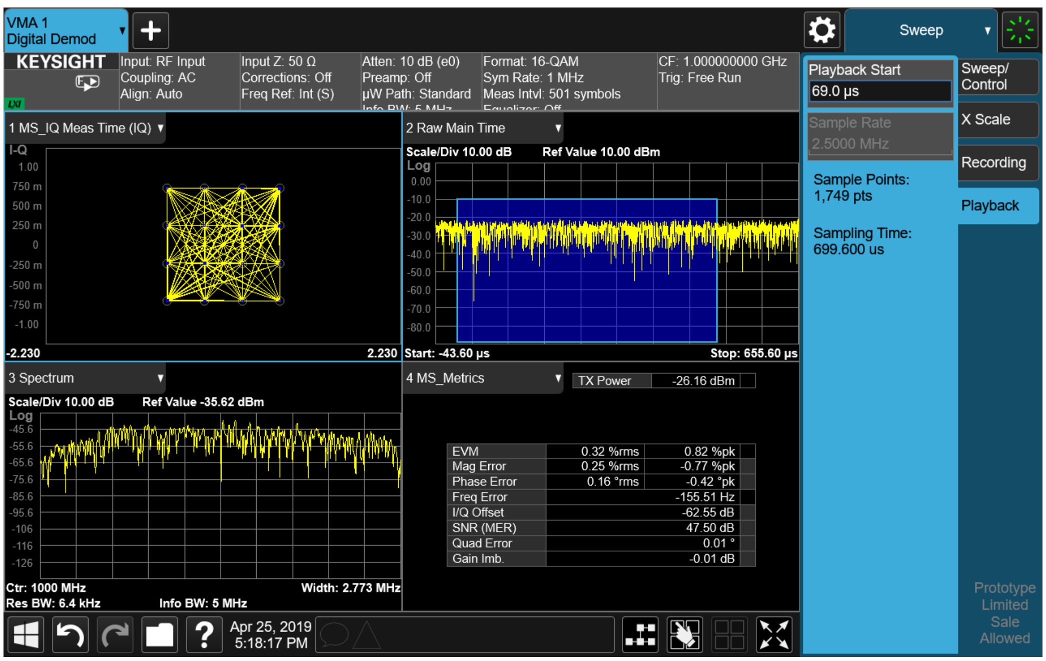
If you wish to return to looking at data at the instrument input, simply change the **Data Source** control from **File** back to **Input**.

Looking at your Recorded data

To examine the data you loaded, go to the **Playback** menu panel under **Sweep**. How you proceed from here depends on whether you are in **Continuous Playback** mode or **Single Pause** mode.

Continuous Playback mode

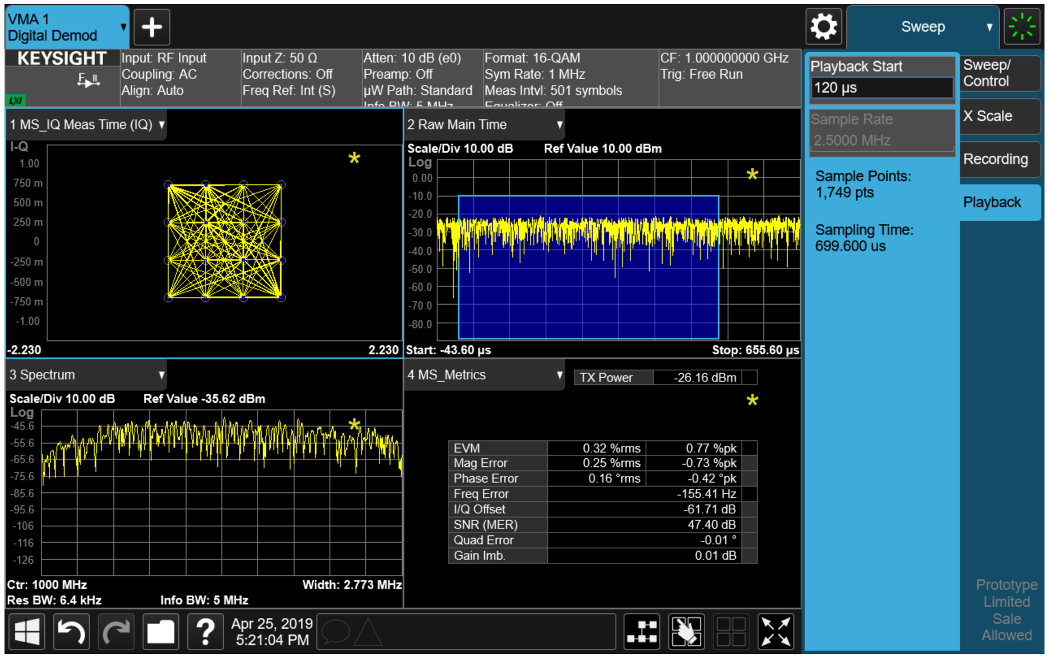
In this mode, turn the knob clockwise or use the **Up** key on the front panel to move through successive records in the recording. You will see the Playback Start control change from 0 to successively higher values as you move through the records.



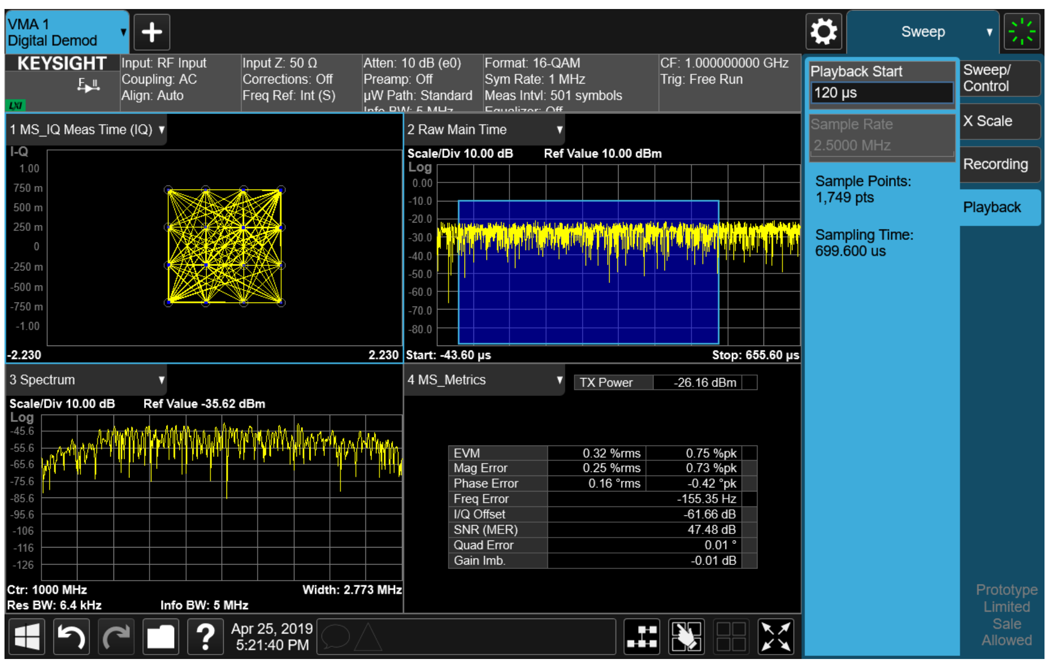
Single Pause mode

In this mode, you can only look at one record. Set the Playback Start time to the desired offset from zero and press **Restart**. A single record will be displayed.

Note that until you press **Restart**, the “invalid data” indicator (yellow asterisk) will be displayed in each window as below:



Once you press **Restart**, the invalid data indicator will disappear, as below:



6.4.1 Data Source

Lets you select the input to the analysis engine. The following options are available:

Input	`INPut`	A hardware input signal (the default). This causes the measurement to take its input data from the hardware input (for example RF, I/Q, or EXTMixer) currently selected on the Input tab under Input/Output
Capture Buffer	`STORed`	Data stored in a storage buffer from a single earlier acquisition. Selecting "Capture Buffer" allows you to use data that has been previously stored using the "Current Meas -> Capture Buffer" control. You can make a measurement and then, if you want to make a different measurement using the exact same data, store the raw data using the "Current Meas -> Capture Buffer" control and select "Capture Buffer" as the Data Source, then switch to the other measurement. You must have previously done a "Current Meas -> Capture Buffer" before the Capture Buffer choice is available for use
Recorded	`RECorded`	Data recorded to memory from a set of earlier acquisitions. Selecting "Recorded" lets you use the record buffer, previously filled by using the "Recording" tab in the Sweep menu, as the input (only available in the Pulse measurement)
File	`FILE`	Data recorded on a storage device from a set of earlier acquisitions. If you load a Recording using Recording under the Recall key, "File" is automatically selected, which lets you use the recorded data as though it were coming from the Input

See "Data Source" on page 2385 for a table of available choices on a per-measurement basis.

Remote Command	`[:SENSe]:FEED:DATA INPut | STORed | RECorded | FILE` `[:SENSe]:FEED:DATA?`

Example	Cause the measurement to look at the input selection:
	`:FEED:DATA INP`
	Cause stored measurement data to be used with a different measurement that supports this:
	`:FEED:DATA STOR`

Dependencies	If you switch to a measurement that does not support the currently selected Data Source, the instrument switches Data Source to "Input". Attempting to select an unavailable Data Source via SCPI generates an error The Data Source setting is independent for each mode. Not all Data Sources are available in all modes
Preset	Unaffected by Preset, but set to `INPut` by **Restore Input/Output Defaults** or **Restore System Defaults->All**
State Saved	Saved in instrument state
Backwards Compatibility SCPI	`[:SENSe]:FEED:SOURce INPut | STORed` `[:SENSe]:FEED:SOURce?`

6.4.2 Current Meas -> Capture Buffer

Stores the raw data of one measurement in the internal memory of the instrument where it can then be used by a different measurement by pressing **Stored Data**. When raw data is stored, then the data source selection switch automatically changes to **Stored Data**. Stored raw data cannot be directly accessed. There is no save/recall function to save the raw data in an external media. If you want to get the stored raw data, you must first perform a measurement using the stored raw data. Now you can access the used raw data, which is the same as stored raw data, using the `:FETch` or `:READ` commands.

Remote Command	`[:SENSe]:FEED:DATA:STORe`
Example	`:FEED:DATA:STOR` stores recorded data
Notes	Command only; no query
Dependencies	Grayed-out in the SA measurement
Backwards Compatibility SCPI	`[:SENSe]:FEED:SOURce:STORe`

6.5 Corrections

Accesses the **Corrections** menu, which lets you select, turn on and off, and configure and edit Corrections. You can also select, turn on and off and configure Complex Corrections and Corrections Groups.

Corrections arrays provide Amplitude Corrections, and can be entered by the user, sent over SCPI, or loaded from a file. They allow you to correct the response of the instrument for various use cases. X-Series supports eight separate Corrections arrays, each of which can contain up to 2000 points. They can be turned on and off individually and any or all can be on at the same time. Corrections Groups let you load several (Amplitude) Corrections at a time into a Correction Group.

Complex Correction arrays provide both Amplitude and Phase Corrections, and can be loaded from a file. Currently the file type supported has the extension .s2p. Complex Corrections operate in much the same manner as Corrections - the X-series supports eight separate Complex Corrections arrays, each of which can contain up to 30000 points, and each Complex Correction can be turned on and off individually and any or all can be on at the same time. Some Modes, such as Spectrum Analyzer Mode, only support only the Amplitude (Magnitude) element of Complex Corrections. Other Modes, such as IQ Analyzer Mode and VMA, support both the Amplitude and Phase elements of Complex Corrections. If a Complex Correction is turned on in a Measurement that does not support Phase, only the Magnitude information will be used for the Correction.

Trace data is in absolute units and corrections data is in relative units. You can edit the Corrections arrays in the Corrections editor using the “Edit Correction” dialog (you cannot edit the Complex Corrections arrays; they can only be loaded from a file).

In zero span measurements (such as Zero Span in the Swept SA measurement), where the frequency is always the center frequency of the instrument, we apply the (interpolated) correction for the center frequency to all points in the trace. In the event where there are two correction amplitudes at the center frequency, we apply the first one in the table.

Note that the corrections are applied as the data is taken; therefore, a trace in **View** (Update Off) will not be affected by changes made to the corrections after the trace is put in **View**.

The **Corrections** tab only appears in Modes and Measurements that support Corrections and/or Complex Corrections. In other Modes, sending SCPI for Corrections and/or Complex Corrections will generate a Settings Conflict message

Corrections and Complex Corrections arrays are not affected by a Preset, because they are in the Input/Output system. They also survive shutdown and restarting of the instrument application, which means they will survive a power cycle. Corrections and Complex Corrections arrays are reset (deleted) by Restore Input/Output Defaults. The following commands delete the correction registers:

- User Preset the current mode `:SYST:PRES:USER`
- User Preset all modes `:SYST:PRES:USER ALL`
- Full mode preset `:SYST:PRES:FULL`
- Restore power on default `:SYST:DEF PON`
- Restore all defaults `:SYST:DEF`; `:SYST:DEF ALL`
- Preset Input/Output variables `:SYST:DEF INP`
- Delete all corrections `:CORR:CSET:ALL:DEL`

The instrument Save State and Save Screen Config + State includes the data in the correction registers. If a measurement setup is saved and then recalled at a later time, the correction data will be recalled as well. This feature is useful for recreating the full instrument condition, but the user has to be careful that the recalled correction data is the desired data. For example, if the state is recalled on a different instrument different correction data might be needed. Or if the system is recalibrated, the correction data in the save state would then be stale. Applications that use measured data for corrections will generally need to reload the correction data from file whenever a state is recalled; this ensures that the correction data is current and applies to hardware in use.

In the EXM and EXF, on the RF Input/Output panel, there are two full-duplex RF ports (RFIO1 and RFIO2), RF Input and RF Output. When RF Input is selected, it will correspond to one input port from two half-duplex RF ports (RFIO3 and RFIO4), and when RF Output is selected, it will correspond to one output port from two half-duplex RF ports (RFIO3 and RFIO4). So, there are 8 sets of corrections in all that can be applied to the RF ports. Ports cannot share the same set of corrections, but a single port can have multiple corrections applied to it. The correction data is applied to incoming signals as well as transmitted signals and is in the form of a list of spot frequencies and amplitude correction levels.

Annotation	In EMI Mode, you can choose to display the correction details in the graph area by turning on Display, Annotation, Correction Annotation

6.5.1 Select Correction

Specifies the selected correction. The term "selected correction" is used throughout this document to specify which correction will be affected by the functions.

Notes	The selected correction is remembered even when not in the correction menu
Preset	Set to Correction 1 by Restore Input/Output Defaults

6.5.2 Correction On/Off

Turning the Selected Correction from `OFF` to `ON` allows the values in it to be applied to the data. This state transition also automatically turns on "Apply Corrections" (sets it to `ON`), otherwise the correction would not take effect.

A new sweep is initiated if an amplitude correction is switched on or off. Note that changing, sending or loading corrections data does *not* directly initiate a sweep, however in general these operations will turn corrections on, which *does* initiate a sweep.

Remote Command	`[:SENSe]:CORRection:CSET[1]|2|…|16[:STATe] ON | OFF | 1 | 0` `[:SENSe]:CORRection:CSET[1]|2|…|16[:STATe]?`
Example	`:SENS:CORR:CSET1 ON`
Dependencies	Changing this from `OFF` to `ON` automatically turns on "Apply Corrections" Note that if any Correction is turned on that has a transducer unit set (other than “None”), the Y-Axis Unit of the instrument is forced to that Transducer Unit. All other Y-Axis Unit choices are grayed-out This command generates an “Option not available” error unless you have the proper option installed in your instrument
Preset	Not affected by Preset. Set to `OFF` by **Restore Input/Output Defaults**
State Saved	Saved in instrument state
Annotation	If *any* Correction is turned on, Corr in the Meas Bar displays in amber to indicate Corrections are in use
Backwards Compatibility Notes	Unlike legacy instruments, Preset does not turn Corrections off (**Restore Input/Output Defaults** does)

6.5.3 Correction Port

Maps one of the sets of corrections to a particular I/O port. This control allows any Input port (including External Mixing, BBIQ, the RF2 input, etc.) to be mapped to a specific Correction, so that the Correction is only applied when that Port is being used by the current Screen. You can also map any internal source Output port to a specific Correction.

When Current Input (CINPut) is selected for **Correction Port**, it chooses the current input port of the current Screen for the selected Correction. In other words, the Correction applies to whichever input is selected. If the input changes, the correction applies to the new input.

When using the VXT M9410A/11A with Remote Radio Heads (such as the Keysight M1740A mmWave Transceiver for 5G), the choices in the dropdown menu appear as :

Head h RFHD p

For example, if you have two Radio Heads (numbered 1 and 2), each of which have two RF half duplex ports, the choices for these ports appear as below:

Head and Port	Choice in dropdown	SCPI parameter
Head 1, port RF Tx/Rx 1	Head 1 RFHD 1	RRH1RFHD1
Head 1, port RF Tx/Rx 2	Head 1 RFHD 2	RRH1RFHD2
Head 2, port RF Tx/Rx 1	Head 2 RFHD 1	RRH2RFHD1
Head 2, port RF Tx/Rx 2	Head 2 RFHD 2	RRH2RFHD2

Remote Command	`[:SENSe]:CORRection:CSET[1]|2|…|16:RF:PORT CINPut	RFIN	RFIN2	AIQ	EMIXer	RFIO1	RFIO2	RFIO3	RFIO4	RFOut	RFHD	RFFD	ANT	GEN	TR	A1	A2	A3	B1	B2	B3	IFIO1	IFIO2	RRHnRFHDp	ERFIN` See "Parameter Options" on page 2400 `[:SENSe]:CORRection:CSET[1]|2|…|16:RF:PORT?`

Example	Set Correction Port for Correction 1 to apply to the currently selected input:
	`:CORR:CSET:RF:PORT CINP`
	Set Correction Port for Correction 4 to apply to Radio Head 1, RF Tx/Rx Port 2:
	`:CORR:CSET4:RF:PORT RRH1RFHD2`

Notes	The RF node in this command is retained for backwards compatibility, even though the scope of the Correction Port command goes beyond the RF ports and includes BBIQ and External Mixing
Dependencies	RFIN2|AIQ|EMIXer are only available on C/E/M/P/UXA analyzers with the appropriate options loaded RFOut is only available on modular products such as VXT ANT, GEN and TR are only available in VXT and only when the M9470A module is installed, such as in the M8920A. Option “HDX” is required to enable the TR port RFHD and RFFD are only available on VXT. Option HDX is required to enable RFHD port and option FDX is required to enable RFFD port RFIO3 and RFIO4 are only available on EXM with hardware M9431A RFIN and RFOut are not available on EXM with hardware M9431A ERFIN requires option “EXW”
Preset	Unaffected by Preset. Set as below by **Restore Input/Output Defaults**: For VXT: RFIN For EXM, EXF: RFIO1 For all other models: CINPut (the currently selected input)
State Saved	Saved in State

Parameter Options

Note that the presence of these ports is highly hardware dependent.

Correction Port	SCPI	Note
Current Input	CINPut	The correction will be applied to whichever input is currently selected in the Input menu
RF Input	RFIN	Main RF Port Not available on EXM with hardware M9431A
RF Input 2	RFIN2	Second RF Port, labeled **RF Input 2** Only available on certain instruments. Not available on modular instruments
BBIQ input	AIQ	Requires option BBA Not available on modular instruments
External Mixer	EMIXer	Requires option EXM Not available on modular instruments
Antenna	ANT	Antenna input port on M9470A, labeled **Ant**
Generator	GEN	Generator output port on M9470A, labeled **Gen**
T/R	TR	T/R port on M9470A, labeled **T/R**
RF Full Duplex	RFFD	On modular instruments, labeled **RFFD**. Option “FDX” is required to enable RFFD port
RF Half Duplex	RFHD	On modular instruments, labeled **RFHD**. Option “HDX” is required to enable RFHD port
A1	A1	On E7760B
A2	A2	On E7760B
A3	A3	On E7760B
B1	B1	On E7760B
B2	B2	On E7760B
B3	B3	On E7760B
IFIO1	IFIO1	On E7760B
IFIO2	IFIO2	On E7760B
RF Output	RFOut	Appears on some modular instruments Not available on EXM with hardware M9431A
RFIO1	RFIO1	Appears on some modular instruments
RFIO2	RFIO2	Appears on some modular instruments
RFIO3	RFIO3	Only available in EXM with hardware M9431A
RFIO4	RFIO4	Only available in EXM with hardware M9431A
GPS out	GPS	Appears on some modular instruments
GNSS out	GNSS	Appears on some modular instruments

6.5.4 Correction Direction

Selects whether corrections will be applied when the device associated with the specified correction is being used as an input, an output or in both directions. The choices are:

INPut	Correct the port only when the port is used as an Input
OUTPut	Correct the port only when the port is used as an Output
BOTH	Correct the port when the port is used as either an Input or an Output (or both)

A port that is only an Output is always corrected as an output if the Correction is On. A port that is only an Input is always corrected as an Input if the Correction is On. For a port that can be either an Input or an Output (or both), the Correction is determined by the Correction Direction setting. The default is BOTH, which means that by default a port that can be either an Input or an Output (or both) is corrected in both directions if the Correction is On.

Remote Command	[:SENSe]:CORRection:CSET[1]|2|…|16:DIRection INPut | OUTPut | BOTH [:SENSe]:CORRection:CSET[1]|2|…|16:DIRection?
Example	:CORR:CSET2:DIR INP
Dependencies	The Correction Direction control only appears when Correction Port selects a port that can either function as an input or an output (or both simultaneously), such as RFIO HD, RFFD or T/R. If the SCPI command is sent to any other port, it is accepted but ignored
Preset	Not affected by a Preset. Set to BOTH by **Restore Input/Output Defaults**
State Saved	Saved in State
Backwards Compatibility SCPI	The following SCPI results in the selection of BOTH (included for compatibility with early Multitouch implementations): [:SENSe]:CORRection:CSET[1]|2|…|8:DIRection BIDirectiona included for compatibility with A-models modular products: [:SENSe]:CORRection:CSET[1]|2|…|8:RF:PORT:RFFD SOURce | ANALyzer | BOTH [:SENSe]:CORRection:CSET[1]|2|…|8:RF:PORT:RFIO1 SOURce | ANALyzer | BOTH [:SENSe]:CORRection:CSET[1]|2|…|8:RF:PORT:RFIO2 SOURce | ANALyzer | BOTH [:SENSe]:CORRection:CSET[1]|2|…|8:RF:PORT:RFIO3 SOURce | ANALyzer | BOTH [:SENSe]:CORRection:CSET[1]|2|…|8:RF:PORT:RFIO4 SOURce | ANALyzer | BOTH

6.5.5 Edit Correction

Invokes the integrated editing facility for this correction set.When entering the menu, the editor window turns on, the selected correction is turned **On**, **Apply Corrections** is set to **On**, the amplitude scale is set to **Log**, and the Amplitude Correction (“Ampcor”) trace is displayed. The actual, interpolated correction trace is shown in green for the selected correction. Note that since the actual interpolated correction is shown, the correction trace may have some curvature to it. This trace represents only the correction currently being edited, rather than the total, accumulated amplitude correction for all amplitude corrections which are currently on, although the total, accumulated correction for all corrections which are turned on is still applied to the data traces.

Because corrections data is always in dB, but the Y-axis of the instrument is in absolute units, it is necessary to establish a reference line for display of the Corrections data. The reference line is halfway up the display and represents 0 dB of correction. It is labeled “0 dB CORREC”. It is drawn in blue. Corrections data is always in dB. Whatever dB value appears in the correction table represents the correction to be applied to that trace at that frequency. So, if a table entry shows 30 dB that means we ADD 30 dB to each trace to correct it before displaying it. By definition all points are connected. If a gap is desired for corrections data, enter 0 dB.

Note that a well-designed Corrections array should start at 0 dB and end at 0 dB. This is because whatever the high-end point is will be extended to the top frequency of the instrument, and whatever the low-end point is will be extended down to 0 Hz. So, for a Corrections array to have no effect outside its range, you should start and end the array at 0 dB.

NOTE **The table editor only operates properly if the instrument is sweeping, because its updates are tied to the sweep system. Thus, you should not try to use the editor in single sweep, and its response will be sluggish during compute-intensive operations like narrow-span FFT sweeps.**

When exiting the edit menu (by using the Return key or by pressing an instrument front-panel key), the editor window turns off and the Ampcor trace is no longer displayed; however, Apply Corrections remains On, any correction that was on while in the editor remains on, and the amplitude scale returns to its previous setting.

Corrections arrays are not affected by a Preset, because they are in the Input/Output system. They also survive shutdown and restarting of the instrument application, which means they will survive a power cycle.

When editing a correction, the editor remembers which correction and which element in the correction array you were editing, and returns you to that correction and that element when you return to the editor after leaving it.

6.5.5.1 Select Correction

Specifies the selected correction. The term "selected correction" is used throughout this document to specify which correction will be affected by the functions.

Notes	The selected correction is remembered even when not in the correction menu
Preset	Set to Correction 1 by Restore Input/Output Defaults

6.5.5.2 Frequency

Touching a frequency value makes the touched row the current row and lets you edit the frequency.

Min	0
Max	1 THz

6.5.5.3 Amplitude

Touching an amplitude value makes the touched row the current row and lets you edit the amplitude.

Min	-1000 dB
Max	1000 dB

6.5.5.4 Go to Row

Lets you move through the table to edit the desired point.

Min	1
Max	2000

6.5.5.5 Insert Row Below

Inserts a point below the current point. The new point is a copy of the current point and becomes the current point. The new point is not yet entered into the underlying table, and the data in the row is displayed in light gray. To enter the row into the table, press the **Enter** key, or tap either value and edit it.

6.5.5.6 Delete Row

Deletes the currently-selected point, whether or not that point is being edited, and selects the Navigate functionality. The point following the currently-selected point (or the point preceding if there is none) will be selected.

6.5.5.7 Scale X Axis

Matches the X-Axis to the selected Correction, as well as possible. Sets the Start and Stop Frequency to contain the minimum and maximum Frequency of the selected Correction. The range between Start Frequency and Stop Frequency is 12.5% above the range between the minimum and maximum Frequency, so that span exceeds this range by one graticule division on either side. If in zero-span, or there is no data in the Ampcor table, or the frequency range represented by the table is zero, no action is taken. Standard clipping rules apply if the value in the table is outside the allowable range for the X-Axis.

Dependencies	If either the first or last point in the array is outside the frequency range of the current input, an error message is generated: "-221. Settings conflict; Start or Stop Freq out of range for current input settings"

6.5.5.8 Delete Correction

Deletes the correction values for this set. When this key is pressed, a prompt appears on the screen saying "Please press **Enter** or **OK** key to delete correction. Press **ESC** or **Cancel** to close this dialog." The deletion is only performed if you press **OK** or **Enter**.

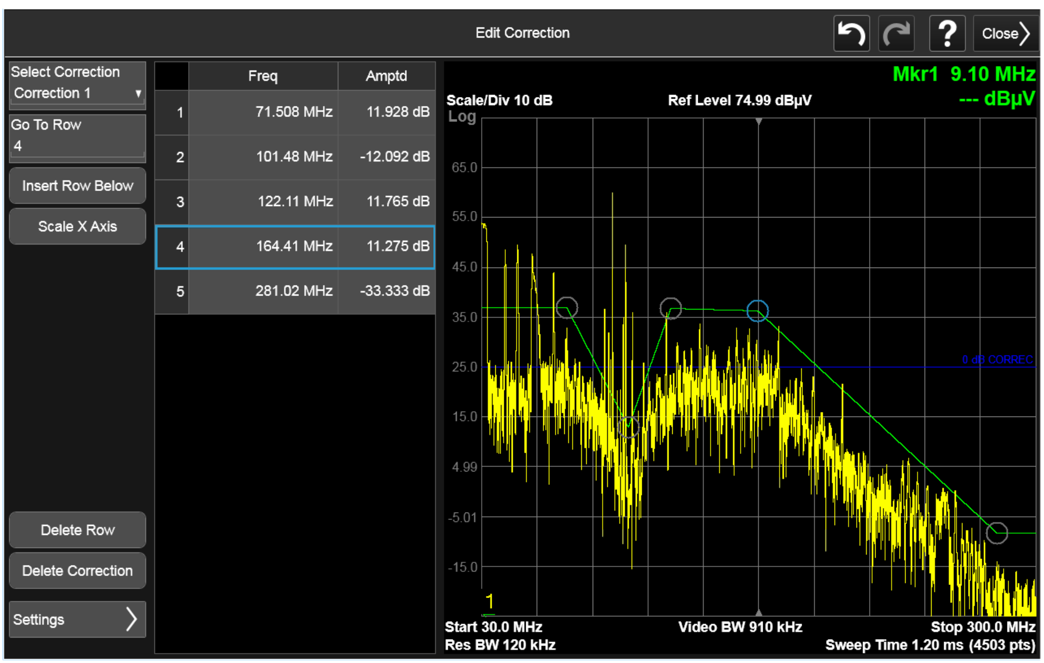
Remote Command	`[:SENSe]:CORRection:CSET[1]|2|…|16:DELete`

Example	`:CORR:CSET:DEL`
	`:CORR:CSET1:DEL`
	`:CORR:CSET4:DEL`

Notes	Pressing this key when no corrections are present is accepted without error

6.5.5.9 Correction Graph

The **Correction Graph** embedded in the Edit Correction dialog lets you edit the Amplitude Correction visually. Each node in the Correction is represented by a gray circle. The current node has a blue outline in the table and a blue circle in the graph. Touch any circle and drag it where you want it to go.



6.5.6 Edit Correction Settings

Opens another menu page that lets you set certain properties of the selected correction, such as Interpolation, Transducer Unit, Description and Comment.

6.5.6.1 Select Correction

Specifies the selected correction. The term "selected correction" is used throughout this document to specify which correction will be affected by the functions.

Notes	The selected correction is remembered even when not in the correction menu
Preset	Set to Correction 1 by Restore Input/Output Defaults

6.5.6.2 Freq Interpolation

Controls how the correction values per-bucket are calculated. We interpolate between frequencies in either the logarithmic or linear scale.

This setting is handled and stored individually per correction set.

VXT models M9410A/11A/15A/16A only support Linear Interpolation. For more details, see "Interpolation" on page 2406

Remote Command	`[:SENSe]:CORRection:CSET[1]|2|…|16:X:SPACing LINear	LOGarithmic` `[:SENSe]:CORRection:CSET[1]|2|…|16:X:SPACing?`
Example	`:CORR:CSET:X:SPAC LIN`
Preset	Unaffected by Preset. Set to Linear by **Restore Input/Output Defaults**
State Saved	Saved in instrument state

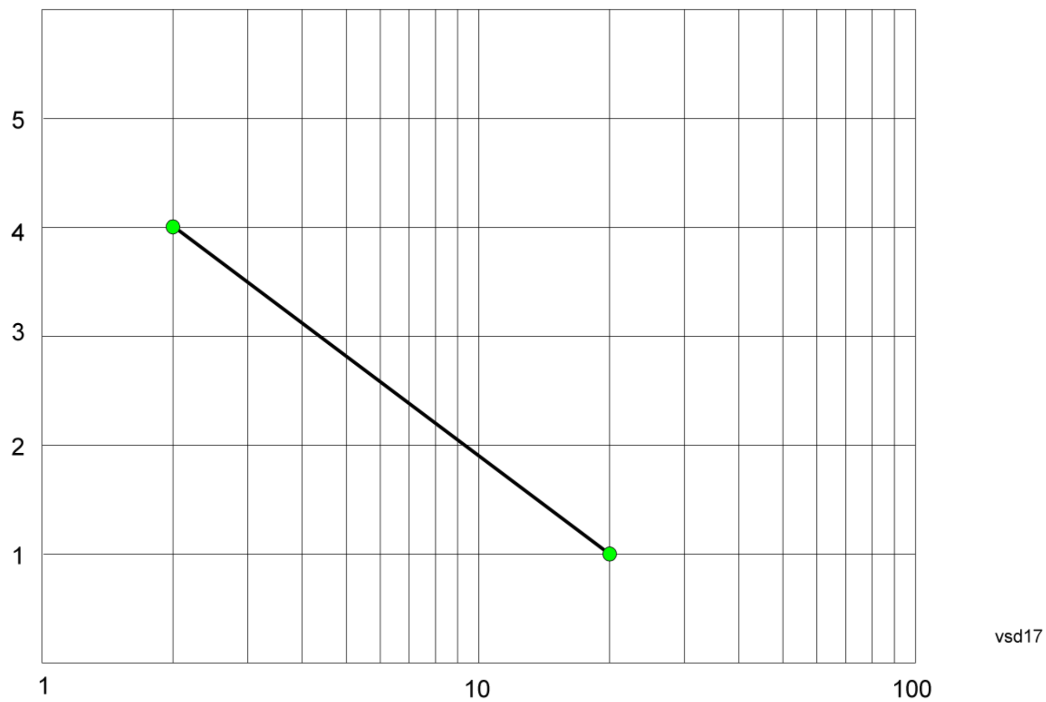
Interpolation

For each bucket processed by the application, all of the correction factors at the frequency of interest (center frequency of each bucket) are summed and added to the amplitude. All trace operations and post processing treat this post-summation value as the true signal to use.

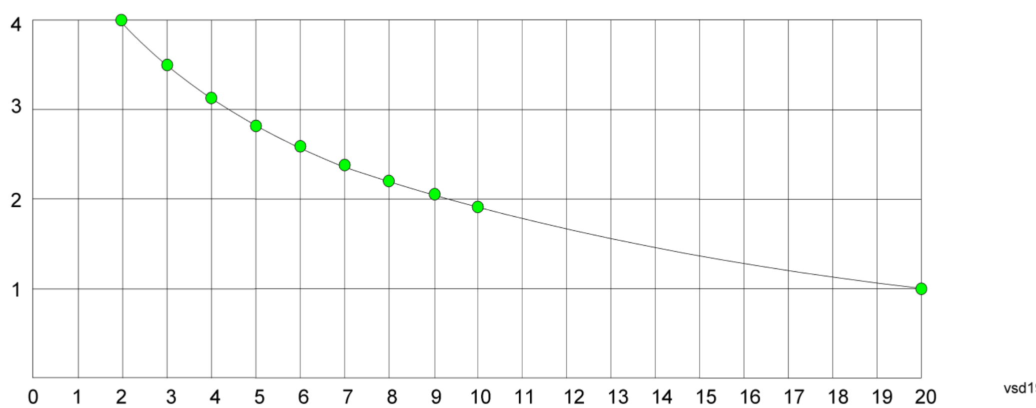
To effect this correction, the goal, for any particular start and stop frequency, is to build a correction trace, whose number of points matches the current Sweep Points setting of the instrument, which will be used to apply corrections on a bucket-by-bucket basis to the data traces.

For amplitudes that lie between two user specified frequency points, we interpolate to determine the amplitude value. You may select either linear or logarithmic interpolation between the frequencies.

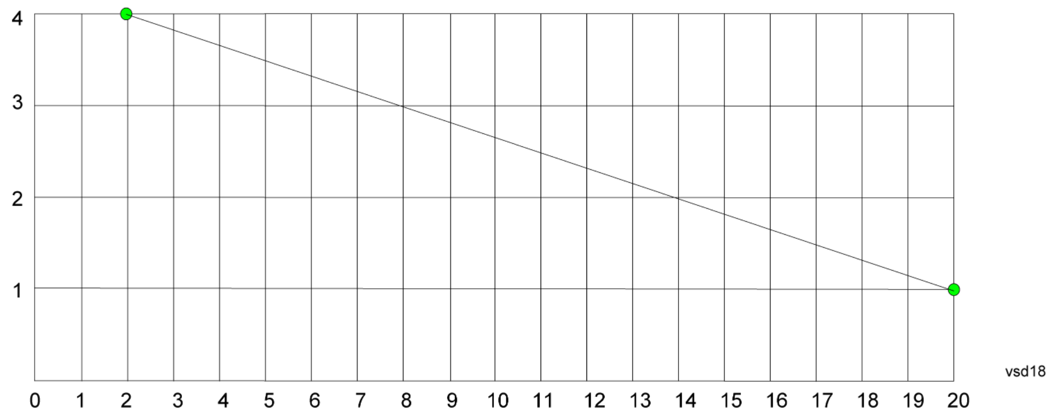
If we interpolate on a log scale, we assume that the line between the two points is a straight line on the log scale. For example, let’s say the two points are (2,4) and (20,1). A straight line between them on a log scale looks like:



On a linear scale (like that of the spectrum analyzer), this translates to:



If we interpolate on a linear scale, we assume that the two points are connected by a straight line on the linear scale, as below:



The correction to be used for each bucket is taken from the interpolated correction curve at the center of the bucket.

6.5.6.3 Transducer Unit

For devices (like antennas) that make measurements of field strength or flux density, the correction array should contain within its values the appropriate conversion factors such that, when the data on the instrument is presented in dBμV, the display is calibrated in the appropriate units. The "Transducer Unit" used for the conversion is contained within the corrections array database. It may be specifiedor loaded in from an external file or SCPI.

When an array with a Transducer Unit other than "None" is turned on, the Y Axis Unit of the instrument is forced to that unit. When this array is turned on, and it contains a Transducer Unit other than “None”, the Y Axis Unit of the instrument is forced to that Transducer Unit., and all other Y Axis Unit choices are grayed out.

Transducer Unit only appears in certain Modes, it does not appear in all Modes that support Corrections.

See "Examples" on page 2409

Remote Command	`[:SENSe]:CORRection:CSET[1]|2|…|16:ANTenna[:UNIT] GAUSs | PTESla | UVM | UAM | UA | NOConversion` `[:SENSe]:CORRection:CSET[1]|2|…|16:ANTenna[:UNIT]?`
Example	`:CORR:CSET:ANT GAUS`
Dependencies	Only one Transducer units can be on at any given time. Note that this means that if a correction file with a Transducer Unit is loaded into a particular Correction, all other Corrections are set to that same Transducer unit When **Normalize** is On (in the **Trace**, **Normalize** menu) Transducer Unit is grayed-out and forced to None
Preset	Unaffected by Preset. Set to NOC by **Restore Input/Output Defaults**
State Saved	Saved in instrument state

Examples

The units that may be specified and what appears in the file and on the screen are shown below:

Transducer Unit	SCPI Example	In the Correction file	On the screen (also Y Axis Unit forced to)
dBµV/m	:CORR:CSET:ANT UVM	Antenna Unit=µV/m	dBµV/m
dBµA/m	:CORR:CSET:ANT UVA	Antenna Unit=µA/m	dBµA/m
dBµA	:CORR:CSET:ANT UA	Antenna Unit=µA	dBµA
dBpT	:CORR:CSET:ANT PTES	Antenna Unit=pTesla	dBpT
dBG	:CORR:CSET:ANT GAUS	Antenna Unit=Gauss	dBG
None	:CORR:CSET:ANT NOC	Antenna Unit= (or no line at all)	none (not forced)

6.5.6.4 Description

Sets an ASCII description field which will be stored in an exported file. Can be displayed in the active function area by selecting as the active function, if desired to appear in a screen capture.

Remote Command	`[:SENSe]:CORRection:CSET[1]|2|…|16:DESCription "text"` `[:SENSe]:CORRection:CSET[1]|2|…|16:DESCription?`
Example	`:CORR:CSET1:DESC "11941A Antenna correction"`
Notes	45 chars max; may not fit on display if max chars used
Preset	Unaffected by a Preset. Set to empty by Restore Input/Output Defaults
State Saved	Saved in instrument state

6.5.6.5 Comment

Sets an ASCII comment field which will be stored in an exported file. Can be displayed in the active function area by selecting as the active function, if desired to appear in a screen capture.

Remote Command	`[:SENSe]:CORRection:CSET[1]|2|…|16:COMMent "text"` `[:SENSe]:CORRection:CSET[1]|2|…|16:COMMent?`

Example	`:CORR:CSET1:COMM "this is a comment"`
Notes	60 chars max; may not fit on display if max chars used
Preset	Unaffected by Preset. Set to empty by **Restore Input/Output Defaults**
State Saved	Saved in instrument state

6.5.7 Complex Corrections

This dialog is used to set up and display information about the **Complex Corrections** set. It also lets you view and edit certain information such as the Description and Comment for the selected Complex Correction.

Complex Corrections (loaded from `.s2p` files) support both magnitude and phase corrections, whereas standard corrections (loaded from standard Ampcor `.csv` files) support only magnitude corrections.

When loading an `.s2p` file, the component representing S21 is the one that is used to generate the complex correction. If no S21 component is present, a Mass Storage error is reported.

NOTE

Data types RI, MA, and DB are supported.

The phase components of the S2P file are taken to be in degrees, not in radians. You must provide the phase correction in degrees.

Unlike Correction files, S2P files describe device characteristics, rather than the correction required to compensate for those characteristics; so, when an S2P file is loaded, both the magnitude and phase are negated to turn it into a correction

Complex Corrections and standard corrections can be turned on at the same time. For example, you could turn on Correction 2, Correction 4, and Complex Correction 1 and 2, all at the same time. The magnitude part of all the corrections would add, and the phase part of the complex corrections would add.

You can have up to 64 Complex Corrections loaded simultaneously. Each Complex Correction can hold up to 30,000 points.

You can load a standard correction into Complex Corrections, but it will only provide a magnitude correction, not a phase correction.

NOTE

A standard correction (from a CSV file) can be loaded into a Complex Correction, but when it is loaded the Phase correction is set to 0 for all points.

Some measurements, like Swept SA, have no phase component to the measurement, but nonetheless support Complex Corrections. For such measurements, only the Magnitude part of the Complex Correction is applied.

6.5.7.1 Go To Row (Select Correction)

Specifies the selected complex correction. The selected correction will be identified by the blue outlined row in the dialog.

The "selected complex correction" is an important concept when sending SCPI commands to the Complex Corrections system, because in each case the SCPI command is directed to the currently selected Complex Correction and that will be the Correction which is modified by the SCPI command.

Remote Command	`[:SENSe]:CCORrection:CSET:SELect <integer>` `[:SENSe]:CCORrection:CSET:SELect?`
Example	`:CCOR:CSET:SEL 3` `:CCOR:CSET:SEL?`
Notes	The selected correction is remembered even when not in the correction menu
Preset	Set to Correction 1 by Restore Input/Output Defaults
Min	1
Max	64

6.5.7.2 Delete Row

Deletes the currently-selected Complex Correction and clears all entries in that row to the default.

Remote Command	`[:SENSe]:CCORrection:CSET:DELete`

Example	Select correction 3:
	`:CCOR:CSET:SEL 3`
	Delete correction 3:
	`:CCOR:CSET:DEL`

6.5.7.3 Delete All

Deletes all complex corrections and clears all entries in all rows to the default.

When this key is pressed a prompt is placed on the screen that says “Please press Enter or OK key to delete all complex corrections. Press ESC or Cancel to close this dialog.” The deletion is only performed if you press **OK** or **Enter**.

Remote Command	`[:SENSe]:CCORrection:CSET:ALL:DELete`
Example	`:CCOR:CSET:ALL:DEL`

6.5.7.4 Correction On

Checking or unchecking this box turns the Selected Complex Correction ON or OFF. Turning it ON causes the values in it to be applied to the data. This state transition also automatically turns on "Apply Corrections" (sets it to ON), otherwise the correction would not take effect.

A new sweep/acquisition is initiated if a complex correction is switched on or off. Note that changing, sending or loading corrections data does *not* directly initiate a sweep, however in general these operations will turn corrections on, which *does* initiate a sweep.

Remote Command	`[:SENSe]:CCORrection:CSET[:STATe] ON | OFF | 1 | 0` `[:SENSe]:CCORrection:CSET[:STATe]?`

Example	Select correction 3:
	`:CCOR:CSET:SEL 3`
	Turn correction 3 on:
	`:CCOR:CSET ON`

Dependencies	Changing this from OFF to ON automatically turns on "Apply Corrections" Grayed-out if Complex Corrections is not supported by the current measurement. A warning or SCPI error is generated if you try to turn it on under these circumstances: “Feature not supported for this measurement”
Preset	Not affected by Preset. Set to OFF by **Restore Input/Output Defaults**
State Saved	Saved in instrument state
Annotation	If *any* Complex Correction is turned on, CC in the Meas Bar will display in amber to indicate Complex Corrections are in use

6.5.7.5 Correction Port

Maps one of the sets of corrections to a particular I/O port. This control allows any Input port (including External Mixing, BBIQ, the RF2 input, etc.) to be mapped to a specific Correction, so that the Correction is only applied when that Port is being used by the current Screen. You can also map any internal source Output port to a specific Correction.

When Current Input (CINPut) is selected for **Correction Port**, it chooses the current input port of the current Screen for the selected Correction. In other words, the Correction applies to whichever input is selected. If the input changes, the correction applies to the new input.

When using the VXT M9410A/11A with Remote Radio Heads (such as the Keysight M1740A mmWave Transceiver for 5G), the choices in the dropdown menu will appear as

Head h RFHD p

For example, if you have two Radio Heads (numbered 1 and 2), each of which have two RF half duplex ports, the choices for these ports will appear as below:

Head and Port	Choice in dropdown	SCPI parameter
Head 1, port RF Tx/Rx 1	Head 1 RFHD 1	RRH1RFHD1
Head 1, port RF Tx/Rx 2	Head 1 RFHD 2	RRH1RFHD2
Head 2, port RF Tx/Rx 1	Head 2 RFHD 1	RRH2RFHD1
Head 2, port RF Tx/Rx 2	Head 2 RFHD 2	RRH2RFHD2

See also the parameters, notes and examples table under "Correction Port" on page 2399.

Remote Command	`[:SENSe]:CCORrection:CSET:PORT CINPut	RFIN	RFIN2	AIQ	EMIXer	RFOut	RFIO1	RFIO2	RFIO3	RFIO4	RFHD	RFFD	ANT	GEN	TR	A1	A2	A3	B1	B2	B3	IFIO1	IFIO2	RRHnRFHD	ERFIN` `[:SENSe]:CCORrection:CSET:PORT?`

Example	Select correction 2:
	`:CCOR:CSET:SEL 2`
	Set correction 2 to RFIN:
	`:CCOR:CSET:PORT RFIN`
	Set Correction 2 to Radio Head 1, RF Tx/Rx Port 2:
	`:CCOR:CSET:PORT RRH1RFHD2`

Dependencies	`RFIN2|AIQ|EMIXer` are only available on C/E/M/P/UXA analyzers with the appropriate options loaded `RFOut` is only available on modular products such as VXT `ANT`, `GEN` and `TR` are only available in VXT and only when the M9470A module is installed, such as in the M8920A. Option "HDX" is required to enable the TR port `RFHD` and `RFFD` are only available on VXT. Option HDX is required to enable RFHD port and Option FDX is required to enable RFFD port `RFIO3` and `RFIO4` are only available on EXM with hardware M9431A `RFIN` and `RFOut` are not available on EXM with hardware M9431A `ERFIN` requires option "EXW"
Preset	Not affected by Preset. Set to `CINPut` by **Restore Input/Output Defaults**
State Saved	Saved in State

6.5.7.6 Direction

Selects whether corrections will be applied when the device associated with the specified correction is being used as an input, an output or in both directions. The choices are:

`INPut`	Correct the port only when the port is used as an Input

OUTPut	Correct the port only when the port is used as an Output
BOTH	Correct the port when the port is used as either an Input or an Output (or both)

Remote Command	`[:SENSe]:CCORrection:CSET:DIRection INPut | OUTPut | BOTH` `[:SENSe]:CCORrection:CSET:DIRection?`

Example	Firstly, select correction 4:
	`:CCOR:CSET:SEL 4`
	Set correction 4 to Input:
	`:CCOR:CSET:DIR INP`

Dependencies	For Inputs, the only choice is `INPut`, so an empty table cell is displayed. For Outputs, the only choice is `OUTPut`, so an empty table cell is displayed. If the SCPI command is sent while one of these ports is selected, it is accepted but ignored For a port that can be either an Input or an Output (or both), such as RFHD, RFFD or T/R, all three choices are available
Preset	Not affected by Preset. Set to `BOTH` by **Restore Input/Output Defaults**
State Saved	Saved in State
Backwards Compatibility SCPI	The following SCPI will result in the selection of `BOTH` (included for compatibility with early Multitouch implementations): `[:SENSe]:CCORrection:CSET:DIRection BIDirectiona`

6.5.7.7 Description

Shows the Description field for the selected Complex Correction. The Description field is loaded from the second line of the `.s2p` file. (Note that, if line 2 begins with "!", the ! is not displayed in the Description field.)

Remote Command	`[:SENSe]:CCORrection:CSET:DESCription "text"` `[:SENSe]:CCORrection:CSET:DESCription?`

Example	Firstly, select correction 4:
	`:CCOR:CSET:SEL 4`
	`:CCOR:CSET:DESC "PNA data import 1-1-18"`

Notes	45 chars max; may not fit on display if max chars used
Preset	Unaffected by Preset. Set to empty by **Restore Input/Output Defaults**
State Saved	Saved in instrument state

6.5.7.8 Comment

Shows the Comment field for the selected Complex Correction. The Comment field is loaded from the third line of the `.s2p` file. (Note that, if line 3 begins with "!", the ! is not displayed in the Comment field.)

Remote Command	`[:SENSe]:CCORection:CSET:COMMent "text"` `[:SENSe]:CCORection:CSET:COMMent?`

Example	Firstly, select correction 4:
	`:CCOR:CSET:SEL 4`
	`:CCOR:CSET:COMM "this is a comment"`

Notes	60 chars max; may not fit on display if max chars used
Preset	Unaffected by Preset. Set to empty by **Restore Input/Output Defaults**
State Saved	Saved in instrument state

6.5.7.9 File

Shows the file from which the selected correction was loaded. If correction was loaded with a SCPI command (see "Set Data (Remote Command Only)" on page 2416) displays “(SCPI)”. If no correction is loaded, displays “(No correction loaded)”

Notes	60 chars max; may not fit on display if max chars used
State Saved	Saved in instrument state

6.5.7.10 Freq Interpolation (Remote Command Only)

Controls how the correction values per-bucket are calculated. We interpolate between frequencies in either the logarithmic or linear scale.

This setting is handled and stored individually per correction set.

VXT models M9410A/11A/15A/16A and M9410E/11E/15E/16E only support Linear Interpolation.

See "Interpolation" on page 2406 under Corrections.

Remote Command	`[:SENSe]:CCORrection:CSET:X:SPACing LINear | LOGarithmic` `[:SENSe]:CCORrection:CSET:X:SPACing?`

Example	Firstly, select correction 4:
	`:CCOR:CSET:SEL 4`
	Set linear interpolation:
	`:CCOR:CSET:X:SPAC LIN`

Preset	Unaffected by Preset. Set to `LINear` by **Restore Input/Output Defaults**
State Saved	Saved in instrument state

6.5.7.11 Set Data (Remote Command Only)

Lets you set the magnitude part of a complex correction’s data via a SCPI command. This is provided for compatibility with the similar command for standard corrections, to allow you to use Complex Corrections as an extension to standard corrections.

Sending this command sets the phase part of the selected correction to 0 for all points.

The command takes an ASCII series of alternating frequency and amplitude points, each value separated by commas.

The values sent in the command will totally replace all existing correction points in the specified set.

A Complex Correction array can contain 30000 points maximum.

Remote Command	`[:SENSe]:CCORrection:CSET:DATA <freq>, <ampl>, ...` `[:SENSe]:CCORrection:DATA?`

Example	Firstly, select correction 4:
	`:CCOR:CSET:SEL 4`
	This defines two correction points at (10 MHz, -1.0 dB) and (20 MHz, 1.0 dB) for correction set 4:
	`:CCOR:CSET:DATA 10000000,-1.0,20000000,1.0`

Preset	Empty after **Restore Input/Output Defaults**. Survives a shutdown or restart of instrument application (including a power cycle)
State Saved	Saved in instrument state
Min/Max	

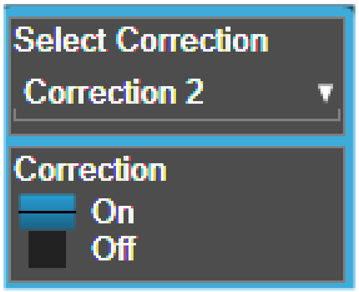
	Min	Max
Freq	0 Hz	1 THz
Amptd	-1000 dBm	+1000 dBm

6.5.8 Apply Corrections

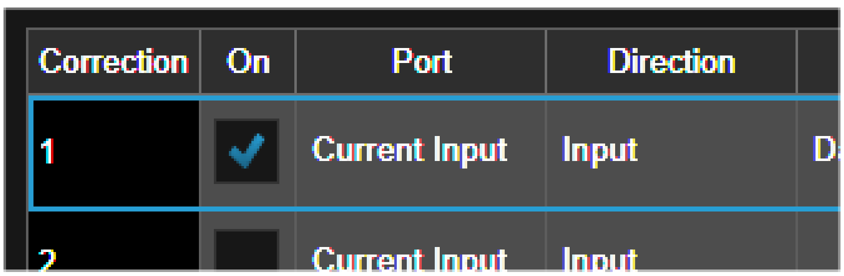
When you turn on Apply Corrections, all of the Corrections that are turned On are applied to the measured data. When you turn off Apply Corrections, no Corrections are applied, even if they are turned On.

With this switch you can turn the entire Corrections system on and off without affecting the settings of any individual Corrections. Turning Apply Corrections On and Off has no effect on the On/Off switches under the individual Corrections.

Apply Corrections affects both normal Corrections and Complex Corrections. Normal Corrections are turned On and Off using the Correction switch under Select Correction:



Complex Corrections are turned On and Off using the checkboxes in the Complex Corrections dialog:



See "Correction On/Off" on page 2399) and "Complex Corrections" on page 2410.

Remote Command	`[:SENSe]:CORRection:CSET:ALL[:STATe] ON | OFF | 1 | 0` `[:SENSe]:CORRection:CSET:ALL[:STATe]?`
Example	`:SENS:CORR:CSET:ALL OFF` This command makes sure that no amplitude corrections are applied, regardless of their individual on/off settings
Couplings	Whenever you turn on any Correction or Complex Correction, **Apply Corrections** is automatically set to ON
Preset	Not affected by Preset. Set to OFF by **Restore Input/Output Defaults**
State Saved	Saved in instrument state
Annunciation	When ON, 'CORREC' appears in the Meas Bar as long as at least one of the individual corrections is enabled

6.5.9 Delete All Corrections

Erases all correction values for all Amplitude Correction sets and Complex Corrections.

When this key is pressed a prompt is placed on the screen that says “Please press Enter or OK key to delete all corrections. Press ESC or Cancel to close this dialog.” The deletion is only performed if you press **OK** or **Enter**.

Remote Command	`[:SENSe]:CORRection:CSET:ALL:DELete`
Example	`:CORR:CSET:ALL:DEL`

6.5.10 Correction Group On/Off

Turns the Correction Group on and off. The Correction Group allow you to preload Correction files and associate them with specific frequency ranges, so that they can be switched in and out during a sweep at the appropriate frequencies. Use the control “Edit Correction Group” below to set up your Correction Group.

The state of each Correction will be set dynamically depending on the active measurement frequency. Only the correction selected for the range that matches the active measurement frequency will be turned on, and vice versa.

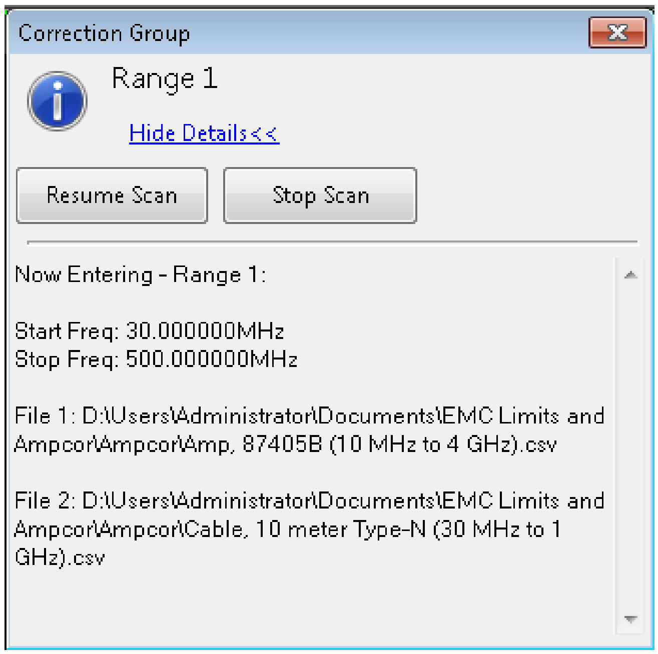
Note that the Corrections in the Correction Group, although they are loaded into memory, are independent of the main Correction registers at the top of the Corrections menu, and will not display under the Select Correction, Correction On/Off or Edit Correction functions.

Remote Command	`[:SENSe]:CORRection:CSET:GROup[:STATe] ON | OFF | 1 | 0` `[:SENSe]:CORRection:CSET:GROup[:STATe]?`
Example	`:SENS:CORR:CSET:GRO ON`
Dependencies	Correction group is supported in EMI Receiver Mode, and in Spectrum Analyzer Mode if option EMC or EMI Receiver Mode is present. If you switch to other measurements or modes, correction group is turned off and the Correction Group functions are not visible
Couplings	When on, Correction 1 through 8 is set to `OFF` and the correction on/off state keys are grayed out. If the grayed-out key is pressed, it generates an advisory message. If sending the SCPI to turn it on, this same message is generated as part of Settings conflict
Preset	Not affected by Preset. Set to `OFF` by **Restore Input/Output Defaults**
State Saved	Saved in instrument state

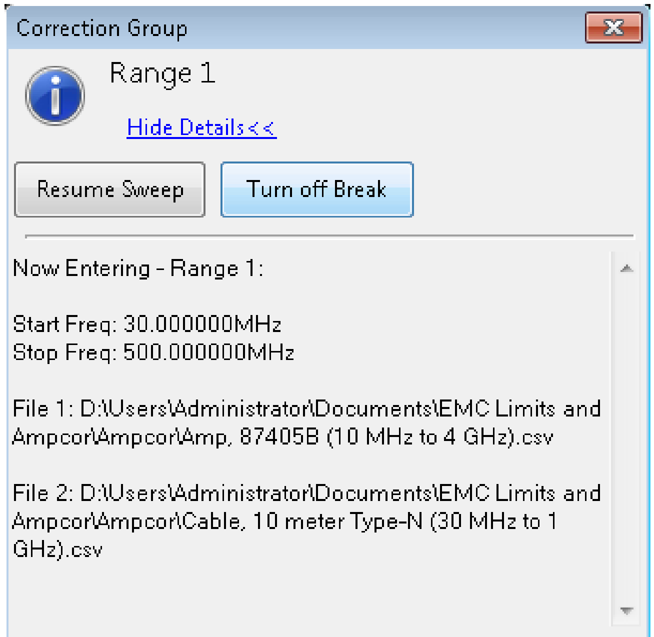
6.5.11 Break

If break is turned on, the scan or sweep will be paused when it reaches the boundary of correction group ranges. At the same time, a window at the size of ~ 6.5cm x 3.5 cm is prompt at the upper right-hand corner of the graticule.

When running Frequency Scan measurement of Emi Receiver application, the message prompt is like below. You are given the option to resume the scan or stop the scan.



When running the Swept SA measurement in Spectrum Analyzer Mode, the message prompt is as below. You are given the option to resume the sweep or turn off the break. If in Continuous sweep, the sweep will resume after the break is turned off.



Remote Command	`[:SENSe]:CORRection:CSET:GROup:BReak ON | OFF | 1 | 0` `[:SENSe]:CORRection:CSET:GROup:BReak?`
Example	`:SENS:CORR:CSET:GRO:BR ON`

Notes	When running the Frequency Scan measurement in EMI Receiver Mode, if break is turned on when a SCPI is sent to start the scan, the scan pauses when it reaches the boundary of correction group ranges. Bit 8 (Paused) of status operation register is set to true. To resume, send `:INITiate2:RESume`. To stop the scan, send `:ABORt`
	When running the Swept SA measurement in Spectrum Analyzer Mode, the break state does not affect the operation of sweep when SCPI to control the sweep is sent. Instead, the SCPI commands close the message prompt if it is showing at the point the commands are sent, and the break is turned off. The SCPI includes:
	`:INITitate:IMMEdiate`
	`:INITitate:RESTart`
	`:INITitate:CONTinuous ON | OFF | 1 | 0`
	`:ABORt`

Dependencies	Correction group is supported in EMI Receiver Mode, and in Spectrum Analyzer Mode if option EMC or EMI Receiver mode is present. If you switch to other measurements or modes, correction group is turned off and the Correction Group functions (like Break) are not visible
Preset	Not affected by Preset. Set to `OFF` by **Restore Input/Output Defaults**
State Saved	Saved in instrument state

6.5.12 Reload Corrections From Files

Because the Correction data for the Correction Group is loaded into memory from Correction files at the time the Group is defined, it will be necessary to reload some or all of the data if any of the files changes. This function reloads all of the correction data from all of the correction files defined in all of the ranges in the Correction Group.

Remote Command	`[:SENSe]:CORRection:CSET:GROup:RELoad`
Example	`:MMEM:STOR:CORR:GRO:REL`
Notes	If invalid data is found in the files, the correction group will be set to off, and an Execution error is generated. Error icon appears on the status column correction group table
Dependencies	Correction group is supported in EMI Receiver Mode, and in Spectrum Analyzer mode if option EMC or EMI Receiver Mode is present. If you switch to other measurements or modes, correction group is turned off and the Correction Group functions (like Reload Correction From File) are not visible
Annotation	If reload fails, error icons appear in the status column of correction group editor for the range that has the error

6.5.13 Edit Correction Group

Opens the Table Editor for the correction group. The content of correction group table including the correction data loaded from the files is not affected by Preset, and it survives power cycle. You can set it to empty with **Restore Input/Output Defaults**.

Dependencies	Correction group is supported in EMI Receiver Mode, and in Spectrum Analyzer Mode if option EMC or EMI Receiver Mode is present. If you switch to other measurements or modes, correction group is turned off and the Correction Group functions (like Edit Correction Group) are not visible

6.5.13.1 Go to Row

Lets you move through the table to edit the desired point.

Min	1
Max	2000

6.5.13.2 Insert Row Below

Inserts a point below the current point. The new point starts from the current range stop frequency and becomes the current point. The new point is not yet entered into the underlying table, and the data in the row is displayed in light gray.

6.5.13.3 Delete Row

Deletes the currently-selected point, whether or not that point is being edited, and selects the Navigate functionality. The point following the currently-selected point (or the point preceding if there is none) will be selected.

6.5.13.4 Select File

Indicate the correction files in which the specify file and remove file operations will take effect.

Preset	Unaffected by a Preset. Set to empty by **Restore Input/Output Defaults**

6.5.13.5 Specify File

Displays the file browsing menu. When a file is selected, correction data will be loaded from the file. The correction data remains until the file is removed or the range is deleted.

Notes	If the file is empty, error -250 is reported. If the file does not exist error -256 is reported. If there is a mismatch of data type, error -250 is reported Only one file with antenna unit can be supported per range. If you try to add another file which contains an antenna unit, a Mass Storage error is generated All ranges have to use a common antenna unit. If you try to add a correction file that contains a different antenna unit, a Mass Storage error is generated If you try to add a correction file that contains data that does not cover the range frequency, the file cannot be added, and an Execution error is generated

6.5.13.6 Remove File

Removes the selected file. When a file is removed, correction data for that file will be removed as well.

Dependencies	The key is grayed-out if there the file has not been specified. If the grayed-out key is pressed, an advisory message is generated

6.5.13.7 Correction Trace Display

Enables you to view the correction traces of all corrections that are added to the range currently selected. A 2-column table in the function of frequency and the accumulated amplitude correction is displayed at the left pane.

Preset	OFF
State Saved	Saved in instrument state

6.5.13.8 Description

Provides a description of up to 60 characters by which you can easily identify the correction group. The descriptions will be stored in the exported file and can be displayed in the active function area by selecting them as the active function, if desired to be in a saved screen dump.

Remote Command	`[:SENSe]:CORRection:CSET:GROup:DESCription "text"` `[:SENSe]:CORRection:CSET:GROup:DESCription?`
Example	`:CORR:CSET:GRO:DESC "Radiated Setup"`
Notes	60 chars max; may not fit on display if max chars used
Preset	Unaffected by Preset. Set to empty by **Restore Input/Output Defaults**
State Saved	Saved in instrument state

6.5.13.9 Comment

Provides a comment of up to 60 characters by which you can easily identify the correction group. The comments will be stored in the exported file and can be displayed in the active function area by selecting them as the active function, if desired to be in a saved screen dump.

Remote Command	`[:SENSe]:CORRection:CSET:GROup:COMMent "text"` `[:SENSe]:CORRection:CSET:GROup:COMMent?`
Example	`:CORR:CSET:GRO:COMM "For internal only"`
Notes	60 chars max; may not fit on display if max chars used
Preset	Unaffected by Preset. Set to empty by **Restore Input/Output Defaults**
State Saved	Saved in instrument state

6.5.13.10 Start Frequency

Touching a **Start Frequency** value makes the touched row the current row and lets you edit the start frequency.

Notes	You cannot set the Start Frequency to a value greater than Stop Frequency or equal to Stop Frequency. You cannot set the Start Frequency to a value that would create a span of less than 10 Hz. If you try to do any of these, the Stop Frequency will change to maintain a minimum span of 10 Hz If you change the Start Frequency of the selected range to a value smaller than the previous range's Stop Frequency, the Stop Frequency of the previous range will be changed to the same value

	If you change the Start Frequency of the selected range to a value out of the correction data frequency range, an error icon appears on the status column and an Execution error is generated
Preset	Unaffected by Preset. Set to empty by **Restore Input/Output Defaults**
Min	0
Max	1 THz

6.5.13.11 Stop Frequency

Touching a **Stop Frequency** value makes the touched row the current row and lets you edit the stop frequency.

Notes	You cannot set the Stop Frequency to a value greater than Start Frequency or smaller than Start Frequency. You cannot set the Stop Frequency to a value that would create a span of less than 10 Hz. If you try to do any of these, the Start Frequency will change to maintain a minimum span of 10 Hz If you change the Stop Frequency of the selected range to a value greater the next range's Start Frequency, the Start Frequency of the next range will be changed to the same value If you change the Stop Frequency of the selected range to a value out of the correction data frequency range, an error icon appears on the status column and an Execution error is generated
Preset	Unaffected by Preset. Set to empty by **Restore Input/Output Defaults**
Min	0
Max	1 THz

6.5.14 Merge Correction Data (Remote Command Only)

Accepts an ASCII series of alternating frequency and amplitude points, each value separated by commas. The difference between this command and **Set Data** is that this merges new correction points into an existing set.

If any new point has the same frequency as an existing correction point, the existing point's amplitude is replaced by that of the new point.

An Ampcor array can contain 2000 total points, maximum.

Remote Command	`[:SENSe]:CORRection:CSET[1]|2|…|16:DATA:MERGe <freq>, <ampl>, ...`
Example	`:CORR:CSET1:DATA:MERGE 15000000,-5.0,25000000,5.0` This adds two correction points at (15 MHz, -5.0 dB) and (25 MHz, 5.0 dB) to whatever values already exist in correction set 1
Preset	Empty after **Restore Input/Output Defaults**. Survives shutdown/restart of instrument application (including power cycle)

Min/Max		**Min**	**Max**
	Freq	0 Hz	1 THz
	Amptd	-1000 dBm	+1000 dBm

6.5.15 Set (Replace) Data (Remote Command Only)

Accepts an ASCII series of alternating frequency and amplitude points, each value separated by commas.

The values sent in the command totally replace all existing correction points in the specified set.

An Ampcor array can contain 2000 points maximum.

Remote Command	`[:SENSe]:CORRection:CSET[1]|2|…|16:DATA <freq>, <ampl>, ...` `[:SENSe]:CORRection:CSET[1]|2|…|16:DATA?`
Example	`:CORR:CSET1:DATA 10000000,-1.0,20000000,1.0` This defines two correction points at (10 MHz, -1.0 dB) and (20 MHz, 1.0 dB) for correction set 1
Preset	Empty after **Restore Input/Output Defaults**. Survives a shutdown or restart of instrument application (including a power cycle)
State Saved	Saved in instrument state
Min	Freq: 0 Hz Amptd: -1000 dBm
Max	Freq: 1 THz Amptd: +1000 dBm

6.5.16 Correction Group Range Data (Remote Command Only)

Accepts an ASCII series of alternating start frequency, stop frequency and file names, each value separated by commas.

The values sent in the command replace the content of correction group.

The default path for CSV files is:

`D:\My Documents\amplitudeCorrections\`

Remote Command	`[:SENSe]:CORRection:CSET:GROup[1]|2|…|10:DATA <startFreq>,<stopFreq>,<filename1>,<filename2>,…,<filename8>`
	See Notes below for explanation of the <filenameN> parameters
	`[:SENSe]:CORRection:CSET:GROup[1]|2|…|10:DATA?`

Example	`:CORR:CSET:GRO:DATA 10000000,20000000,"myAmpcor.csv"` `myAmpcor.csv` refers to the Amplitude Correction data from the file `myAmpcor.csv` in the default path
Notes	`<filename>` is the string containing the path of the correction files <filename2>, <filename3>, <filename4>, <filename5>, <filename6>, <filename7>, <filename8> are optional. You can define only <filename1>. The file name defined is added to corresponding File keys based on the sequence sent in the command. File keys with no file name set in the SCPI will be emptied Data for ranges 1 to 10 must be set in ascending order. If you try to set the data for a correction group range that is not connecting to the range currently available, a Data out of range error is generated If the file defined in data is empty, error -250 is reported. If the file does not exist, error -256 is reported. If there is a mismatch of data type, error -250 is reported Only one file with antenna unit can be supported per range. If you try to add another file that contains an antenna unit, a Mass Storage error is generated All ranges have to use a common antenna unit. If you try to add a correction file that contains a different antenna unit, a Mass Storage error is generated
Preset	Reset to Not a Number (9.91e+37) for frequencies and "" for File 1 through File 8 after **Restore Input/Output Defaults**. Survives a shutdown or restart of instrument application (including a power cycle)
State Saved	Saved in instrument state
Min	Start Freq and Stop Freq: 0 Hz
Max	Start Freq and Stop Freq:1 THz

6.5.17 Delete Correction Group Range (Remote Command Only)

Deletes all range values of corrections Group.

Remote Command	`[:SENSe]:CORRection:CSET:GROup:DELete`
Example	`:CORR:CSET:GRO:DEL`
Notes	Sending this command when no range is defined in table is accepted without error

6.6 Freq Ref Input

Lets you configure the External Frequency Reference input on the rear panel.

6.6.1 Freq Ref Input

Specifies the frequency reference as being the internal reference, an external reference at the rear panel input labeled EXT REF IN, a 1 pulse per second signal at the EXT REF IN input, or automatically sensing the appropriate reference.

See "More Information" on page 2429

Remote Command	`[:SENSe]:ROSCillator:SOURce:TYPE INTernal | EXTernal | SENSe | PULSe` `[:SENSe]:ROSCillator:SOURce:TYPE?`

Example	`:ROSC:SOUR:TYPE SENS`
	`:ROSC:SOUR:TYPE INT`
	`:ROSC:SOUR:TYPE EXT`
	`:ROSC:SOUR:TYPE PULS`

Dependencies	The `PULSe` parameter, and support of the 1 pps signal at the EXT REF IN input, are not available in some models. If not available, the choice does not appear, and sending the `PULSe` parameter via SCPI generates an error For VXT models M9420A/10A/11A/15A and M9410E/11E/15E/16E the only available selection is `EXTernal`, unless M9420A/10A/11A/15A is configured in MIMO mode as Primary module. If configured in MIMO mode as Primary module, the available selection is `INTernal | EXTernal | SENSe` For EXM the only available selections are `INTernal | EXTernal | SENSe` For E7760B and M8920A/20B the only available selections are `INTernal | EXTernal` Not available in UXM
Preset	Unaffected by Preset, but set to `EXTernal` in VXT models M9420A/10A/11A/15A, `INTernal` for E7760B, and `SENSe` for other models, by **Restore Input/Output Defaults** or **Restore System Defaults->All**
State Saved	Saved in instrument state
Annunciation	In the Meas Bar: If you set this to Internal and no external reference is plugged in: Freq Ref: Internal If you set this to Internal and an external reference between 1 and 50 MHz, or a 1 pps signal, IS plugged in: Freq Ref: Internal (in amber, as a warning sign) If you set this to External and an External Reference between 1 and 50 MHz is plugged in: Freq Ref: External

	If you set this to External and no External Reference is sensed: Freq Ref: External (in amber, as a warning sign) When set to Pulse and a 1 pps signal is plugged in: Freq Ref: Pulse If you set this to Pulse and no Pulse Reference is sensed: Freq Ref: Pulse (in amber, as a warning sign) When set to Sense and neither a signal between 1 and 50 MHz nor a 1 pps signal is detected at the EXT REF IN input, "Sense:Int" is displayed: Freq Ref: Sense,Int When set to Sense and a signal within 5 ppm of the External Ref Freq (as set on the Ext Ref Freq control) is detected at the EXT REF IN input: Freq Ref: Sense,Ext When set to Sense and a 1 pps signal is detected at the EXT REF IN input, "Sense:Pulse" is displayed: Freq Ref: Sense,Pls
Status Bits/OPC dependencies	`STATus:QUEStionable:FREQuency` bit 1 set if unlocked Note: In EXM, the status bit is not set for non-controlling instances. To determine if the frequency reference is unlocked, the controlling instance must be queried
Backwards Compatibility Notes	Freq Ref In was not saved in state in the legacy instruments. It is part of state in the X-Series

Remote Query

Remote Command	`[:SENSe]:ROSCillator:SOURce?`
Notes	Returns the current switch setting. This means: 1. If it was set to `SENSe` but there is no external reference nor 1pps signal, so the instrument is actually using the internal reference, then this query returns `INTernal`, not `SENSe` 2. If it was set to `SENSe` and there is an external reference present, the query returns `EXTernal`, not `SENSe` 3. If it was set to `SENSe` and there is a 1 pps signal present, the query returns `PULSe`, not `SENSe` 4. If it was set to `EXTernal`, then the query returns `EXTernal` 5. If it was set to `INTernal`, then the query returns `INTernal` 6. If it was set to `PULSe`, then the query returns `PULSe` Note: In EXM, the SCPI query always returns `INTernal` for non-controlling instances
Preset	For VXT models M9420A/10A/11A/15A: `EXTernal` For E7760B, M8920A/20B: `INTernal` All other models: `SENSe`
Backwards	`[:SENSe]:ROSCillator:SOURce?` was query-only in ESA which always returned whichever

Compatibility Notes	reference the instrument was using. The instrument automatically switched to the ext ref if it was present In PSA (which had no sensing), `[:SENSe]:ROSCillator:SOURce` set the reference (INT or EXT), so again its query returned the actual routing Thus, the query is 100% backwards compatible with both instruments

Backwards Compatibility Command

Notes	For PSA compatibility the command form is provided and is directly mapped to `[:SENSe]:ROSCillator:SOURce:TYPE` Note: In EXM, the command does nothing for non-controlling instances
Backwards Compatibility SCPI	`[:SENSe]:ROSCillator:SOURce INTernal | EXTernal`

More Information

When the frequency reference is set to internal, the internal 10 MHz reference is used even if an external reference is connected.

When the frequency reference is set to external, the instrument will use the external reference. However, if there is no external signal present, or it is not within the proper amplitude range, a condition error message is generated. When the external signal becomes valid, the error is cleared.

When the frequency reference is set to Pulse, the instrument expects a 1 pulse per second signal at the EXT REF IN input. The instrument uses this signal to adjust the frequency of the internal reference.

If Sense is selected, the instrument checks whether a signal is present at the external reference connector. If it senses a signal within 5 ppm of the External Ref Freq (as set on the **External Ref Freq** control), it will automatically switch to the external reference. If it senses a 1 pulse per second signal, it enters Pulse mode, wherein the signal is used to adjust the internal reference. When no signal is present, it automatically switches to the internal reference. No message is generated as the reference switches between pulse, external and internal. The monitoring of the external reference occurs approximately on 1 millisecond intervals, and never occurs in the middle of a measurement acquisition, only at the end of the measurement (end of the request).

If for any reason the instrument's frequency reference is not able to obtain lock, Status bit 1 in the Questionable Frequency register will be true and a condition error message is generated. When lock is regained, Status bit 1 in the Questionable Frequency register will be cleared and the condition error will be cleared.

If an external frequency reference is being used, you must enter the frequency of the external reference if it is not exactly 10 MHz. The **External Ref Freq** key is provided for this purpose.

For VXT models M9420A/10A/11A/15A, there is no internal frequency reference. To work correctly, a 100MHz external frequency reference signal is needed to connect to the front panel of the module. The default Freq Ref In setting is “External” and it cannot be set to any other types.

For VXT models M9410A/11A, External Freq Ref Input controls the “100 MHz In” port on the front panel. For VXT models M9415A/16A, External Freq Ref Input controls the “REF In” port on the front panel. For M941xE, the External Freq Ref Input is the reference in port on M941xA module.

NOTE

In EXM, a common frequency reference module serves all instrument instances, but only one instance of the software application can change the reference input type (INT or EXT or SENSE). The software application allowed to change the reference input is called the primary or controlling instance; by default, the leftmost instrument instance is the controlling instance. This can be changed in the config file “`E66XXModules.config`” located in the folder `E:\Keysight\Instrument`. For the non-controlling instance(s) the reference input types (in SCPI commands, and in the Virtual Front Panel menus) are blanked and unavailable for use.

Sense

If **Sense** is selected, the instrument checks whether a signal is present at the external reference connector. If it senses a signal within 5 ppm of the External Ref Freq (as set by **External Ref Freq**), it uses this signal as an External Reference. If it senses a 1 pulse per second signal, it uses this signal to adjust the internal reference by adjusting the User setting of the Timebase DAC. When no signal is present, it automatically switches to the internal reference.

If set to `SENSe` and the instrument senses a 1 pulse per second signal, it sets the **System, Alignments, Timebase DAC** setting to **User**. This setting survives Preset and Power Cycle but is set to **Calibrated** by **System, Restore Defaults, Align** or **System, Restore Defaults, All**

Internal

The internal reference is used. A 1 pps signal at the EXT REF IN port, or a signal there between 1 and 50 MHz, causes a warning triangle to appear in the settings panel next to the word “INTERNAL”, but will otherwise be ignored.

External

The external reference is used.

Pulse

The internal reference continues to be the frequency reference for the instrument in that it determines the reference contribution to the phase noise, but its average frequency is adjusted to follow the 1 pps signal at the EXT REF IN input. Therefore, the instrument frequency accuracy will be dominated by the aging rate of the 1 pps signal instead of the aging rate of the internal reference, except during the time it takes to lock to a new 1 pps signal, approximately 10 minutes.

Sets the System, Alignments, Timebase DAC setting to “User”. This setting survives Preset and Power Cycle, but it set to “Calibrated” on a System, Restore Defaults, Align or a System, Restore Defaults, All

When a 1 pps signal is present at the EXT REF IN input, and either **Pulse** or **Sense** is selected, the internal reference frequency is affected by this signal; in effect, it “learns” a new accuracy setting. This setting can be seen by going to the **System, Alignments, Timebase Dac** menu, and looking at the **User** key in that menu. You will note that User has become automatically selected, and that the value shown on the **User** key is the updated value of the timebase DAC as “learned” from the 1 pps signal. Note that this replaces any value the user might have previously set on this key.

Once the setting is learned the user may remove the 1 pps signal; the User setting for the Timebase DAC is retained until you manually select “Calibrated” or execute a System, Restore Defaults, Align or a System, Restore Defaults, All. If you want to make the User setting permanent there is information in the Service Guide that tells you how to change the Calibrated setting of the Timebase DAC.

Note also that if the 1 pps signal is removed when Sense is selected, the instrument will simply switch to the normal state of the Internal reference and display SENSE:INT in the Settings Panel. However, if the 1 pps signal is removed when Pulse is selected, the instrument will generate an error

The J7203A Atomic Frequency Reference is an accessory for the X-Series Signal Analyzer that provides a highly accurate 1 pps timebase to use in conjunction with the Pulse setting. With the J7203A, the 1 pps signal is guaranteed to meet the input requirements of the EXT REF IN port, and the improved accuracy of the instrument’s internal frequency reference is specified. This is the only 1 pps signal that is guaranteed to function properly with the X-Series.

6.6.2 Ext Ref Freq

This key tells the instrument the frequency of the external reference. When the external reference is in use (either because the reference has been switched to External or because the Reference has been switched to Sense and there is a valid external reference present) this information is used by the instrument to determine the internal settings needed to lock to that particular external reference signal.

For the instrument to stay locked, the value entered must be within 5 ppm of the actual external reference frequency. So, it is important to get it close, or you risk an unlock condition.

Note that this value only affects the instrument’s ability to lock. It does not affect any calculations or measurement results. See "Freq Offset" in the Frequency section for information on how to offset frequency values.

Remote Command	`[:SENSe]:ROSCillator:EXTernal:FREQuency <freq>` `[:SENSe]:ROSCillator:EXTernal:FREQuency?`

Example	Set the external reference frequency to 20 MHz, but does not select the external reference:
	`:ROSC:EXT:FREQ 20 MHz`
	Select the external reference:
	`:ROSC:SOUR:TYPE EXT`

Dependencies	Still available with Internal or Pulse selected, to allow setup for when External is in use. However, the setting has no effect if the Internal Reference is in use (Freq Ref In set to Internal, Pulse, or SENSE:INT or SENSE:PULSE) Not available in UXM For VXT models M9420A/10A/11A/15A/16A and M9410E/11E/15E/16E: only 100 MHz is available
Preset	Unaffected by **Mode Preset**, **Input/Output Preset**, or **Restore Defaults, Input/Output**, but set to 100 MHz for VXT models and 10 MHz for other models, by **Restore Defaults, Misc**, or **Restore Defaults, All**, or **Default External Ref Freq**
State Saved	Power On Persistent (survives power cycle)
Min/Max	See "Minimum & Maximum Values" on page 2432

Minimum & Maximum Values

Model	Min	Max
CXA, N897xB, E7760B, M8920A/20B, CXA-m	10 MHz	10 MHz
EXA without option R13	10 MHz	10 MHz
EXA with option R13	10 MHz	20 MHz
MXA, PXA, EXM	10 MHz	50 MHz

Model	Min	Max
VXT models	100 MHz	100 MHz
M9410E/11E/15E/16E	100 MHz	100 MHz
All other models	1 MHz	100 MHz

6.6.3 Default External Ref Freq

Restores the External Ref Freq to its default of 10 MHz.

When you set an External Ref Freq value with the **Ext Ref Freq** control, that Frequency is persistent; is not affected by Mode Preset or Input/Output Preset, and survives shutdown and power cycle. This control allows you to reset the External Ref Freq to its default value.

NOTE: The persistence of the External Ref Freq is a new behavior as of firmware version A.18.00, necessitating the addition of this control. In versions before A.18.00, the frequency reset on a power cycle/restart. Thus, you may need to use this command to retain backwards compatibility.

Remote Command	`[:SENSe]:ROSCillator:EXTernal:FREQuency:DEFault`
Example	`:ROSC:EXT:FREQ:DEF` resets the external ref frequency
Notes	Command only; no query
Dependencies	Grayed-out if the Ext Ref Freq is already set to the default Does not appear in EXM, UXM, VXT models or M8920A/20B

6.6.4 LO Ref Input

This parameter sets the LO Reference signal Input to External or Internal.

Remote Command	`[:SENSe]:ROSCillator:LO:INPut INTernal | EXTernal`
	See "Option Details" on page 2434
	`[:SENSe]:ROSCillator:LO:INPut?`

Example	`:ROSC:LO:INP EXT` `:ROSC:LO:INP?`
Dependencies	Only available in VXT models M9410A/11A/15A/16A when MIMO is on
Preset	`INTernal`
State Saved	Saved in instrument state

Option Details

Parameter	SCPI	Notes
Internal	`INTernal`	When Internal is selected, internal reference signal will be used to synchronize the LO board
External	`EXTernal`	When External is selected, external reference signal will be used to synchronize the LO board. Route the correct reference signal to the specified port before changing the LO Ref Input to External For VXT models M9410A/11A, a 4.8 GHz reference signal is required to rout to the 4.8 GHz In port

6.6.5 Ref Lock BW

Lets you adjust the Frequency Reference phase lock bandwidth. This control is available in some models of the X-Series.

It is possible to improve the phase noise of the instrument by several dB, even tens of dB, by using an external reference with excellent phase noise. When an external reference is used the instrument's close-in phase noise improves to match that of the reference.

Normally a narrow loop bandwidth is used to phase lock to the external reference. However, the Ref Lock BW control allows you to choose a wider loop bandwidth to reduce the phase noise at low offset frequencies, especially 4 to 400 Hz offset. The Wide setting represents about a 60 Hz loop bandwidth, the Narrow setting about 15 Hz.

When using an external reference with superior phase noise, Keysight recommends setting the external reference phase-locked-loop bandwidth to Wide to take advantage of that superior performance.

When using an external reference with inferior phase noise performance, Keysight recommends setting the bandwidth to Narrow.

In these relationships, inferior and superior phase noise are with respect to –134 dBc/Hz at 30 Hz offset from a 10 MHz reference. Because most reference sources have phase noise behavior that falls off at a rate of 30 dB/decade, this is usually equivalent to –120 dBc/Hz at 10 Hz offset.

In instruments with EP1 or EP2, this control only affects the external reference loop bandwidth. In instruments with EP0, this control also affects the loop bandwidth used when the Internal reference is selected (reference set manually to Internal or Pulse, or set to Sense and set by sensing to Internal or Pulse).

Remote Command	`[:SENSe]:ROSCillator:BANDwidth WIDE | NARRow` `[:SENSe]:ROSCillator:BANDwidth?`

Example	`:ROSC:BAND WIDE`
Dependencies	In instruments with EP1 or EP2: the control is available (not grayed-out) even with Internal or Pulse selected, to allow setup for when External is in use. However, the setting has no effect if the Internal Reference is in use Only appears in instruments equipped with the required hardware Does not appear in EXM, UXM, VXT models, or E7760B
Preset	Unaffected by Preset, but set to `NARRow` by **Restore Input/Output Defaults** or **Restore System Defaults -> All**
State Saved	Saved in Input/Output state

6.6.6 Reference Oscillator On/Off (Remote Command Only)

Provided for PSA code compatibility.

In PSA it turned the Reference Oscillator on and off, however in the X-Series the reference oscillator cannot be turned off, so no hardware is affected when it is received.

If queried it returns the state you set with the command, but note that this does not necessarily reflect the actual state of the Reference Oscillator, which is always `ON`.

Example	`:ROSCillator:OUTP ON`
Preset	Unaffected by Preset, but set to `ON` by **Restore Input/Output Defaults** or **Restore System Defaults -> All**
Backwards Compatibility SCPI	`[:SENSe]:ROSCillator:OUTPut[:STATe] ON | OFF | 1 | 0` `[:SENSe]:ROSCillator:OUTPut[:STATe]?`

6.6.6.1 Select Ref

Lets you select the reference model to control.

The reference status is not saved in a state file, because Reference is a standard alone module.

Remote Command	`[:SENSe]:ROSCillator:PXIReference:SELect NONE | M9300a` `[:SENSe]:ROSCillator:PXIReference:SELect?`
Example	`:ROSC:PXIR:SEL M9300` `:ROSC:PXIR:SEL?`
Dependencies	Only Keysight M9300A Frequency Reference is supported
State Saved	No

6.6.6.2 Freq Ref In

Specifies the frequency reference as being the internal reference, an external reference at the front panel input labeled **Ref In**.

Remote Command	`[:SENSe]:ROSCillator:PXIReference:SOURce INTernal | EXTernal` `[:SENSe]:ROSCillator:PXIReference:SOURce?`
Example	`:ROSC:PXIR:SOUR INT` `:ROSC:PXIR:SOUR?`
Dependencies	Only available when **Select Ref** is not NONE
Preset	`INTernal`
State Saved	Saved in instrument state

6.6.6.3 External Freq Ref

Tells the PXIe Ref module the frequency of the external reference. When the external reference is in use this information is used by the Ref module to determine the internal settings needed to lock to that particular external reference signal.

For the instrument to stay locked, the value entered must be within 5 ppm of the actual external reference frequency. So, it is important to get it close, or you risk an unlock condition.

Remote Command	`[:SENSe]:ROSCillator:PXIReference:EXTernal:FREQuency <freq>` `[:SENSe]:ROSCillator:PXIReference:EXTernal:FREQuency?`

Example	Set the external reference frequency to 20 MHz, but does not select the external reference:
	`:ROSC:PXIR:EXT:FREQ 20 MHz`
	Select the external reference:
	`:ROSC:PXIR:SOUR EXT`

Dependencies	Only available when **Select Ref** is not NONE
Preset	10 MHz
State Saved	Yes
Min	1 MHz
Max	110 MHz

6.6.6.4 Ext Ref Locked (Remote Query Only)

Returns the External Reference locked status

Remote Command	`[:SENSe]:ROSCillator:PXIReference:EXTernal:LOCK?`

Example	`:ROSC:PXIR:EXT:LOCK?`
Notes	Returns “1” if the Freq Ref Input is External and Reference is locked. Otherwise returns “0” When the Freq Ref Input is External and Reference is unlocked, the following warning message appears in the status bar: `Settings Alert; M9300A Ext Ref Unlocked`
Dependencies	Only available when **Select Ref** is not NONE

6.7 Output

Accesses controls that configure various output settings, like the frequency reference output, IF outputs and analog output.

Not all measurements support all output functions. For example, the Swept SA Measurement does not support the Digital Bus function or the I/Q Cal Out function under the **Output** tab; although the controls are visible, the outputs do not function in this measurement.

In addition, if the appropriate license is not present, some controls may not appear. In Modes/Measurements that do not support particular controls, the controls may appear, but no output will be generated if they are selected.

This tab does not appear in EXM or VXT model M9420A.

6.7.1 Analog Out

Lets you control which signal is fed to the “Analog Out” connector on the instrument rear panel.

In the Auto state, the Analog Output will automatically be set to the most sensible setting for the current mode or measurement.

If you make a selection manually from the **Analog Out** menu, the manually selected choice will remain in force until you change it (or re-select Auto), even if you switch to a mode or measurement for which the selected output does not apply.

Remote Command	`:OUTPut:ANALog OFF | SVIDeo | LOGVideo | LINVideo | DAUDio!See Option Details` `:OUTPut:ANALog?`
Example	`:OUTP:ANAL SVIDeo` causes the analog output type to be Screen Video
Preset	Unaffected by Preset, but set to `DAUDio` by **Restore Input/Output Defaults** or **Restore System Defaults->All**
State Saved	Saved in Input/Output State
Backwards Compatibility Notes	Prior to A.04.00, `OFF` was the default functionality except when in the Analog Demod application or with Tune and Listen, in which case it was `DAUDio`, and there was no selection menu. For backwards compatibility with earlier X-Series firmware versions, Auto (`:OUTP:ANAL:AUTO ON`) duplicates the prior behavior The `DNWB` and `SANalyzer` parameters, which were legal in PSA but perform no function in the X-Series, are accepted without error

Auto Function

Remote Command	`:OUTPut:ANALog:AUTO OFF | ON | 0 | 1` `:OUTPut:ANALog:AUTO?`
Example	`:OUTP:ANAL:AUTO ON`
Preset	`ON`

Option Details

Source	SCPI	Notes
Off	`OFF`	The Analog Output is off
Screen Video	`SVIDeo`	Selects the analog output to be the screen video signal. In this mode, the pre-detector data is output to the Analog Out connector. The output looks very much like the trace displayed on the instrument's screen, and depends on the Log/Lin display Scale, Reference Level, and dB per division, but is not influenced by the selected detector or any digital flatness corrections or trace post-processing (like Trace Averaging)
Log Video	`LOGVideo`	Selects the analog output to be the log of the video signal. In this mode, the pre-detector data is output to the Analog Out connector with a Log scaling. The output is referenced to the current level at the mixer, does not depend on display settings like Reference Level or dB per division, and it is not influenced by the selected detector or any digital flatness corrections or trace post-processing (like Trace Averaging), but does change with input attenuation
Linear Video	`LINVideo`	Selects the analog output to be the envelope signal on a linear (voltage) scale. In this mode, the pre-detector data is output to the Analog Out connector with a Linear scaling. The output is based on the current Reference Level, and is not influenced by the selected detector or any digital flatness corrections or trace post-processing (like Trace Averaging)
Demod Audio	`DAUDio`	Selects the analog output to be the demodulation of the video signal. When Demod Audio is selected, the demodulated audio signal appears at this output whenever the Analog Demod application is demodulating a signal or when **Analog Demod Tune and Listen** is operating in the Swept SA measurement When Analog Out is in the Auto state, this output is auto-selected when in the Analog Demod mode or when **Analog Demod Tune and Listen** is operating in the Swept SA measurement

The table below specifies the range for each output.

Analog Out	Nominal Range exc (10% overrange)	Scale Factor	Notes
Off	0 V		
Screen Video	0 – 1 V open circuit	10%/division	8566 compatible
Log Video	0 – 1 V terminated	1/(192.66 dB/V)	dB referenced to mixer level, 1V out for –10 dBm at the mixer
Linear Video	0 – 1 V terminated	100%/V	Linear referenced to Ref Level, 1 V out for RF envelope at the Ref Level

Analog Out	Nominal Range exc (10% overrange)	Scale Factor	Notes
Demod Audio	(varies with instrument setting)		

Notes about the Analog Outputs

Screen Video

This mode is similar to the Analog Output of the HP 8566 family and the Video Out (opt 124) capability of the Keysight PSA analyzer (E444x), although there are differences in the behavior.

Screen Video output changes while in FFT Sweeps, so for measurements that use exclusively FFT Sweeps, or if the user manually chooses FFT Sweeps, the Screen Video output will look different than it does in swept mode

Because the Screen Video output uses one of the two IF processing channels, only one detector is available while Screen Video is selected. All active traces will change to use the same detector as the selected trace when Screen Video is activated.

Screen Video output is not available while any EMI Detector is selected (Quasi Peak, RMS Average or EMI Average), because these detectors use both IF processing channels. Consequently, if the user chooses an EMI Detector, there will be no Screen Video output.

The output holds at its last value during an alignment and during a marker count. After a sweep:

- If a new sweep is to follow (as in Continuous sweep mode), the output holds at its last value during the retrace before the next sweep starts. If the instrument is in zero-span, there is no retrace, as the instrument remains tuned to the Center Frequency and does not sweep. Therefore, in zero-span, the output simply remains live between display updates
- If no new sweep is to follow (as in Single sweep mode), the output remains live, and continues to show the pre-detector data

This function depends on optional capability; the selection is not available, and the command will generate an “Option not available” error unless you have Option YAV or YAS licensed in your instrument.

The Screen Video function is intended to be very similar to the 8566 Video Output and the PSA Option 124. However, unlike the PSA, it is not always on; it must be switched on by the Screen Video key. Also, unlike the PSA, there are certain dependencies (detailed above) – for example, the Quasi Peak Detector is unavailable when Screen Video is on.

Furthermore, the PSA Option 124 hardware was unipolar, and its large range was padded to be exactly right for use as a Screen Video output. In the X-Series, the hardware is bipolar and has a wider range to accommodate the other output choices. Therefore, the outputs won't match up exactly and users may have to modify their setup when applying the X-Series in a PSA application.

Log Video

Log Video shows the RF Envelope with the Reference equal to the Mixer Level. The output is designed so that full scale (1 V) corresponds to -10 dBm at the mixer. The full range (0-1 V) covers 192.66 dB ; thus, 0 V corresponds to -202.66 dBm at the mixer.

Because the Log Video output uses one of the two IF processing channels, only one detector is available while Screen Video is selected. All active traces will change to use the same detector as the selected trace when Log Video is activated.

Log Video output is not available while any EMI Detector is selected (Quasi Peak, RMS Average or EMI Average), because these detectors use both IF processing channels. Consequently, if the user chooses an EMI Detector, there will be no Log Video output.

The output holds at its last value during an alignment, during a marker count, and during retrace (after a sweep and before the next sweep starts).

This function depends on optional capability. The choice will not appear, and the command will generate an “Option not available” error unless you have Option YAV licensed in your instrument.

Log Video output changes while in FFT Sweeps, so for measurements that use exclusively FFT Sweeps, or if the user manually chooses FFT Sweeps, the Log Video output will look different than it does in swept mode.

Linear Video

Linear Video shows the RF Envelope with the Reference equal to the Ref Level. The scaling is set so that 1 V output occurs with an instantaneous video level equal to the reference level, and 0 V occurs at the bottom of the graticule. This scaling gives you the ability to control the gain without having another setup control for the key. But it requires you to control the look of the display (the reference level) in order to control the analog output.

This mode is ideal for looking at Amplitude Modulated signals, as the linear envelope effectively demodulates the signal.

Because the Linear Video output uses one of the two IF processing channels, only one detector is available while Linear Video is selected. All active traces will change to use the same detector as the selected trace when Log Video is activated.

Linear Video output is not available while any EMI Detector is selected (Quasi Peak, RMS Average or EMI Average), because these detectors use both IF processing channels. Consequently, if the user chooses an EMI Detector, there will be no Linear Video output.

The output holds at its last value during an alignment and during a marker count and during retrace (after a sweep and before the next sweep starts).

This function depends on optional capability; the choice will not appear, and the command will generate an “Option not available” error unless you have Option YAV licensed in your instrument. Linear Video output changes while in FFT Sweeps, so for measurements that use exclusively FFT Sweeps, or if the user manually chooses FFT Sweeps, the Linear Video output will look different than it does in swept mode.

Demod Audio

When Analog Out is in the Auto state, this output is auto-selected when in the Analog Demod mode or when **Analog Demod Tune and Listen** is operating in the Swept SA measurement.

If any other Analog Output is manually selected when in the Analog Demod mode or when **Analog Demod Tune and Listen** is operating in the Swept SA measurement, a condition warning message appears. This choice only appears if the Analog Demod application (N9063A), the N6141A or W6141A application, or Option EMC is installed and licensed, otherwise the choice will not appear, and the command will generate an “Option not available” error.

The output holds at its last value during an alignment and during a marker count. It is not held between sweeps, in order for Tune and Listen to work properly.

When Demod Audio is the selected Analog Output, all active traces are forced to use the same detector, and the CISPR detectors (QPD, EMI Avg, RMS Avg) are unavailable

6.7.2 Screen Video Level

Lets you control the amplitude of the Analog Output when Screen Video is selected.

- The 1V (`NORMal`) setting provides a nominal output of 1 V peak-to-peak into an open circuit. This matches the traditional behavior of X-series instruments
- The 2V (`COMPatible`) setting provides a nominal output of 2 V peak-to-peak into an open circuit. This matches the legacy behavior of PSA and earlier analyzers

Remote Command	`:OUTPut:ANALog:SVIDeo NORMal | COMPatible` `:OUTPut:ANALog:SVIDeo?`
Example	`:OUTP:ANAL:SVID COMP` causes the Screen Video level to be 2 V

Dependencies	Only appears if Screen Video is the selected Analog Output
Preset	Unaffected by Preset, but set to NORM by **Restore Input/Output Defaults** or **Restore System Defaults->All**
State Saved	Saved in Input/Output State

6.7.3 Digital Bus Out

Turns on the LVDS Digital Output port for outputting digital acquisition data.

- When ON, all acquisitions are streamed to the output port including acquisitions for internal purposes such as Alignment. The internal processing and routing of acquisitions continues as usual and is unaffected by the state of Bus Out
- When OFF, no signal appears on the LVDS port

Remote Command	`:OUTPut:DBUS[1][:STATe] ON | OFF | 1 | 0` `:OUTPut:DBUS[1][:STATe]?`
Example	`:OUTP:DBUS ON`
Dependencies	Requires option RTL or control is not displayed **Digital Bus Out** and **Wideband Digital Bus** cannot both be ON at the same time, so: – When **Wideband Digital Bus** is turned ON, if **Digital Bus Out** is already ON, an advisory message is displayed, "Wideband Digital Bus On, Digital Bus (narrow band) forced to Off" – When **Digital Bus Out** is turned ON, if **Wideband Digital Bus** is already ON, an advisory message is displayed, "Digital Bus (narrow band) On, Wideband Digital Bus forced to Off"
Preset	OFF Set by **Restore Input/Output Defaults**
State Saved	Saved in Input/Output State

6.7.4 Wideband Digital Bus

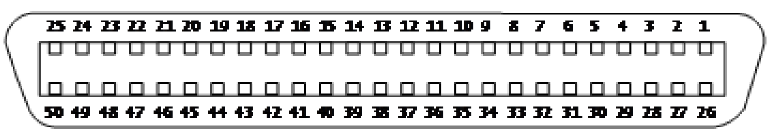
Turns on the LVDS port on the Wideband IF, which causes the I/Q pairs from the current measurement to be sent to this port.

NOTE **This control is grayed-out in all Modes except RTSA, which offers the only measurement that supports wideband streaming.**

- When ON, the internal processing and routing of acquisitions continues as usual, and the display of measurement data is unaffected
- When OFF, no signal appears on the LVDS port

Remote Command	`:OUTPut:DBUS2[:STATe] OFF | ON | 0 | 1` `:OUTPut:DBUS2[:STATe]?`
Example	`:OUTP:DBUS2 ON`
Notes	If this command is sent while running a measurement that does not support **Wideband Digital Bus**, the message “Settings conflict; Feature not supported for this measurement” is displayed
Dependencies	Requires option RTS or control is not displayed **Digital Bus Out** and **Wideband Digital Bus** cannot both be ON at the same time, so: – When **Wideband Digital Bus** is turned ON, if **Digital Bus Out** is already ON, an advisory message is displayed, “Wideband Digital Bus On, Digital Bus (narrow band) forced to Off” – When **Digital Bus Out** is turned ON, if **Wideband Digital Bus** is already ON, an advisory message is displayed, “Digital Bus (narrow band) On, Wideband Digital Bus forced to Off”
Preset	OFF Set by **Restore Input/Output Defaults**
State Saved	Saved in Input/Output State

Here is the Wideband LVDS connector as viewed from the rear panel. The pin assignments are listed below:



I-Cable

Connection	“-“ pin #	“+” pin #
GND	1	26
N/C	2	27
Stream_I[00]	3	28
Stream_I[01]	4	29
Stream_I[02]	5	30
Stream_I[03]	6	31
GND	7	32
Stream_I[04]	8	33
Stream_I[05]	9	34
Stream_I[06]	10	35
Stream_I[07]	11	36
GND	12	37
Stream_I[08]	13	38
Stream_I[09]	14	39

Connection	"-" pin #	"+" pin #
Stream_I[10]	15	40
Stream_I[11]	16	41
GND	17	42
Stream_I[12]	18	43
Stream_I[13]	19	44
Stream_I[14]	20	45
Stream_I[15]	21	46
GND	22	47
GND	23	48
Stream_VALID	24	49
Stream_CLK	25	50

Q-Cable

Connection	"-" pin #	"+" pin #
GND	1	26
Stream_ALT	2	27
Stream_Q[00]	3	28
Stream_Q[01]	4	29
Stream_Q[02]	5	30
Stream_Q[03]	6	31
GND	7	32
Stream_Q[04]	8	33
Stream_Q[05]	9	34
Stream_Q[06]	10	35
Stream_Q[07]	11	36
GND	12	37
Stream_Q[08]	13	38
Stream_Q[09]	14	39
Stream_Q[10]	15	40
Stream_Q[11]	16	41
GND	17	42
Stream_Q[12]	18	43
Stream_Q[13]	19	44
Stream_Q[14]	20	45
Stream_Q[15]	21	46
GND	22	47

Connection	"-" pin #	"+" pin #
GND	23	48
Stream_MARK_1	24	49
Stream_MARK_2	25	50

Stream_I	16 bit "I" Data
Stream_Q[15:0]	16 bit "Q" Data
Stream_VALID	Data valid, when '1' then I/Q data is valid
Stream_CLK	150 MHz DDR clock
Stream_MARK_1	Stream Mark Bit 1
Stream_MARK_2	Stream Mark Bit 2
Stream_ALT	currently unused

6.7.5 Data Stream

Lets you choose data or a test pattern to output to the Wideband IF LVDS port. This can help you set up your streaming target devices.

Remote Command	`:OUTPut:DBUS2:DATA MEASure | TEST` `:OUTPut:DBUS2:DATA?`
Example	`:OUTP:DBUS2:DATA TEST`
Notes	Selecting `TEST` routes a test pattern to the Wideband Digital Bus stream output
Preset	`MEAS` (set by Restore Input/Output Defaults)
State Saved	Saved in Input/Output State

6.7.6 I/Q Cal Out

The Baseband I/Q "Cal Out" port can be turned on with either a 1 kHz or a 250 kHz square wave. This can be turned on independent of the input selection. Preset resets this to `OFF`.

Remote Command	`:OUTPut:IQ:OUTPut IQ1 | IQ250 | OFF` `:OUTPut:IQ:OUTPut?`
Example	`:OUTP:IQ:OUTP IQ1`
Dependencies	Only available with Option BBA
Couplings	An I/Q Cable Calibration or an I/Q Probe Calibration will change the state of the Cal Out port as needed by the calibration routine. When the calibration is finished the I/Q Cal Out is restored to the pre-calibration state
Preset	`OFF`

State Saved	Saved in instrument state
Range	1 kHz Square Wave | 250 kHz Square Wave | Off

6.7.7 Aux IF Out

Controls the signals that appear on the SMA output on the rear panel labeled **AUX IF OUT**

NOTE **Aux IF Out** is valid for the RF Input and for the External Mixer input. In external mixing, the Aux IF output level is set by factory default to accommodate expected IF levels for the RF path. When using the External Mixing path, the **Aux IF Out** levels (for all three options CR3, CRP and ALV) will therefore be uncalibrated.

Remote Command	`:OUTPut:AUX SIF | AIF | LOGVideo | OFF`
	See "Option Details" on page 2447 and "Notes on the Aux IF Outputs" on page 2448 below
	`:OUTPut:AUX?`

Dependencies	Does not appear in models that do not support the Aux IF Out
Preset	Unaffected by Preset, but set to `OFF` by **Restore Input/Output Defaults** or **Restore System Defaults->All**
State Saved	Saved in Input/Output state
Backwards Compatibility Notes	In PSA, the IF output had functionality equivalent to the `SIF` option in X-Series' **Aux IF Out** menu. In X-Series, it is necessary to switch **Aux IF Out** to `SIF` to get this functionality, whereas in PSA it is always on, since there are no other choices Hence, if you are migrating remote code from PSA, and you use the IF Output in PSA, you will need to add a command to switch this function to `SIF`

Option Details

The Aux IF Output options are:

Source	SCPI	Notes
Off	`OFF`	No signal is output from the **AUX IF OUT** connector on the rear panel The connector appears as an open-circuit (that is, it is not terminated in any way)
Second IF	`SIF`	The 2nd IF output is routed to the rear panel connector. Annotation on the menu panel shows the current 2nd IF frequency in use in the instrument
Arbitrary IF	`AIF`	The 2nd IF output is mixed with a local oscillator and mixer to produce an arbitrary IF output between 10 MHz and 75 MHz with 500 kHz resolution. The phase noise in this mode will not be as good as in Second IF mode The IF output frequency is adjustable, through an active function which appears on the menu panel, from 10 MHz to 75 MHz with 500 kHz resolution Note that, in instruments with Options B2X or B5X, the Arbitrary IF Output is only

Source	SCPI	Notes
		practical when the IF Bandwidth is <= 40 MHz, IF Path is <= 40 MHz, or FFT Width is <= 40 MHz
Fast Log Video	LOGVideo	The 2nd IF output is passed through a log amp and the log envelope of the IF signal is sent to the rear panel. The open circuit output level varies by about 25 mV per dB, with a top-of-screen signal producing about 1.6 Volts. The output impedance is nominally 50 ohms This mode is intended to meet the same requirement as Option E4440A-H7L Fast Rise Time Video Output on E4440A PSA Series, allowing you to characterize pulses with fast rise times using standard measurement suites on modern digital scopes

Notes on the Aux IF Outputs

Second IF

Does not appear unless Option CR3 is installed.

The frequency of the 2nd IF depends on the current IF signal path as shown in the table below:

IF Path Selected	Frequency of “Second IF” Output
10 MHz	322.5 MHz
25 MHz	322.5 MHz
40 MHz	250 MHz
85-160 MHz	300 MHz
255 MHz	750 MHz
510 MHz	877.1484375 MHz

The signal quality, such as signal to noise ratio and phase noise, are excellent in this mode.

Arbitrary IF

Does not appear unless Option CRP is installed.

The bandwidth of this IF output varies with band and center frequency, but is about 40 MHz at the -3 dB width. When the output is centered at lower frequencies in its range, signal frequencies at the bottom of the bandwidth will “fold”. For example, with a 40 MHz bandwidth (20 MHz half-bandwidth), and a 15 MHz IF center, a signal -20 MHz relative to the spectrum analyzer center frequency will have a relative response of about -3 dB with a frequency 20 MHz below the 15 MHz IF center. This -5 MHz frequency will fold to become a +5 MHz signal at the IF output. Therefore, lower IF output frequencies are only useful with known band-limited signals.

Fast Log Video

Does not appear unless Option ALV is installed.

The output is off during an alignment but not during a marker count, and is not blanked during retrace (after a sweep and before the next sweep starts).

6.7.8 Arbitrary IF Freq

Sets the frequency of the Arbitrary IF when "Aux IF Out" on page 2447 is set to `AIF`.

NOTE **In instruments with Options B2X or B5X, the Arbitrary IF Output is only practical when the IF Bandwidth is <= 40 MHz, IF Path is <= 40 MHz, or FFT Width is <= 40 MHz.**

Remote Command	`:OUTPut:AUX:AIF <value>` `:OUTPut:AUX:AIF?`
Example	`:OUTP:AUX:AIF 50 MHZ`
Dependencies	Only appears if "Aux IF Out" on page 2447 is `AIF`
Preset	Unaffected by a Preset, but set to 70 MHz by **Restore Input/Output Defaults** or **Restore System Defaults->All**
State Saved	Saved in Input/Output State
Min	10 MHz
Max	75 MHz

6.7.9 Ext/Wide IF Out

Causes the signal that is normally routed to the IF to be routed instead to the **Ext IF Out** connector on the rear panel (N9041B) or **Wide IF Out** connector on the front panel (N9042B) or rear panel (N9032B). This is available in N9041B when RF Input 2 is the selected input port and in N9032B/N9042B on RF Input and, when V3050A is attached, External RF Input.

Only one IF output (**Ext/Wide IF Out**, IF2 Out, or Aux IF Out) can be selected at a time, so switching Ext/Wide IF Out to `ON` changes IF2 Out and Aux IF Out to `OFF`, and setting Aux IF Out to something other than `OFF` or IF2 Out to `ON` forces Ext/Wide IF Out to `OFF`.

Remote Command	`:OUTPut:EIF ON | OFF | 1 | 0` `:OUTPut:EIF?`
Example	`:OUTP:EIF ON`
Dependencies	Only appears in N9041B, N9032B, and N9042B For N9041B, enabled when RF Input 2 is the selected input. When RF Input 2 is not selected, the control is grayed out and forced to Off and attempting to set it On will result in an error message

	For N9032B/N9042B, enabled on RF Input and on External RF Input when V3050A is attached When this switch is ON, no measurement is displayed, and the error “No result; meas invalid with Ext/Wide IF Out set to On” appears in the Status bar
Preset	OFF Not affected by **Mode Preset**, but set to OFF by **Input/Output Preset**
State Saved	Saved in Input/Output state
Annotation	None (but error message appears when on)
Status Bits/OPC dependencies	`STATus:QUEStionable:INTegrity` bit 1 is set when **Ext/Wide IF Out** is ON. This indicates an error, because no valid data is on the screen or available via SCPI. However, the signal at the **Ext/Wide IF Out** port is still valid given the other settings

6.7.10 IF2 Out

Causes the signal that is normally routed to the IF, when the 1 GHz IF Path is selected, to be routed instead to the **IF2 Out** connector on the rear panel.

Only one IF output (Ext IF Out, **IF2 Out**, or Aux IF Out) can be selected at a time, so switching IF2 Out to On changes Ext IF Out and Aux IF Out to Off, and setting Aux IF Out to something other than Off or Ext IF Out to On forces IF2 Out to Off.

This control only appears if Option H1G is installed. It is only available when the 1 GHz IF Path is chosen, either directly or indirectly. In all other paths it is visible but grayed out and forced to Off. Attempting to set it On when the 1GHz path is not selected generates an error.

– Direct selection of the 1 GHz path: Measurements that directly support the 1 GHz path have a 1 GHz selection in the IF Path menu in Meas Setup

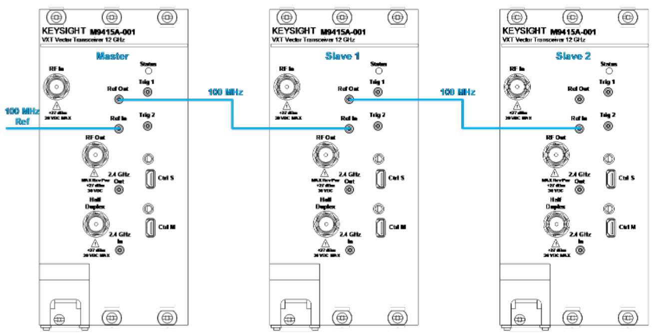
– Indirect selection of the 1 GHz path: certain measurements, like CCDF, always choose the widest available path, and so will choose the 1 GHz path if it is available, even if there is no IF Path menu in the measurement. IF2 Out will be visible when this results in the 1 GHz path being selected, even if there is no control or readout indicating that the 1 GHz path is chosen

Remote Command	`:OUTPut:IF2 ON | OFF | 1 | 0` `:OUTPut:IF2?`
Example	`:OUTP:IF2 ON`
Dependencies	Only appears in UXA and only when Option HIG is installed When this is ON, no measurement is displayed, and the error “No result; meas invalid with IF2 Out set to On” appears in the Status bar
Preset	OFF Not affected by Mode Preset but set to OFF by Input/Output Preset
State Saved	Saved in Input/Output state

Annotation	None (but error message appears when on)
Status Bits/OPC dependencies	`STATus:QUEStionable:INTegrity` bit 1 is set when IF2 Out is `ON`. This indicates an error, because no valid data is on the screen or available via SCPI. However, the signal at the **IF2 Out** port is still valid given the other settings

6.7.11 REF Out

Lets you toggle the state of REF Out. The REF Out port is designed for MIMO, which provides the reference daisy chain for the Primary and Secondary modules.



Remote Command	`:OUTPut:EREFerence:OUTPut ON | OFF | 1 | 0` `:OUTPut:EREFerence:OUTPut?`
Example	`:OUTP:EREF:OUTP ON` `:OUTP:EREF:OUTP?`
Notes	Used to route the 100 MHz reference signal on the REF In port to the REF Out port
Dependencies	Only available in VXT models M9415A/16A and M9415E/16E when **Freq Ref Input** is External, and **Ext Ref Freq** is 100 MHz
Preset	`OFF`
Range	`ON|OFF`

6.7.12 LO Ref Out

Turns the LO Reference Signal Out on or off. **LO Ref Out** is used to provide reference daisy chain in MIMO or Phase Coherency.

For VXT models M9410A/11A, controls the **4.8 GHz Out** port on the front panel. Setting it ON outputs a 4.8 GHz reference signal.

Remote Command	`:OUTPut:ROSCillator:LO:OUTPut ON | OFF | 1 | 0` `:OUTPut:ROSCillator:LO:OUTPut?`
Example	`:OUTP:ROSC:LO:OUTP ON` `:OUTP:ROSC:LO:OUTP?`
Dependencies	Only available in VXT models M9410A/11A/15A/16A and M9410E/11E/15E/16E
Preset	`OFF`

6.8 Trigger Output

Accesses controls that configure the **Trigger Output** settings.

6.8.1 Trig 1 – 4 Out

Selects the type of output signal that will be output from the available **Trig n Out** connectors, where **n** = 1, 2, 3, or 4.

Some instruments do *not* support **Trig 2 Out** through **Trig 4 Out** outputs, nor their associated controls.

For most instruments, **Trig 1 Out** applies to the connector labeled **Trigger 1**, but for VXT model M9420A, it is labeled **Trigger 4**.

The front panel includes separate controls for each available trigger: **Trig 1 Out** – **Trig 4 Out**. The remote command can be used for *any* of the **Trig n Out** connectors, by specifying the appropriate parameter (for example `TRIG1`, `TRIG2`, etc.).

NOTE **Option `TARMed` is *not* available in modular instruments.**

Remote Command	`:TRIGger[1]|2|…|4[:SEQuence]:OUTPut HSWP | MEASuring | MAIN | GATE | GTRigger | OEVen | TARMed | SPOint | S1Marker | S2Marker | S3Marker | S4Marker | PARB | FSYNc | OFF`
	See "Trigger Out Options" on page 2454
	`:TRIGger[1]|2|…|4[:SEQuence]:OUTPut?`

Example	`:TRIG:OUTP HSWP` `:TRIG2:OUTP GATE`
Notes	**Trig 2 Out** is used as the source trigger out in EXM and VXT model M9420A The available choices in EXM and VXT model M9420A are `S1Marker`, `S2Marker`, `S3Marker`, `S4Marker` and `OFF` For Power Amplifier Mode, **Trig 2 Out** is set to Source Marker2 when **Burst Shape & Mask** is `ON`. In this case, **Trigger 2** is used to output PA Enable Mask
Dependencies	**Trig 2 Out** through **Trig 4 Out** are not supported in all models. In models that do not support them, the **Trig n Out** control is blanked, and sending the SCPI command for this output generates an error, "Hardware missing; Not available for this model number" Querying **Trig 2 Out** through **Trig 4 Out** in models that do not support them returns `OFF` For VXT models M9410A/11A/15A/16A and M9410E/11E/15E/16E: – When **Trig n Out Device** is `ANALyzer`, only `MEASuring`, `MAIN` and `OFF` are available – When **Trig n Out Device** is `SOURce`, only `S1Marker`, `S2Marker`, `S3Marker`, `S4Marker`, `PARB`, `FSYNc` and `OFF` are available

	For VXT model M9421A, **Trig 2 Out** is used as the Analyzer trigger output
Preset	Unaffected by Preset, but preset to the following values by **Restore Input/Output Defaults** or **Restore System Defaults->All**: Trigger 1: Sweeping (HSWP) Trigger 2: Gate Trigger 3: Sweeping (HSWP) Trigger 4: Gate
State Saved	Saved in instrument state

Trigger Out Options

Source	SCPI	Notes
Off	OFF	Selects no signal to be output to the **Trig n Out** connector
Sweeping	HSWP	Selects the Sweeping Trigger signal to be output to the **Trig n Out** connector when a measurement is made This signal has historically been known as HSWP (High = Sweeping), and is 5 V TTL level with 50 **Ω** output impedance
Measuring	MEASuring	Selects the Measuring trigger signal to be output to the **Trig n Out** connector. This signal is true while the Measuring status bit is true
Main Trigger	MAIN	Selects the current instrument trigger signal to be output to the **Trig n Out** connector Note: For multi segment sweeps, only the first sweep segment uses the selected trigger signal. All other sweep segments trigger using Free-Run and the trigger output will reflect that
Gate Trigger	GTRigger	Selects the gate trigger signal to be output to the **Trig n Out** connector. This is the source of the gate timing, not the actual gate signal
Gate	GATE	Selects the gate signal to be output to the **Trig n Out** connector. The gate signal has been delayed and its length determined by delay and length settings. When the polarity is positive, a high on the **Trig n Out** connector represents the time the gate is configured to pass the signal
Odd/Even Trace Point	OEVen	Selects either the odd or even trace points as the signal to be output to the **Trig n Out** connector when performing swept spectrum analysis. When the polarity is positive, this output goes high during the time the instrument is sweeping past the first point (Point 0) and every other following trace point. The opposite is true if the polarity is negative
Trigger Armed	TARMed	Selects the “trigger armed” trigger signal to be output to the **Trig n Out** connector. This signal is true when the instrument reaches its trigger armed state *Not* available in modular instruments
Source Point Trigger	SPOint	Selects the gate signal to be output to the **Trig n Out** connector for use as the Point Trigger when operating an external source in Tracking mode. When Ext Trigger 1 is

Source	SCPI	Notes
		selected as the Point Trigger under **Source**, the Source Point Trigger under **Trig 1 Out** automatically gets selected. A similar pattern is used for the other Ext Trigger inputs; for example, when Ext Trigger 2 is selected as the Point Trigger under **Source**, the Source Point Trigger under **Trig 2 Out** automatically gets selected
Source Marker 1	`S1Marker`	Only available in VXT and M941xE. For M9420A, only for `TRIG2`, for M9410A/11A/15A/16A available for both `TRIG1` and `TRIG2` Selects the Trigger Output at Marker 1 in the Waveform file that is currently playing
Source Marker 2	`S2Marker`	Only available in VXT and M941xE. For M9420A, only for `TRIG2`, for M9410A/11A/15A/16A and M9410E/11E/15E/16E available for both `TRIG1` and `TRIG2` Selects the Trigger Output at Marker 2 in the Waveform file that is currently playing
Source Marker 3	`S3Marker`	Only available in VXT and M941xE. For M9420A, only for `TRIG2`, for M9410A/11A/15A/16A and M9410E/11E/15E/16E available for both `TRIG1` and `TRIG2` Selects the Trigger Output at Marker 3 in the Waveform file that is currently playing
Source Marker 4	`S4Marker`	Only available in VXT and M941xE. For M9420A, only for `TRIG2`, for M9410A/11A/15A/16A and M9410E/11E/15E/16E available for both `TRIG1` and `TRIG2` Selects the Trigger Output at Marker 4 in the Waveform file that is currently playing
PerArb	`PARB`	Only available in VXT Models M9410A/11A/15A/16A and M9410E/11E/15E/16E Selects the Trigger Output as PerArb. PerArb is a synchronization trigger which is generated by the ARB at the beginning of each repetition of playing the signal

FSYNc	`FSYNc`	Only available in VXT Models M9410A/11A/15A/16A and M9410E/11E/15E/16E
		Selects the Trigger Output as `FSYNc`, routing the Periodic Timer Sync Source signal to the specified Trigger output. That is, the signal selected by `:TRIGger[:SEQuence]:FRAMe:SYNC` is routed to the specified trigger output
		The following example specifies that External 1 trigger will be used as the Periodic Timer Sync Source, and this signal will then be routed to the **Trigger 2** output:
		`TRIG:FRAM:SYNC EXT1`
		`TRIG2:OUTP FSYNc`

–

6.8.2 Trig 1 – 4 Out Polarity

Sets the output to the **Trig n Out** connector to trigger on either the positive or negative polarity.

Remote Command	`:TRIGger[1]|2|…|4[:SEQuence]:OUTPut:POLarity POSitive | NEGative` `:TRIGger[1]|2|…|4[:SEQuence]:OUTPut:POLarity?`
Example	`:TRIG1:OUTP:POL POS`

Dependencies	You can only send TRIG parameters for the hardware you have; for example, you cannot send a TRIG3 parameter if your hardware does not support TRIG3. Sending the command for an output you do not have generates an error, "Hardware missing; Not available for this model number" Querying a non-existent output returns OFF **Trig 2 Out Polarity** does not appear in EXM or VXT
Preset	Unaffected by Preset, but set to POSitive by **Restore Input/Output Defaults** or **Restore System Defaults->All**
State Saved	Saved in instrument state

6.8.3 Trig 1 – 4 Out Device

Sets the output to the **Trig n Out** connector to trigger on either ANALyzer or SOURce.

Remote Command	`:TRIGger[1]|2|…|4[:SEQuence]:OUTPut:DIRection ANALyzer	SOURce` `:TRIGger[1]|2|…|4[:SEQuence]:OUTPut:DIRection?`
Example	`:TRIG1:OUTP:DIR ANAL`
Dependencies	Only available on VXT models M9410A/11A/15A/16A and M9410E/11E/15E/16E
Preset	Unaffected by Preset **Restore Input/Output Defaults** and **Restore System Defaults->All** preset the triggers as follows: **Trig n Out Device** / **Preset**: 1, 3, 4 — ANALyzer 2 — SOURce
State Saved	Saved in instrument state

6.8.4 Src PXI Trig Out

Selects which signal will be routed to the backplane Source PXI Trigger Output Line.

Remote Command	`:TRIGger:PXIE:SOURce[:SEQuence]:OUTPut S1Marker	S2Marker	S3Marker	S4Marker	PARB	OFF` See "Option details" on page 2457 `:TRIGger:PXIE:SOURce[:SEQuence]:OUTPut?`
Example	`:TRIG:PXIE:SOUR:OUTP S1M` `:TRIG:PXIE:SOUR:OUTP?`
Dependencies	Only appears in EXM, VXT and M941xE
Preset	OFF
State Saved	Saved in instrument state

Option details

Here are details of all Source PXI Trigger Output options:

Source	SCPI	Notes
Off	OFF	Selects no signal to be output to the Source PXI backplane line
Source Marker 1	S1Marker	Selects the Trigger Output at Marker 1 in the Waveform file that is currently playing to be output to the Source PXI backplane line
Source Marker 2	S2Marker	Selects the Trigger Output at Marker 2 in the Waveform file that is currently playing to be output to the Source PXI backplane line
Source Marker 3	S3Marker	Selects the Trigger Output at Marker 3 in the Waveform file that is currently playing to be output to the Source PXI backplane line
Source Marker 4	S4Marker	Selects the Trigger Output at Marker 4 in the Waveform file that is currently playing to be output to the Source PXI backplane line
PerArb	PARB	A synchronization trigger that is generated by the ARB at the beginning of each repetition of playing the signal. This selection causes the PerArb Trigger Output that is currently playing to be output to the Source PXI backplane line Only available in VXT Models M9410A/11A/15A/16A and M9410E/11E/15E/16E

6.8.5 Src Trig Out Polarity

Sets the output to the Source PXI backplane trigger line to trigger on either the positive or negative polarity.

Remote Command	`:TRIGger:PXIE:SOURce[:SEQuence]:OUTPut:POLarity POSitive | NEGative` `:TRIGger:PXIE:SOURce[:SEQuence]:OUTPut:POLarity?`
Example	`:TRIG:PXIE:SOUR:OUTP:POL POS`
Dependencies	Only appears in EXM, VXT and M941xE
Preset	Unaffected by Preset, but set to `POSitive` by **Restore Input/Output Defaults** or **Restore System Defaults->All**
State Saved	Saved in instrument state

6.8.6 Select Src PXI Line

Controls which backplane trigger line `TRIG[0…7]` is used for the Source Trigger Output.

Remote Command	`:TRIGger:PXIE:SOURce[:SEQuence]:OUTPut:LINE <line>` `:TRIGger:PXIE:SOURce[:SEQuence]:OUTPut:LINE?`

Example	`:TRIGger:PXIE:SOURce:OUTPut:LINE 0`
Dependencies	Only appears in EXM, VXT and M941xE
Preset	4
State Saved	Saved in instrument state
Range	[0,7]

6.8.7 Analyzer PXI Trig Out

Selects the signal that will be output from Analyzer PXI Trigger Line (Backplane Trigger Line 0~3).

Remote Command	`:TRIGger:PXIE:ANALyzer[:SEQuence]:OUTPut HSWP | MEASuring | MAIN | GATE | GTRigger | OEVen | OFF`
	See "Option Details" on page 2458
	`:TRIGger:PXIE:ANALyzer[:SEQuence]:OUTPut?`

Example	`:TRIG:PXIE:ANAL:OUTP HSWP`
Dependencies	Only available on certain modular analyzers, such as CXA-m, VXT models M9410A/11A/15A/16A and M9410E/11E/15E/16E For VXT models M9410A/11A/15A/16A, only `OFF`, `MEASuring` and `MAIN` are available
Preset	Unaffected by **Preset** but is preset to `OFF` by **Restore Input/Output Defaults** or **Restore System Defaults->All**
State Saved	Saved in instrument state

Option Details

Here are details of all Analyzer PXI Trigger Output options:

Source	SCPI	Notes
Off	`OFF`	Selects no signal to be output to the Analyzer PXI backplane trigger line
Sweeping (HSWP)	`HSWP`	Selects the Sweeping Trigger signal to be output to the Analyzer PXI backplane trigger line when a measurement is made. This signal has historically been known as "HSWP" (High = Sweeping), and is 5 V TTL level with 50-ohm output impedance
Measuring	`MEAS`	Selects the Measuring trigger signal to be output to the Analyzer PXI backplane trigger line. This signal is true while the Measuring status bit is true
Main Trigger	`MAIN`	Selects the current instrument trigger signal to be output to the Analyzer PXI backplane trigger line
Gate Trigger	`GTR`	Selects the gate trigger signal to be output to the Analyzer PXI backplane trigger line. This is the source of the gate timing, not the actual gate signal
Gate	`GATE`	Selects the gate signal to be output to the Analyzer PXI backplane trigger line. The gate signal has been delayed and its length determined by delay and length settings. When the

Source	SCPI	Notes
		polarity is positive, a high on the Trig Out connector represents the time the gate is configured to pass the signal
Odd/Even Trace Point	OEV	Selects either the odd or even trace points as the signal to be output to the Analyzer PXI backplane trigger line when performing swept spectrum analysis. When the polarity is positive, this output goes high during the time the instrument is sweeping past the first point (Point 0) and every other following trace point. The opposite is true if the polarity is negative

6.8.8 Analyzer Trig Out Polarity

Sets the output to the Analyzer PXI backplane trigger line to trigger on either the positive or negative polarity.

Remote Command	`:TRIGger:PXIE:ANALyzer[:SEQuence]:OUTPut:POLarity POSitive | NEGative` `:TRIGger:PXIE:ANALyzer[:SEQuence]:OUTPut:POLarity?`
Example	`:TRIG:PXIE:ANAL:OUTP:POL POS`
Dependencies	Only available on certain modular analyzers, such as CXA-m, VXT models M9410A/11A/15A/16A and M9410E/11E/15E/16E
Preset	Unaffected by Preset, but set to `POSitive` by **Restore Input/Output Defaults** or **Restore System Defaults->All** `POSitive`
State Saved	Saved in instrument state

6.8.9 Select Analyzer PXI Line

Controls which `PXI_TRIG[0…3]` is used for the Analyzer Trigger Output.

Remote Command	`:TRIGger:PXIE:ANALyzer[:SEQuence]:OUTPut:LINE <line>` `:TRIGger:PXIE:ANALyzer[:SEQuence]:OUTPut:LINE?`
Example	`:TRIGger:PXIE:ANALyzer:OUTPut:LINE 0`
Dependencies	Only available on certain modular analyzers, such as CXA-m, VXT models M9410A/11A/15A/16A and M9410E/11E/15E/16E
Preset	0
State Saved	Saved in instrument state
Range	[0,3]

6.8.10 Source Internal Trig Out

Selects the signal which will be output from Source Internal Trigger Line.

NOTE In some software released in 2018 and 2019, the SCPI command for this function was as below:

`:TRIGger:SOURce:INTernal[:SEQuence]:OUTPut S1Marker|S2Marker|S3Marker|S4Marker|OFF`

It was necessary to change this SCPI in release A.24.00 due to internal conflicts in the software. User code written for the A.22.xx or A.23.xx instrument software which used the old form must be rewritten to use the form below.

Remote Command	`:TRIGger[:SEQuence]:INTernal:SOURce:OUTPut S1Marker | S2Marker | S3Marker | S4Marker | PARB | OFF` `:TRIGger[:SEQuence]:INTernal:SOURce:OUTPut?`
Example	`:TRIG:INT:SOUR:OUTP S1M`
Notes	`PARB` (Per ARB) -A synchronization trigger that is generated by the ARB at the beginning of each repetition of playing the signal
Dependencies	Only available on VXT models M9420A, M9410A/11A/15A/16A and M9410E/11E/15E/16E
Preset	Unaffected by Preset but preset by **Restore Input/Output Defaults** or **Restore System Defaults->All**. The value is Mode-dependent: Power Amplifier Mode: `S1Marker` All other Modes: `OFF`
State Saved	Saved in instrument state

6.8.11 Source Internal Trig Out Polarity

Sets the output to the Source Internal trigger line to trigger on either the positive or negative polarity.

NOTE In some software released in 2018 and 2019, the SCPI command for this function was as below:

`:TRIGger:SOURce:INTernal[:SEQuence]:OUTPut:POLarity POSitive|NEGative`

It was necessary to change this SCPI in release A.24.00 due to internal conflicts in the software. User code written for the A.22.xx or A.23.xx instrument software which used the old form must be rewritten to use the form below.

Remote Command	`:TRIGger[:SEQuence]:INTernal:SOURce:OUTPut:POLarity POSitive | NEGative` `:TRIGger[:SEQuence]:INTernal:SOURce:OUTPut:POLarity?`
Example	`:TRIG:INT:SOUR:OUTP:POL POS`
Dependencies	Only available on VXT models and M9410E/11E/15E/16E
Preset	Unaffected by **Preset**, but set to `POSitive` by **Restore Input/Output Defaults** or **Restore System**

	Defaults->All
State Saved	Saved in instrument state

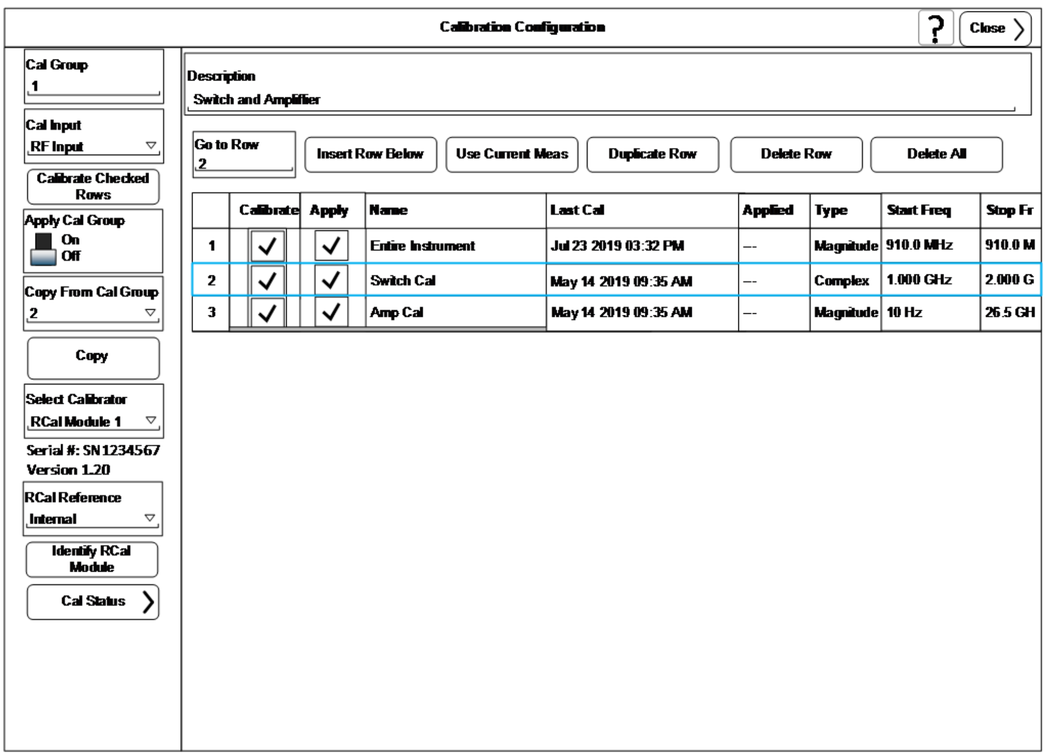
6.9 Calibration

Lets you configure the Comb Calibrator. This tab only appears when an RCal license is installed. Settings associated with the Calibrator are configured here.

6.9.1 Configuration

Opens the dialog shown below. This is a full screen dialog. Configuring of Cals is done using this dialog. The table consists of rows of Cals and Columns of Cal settings. You can scroll or swipe vertically or horizontally to view Cals or settings not currently shown on the screen.

Dialog with Example Table entries:



Full Cal Group Table with Example entries:

RCal Calibrations Table

Table will scroll vertically and horizontally

	Calibrate	Apply	Name	Last Cal	Applied	External Mixer	Cal Type
1	✓	✓	Entire Instrument	Aug 30 2018 03:32 PM	Yes	11970A : Normal	Vector
2	✓	✓	Wednesday with remote head	Sep 1 2018 02:27 PM	No	Custom : Normal	Vector
3	✓	✓	20190119 3:54pm	---	---	11970U : Normal	Vector
4			1 GHz – 3 GHz	---	---	11970V : Normal	Scalar
5			2 GHz – 4 GHz	---	---	K Band Single Harmonic No Doubler : Normal	Scalar
6			External Preamp	---	---	W Band Single Harmonic No Doubler : Normal	Scalar
7			(None)				
8			(None)				
9			(None)				
10			(None)				

Only shows when External Mixer is the selected Cal Input

Scalar
Vector

Start Freq	Stop Freq	Freq Step	Freq Points	Mech Atten	Mech Atten Start	Mech Atten Stop	Mech Atten Step	Elec Atten	Elec Atten Start
910.0 MHz	910.0 MHz	0 Hz	1	Step	0 dB	10 dB	2 dB	Step	0 dB
1.000 GHz	2.000 GHz	100.000 MHz	100	Reference	10 dB	10 dB	0 dB	Bypass	0 dB
10 Hz	26.5 GHz	0 Hz	3	All	0 dB	70 dB	2 dB	All	0 dB
1.000 GHz	3.000 GHz	100.00 MHz	20	Step	10 dB	50 dB	10 dB	Step	10 dB
2.000 GHz	4.000 GHz	10.000 MHz	200	Bypass	0 dB	70 dB	2 dB	All	0 dB
2.000 GHz	2.000 GHz	0 Hz	1	Reference	10 dB	10 dB	0 dB	Reference	10 dB

Step
All
Bypass

Step
All
Bypass

Elec Atten Stop	Elec Atten Step	Full Atten	Full Atten Start	Full Atten Stop	Freq Ext Atten	Freq Ext Atten Start	Freq Ext Atten Stop	IF Path
10 dB	5 dB	Step	0 dB	6 dB	Step	0 dB	6 dB	10 MHz
0 dB	0 dB	All	0 dB	0 dB	All	0 dB	0 dB	510 MHz
24 dB	1 dB	All	0 dB	20 dB	All	0 dB	20 dB	25 MHz
20 dB	2 dB	Step	6 dB	20 dB	Step	6 dB	20 dB	10 MHz
24 dB	1 dB	All	0 dB	24 dB	All	0 dB	24 dB	25 MHz
100 dB	0 dB	All	100 dB	100 dB	All	100 dB	100 dB	40 MHz

Step
All

Step
All

10 MHz
25 MHz
40 MHz
510 MHz
1 GHz
2 GHz
4 GHz

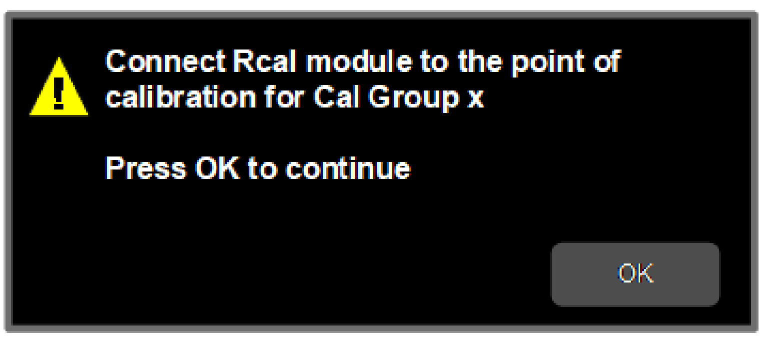
6.9.1.1 Cal Group

This is the same as "Cal Group" on page 2497 in the **Calibration** tab.

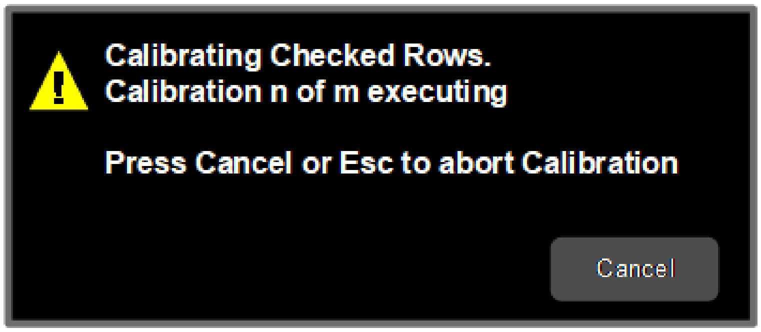
6.9.1.2 Calibrate Checked Rows

Executes the Cals within the currently selected Cal Group that have the **Calibrate** box checked in the RCal Configuration Table.

Once selected, the following dialog box is displayed;



When you click **OK**, the following dialog is displayed;



If there are multiple Cals being executed in a Cal Group, this dialog advises you when each Cal is complete. It also provides the ability to abort the Execute Cal Request.If you choose to abort, calibrations that have completed use the new Cal data and update the Last Cal field. Calibrations that have not completed retain the existing Cal data and Last Cal timestamp, or show “---” if the Cal had never been executed.

Remote Command	`:SYSTem:CALibration:INITiate:SELected`
Example	`:SYST:CAL:INIT:SEL`
Notes	Cals cannot be applied until they have been calibrated. Once a Cal has been calibrated, the Last Cal field in the table displays the date and time the Cal was last calibrated
Dependencies	Applied to the currently selected Cal Group
Couplings	**Calibrate Selected** is disabled if there are no Calibrate checkboxes checked. If the disabled control is selected, the advisory message “Check the Calibrate box for the Cals you want to calibrate” is displayed

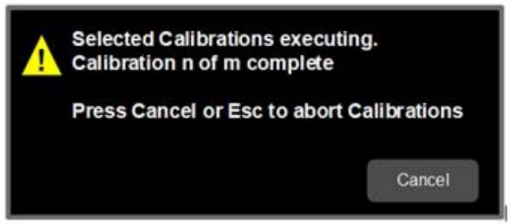
6.9.1.3 Apply Cal Group

This is the same as "Apply Cal Group" on page 2497 in the **Calibration** tab.

6.9.1.4 Abort Calibration

Aborts the Calibration routine of the currently selected Cal Group

Remote Command	`:SYSTem:CALibration:ABORt`
Example	`:SYST:CAL:ABOR`
Dependencies	Aborts the currently running calibration. The previously-run calibrations will still be available, but the current calibration is halted, and next calibrations selected are not executed. Once the calibration starts, the modal dialog appears, and the abort can be executed by selecting **Cancel**



6.9.1.5 Copy From Cal Group

Determines the Cal Group from which existing rows are copied when using the "Copy" on page 2466**Group** feature.

Remote Command	`:SYSTem:CALibration:CGRoup:COPY:FROM <integer>` `:SYSTem:CALibration:CGRoup:COPY:FROM?`
Example	`:SYST:CAL:CGR:COPY:FROM 2` `:SYST:CAL:CGR:COPY:FROM?`
Preset	1
Min	1
Max	100

6.9.1.6 Copy

Lets you copy the settings in the Cal Group specified by the **Copy From Cal Group** parameter.

All the rows in the table are copied to the selected Cal Group. The columns **Apply**, **Last Cal** and **Applied** are set to their default values.

The group level parameters are also copied, with the exception of **Apply Cal Group** and **Copy From Cal Group**.

Remote Command	`:SYSTem:CALibration:CGRoup:COPY`
Example	`:SYST:CAL:CGRoup:COPY`
Dependencies	Applied to the currently selected Cal Group
Couplings	Disabled if **Copy From Cal Group** is the same as the currently selected Cal Group. If the disabled control is selected, the advisory message “Unable to Copy from same Cal Group” is displayed, and the same message is returned remotely as a Settings Conflict If you attempt to copy from a Cal Group that is empty, the advisory message “Copy From Cal Group is empty” is displayed, and the same message is returned remotely as a Settings Conflict

6.9.1.7 Cal Input

Maps the currently selected Cal Group to a particular I/O port. This control allows any Input port (including External Mixing, the RF2 input, etc.) to be mapped to a specific Cal Group

Remote Command	`:SYSTem:CALibration:INPut RFIN | RFIN2 || EMIXer | ERFIN`
	See "Option Details" on page 2467
	`:SYSTem:CALibration:INPut?`

Example	`:SYST:CAL:INPut RFIN2`
Dependencies	`RFIN2|EMIXer` are only available on C/E/M/P/UXA analyzers with the appropriate options loaded `ERFIN` is only available if a V3050A unit is connected
State Saved	Saved in State

Option Details

Note that the presence of these ports is highly hardware dependent.

Cal Input	SCPI	Notes
RF Input	`RFIN`	Main RF Port Not available on EXM with hardware M9431A
RF Input 2	`RFIN2`	Second RF Port, labeled RF Input 2 Only available on certain instruments
External Mixer	`EMIX`	Requires option EXM
External RF	`ERFIN`	Only available if a V3050A unit is connected

6.9.1.8 Freq Offset

Specifies any frequency offset that is to be applied to the currently selected Cal Group. This can be used when using an external mixer.

Remote Command	`:SYSTem:CALibration:FREQuency:OFFSet <freq>` `:SYSTem:CALibration:FREQuency:OFFSet?`
Example	`:SYST:CAL:FREQ:OFFS 1e9`
Dependencies	The query applies to the currently selected Cal Group
Preset	All 0 Hz
State Saved	Saved in instrument state
Min	0 Hz
Max	100.0 GHz

6.9.1.9 Select Calibrator

Selects the calibrator for the currently selected Cal Group to use for executing the calibration when multiple modules are connected.

Remote Command	`:SYSTem:CALibration:MODule:SELect NONE | RCM1 | RCM2 | RCM3 | RCM4 | RCM5 | RCM6 | RCM7 | RCM8 | RCM9 | RCM10` `:SYSTem:CALibration:MODule:SELect?`
Example	`:SYST:CAL:MODule:SELect RCM1`
Notes	Details of the RCal module are displayed beneath the control. If there are no modules connected, the text states “No Modules Connected” For SCPI, if the parameter sent is for a module that is not currently connected to the instrument, the message “Selected RCal module not connected” is generated
Dependencies	The SCPI command is applied to the currently selected Cal Group
State Saved	Saved in instrument state
Range	All connected RCal modules

6.9.1.10 Identify RCal Module

Control to connect to the RCal module of the currently selected Cal Group and blink its identity light

6.9.1.11 RCal Module Serial Number (Remote Query Only)

Returns the serial number of the specified module

Remote Command	`:SYSTem:CALibration:MODule[1]|2|...|10:SNUMber?`
Example	`:SYST:CAL:MOD:SNUM?`
Notes	If there is no module associated with the specified module number, returns an empty string

6.9.1.12 RCal Reference

Determines the reference type used by the RCal module of the currently selected Cal Group

Remote Command	`:SYSTem:CALibration:REFerence INTernal | EXTernal` `:SYSTem:CALibration:REFerence?`
Example	`:SYST:CAL:REF EXT`
Dependencies	The SCPI command is applied to the currently selected Cal Group

Preset	`EXTernal`
State Saved	Saved in instrument state
Range	`INTernal|EXTernal`

6.9.1.13 RCal Status

Opens a dialog that is used to provide the status of all active rows in all groups. Status can be one of the following: Calibrated, Applied, Calibration Failed or Apply Failed.

If a Calibration Fails, an error icon is shown in the **Calibrate** column of the row(s) that failed, with a message indicating the nature of the failure. If the failure cannot be addressed by the user, the error message “Calibration Failed. See Error Log” will be shown and details of the failure will be written to the SA Event Log.

Applying the Calibration can result in a warning if there is a mismatch between the currently executing instrument state and any of the following parameter settings;

- Cal Input
- Frequency
- IF Path
- IF Gain
- Phase Noise Optimization
- Preamp
- Coupling
- Mechanical Attenuator
- Electrical Attenuator
- Full Range Attenuator
- uW Path Control
- Mixing Mode
- External Mixer

When there is a mismatch a warning icon will be shown in the Applied column of the row(s) that had the mismatch with details in the format “<Parameter Name> does not match meas state”.

The Status dialog provides you with the group and row of a Calibration and its current state and any error details if the status is not OK.

RCal Status (Remote Query Only)

Returns a comma-separated list of the status of an individual row status in the format “Group”, “Row”, ‘Status’, “Details”

Remote Command	`:SYSTem:CALibration:ROW[1]|2|…|100:STATus?`
Example	Return a comma-separated list for the status of an individual row, in the format “Group”, “Row”, ‘Status’, “Details”: `:SYST:CAL:ROW2:STAT?`
Dependencies	The SCPI command is applied to the currently selected Cal Group. The subopcode is used to identify the Cal row in the Cal Group If the subopcode does not reference an existing Cal row in the Cal Group, the error message “-221, Settings conflict; Subopcode does not reference an existing Cal row” is generated

All RCal Status (Remote Query Only)

Returns a comma-separated list of all entries in the Cal Status table in the format “Group”, “Row”, ‘Status’, “Details”, which is repeated for each row in the table. If there are no entries in the table, returns an empty string.

Remote Command	`:SYSTem:CALibration:STATus:ALL?`
Example	Return a comma-separated list of all entries in the Cal Status table in the format “Group”, “Row”, ‘Status’, “Details”, repeated for each row in the table: `:SYST:CAL:STAT:ALL?`

6.9.1.14 Go to Row

Sets the selected row in the Cal table for the currently selected Cal Group.

Notes	You can only go to a row that has already been added
Preset	1
State Saved	Saved in instrument state
Min	1
Max	32

6.9.1.15 Insert Row Below

Adds a new row to the currently selected Cal Group, under the currently selected row in the table or after the sub opcode used in the SCPI command. The default values for each of the settings in the row is used.

Remote Command	`:SYSTem:CALibration:ROW[1]|2|…|100:INSert`
Example	`:SYST:CAL:ROW2:INSert`
Dependencies	The SCPI command is applied to the currently selected Cal Group. The subopcode is used to identify the Cal row in the Cal Group If the subopcode does not reference an existing Cal row in the Cal Group, the error message "-221, Settings conflict; Subopcode does not reference an existing Cal row" is generated

6.9.1.16 Description

Provides a description for the currently selected Cal Group from which the operator can easily identify the Cal Group.

Remote Command	`:SYSTem:CALibration:DESCription "Description"` `:SYSTem:CALibration:DESCription?`
Example	`:SYST:CAL:DESC "Description"`
Notes	Also shown on the **Calibration** menu panel, but limited to the first 18 characters
Dependencies	The SCPI command is applied to the currently selected Cal Group
State Saved	Saved in instrument state

6.9.1.17 Use Current Meas

Takes the settings from the current running measurement state to populate the Cal Row settings of the currently selected Cal Group.

Remote Command	`:SYSTem:CALibration:ROW[1]|2|…|100:UCMeas`
Example	`:SYST:CAL:ROW2:UCM`
Dependencies	The SCPI command is applied to the currently selected Cal Group. The subopcode is used to identify the Cal row in the Cal Group If the group table is empty and subopcode is omitted or 1, a new row is created and populated using the current running measurement If the subopcode does not reference an existing Cal row in the Cal Group, the error message "-221,Settings conflict; Subopcode does not reference an existing Cal row" is generated Pressing the control or sending the SCPI command in measurements that do not support this parameter generates error -221, "Settings conflict; Feature not supported for this measurement"

6.9.1.18 Duplicate Row

Creates a new row the currently selected row, and populates the new row with the settings from the selected row of the currently selected Cal Group

Remote Command	`:SYSTem:CALibration:ROW[1]|2|…|100:DUPLicate`
Example	`:SYST:CAL:ROW2:DUPL`
Dependencies	The SCPI command is applied to the currently selected Cal Group. The subopcode is used to identify the Cal row in the Cal Group If the subopcode does not reference an existing Cal row in the Cal Group, the error message "-221,Settings conflict; Subopcode does not reference an existing Cal row" is generated

6.9.1.19 Delete Row

Deletes the settings from the selected row of the currently selected Cal Group

Remote Command	`:SYSTem:CALibration:ROW[1]|2|…|100:DELete`
Example	`:SYST:CAL:ROW2:DEL`
Notes	Disabled if the Cal Group contains no Cal rows
Dependencies	The SCPI command is applied to the currently selected Cal Group. The subopcode is used to identify the Cal row in the Cal Group If the subopcode does not reference an existing Cal row in the Cal Group, the error message "-221, Settings conflict; Subopcode does not reference an existing Cal row" is generated

6.9.1.20 Delete All

Deletes all the Cals in the currently selected Cal Group

Remote Command	`:SYSTem:CALibration:DELete:ALL`
Example	`:SYST:CAL:DEL:ALL`
Notes	Disabled if the Cal Group contains no Cal rows
Dependencies	The SCPI command is applied to the currently selected Cal Group

6.9.1.21 Calibrate

Determines whether the Cal row should be included when Calibrate Selected is executed.

Remote Command	`:SYSTem:CALibration:ROW[1]|2|…|100:CALibrate:STATe ON	OFF	1	0` `:SYSTem:CALibration:ROW[1]|2|…|100:CALibrate:STATe?`

Example	:SYST:CAL:ROW2:CAL:STAT ON :SYST:CAL:ROW2:CAL:STAT?
Dependencies	The SCPI command is applied to the currently selected Cal Group. The subopcode is used to identify the Cal row in the Cal Group If the subopcode does not reference an existing Cal row in the Cal Group, the error message "-221, Settings conflict; Subopcode does not reference an existing Cal row" is generated
Preset	All OFF
State Saved	Saved in instrument state
Range	ON|OFF

6.9.1.22 Apply

Determines the Cal that is applied.

Remote Command	:SYSTem:CALibration:ROW[1]|2|…|100:APPLy:STATe ON | OFF | 1 | 0 :SYSTem:CALibration:ROW[1]|2|…|100:APPLy:STATe?
Example	:SYST:CAL:ROW2:APPL:STAT ON :SYST:CAL:ROW2:APPL:STAT?
Dependencies	The SCPI command is applied to the currently selected Cal Group. The subopcode is used to identify the Cal row in the Cal Group If the subopcode does not reference an existing Cal row in the Cal Group, the error message "-221, Settings conflict; Subopcode does not reference an existing Cal row" is generated You can only check the **Apply** checkbox for a Cal that has been executed. If you attempt to select the **Apply** checkbox for Cal's that have not been executed, the advisory message "Cal must be executed before it can be applied" is displayed If Apply Cal is ON, and you attempt to check the **Apply** checkbox for a Cal that is invalid for use with the current measurement state, the error "Cal invalid with current measurement settings is shown, and the checkbox remains unchecked
Couplings	When the **Apply** check box is checked, if the Apply Cal Group setting is OFF, it will be turned on. Calibrations are only applied when the Apply Cal Group is ON
Preset	All OFF
State Saved	Saved in instrument state
Range	ON|OFF
Annotation	If *any* Cal check box in any group is checked and Apply Cal Group for that group is ON, RCal in the Meas Bar displays in amber to indicate Calibrations are in use

6.9.1.23 Name

Sets an ASCII text field allowing you to name the selected Cal

Remote Command	`:SYSTem:CALibration:ROW[1]|2|…|100:NAME <string>` `:SYSTem:CALibration:ROW[1]|2|…|100:NAME?`
Example	`:SYST:CAL:ROW2:NAM "Monday AM Cal"`
Notes	45 chars max; may not fit on display if max chars used
Dependencies	The SCPI command is applied to the currently selected Cal Group. The subopcode is used to identify the Cal row in the Cal Group If the subopcode does not reference an existing Cal row in the Cal Group, the error message “-221, Settings conflict; Subopcode does not reference an existing Cal row” is generated
Preset	“Cal #”, where # is corresponding Cal number
State Saved	Saved in instrument state

6.9.1.24 Last Cal

Displays the date and time the selected Cal was last executed. Read only field.

Remote Command	`:SYSTem:CALibration:ROW[1]|2|…|100:LAST?`
Example	Return data and time Cal 2 was last executed: `:SYST:CAL:ROW2:LAST?`
Notes	Returns a string containing the date and time the Cal was executed. If the Cal has never been executed, or any of the settings are changed, SCPI returns an empty string, and the front panel displays “---"
Dependencies	The SCPI query applies to the currently selected Cal Group If the subopcode does not reference an existing Cal row in the Cal Group, the error message “-221, Settings conflict; Subopcode does not reference an existing Cal row” is generated

6.9.1.25 Cal Applied

Displays the status of a Cal once it is applied. Is either Yes or No, depending on if the Cal was successfully applied or not. See RCalStatus for more details. If it is not being applied, the field shows “---". Read-only field.

Remote Command	`:SYSTem:CALibration:ROW[1]|2|…|100:CAPPlied?`
Example	Return Cal Stats of Cal 2: `:SYST:CAL:ROW2:CAPP?`
Notes	Returns a string containing the date and time the Cal was executed. If the Cal has never been executed, or any of the settings are changed, SCPI returns an empty string, and the front panel displays “---"
Dependencies	The SCPI query applies to the currently selected Cal Group If the subopcode does not reference an existing Cal row in the Cal Group, the error message “-221, Settings conflict; Subopcode does not reference an existing Cal row” is generated

6.9.1.26 Cal Type

Specifies how the calibration is to be performed on the selected Cal. Options are;

- `MAGNitude`: A single CW tone is measured at the center of the screen for each frequency point
- `COMPlex`: A comb signal is measured across the full IF passband at each frequency point. Magnitude and Phase are measured

Remote Command	`:SYSTem:CALibration:ROW[1]|2|…|100:TYPE MAGNitude | COMPlex` `:SYSTem:CALibration:ROW[1]|2|…|100:TYPE?`
Example	`:SYST:CAL:ROW2:TYPE COMP`
Dependencies	Only available if the selected RCal module has a license for complex calibrations. If it does not, this control is disabled The SCPI command applies to the currently selected Cal Group If the subopcode does not reference an existing Cal row in the Cal Group, the error message “-221, Settings conflict; Subopcode does not reference an existing Cal row” is generated
Preset	`MAGNitude`
State Saved	Saved in instrument state
Range	`MAGNitude|COMPlex`

6.9.1.27 Start Freq

Specifies the start frequency of the selected Cal.

Remote Command	`:SYSTem:CALibration:ROW[1]|2|…|100:FREQuency:STARt <freq>` `:SYSTem:CALibration:ROW[1]|2|…|100:FREQuency:STARt?`
Example	`:SYST:CAL:ROW2:FREQ:STAR 1e9`
Notes	Max values depend on Hardware Options (503, 507, 508, 513, 526)
Dependencies	The SCPI command applies to the currently selected Cal Group If the subopcode does not reference an existing Cal row in the Cal Group, the error message “-221, Settings conflict; Subopcode does not reference an existing Cal row” is generated By direct entry: You cannot set Start Frequency > Stop Frequency. You can set the Start frequency = Stop frequency. If you set Start Frequency = Stop Frequency, "Freq Step" on page 2477 is adjusted to 0, and "Freq Points" on page 2477 is adjusted to 1 With the knob or step keys: If you set Start Frequency = Stop Frequency, **Freq Step** is adjusted to 0, and **Freq Points** is adjusted to 1
Couplings	If you change the start frequency of the selected range to a value > the range’s stop frequency, the

	stop frequency of the previous range is changed to the same value. **Freq Step** is set to 0 Hz and **Freq Points** is set to 1 If you change the start frequency <= min frequency of the instrument, the start frequency of the selected range is set to the minimum frequency of the instrument If you change the start frequency >= maximum frequency of the instrument, the start frequency of the selected range is set to the maximum frequency of the instrument and the stop frequency of selected range is set to the maximum frequency of the instrument. **Freq Step** is set to 0 Hz and **Freq Points** is set to 1
Preset	Depends on the instrument maximum frequency
State Saved	Saved in instrument state
Min	If **Scale Type** is set to Lin, the min Start Frequency changes to -80 MHz
Max	Depends on the instrument maximum frequency – 10 Hz minimum span

6.9.1.28 Stop Freq

Specifies the stop frequency of the selected Cal.

Remote Command	`:SYSTem:CALibration:ROW[1]|2|…|100:FREQuency:STOP <freq>` `:SYSTem:CALibration:ROW[1]|2|…|100:FREQuency:STOP?`
Example	`:SYST:CAL:ROW2:FREQ:STOP 1e9`
Notes	Max values depend on Hardware Options
Dependencies	The SCPI command applies to the currently selected Cal Group If the subopcode does not reference an existing Cal row in the Cal Group, the error message “-221, Settings conflict; Subopcode does not reference an existing Cal row” is generated By direct entry: You cannot set Stop frequency < Start frequency. You cannot set Start frequency = Stop frequency. You can set Start frequency = Stop frequency. If you set Start Frequency = Stop Frequency, "Freq Step" on page 2477 is adjusted to 0, and "Freq Points" on page 2477 is adjusted to 1 With the knob or step keys: If you set Start Frequency = Stop Frequency, **Freq Step** is adjusted to 0, and **Freq Points** is adjusted to 1
Couplings	If you change the stop frequency of the selected range to a value < the range’s start frequency the start frequency of the range is changed to the same value. **Freq Step** is set to 0 Hz and **Freq Points** is set to 1 If you change the stop frequency >=the maximum frequency of the instrument, the stop frequency of the selected range is set to the maximum frequency of the instrument If you change stop frequency <= the minimum frequency of the instrument, the stop frequency of the selected range is set to the minimum frequency of the instrument and the start frequency of the selected range is set to the minimum frequency of the instrument. **Freq Step** is set to 0 Hz and **Freq Points** is set to 1
Preset	Depends on the instrument maximum frequency

State Saved	Saved in instrument state
Min	If **Scale Type** is Lin, the min Stop Frequency is changed to -79.999990 MHz
Max	Depends on the instrument maximum frequency

6.9.1.29 Freq Step

Specifies the step frequency of the selected Cal. This determines the points between the start and stop frequencies to use for Calibration.

Remote Command	`:SYSTem:CALibration:ROW[1]|2|…|100:FREQuency:STEP <freq>` `:SYSTem:CALibration:ROW[1]|2|…|100:FREQuency:STEP?`
Example	`:SYST:CAL:ROW2:FREQ:STEP 1e9`
Notes	Max values depend on Hardware Options
Dependencies	The SCPI command applies to the currently selected Cal Group If the subopcode does not reference an existing Cal row in the Cal Group, the error message "-221, Settings conflict; Subopcode does not reference an existing Cal row" is generated You cannot set **Freq Step** > Stop frequency - Start frequency Attempts to set **Freq Step** > Stop frequency - Start frequency results in **Freq Step** being set to Stop frequency - Start frequency
Couplings	Coupled to "Freq Points" on page 2477. Changing **Freq Step** adjusts **Freq Points** using (((Stop Freq – Start Freq) / Freq Step) + 1) and clips to the next integer value, which may result in **Freq Step** being clipped too If **Freq Step** is set to a value > Stop Freq – Start Freq **Stop Freq** is increased, and **Freq Points** is set to 1
Preset	All 10 kHz
State Saved	Saved in instrument state
Min	1 Hz
Max	Depends on the instrument maximum frequency

6.9.1.30 Freq Points

Specifies the frequency points of the selected Cal. This determines the points between the start and stop frequencies to use for Calibration.

Remote Command	`:SYSTem:CALibration:ROW[1]|2|…|100:FREQuency:POINts` `:SYSTem:CALibration:ROW[1]|2|…|100:FREQuency:POINts?`
Example	`:SYST:CAL:ROW2:FREQ:POIN 100`
Couplings	Coupled to "Freq Step" on page 2477. Changing **Freq Points** adjusts **Freq Step** using (Stop Freq – Start Freq) / (Freq Points – 1) and clips to the next integer value, which may result in **Freq Step** being clipped

Preset	1
Min	1
Max	100000

6.9.1.31 Mech Atten Type

Specifies the Mech Atten type to use:

- STEP: Use multiple Mech Atten states determined by Mech Atten Start, Mech Atten Stop and Mech Atten Step
- ALL: Use all the attenuator states
- BYPass: Bypasses the attenuator

Remote Command	:SYSTem:CALibration:ROW[1]|2|…|100:ATTenuation:TYPE STEP | ALL | BYPass :SYSTem:CALibration:ROW[1]|2|…|100:ATTenuation:TYPE?
Example	:SYST:CAL:ROW3:ATT:TYPE STEP
Dependencies	The SCPI command applies to the currently selected Cal Group If the subopcode does not reference an existing Cal row in the Cal Group, the error message "-221,Settings conflict; Subopcode does not reference an existing Cal row" is generated
Preset	STEP
State Saved	Saved in instrument state
Range	STEP|ALL|BYPass

6.9.1.32 Mech Atten Start

Determines the first Mechanical Attenuator to be used in the Calibration

Remote Command	:SYSTem:CALibration:ROW[1]|2|…|100:ATTenuation:STARt <rel_ampl> :SYSTem:CALibration:ROW[1]|2|…|100:ATTenuation:STARt?
Example	:SYST:CAL:ROW3:ATT:STARt 20
Dependencies	Disabled unless "Mech Atten Type" on page 2478 is STEP The SCPI command applies to the currently selected Cal Group If the subopcode does not reference an existing Cal row in the Cal Group, the error message "-221,Settings conflict; Subopcode does not reference an existing Cal row" is generated
Couplings	Coupled to "Mech Atten Stop" on page 2479. **Mech Atten Start** must be <= **Mech Atten Stop**. If **Mech Atten Start** > **Mech Atten Stop**, then **Mech Atten Stop** = **Mech Atten Start**
Preset	10 dB
State Saved	Saved in instrument state
Min	0 dB

	The attenuation set by this control cannot be decreased below 6 dB with the knob or step keys. To get to a value below 6 dB it must be directly entered from the keypad or via SCPI. This protects from adjusting the attenuation to a dangerously small value, which can put the instrument at risk of damage to input circuitry. However, if the current mechanical attenuation is below 6 dB it can be increased with the knob and step keys, but not decreased
Max	CXA Option 503 or 507: 50 dB EXA: 60 dB All other models: 70 dB Note that, in the single attenuator configuration, the total of ATT and EATT cannot exceed 50 dB, so if the EATT is set to 24 dB first, the main attenuation cannot be greater than 26 dB and is reduced accordingly; if the main attenuator is set to 40 dB first, EATT cannot be greater than 10 dB

6.9.1.33 Mech Atten Stop

Determines the last Mechanical Attenuator to be used in the Calibration

Remote Command	`:SYSTem:CALibration:ROW[1]|2|…|100:ATTenuation:STOP <rel_ampl>` `:SYSTem:CALibration:ROW[1]|2|…|100:ATTenuation:STOP?`
Example	`:SYST:CAL:ROW3:ATT:STOP 30`
Dependencies	Disabled unless "Mech Atten Type" on page 2478 is `STEP` The SCPI command applies to the currently selected Cal Group If the subopcode does not reference an existing Cal row in the Cal Group, the error message "-221,Settings conflict; Subopcode does not reference an existing Cal row" is generated
Couplings	Coupled to "Mech Atten Start" on page 2478. **Mech Atten Start** must be <= **Mech Atten Stop**. If **Mech Atten Start** > **Mech Atten Stop**, then **Mech Atten Stop** = **Mech Atten Start**
Preset	10 dB
State Saved	Saved in instrument state
Min	0 dB The attenuation set by this control cannot be decreased below 6 dB with the knob or step keys. To get to a value below 6 dB it must be directly entered from the keypad or via SCPI. This protects from adjusting the attenuation to a dangerously small value which can put the instrument at risk of damage to input circuitry. However, if the current mechanical attenuation is below 6 dB it can be increased with the knob and step keys, but not decreased
Max	CXA Option 503 or 507: 50 dB EXA: 60 dB All other models: 70 dB Note that, in the single attenuator configuration, the total of ATT and EATT cannot exceed 50 dB, so if the EATT is set to 24 dB first, the main attenuation cannot be greater than 26 dB and is reduced accordingly; if the main attenuator is set to 40 dB first, EATT cannot be greater than 10 dB

6.9.1.34 Mech Atten Step

Determines the Mech Attenuation Step. This determines the points between the Mechanical Attenuation min and max to use for Calibration.

Remote Command	`:SYSTem:CALibration:ROW[1]|2|…|100:ATTenuation:STEP <rel_ampl>` `:SYSTem:CALibration:ROW[1]|2|…|100:ATTenuation:STEP?`
Example	`:SYST:CAL:ROW2:ATT:STEP 2dB`
Dependencies	Disabled unless "Mech Atten Type" on page 2478 is `STEP` The SCPI command applies to the currently selected Cal Group If the subopcode does not reference an existing Cal row in the Cal Group, the error message "-221, Settings conflict; Subopcode does not reference an existing Cal row" is generated
Preset	2 dB
State Saved	Saved in instrument state
Min	2 dB
Max	10 dB

6.9.1.35 Elec Atten Type

Specifies the Elec Atten type to use:

- `STEP`: Use multiple Elec Atten states determined by Elec Atten Start, Elec Atten Stop and Elec Atten Step
- `ALL`: Use all the attenuator states
- `BYPass`: Bypasses the attenuator

Remote Command	`:SYSTem:CALibration:ROW[1]|2|…|100:EATTenuation:TYPE STEP	ALL	BYPass` `:SYSTem:CALibration:ROW[1]|2|…|100:EATTenuation:TYPE?`
Example	`:SYST:CAL:ROW3:EATT:TYPE STEP`
Dependencies	The SCPI command applies to the currently selected Cal Group If the subopcode does not reference an existing Cal row in the Cal Group, the error message "-221, Settings conflict; Subopcode does not reference an existing Cal row" is generated
Preset	`STEP`
State Saved	Saved in instrument state
Range	`STEP|ALL|BYPass`

6.9.1.36 Elec Atten Start

Determines the first Electronic Attenuator to be used in the Calibration

Remote Command	`:SYSTem:CALibration:ROW[1]|2|…|100:EATTenuation:STARt <rel_ampl>` `:SYSTem:CALibration:ROW[1]|2|…|100:EATTenuation:STARt?`
Example	`:SYST:CAL:ROW3:EATT:STARt 0`
Dependencies	Only appears in Dual Attenuator models with an Electronic Attenuator installed and licensed. It does not appear in models with the Single Attenuator configuration, as in the single attenuator configuration there is no “electronic attenuator” there is only a single integrated attenuator (which has both a mechanical and electronic stage) Disabled unless "Elec Atten Type" on page 2480 is STEP The electronic attenuator is unavailable above the low band (0-3.6 GHz, 0-3.4 GHz, or 0-3 GHz, depending on the model). If the low band ranges from 0-3.6 GHz, and Stop Frequency of the Calibration is > 3.6 GHz, then this parameter is grayed out If the Internal Preamp is on, meaning it is set to Low Band or Full, or the electronic attenuator is unavailable, then this parameter is grayed-out If either of the above is true, and if the SCPI command is sent, an error indicating that the electronic attenuator is unavailable is sent If both of the above are true, pressing the control generates error message -221, in other words, the frequency range lockout takes precedence The SCPI command applies to the currently selected Cal Group If the subopcode does not reference an existing Cal row in the Cal Group, the error message “-221, Settings conflict; Subopcode does not reference an existing Cal row” is generated
Couplings	Coupled to Elec Atten Stop. Elec Atten Start must be <= Elec Atten Stop. If Elec Atten Start > Elec Atten Stop, Elec Atten Stop = Elec Atten Start
Preset	0 dB
State Saved	Saved in instrument state
Min	0 dB
Max	24 dB

6.9.1.37 Elec Atten Stop

Determines the last Electrical Attenuator to be used in the Calibration

Remote Command	`:SYSTem:CALibration:ROW[1]|2|…|100:EATTenuation:STOP <rel_ampl>` `:SYSTem:CALibration:ROW[1]|2|…|100:EATTenuation:STOP?`
Example	`:SYST:CAL:ROW3:EATT:STOP 10`
Dependencies	Only appears in Dual Attenuator models with an Electronic Attenuator installed and licensed. It does not appear in models with the Single Attenuator configuration, as in the single attenuator configuration there is no “electronic attenuator” there is only a single integrated attenuator (which has both a mechanical and electronic stage) Disabled unless "Elec Atten Type" on page 2480 is STEP The electronic attenuator is unavailable above the low band (0-3.6 GHz, 0-3.4 GHz or 0-3 GHz, depending on the model). If the low band ranges from 0-3.6 GHz, and Stop Frequency of the

	Calibration is > 3.6 GHz, then this parameter is grayed out If the Internal Preamp is on, meaning it is set to Low Band or Full, the electronic attenuator is unavailable, then this parameter is grayed out If either of the above is true, and if the SCPI command is sent, an error indicating that the electronic attenuator is unavailable is sent If both of the above are true, pressing the control generates error message -221, in other words, the frequency range lockout takes precedence For SCPI, this query applies to the currently selected Cal Group If the subopcode does not reference an existing Cal row in the Cal Group, the error message "-221, Settings conflict; Subopcode does not reference an existing Cal row" is generated
Couplings	Coupled to Elec Atten Start. Elec Atten Stop must be >= Elec Atten Start. If Elec Atten Stop < Elec Atten Start, Elec Atten Start = Elec Atten Stop
Preset	0 dB
State Saved	Saved in instrument state
Min	0 dB
Max	24 dB

6.9.1.38 Elec Atten Step

Determines the Elec Attenuation Step. This determines the points between the Electric Attenuation min and max to use for Calibration.

Remote Command	`:SYSTem:CALibration:ROW[1]|2|…|100:EATTenuation:STEP <rel_ampl>` `:SYSTem:CALibration:ROW[1]|2|…|100:EATTenuation:STEP?`
Example	`:SYST:CAL:ROW2:EATT:STEP 2dB`
Dependencies	Disabled unless "Elec Atten Type" on page 2480 is `STEP` The SCPI command applies to the currently selected Cal Group If the subopcode does not reference an existing Cal row in the Cal Group, the error message "-221, Settings conflict; Subopcode does not reference an existing Cal row" is generated
Preset	1 dB
State Saved	Saved in instrument state
Min	1 dB
Max	24 dB

6.9.1.39 Full Range Atten Type

Specifies the Full Range Atten type to use. The Full Range Attenuator adds a second input attenuator at the beginning of the RF Input 2, which enhances the protection and optimizes the performance of the extra internal mixers used by RF Input 2.

– STEP: Use multiple Full Range Atten states determined by Full Range Atten Start and Full Range Atten Stop

– ALL: Use all the attenuator states

Remote Command	:SYSTem:CALibration:ROW[1]|2|…|100:FATTenuation:TYPE STEP | ALL | :SYSTem:CALibration:ROW[1]|2|…|100:FATTenuation:TYPE?
Example	:SYST:CAL:ROW3:FATT:TYPE STEP
Dependencies	Only appears if input RF is selected, and RF Input Port 2 is selected, and the Full Range Attenuator exists The SCPI command applies to the currently selected Cal Group If the subopcode does not reference an existing Cal row in the Cal Group, the error message "-221, Settings conflict; Subopcode does not reference an existing Cal row" is generated
Preset	STEP
State Saved	Saved in instrument state
Range	STEP|ALL|

6.9.1.40 Full Range Atten Start

Determines the first Full Range Attenuator to be used in the Calibration

Remote Command	:SYSTem:CALibration:ROW[1]|2|…|100:FATTenuation:START <rel_ampl> :SYSTem:CALibration:ROW[1]|2|…|100:FATTenuation:STARt?
Example	:SYST:CAL:ROW3:FATT:STARt 0
Dependencies	Only appears in N9041B, when the RF input is selected, and the RF Input Port is set to RF Input 2, and the Full Range Attenuator is installed Disabled unless "Full Range Atten Type" on page 2482 is STEP The SCPI command applies to the currently selected Cal Group If the subopcode does not reference an existing Cal row in the Cal Group, the error message "-221, Settings conflict; Subopcode does not reference an existing Cal row" is generated
Couplings	Coupled to Full Range Atten Stop. Full Range Atten Start must be <= Full Range Atten Stop. If Full Range Atten Start > Full Range Atten Stop, Full Range Atten Stop = Full Range Atten Start
Preset	20 dB
State Saved	Saved in instrument state
Min	0 dB
Max	Only valid values are 0, 6, 14, 20 dB

6.9.1.41 Full Range Atten Stop

Determines the last Full Range Attenuator to be used in the Calibration

Remote Command	`:SYSTem:CALibration:ROW[1]|2|…|100:FATTenuation:STOP <rel_ampl>` `:SYSTem:CALibration:ROW[1]|2|…|100:FATTenuation:STOP?`
Example	`:SYST:CAL:ROW3:FAT:PT:STOP 10`
Dependencies	Only appears in N9041B, when the RF input is selected, and the RF Input Port is set to RF Input 2, and the Full Range Attenuator is installed Disabled unless "Full Range Atten Type" on page 2482 is STEP The SCPI command applies to the currently selected Cal Group If the subopcode does not reference an existing Cal row in the Cal Group, the error message "-221, Settings conflict; Subopcode does not reference an existing Cal row" is generated
Couplings	Coupled to Full Range Atten Start. Full Range Atten Stop must be >= Full Range Atten Start. If Full Atten Stop < Full Range Atten Start, Full Range Atten Start = Full Range Atten Stop
Preset	20 dB
State Saved	Saved in instrument state
Min	0 dB
Max	Only valid values are 0, 6, 14, 20 dB

6.9.1.42 Frequency Extender Attenuation Type

Specifies the Frequency Extender Attenuation type to use. **Frequency Extender Attenuation** is applied to the frequency extender's high frequency input signal path (for example, with a V3050A frequency extender, the high frequency path is 50 GHz to 110 GHz).

- STEP: Use multiple Frequency Extender Attenuation states determined by Frequency Extender Attenuation Start and Frequency Extender Attenuation Stop
- ALL: Use all the attenuator states

Remote Command	`:SYSTem:CALibration:ROW[1]|2|…|100:FEATtenuation:TYPE STEP | ALL` `:SYSTem:CALibration:ROW[1]|2|…|100:FEATtenuation:TYPE?`
Example	`:SYST:CAL:ROW3:FEAT:TYPE STEP`
Dependencies	Only applies, and is only visible, when the External RF (ERFIN) input is selected The SCPI command applies to the currently selected Cal Group If the subopcode does not reference an existing Cal row in the Cal Group, the error message "-221, Settings conflict; Subopcode does not reference an existing Cal row" is generated
Preset	STEP
State Saved	No
Range	STEP|ALL|REFerence

6.9.1.43 Frequency Extender Attenuation Start

Determines the first Frequency Extender Attenuator to be used in the Calibration.

Remote Command	`:SYSTem:CALibration:ROW[1]|2|…|100:FEATtenuation:STARt <rel_ampl>` `:SYSTem:CALibration:ROW[1]|2|…|100:FEATtenuation:STARt?`
Example	`:SYST:CAL:ROW3:FEAT:STARt 0`
Dependencies	Only applies, and is only visible, when the External RF (ERFIN) input is selected Disabled unless "Frequency Extender Attenuation Type" on page 2484 is STEP The SCPI command applies to the currently selected Cal Group If the subopcode does not reference an existing Cal row in the Cal Group, the error message "-221, Settings conflict; Subopcode does not reference an existing Cal row" is generated
Couplings	Coupled to Frequency Extender Attenuation Stop. Frequency Extender Attenuation Start must be <= Frequency Extender Attenuation Stop. If Frequency Extender Attenuation Start > Frequency Extender Attenuation Stop, Frequency Extender Attenuation Stop = Frequency Extender Attenuation Start
Preset	0 dB
State Saved	Saved in instrument state
Min	0 dB
Max	V3050A: 26 dB

6.9.1.44 Frequency Extender Attenuation Stop

Determines the last Frequency Extender Attenuation to be used in the Calibration.

Remote Command	`:SYSTem:CALibration:ROW[1]|2|…|100:FEATtenuation:STOP <rel_ampl>` `:SYSTem:CALibration:ROW[1]|2|…|100:FEATtenuation:STOP?`
Example	`:SYST:CAL:ROW3:FEAT:PT:STOP 26`
Dependencies	Only applies, and is only visible, when the External RF (ERFIN) input is selected Disabled unless "Frequency Extender Attenuation Type" on page 2484 is STEP The SCPI command applies to the currently selected Cal Group If the subopcode does not reference an existing Cal row in the Cal Group, the error message "-221, Settings conflict; Subopcode does not reference an existing Cal row" is generated
Couplings	Coupled to Frequency Extender Attenuation Start. Frequency Extender Attenuation Stop must be >= Frequency Extender Attenuation Start. If Frequency Extender Attenuation Stop < Frequency Extender Attenuation Start, Frequency Extender Attenuation Start = Frequency Extender Attenuation Stop
Preset	26 dB
State Saved	Saved in instrument state
Min	0 dB
Max	V3050A: 26 dB

6.9.1.45 Frequency Extender Atten Step

Determines the Frequency Extender Attenuation Step. This determines the points between the Frequency Extender Attenuation min and max to use for Calibration.

Remote Command	`:SYSTem:CALibration:ROW[1]|2|…|100:FEATtenuation:STEP <rel_ampl>` `:SYSTem:CALibration:ROW[1]|2|…|100:FEATtenuation:STEP?`
Example	`:SYST:CAL:ROW2:FEAT:STEP 2dB`
Dependencies	Only applies, and is only visible, when the External RF (`ERFIN`) input is selected The SCPI command applies to the currently selected Cal Group If the subopcode does not reference an existing Cal row in the Cal Group, the error message "-221, Settings conflict; Subopcode does not reference an existing Cal row" is generated
Preset	1 dB
State Saved	No
Min	1 dB
Max	V3050A: 26 dB

6.9.1.46 IF Path

Determines the IF Path to be used in the Calibration.

Remote Command	`:SYSTem:CALibration:ROW[1]|2|…|100:IF:PATH B10M | B25M | B40M | B85M | B125M | B140M | B160M | B255M | B510M | B1G | B1500M | B2G | B4G | EXT` `:SYSTem:CALibration:ROW[1]|2|…|100:IF:PATH?`
Example	`:SYST:CAL:ROW2:IF:PATH B25M`
Notes	see table below

`B10M`	10 MHz
`B25M`	25 MHz
`B40M`	40 MHz
`B85M`	85 MHz
`B125M`	125 MHz
`B140M`	140 MHz
`B160M`	160 MHz
`B255M`	255 MHz
`B510M`	510 MHz
`B1G`	1 GHz
`B1500M`	1.5 GHz
`B2G`	2 GHz

	B4G — 4 GHz EXT — Depends on the hardware In cases where the path is not available but is selected via SCPI, generates error -241,"Hardware missing; Option not installed"
Dependencies	See table below
Preset	If the 25 MHz path is not available, presets to 10 MHz
State Saved	No
Range	B10M | B25M | B40M | B85M | B125M | B140M | B160M | B255M | B510M | B1G | B1500M | B2G | B4G | EXT

B4G	4 GHz
EXT	Depends on the hardware

In cases where the path is not available but is selected via SCPI, generates error -241,"Hardware missing; Option not installed"

Dependencies:

Path	Availability requires Installation of:
25 MHz	25 MHz or wider IF Bandwidth option
40 MHz	40 MHz or wider IF Bandwidth option
85 MHz	85 MHz or wider IF Bandwidth option
125 MHz	125 MHz or wider IF Bandwidth option
140 MHz	Option B1X
160 MHz	Option B1Y. B1Y cannot be installed without B1X
255 MHz	Option B2X or wider IF Bandwidth option
510 MHz	Option B5Y or wider IF Bandwidth option
1 GHz	Option H1G/B1G or wider IF Bandwidth option
2 GHz	Option B2G(R20) or wider IF Bandwidth option
4 GHz	Option B4G(R40) or wider IF Bandwidth option
1.5 GHz	Option R15

If Option B85 *and* either Option B1A or Option B1X are installed, the 85 MHz option does not appear, and B85M is disabled. Sending the command to select B85M in this case generates an error -221, "Settings Conflict; Use wider bandwidth selection"

If Option B1A *and* Option B1X are both installed, the 125 MHz option does not appear, and B125M is disabled. Sending the command to select B125M in this case generates an error -221, "Settings Conflict; Use wider bandwidth selection"

In cases where the path is not available, but is selected via SCPI, error -241,"Hardware missing; Option not installed" is generated

The preset value depends on the Digital IF BW setting of the default measurement

Preset	If the 25 MHz path is not available, presets to 10 MHz
State Saved	No
Range	B10M | B25M | B40M | B85M | B125M | B140M | B160M | B255M | B510M | B1G | B1500M | B2G | B4G | EXT

6.9.1.47 IF Gain

Determines the IF Gain to be used in the Calibration

Remote Command	:SYSTem:CALibration:ROW[1]|2|…|100:IF:GAIN[:STATe]AUTO|HIGH|LOW|ALL :SYSTem:CALibration:ROW[1]|2|…|100:IF:GAIN[:STATe]?

Example	`:SYST:CAL:ROW3:IF:GAIN ALL`
Dependencies	The SCPI command applies to the current selected Cal Group If the subopcode does not reference an existing Cal row in the Cal Group, the error message "-221, Settings conflict; Subopcode does not reference an existing Cal row" is generated
Preset	`AUTO`
State Saved	Saved in instrument state
Range	Auto | High Gain | Low Gain | All

6.9.1.48 Preamp

Determines if the Preamp is to be used in the Calibration

Remote Command	`:SYSTem:CALibration:ROW[1]|2|…|100:POWer[:RF]:GAIN:BAND OFF	LOW	FULL` `:SYSTem:CALibration:ROW[1]|2|…|100:POWer:GAIN:BAND?`
Example	`:SYST:CAL:ROW2:POWer:GAIN:BAND OFF`
Dependencies	The SCPI command applies to the current selected Cal Group If the subopcode does not reference an existing Cal row in the Cal Group, the error message "-221, Settings conflict; Subopcode does not reference an existing Cal row" is generated
Preset	`OFF`
State Saved	Saved in instrument state
Range	`OFF|LOW|FULL`

6.9.1.49 Low Noise Amplifier (LNA)

Determines if the LNA is to be used in the Calibration.

Remote Command	`:SYSTem:CALibration:ROW[1]|2|…|100:POWer[:RF]:GAIN:LNA[:STATe] ON	OFF	1	0` `:SYSTem:CALibration:ROW[1]|2|…|100:POWer[:RF]:GAIN:LNA[:STATe]?`
Example	`:SYST:CAL:ROW2:POW:GAIN:LNA ON` `:SYST:CAL:ROW2:POW:GAIN:LNA?`
Dependencies	The SCPI command is applied to the currently selected Cal Group. The subopcode is used to identify the Cal row in the Cal Group If the subopcode does not reference an existing Cal row in the Cal Group, the error message "-221, Settings conflict; Subopcode does not reference an existing Cal row" is generated
Preset	`OFF`
State Saved	No
Range	`ON|OFF`

6.9.1.50 µW Path Control

Determines the µW Path Control to be used in the Calibration.

Option	SCPI
Standard Path	STD
Low Noise Path	LNPath
µW Presel Bypass	MPBypass
Full Bypass	FULL

Remote Command	:SYSTem:CALibration:ROW[1]|2|…|100:POWer[:RF]:MW:PATH STD | LNPath | MPBypass | FULL :SYSTem:CALibration:ROW[1]|2|…|100:POWer[:RF]:MW:PATH?
Example	:SYST:CAL:ROW2:POW:MW:PATH FULL
Dependencies	The SCPI command applies to the current selected Cal Group If the subopcode does not reference an existing Cal row in the Cal Group, the error message “-221, Settings conflict; Subopcode does not reference an existing Cal row” is generated This column is not shown in the table unless *either* Option MPB or Option LNB is present and licensed The Low Noise Path selection does not appear unless Option LNP is present and licensed The µW Presel Bypass selection does not appear unless Option MPB is present and licensed The Full Bypass selection does not appear unless Options LNP, MPB and FBP are installed and licensed In any of these cases, if the required options are not present and the SCPI command is sent, error -241, "Hardware missing; Option not installed" is generated
Preset	STD
State Saved	Saved in instrument state
Range	STD|LNPath|MPBypass|FULL

6.9.1.51 Coupling

Determines the Coupling to be used in the Calibration

Remote Command	:SYSTem:CALibration:ROW[1]|2|…|100:COUPling AC | DC :SYSTem:CALibration:ROW[1]|2|…|100:COUPling?
Example	:SYST:CAL:ROW3:COUP AC
Dependencies	The SCPI command applies to the current selected Cal Group If the subopcode does not reference an existing Cal row in the Cal Group, the error message “-221, Settings conflict; Subopcode does not reference an existing Cal row” is generated
Preset	AC

State Saved	Saved in instrument state
Range	AC|DC

6.9.1.52 Phase Noise Optimization

Selects the LO (local oscillator) phase noise behavior for various desired operating conditions.

For full details, see "Parameter Options & Installed Options" on page 2490 below.

Remote Command	`:SYSTem:CALibration:ROW[1]|2|…|100:FREQuency:SYNThesis[:STATe] 1 | … | 5`
	For the meaning of each numeric option value, see "Parameter Options & Installed Options" on page 2490 below
	`:SYSTem:CALibration:ROW[1]|2|…|100:FREQuency:SYNThesis[:STATe]?`

Example	Select optimization for best wide offset phase noise: `:SYST:CAL:ROW1:FREQ:SYNT 2`
Dependencies	The SCPI command applies to the current selected Cal Group If the subopcode does not reference an existing Cal row in the Cal Group, the error message "-221, Settings conflict; Subopcode does not reference an existing Cal row" is generated
Couplings	Coupled with "Phase Noise Optimization All Option" on page 2495 When **Phase Noise Optimization All** is ON, selects all available LO mappings, and Phase Noise Optimization parameter will display **All** in the Configuration table. SCPI Query is still available to determine which parameter will be displayed when **Phase Noise Optimization All** is OFF
Preset	2
State Saved	Yes
Range	See "Ranges" on page 2495 below
Min	1
Max	5

Parameter Options & Installed Options

The Phase Noise Optimization control lets you optimize the setup and behavior of the Local Oscillator (LO) depending on your specific measurement conditions. You may wish to trade off noise and speed, for example, to make a measurement faster without regard to noise or with optimum noise characteristics without regard to speed.

Parameter Values Summary

Option	#	Description
"Balanced" on page 2492	1	– In instruments with EP0, balances close-in phase noise with spur avoidance

Option	#	Description
		– In instruments without EP0 optimizes phase noise for small frequency offsets from the carrier
"Best Wide-offset" on page 2492	2	Optimizes phase noise for wide frequency offsets from the carrier
"Fast Tuning" on page 2492	3	Optimizes LO for tuning speed
"Best Close-in" on page 2491	4 or 1*	– In instruments with EP0, emphasizes close-in phase noise performance without regard to spur avoidance – In instruments without EP0, this setting is accepted but no action is taken
"Best Spurs" on page 2492	5	– In instruments with EP0, emphasizes spur avoidance over close-in phase noise performance – In instruments without EP0, this setting is accepted but no action taken
Auto	-	Automatically selects LO (local oscillator) phase noise behavior to optimize dynamic range and speed for various instrument operating conditions

*Dependent on Option EP0 installation. See "Best Close-in" on page 2491 below.

The actual behavior varies somewhat depending on model number and option; for example, you always get Fast Tuning by choosing Option #3, but in some models, "Fast Tuning" on page 2492 is identical in effect to "Best Close-in" on page 2491.

Best Close-in

Without option EP0

```
:FREQ:SYNT 1
```

The LO phase noise is optimized for smaller offsets from the carrier, at the expense of phase noise farther out.

The actual frequency offset within which noise is optimized is shown with in square brackets, as this can vary depending on the hardware set in use. For example, in some instruments this annotation appears as [offset <20 kHz]

With option EP0

```
:FREQ:SYNT 4
```

In instruments with Option EP0, the LO is configured for the best possible close-in phase noise (offsets up to 600 kHz from the carrier), regardless of spurious products that occur with some center frequencies. Because this is generally less desirable for close-in measurements than the "Balanced" on page 2492 setting, parameter 1 selects "Balanced" on page 2492 in EP0 instruments, in the interests of optimizing code compatibility across the family. Parameter 4 selects "Best Close-in" on page 2491, which is usually not as good a choice as "Balanced" on page 2492.

Balanced

`:FREQ:SYNT 1`

In instruments with EP0, the LO is configured for the best possible phase noise at offsets up to 600 kHz from the carrier whenever there are no significant spurs within the span observed with an on-screen carrier. When there will be such a spur, the LO is reconfigured in a way that allows the phase noise to increase by 7 dB mostly within ±1 octave around 400 kHz offset. The spurs will always be below –70 dBc.

Best Spurs

`:FREQ:SYNT 5`

In instruments with EP0, the LO is configured for better phase noise than the "Best Wide-offset" on page 2492 case close to the carrier, but the configuration has 11 dB worse phase noise than the "Best Close-in" on page 2491 case mostly within ±1 octave around 300 kHz offset. Spurs are even lower than in the "Balanced" on page 2492 case at better than –90 dBc, whether or not the carrier is on-screen.

This setting is never selected when Phase Noise Optimization is in Auto, you must select it manually.

Best Wide-offset

`:FREQ:SYNT 2`

The LO phase noise is optimized for wider offsets from the carrier. Optimization is especially improved for offsets from 70 kHz to 300 kHz. Closer offsets are compromised and the throughput of measurements (especially remote measurements where the center frequency is changing rapidly), is reduced.

The actual frequency offset beyond which noise is optimized is shown with in square brackets, as this can vary depending on the hardware set in use. For example, in some instruments this annotation appears as [offset >30 kHz]

In instruments with Option EP0, the LO is configured for the best possible phase noise at offsets up to 600 kHz from the carrier whenever there are no significant spurs within the span observed with an on-screen carrier. When there will be such a spur, the LO is reconfigured in a way that allows the phase noise to increase by 7 dB mostly within ±1 octave around 400 kHz offset. The spurs will always be below –70 dBc.

Fast Tuning

`:FREQ:SYNT 3`

In this mode, the LO behavior compromises phase noise at many offsets from the carrier in order to allow rapid measurement throughput when changing the center frequency or span. The term "Fast Tuning" on page 2492 refers to the time it takes to move the local oscillator to the start frequency and begin a sweep; this setting does not impact the actual sweep time in any way.

In instruments with EP1, the LO behavior compromises phase noise at offsets below 4 MHz in order to improve measurement throughput. The throughput is especially affected when moving the LO more than 2.5 MHz and up to 10 MHz from the stop frequency to the next start frequency.

In instruments with Option EP0, this is the same configuration as "Best Spurs" on page 2492. It is available with the "Fast Tuning" on page 2492 label for convenience, and to make the user interface more consistent with other X-Series instrument family members.

(In models whose hardware does not provide for a "Fast Tuning" on page 2492 option, the settings for "Best Close-in" on page 2491 are used if "Fast Tuning" on page 2492 is selected. This gives the fastest possible tuning for that hardware set.)

Auto

```
:FREQ:SYNT:AUTO ON
```

Selects the LO (local oscillator) phase noise behavior to optimize dynamic range and speed for various instrument operating conditions. The selection rules are as follows.

Auto Optimization Rules

X-Series instruments have several grades of LO, offering different configurations when in the Auto Mode. The rules for Auto selection are as follows:

Models with Option	Conditions	Selection
EP0 Models with option EP0 have a two stage local oscillator, which switches to a single loop for fast tuning (available in UXA)	Center frequency is < 699.9 kHz	"Balanced" on page 2492
	Span > 114.1 MHz, *or* RBW > 800 kHz	"Fast Tuning" on page 2492
	RBW > 290 kHz, *or* Span > 4.2 MHz	"Best Wide-offset" on page 2492
	Other conditions	"Balanced" on page 2492
EP1 Models with option EP1 have a two-	Span > 44.44 MHz, *or* RBW > 1.9 MHz, *or*	"Fast Tuning" on page 2492

Models with Option	Conditions	Selection
loop local oscillator, which switches to a single loop for fast tuning	Source Mode is set to "Tracking"	
(available in PXA)	Center frequency is < 195 kHz, *or* CF >= 1 MHz *and* Span <= 1.3 MHz *and* RBW <= 75 kHz	"Best Close-in" on page 2491
	All other conditions	"Best Wide-offset" on page 2492
EP2 Models with option EP2 use a different loop bandwidth for the fast-tuning choice, which is a compromise between tuning speed and phase noise, giving good tuning speed at all offsets. Although not as good as for "Best Close-in" on page 2491; this is useful when you have to look across a wide range of spans (available, for example, in MXA for excellent phase noise)	CF < 130 kHz , *or* CF > 12 MHz *and* Span < 495 kHz *and* RBW < 40 kHz	"Best Close-in" on page 2491
	Span > 22 MHz, *or* RBW > 400 kHz, *or* CF ≤ 12 MHz *and* Span < 495 kHz *and* RBW < 23 kHz	"Fast Tuning" on page 2492
	All other conditions	"Best Wide-offset" on page 2492
EP4 (available in CXA for improved phase noise)	Span > 101 MHz *or* RBW > 1.15 MHz *or* Source Mode is set to "Tracking"	"Fast Tuning" on page 2492
	CF is < 109 kHz *or* CF >= 4.95 MHz *and* Span <= 666 kHz *and* RBW < 28 kHz	"Best Close-in" on page 2491
	All other conditions	"Best Wide-offset" on page 2492
All Other Models Note that in these models, the hardware does not actually provide for an extra-fast tuning option, so the settings for "Fast Tuning" on page 2492 are actually the same as "Best Close-in" on page 2491, but the rules are implemented this way so that the user who doesn't care about phase noise but does care about tuning speed doesn't have to remember which of the other two settings gives faster tuning	Span > 12.34 MHz, *or* RBW > 250 kHz, *or* Source Mode is set to "Tracking"	"Fast Tuning" on page 2492
	Center frequency is < 25 kHz, *or* CF >= 1 MHz *and* Span <= 141.4 kHz *and* RBW <= 5 kHz	"Best Close-in" on page 2491
	All other conditions	"Best Wide-offset" on page 2492

In all the above cases:

- The RBW to be used in the calculations is the equivalent –3 dB bandwidth of the current RBW filter
- The rules apply whether in swept spans, zero span, or FFT spans

Ranges

Option	Option #	Phase Noise Option	Range
No EPx Option	1	Best Close-in	[offset < 20 kHz]
	2	Best Wide-offset	[offset > 30 kHz]
	3	Fast Tuning	[same as Best Close-In]
EP0	4	Best Close-in	[offset < 600 kHz]
	1	Balanced	[offset < 600 kHz]
	5	Best Spurs	[offset < 600 kHz]
	2	Best Wide-offset	[offset > 800 kHz]
	3	Fast Tuning	[same as Best Close-In]
EP1	1	Best Close-in	[offset < 140 kHz]
	2	Best Wide-offset	[offset > 160 kHz]
	3	Fast Tuning	[single loop]
EP2, EP3, EP5	1	Best Close-in	[offset < 70 kHz]
	2	Best Wide-offset	[offset > 100 kHz]
	3	Fast Tuning	[medium loop bw]
EP4	1	Best Close-in	[offset < 90 kHz]
	2	Best Wide-offset	[offset > 130 kHz]
	3	Fast Tuning	[same as Best Close-In]

6.9.1.53 Phase Noise Optimization All Option

Selects all available LO settings

Remote Command	`:SYSTem:CALibration:ROW[1]|2|…|100:FREQuency:SYNThesis:ALL[:STATe] ON | OFF | 1 | 0` `:SYSTem:CALibration:ROW[1]|2|…|100:FREQuency:SYNThesis:ALL[:STATe]?`
Example	`:SYST:CAL:ROW1:FREQ:SYNT:ALL ON`
Notes	When this parameter is ON, it overrides the Phase Noise Optimization parameter, and selects all available LO settings
Dependencies	The SCPI command applies to the current selected Cal Group If the subopcode does not reference an existing Cal row in the Cal Group, the error message "-221, Settings conflict; Subopcode does not reference an existing Cal row" is generated

Couplings	Coupled with "Phase Noise Optimization" on page 2490. When this parameter is ON, it selects all available LO mappings, and **Phase Noise Optimization** parameter displays **All** in the Configuration table. When this parameter is OFF, the **Phase Noise Optimization** parameter displays its previously set value in the Configuration table
Preset	OFF
State Saved	Saved in instrument state
Range	ON|OFF

6.9.1.54 Mixing Mode

Determines the LO Mixing Mode to be used.

Remote Command	:SYSTem:CALibration:ROW[1]|2|…|100:LO:MMODe NORMal | ALTernate | ALL :SYSTem:CALibration:ROW[1]|2|…|100:LO:MMODe?
Example	:SYST:CAL:ROW3:LO:MMOD NORM
Dependencies	The SCPI command applies to the current selected Cal Group If the subopcode does not reference an existing Cal row in the Cal Group, the error message "-221,Settings conflict; Subopcode does not reference an existing Cal row" is generated
Preset	NORMal
State Saved	Saved in instrument state
Range	NORMal|ALTernate|ALL

6.9.1.55 Match State

Determines if the Cal settings must match exactly when applying the correction. If not, the system may find the closest matching state or interpolate between states.

Remote Command	:SYSTem:CALibration:ROW[1]|2|…|100:MATCh[:STATe] ON | OFF | 1 | 0 :SYSTem:CALibration:ROW[1]|2|…|100:MATCh[:STATe]?
Example	:SYST:CAL4:MATC ON :SYST:CAL4:MATC?
Dependencies	The SCPI command is applied to the currently selected Cal Group. The subopcode is used to identify the Cal row in the Cal Group If the subopcode does not reference an existing Cal row in the Cal Group, the error message "-221, Settings conflict; Subopcode does not reference an existing Cal row" is generated
Preset	All True
State Saved	Saved in instrument state
Range	True | False

6.9.2 Cal Group

Specifies the selected Calibration Group. You can use different Cal Groups for different external hardware configurations. The Cal Group is also an important concept when sending SCPI commands to the Calibration System, because in each case the SCPI command is directed to the currently-selected Cal Group, which is the Cal Group that is modified by the SCPI command.

Remote Command	`:SYSTem:CALibration:CGRoup <integer>` `:SYSTem:CALibration:CGRoup?`
Example	`:SYST:CAL:CGR 2` `:SYST:CAL:CGR?`
Preset	1
Min	1
Max	100

6.9.3 Apply Cal Group

Controls whether or not the checked **Apply** rows of the currently selected Cal Group are applied.

Remote Command	`:SYSTem:CALibration:CGRoup:APPLy <bool>` `:SYSTem:CALibration:CGRoup:APPLy?`
Example	`:SYST:CAL:CGR:APPL ON` `:SYST:CAL:CGR:APPL?`
Dependencies	The SCPI command is applied to the currently selected Cal Group You can only turn on **Apply Cal Group** if at least one Cal for the currently selected group has been executed. If you attempt to select **Apply Cal Group** before any Cals have been executed, the advisory message “At least one Row must be calibrated before it can be applied” is displayed
Preset	`OFF`
State Saved	Saved in instrument state
Range	`ON|OFF`
Annotation	If *any* Cal Group is `ON`, RCal in the Meas Bar displays in amber, to indicate that Calibrations are in use

6.9.4 All Apply Cal Group Off

Turns off **Apply Cal Group** for all groups.

Remote	`:SYSTem:CALibration:CGRoup:APPLy:AOFF`

Command Example	:SYST:CAL:CGR:APPL:AOFF

6.9.5 Connection

Opens the **Connection** dialog, which provides step-by-step instructions for its use.

6.10 Calibrator Control

Lets you select a calibrator and control the calibrator settings.

6.10.1 Select Cal Source

Lets you select the calibrator to control.

Remote Command	`:SYSTem:CALibration:TUNE[:SELected] NONE | REF50 | REF4800 | TUNAble | CALOUT | RCM1 | RCM2 | RCM3 | RCM4 | RCM5 | RCM6 | RCM7 | RCM8 | RCM9 | RCM10` `:SYSTem:CALibration:TUNE[:SELected]?`
Example	`:SYST:CAL:TUNE:SEL TUNABLE` `:SYST:CAL:TUNE?`
Notes	Options are: `NONE` – No calibrator selected `TUNAble` – Tunable internal calibrator present in N9042B `CALOUT` – Tunable calibrator available through CALOUT front panel port in N9042B `REF50` – 50 MHz calibrator `REF4800` – 4.8 GHz calibrator `RCM1 – RCM10` – RCal module
Dependencies	If the selected calibrator is not available, it does not appear in the dropdown. If you send SCPI to select a calibrator that is not available, the instrument generates an error
Couplings	Selecting `REF50` sets the RF Calibrator to `REF50` Selecting `REF4800` sets the RF Calibrator to `REF4800` Selecting a calibrator source other than `REF50` or `REF4800` sets RF Calibrator to `OFF`
Preset	Unaffected by **Mode Preset**. Set to `NONE` by **Restore Input/Output Defaults** or **Restore System Defaults->All**

6.10.2 Cal Output

Lets you set the selected calibrator's RF power output state.

Remote Command	`:SYSTem:CALibration:TUNE:OUTPut[:STATe] ON | OFF | 1 | 0` `:SYSTem:CALibration:TUNE:OUTPut[:STATe]?`
Example	`:SYST:CAL:TUNE:OUTP ON` `:SYST:CAL:TUNE:OUTP?`

Preset	Unaffected by **Mode Preset**. Set to `OFF` by **Restore Input/Output Defaults** or **Restore System Defaults->All**

6.10.3 Cal Frequency

Lets you set the selected calibrator's frequency.

Remote Command	`:SYSTem:CALibration:TUNE:FREQuency <freq>` `:SYSTem:CALibration:TUNE:FREQuency?`
Example	Set source frequency to 150 MHz: `:SYST:CAL:TUNE:FREQ 150000000`
Preset	Unaffected by **Mode Preset**. Set to 1 GHz by **Restore Input/Output Defaults** or **Restore System Defaults->All**
Min/Max	Depend on the selected calibrator

6.10.4 Cal Signal Type

Lets you set the selected calibrator's signal type.

Remote Command	`:SYSTem:CALibration:TUNE:TYPE CW | COMB` `:SYSTem:CALibration:TUNE:TYPE?`
Example	`:SYST:CAL:TUNE:TYPE CW` `:SYST:CAL:TUNE:TYPE?`
Dependencies	If the selected calibrator does not support a signal type, then that type is disabled in the dropdown Changing the signal type to a disabled option generates an error
Preset	Unaffected by **Mode Preset**. Set to `CW` by **Restore Input/Output Defaults** or **Restore System Defaults->All**

6.10.5 Cal Comb Spacing

Lets you set the calibrator's comb spacing, when the signal type is `COMB`.

Remote Command	`:SYSTem:CALibration:TUNE:SPACing <freq>` `:SYSTem:CALibration:TUNE:SPACing?`
Example	Set comb spacing to 1 MHz: `:SYST:CAL:TUNE:SPAC 1000000`
Dependencies	Only appears when `COMB` is selected as "Cal Signal Type" on page 2500 If the selected calibrator does not support the Comb signal, attempting to set the spacing generates an error

Preset	Unaffected by **Mode Preset.** Set to 0 Hz by **Restore Input/Output Defaults** or **Restore System Defaults->All**
Min/Max	Dependent on the selected calibrator

6.10.6 Calibrator Reference

Determines the frequency reference type used by the RCal module of the currently selected Cal Group

Remote Command	`:SYSTem:CALibration:TUNE:REFerence INTernal | EXTernal` `:SYSTem:CALibration:TUNE:REFerence?`
Example	Set the calibrator frequency reference to Internal: `:SYSTem:CALibration:TUNE:REFerence INTERNAL`
Dependencies	Only displayed when an RCal module is the selected calibrator
Preset	Unaffected by **Mode Preset**. Set to preset value by **Restore Input/Output Defaults** or **Restore System Defaults->All**
Range	`INTernal|EXTernal`

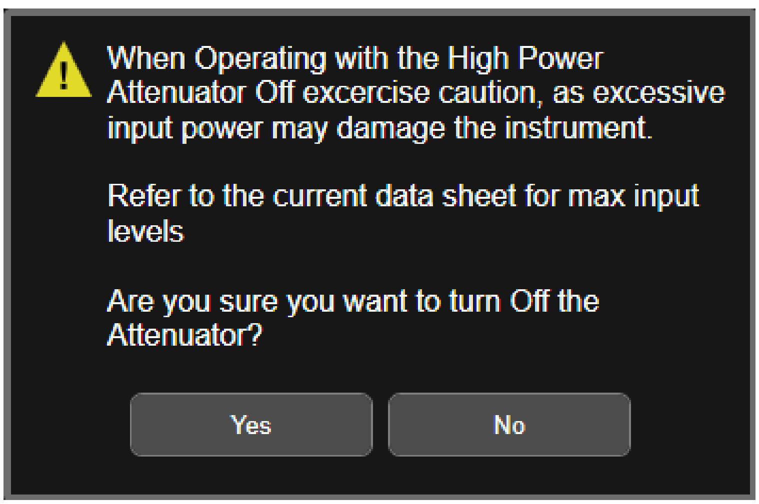
6.11 Advanced

6.11.1 T/R Port High Power Attenuator

Controls whether additional attenuation is added at the T/R Port. The T/R port has twoinput paths, one that provides a 16 dB attenuator, and the other that bypasses this attenuator.

- When `ON`, the path includes the 16 dB attenuator, so the max input level for this path is +47 dBm (50 W)
- When `OFF`, the 16 dB attenuator is bypassed, so the max input level for this path is +33 dBm (2 W)

If the attenuator is turned off, the following warning message is displayed and confirmation that the attenuator is to be turned off is required;



Whenever the attenuator is bypassed (`OFF`), a warning appears in the status bar: “Input caution; T/R unprotected"

In the case of an input overload at the T/R input, (>2 W with Attenuator off, or >50 W with attenuator on), or an over-temperature at the T/R input, the input is disconnected, and a dialog is displayed, stating:

“CAUTION! Excessive power has been detected at the T/R Port. The input has been disconnected. Remove the high signal power and press OK”

Or:

“CAUTION! Over temperature has been detected at the T/R Port. The input has been disconnected. Remove the signal, allow to cool & press OK”

Until you press **OK**, the input remains disconnected, and no measurement can be made.

Remote Command	`[:SENSe]:FEED:RF:PORT:TR:HPOWer:ATTenuator[:STATe] ON | OFF` `[:SENSe]:FEED:RF:PORT:TR:HPOWer:ATTenuator[:STATe]?`
Example	`:FEED:RF:PORT:TR:HPOW:ATT ON` `:FEED:RF:PORT:TR:HPOW:ATT?`
Dependencies	Only appears in modular analyzers, and only when the M9470A module is installed, such as in M8920A. Option HDX is required to enable the T/R port
Preset	`ON`
State Saved	Saved in instrument state

6.12 Aux I/O Control

This menu is only available with Option LSN, indicating that the LISN IO board is installed. It is used to control each of the eight control lines out of the rear panel connector independently. There are eight bits of control lines. The LISN Control (Mode setup) of the EMI Receiver application affects the **AUX I/O Control** settings. Whenever you change the LISN Control in Mode Setup, the corresponding AUX I/O Control data lines will also be changed. The selection at the AUX I/O Control does not affect the LISN Control (Mode Setup) setting.

6.12.1 Data 0 – Data 7

Sets the value for Data 0 through Data 7 respectively.

Remote Command	`:OUTPut:AUX:IO:DATA<n> OFF | ON | 0 | 1` where `<n>` in an integer 0 - 7
Example	`:OUTP:AUX:IO:DATA0 OFF`
Notes	Unaffected by **Mode Preset**, but **Input/Output Preset** presets the value to ON for all 8 data lines
Preset	ON
Range	OFF|ON

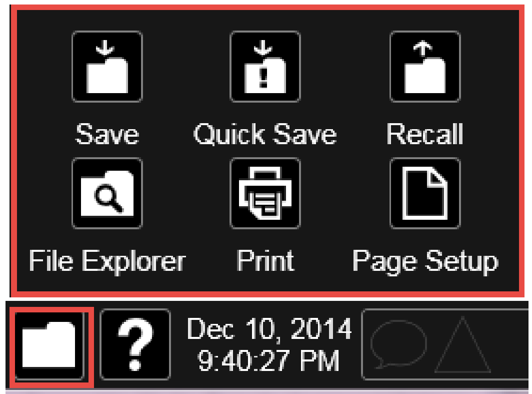
6.12.2 Aux IO Control (Remote Command Only)

Sets/Queries the value for all 8 data lines.

Remote Command	`:OUTPut:AUX:IO <Value>` `:OUTPut:AUX:IO?`
Example	`:OUTP:AUX:IO 31`
Notes	Unaffected by **Mode Preset**, but **Input/Output Preset** presets the value to ON for all 8 data lines
Couplings	The states of Data 0 to Data 7 under the **AUX I/O Control** panel (**Input/Output** menu) change according to the keyed-in AUX IO value
Preset	31
Min	0
Max	255
Backwards Compatibility SCPI	`:OUTPut:UPORt <Value>`

7 Save/Recall/Print

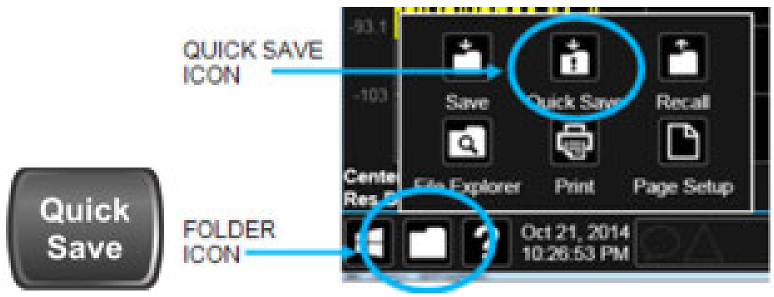
This section describes the functions that can be accessed via the front panel **Save**, **Quick Save**, and **Recall** hardkeys, as well as via the controls in the front-panel folder icon, as shown below.



7.1 Quick Save

Quick Save repeats the previous Save at the touch of a single button. Whatever you saved before gets saved again to the same directory, and with a filename derived from the previous filename.

You access Quick Save by pressing the **Quick Save** hardkey, or by pressing the folder icon at the bottom of the display and then pressing the **Quick Save** icon. In addition, if you have a PC keyboard plugged in, the sequence `CTL-Q` will perform a Quick Save.



The **Quick Save** front-panel key repeats the most recent save that was performed from the **Save** menu, with the following exceptions:

- Register saves are not remembered as Saves for the purpose of the Quick Save function
- If the current measurement does not support the last non-register save that was performed, an informational message is generated, “File type not supported for this measurement”

Quick Save repeats the last type of qualified save (that is, a save qualified by the above criteria) in the last save directory by creating a unique filename using the Auto File Naming algorithm described below.

If the previous save was a Screen Image save, Quick Save saves a Screen Image when the Quick Save button is pressed. This image is *exactly* what is on the screen when the **Quick Save** button is pressed. Quick Save does *not* force a dialog exit or navigate in any way, it simply snaps the image on the screen and saves it. This lets you save images of dialogs and setup screens that would be impossible to save using the **Save** dialog.

NOTE **When Quick Save is pressed the display theme changes to the theme specified by the Screen Image Theme control in order to take the screen shot, and then changes back to the Display Theme, but no navigation is performed, and no dialogs are exited.**

If **Quick Save** is pressed after startup and before any qualified Save has been performed, the Quick Save function performs a Screen Image save using the current settings for Screen Image saves (current theme, current directory), which then becomes the "last save" for the purpose of subsequent Quick Saves.

The Auto File Naming feature automatically generates a file name for use when saving a file. The filename consists of a prefix and suffix separated by a dot, as is standard for the Windows file system. A default prefix exists for each of the available file types:

Type	Default Prefix	Menu
State	`State_`	(Save/Recall)
Trace + State	`State_`	(Save/Recall)
Screen	`Screen_`	(Save/Recall)
Amplitude Corrections	`Ampcor_`	(Import/Export)
Traces	`Trace_`	(Import/Export)
Limit Lines	`Limit_`	(Import/Export)
Measurement Result	`MeasR_`	(Import/Export)
Capture Buffer	`CapBuf_`	(Import/Export)

A four-digit number is appended to the prefix to create a unique file name. The numbering sequence starts at 0000 within each Mode for each file type and updates incrementally to 9999, then wraps to 0000 again. It remembers where it was through a Mode Preset and when leaving and returning to the Mode. It is reset by Restore Misc Defaults and Restore System Defaults and subsequent running of the instrument application. So, for example, the first auto file name generated for State files is `State_0000.state`. The next is `State_0001`, and so forth.

One of the key features of Auto File Name is that we guarantee that the Auto File Name will never conflict with an existing file.The algorithm looks for the next available number. If it gets to 9999, then it looks for holes. If it find no holes, that is no more numbers are available, it gives an error.

For example, if when we get to State_0010.state there is already a State_0010.state file in the current directory, it advances the counter to State_0011.state to ensure that no conflict will exist (and then it verifies that State_0011.state also does not exist in the current directory and advances again if it does, and so forth).

If you enter a file name for a given file type, then the prefix becomes the filename you entered instead of the default prefix, followed by an underscore. The last four letters (the suffix) are the 4-digit number.

For example, if you save a measurement results file as "`fred.csv`", then the next auto file name chosen for measurement results save will be `fred_0000.csv`.

NOTE **Although 0000 is used in the example above, the number that is used is actually the current number in the Meas Results sequence, that is, the number that would** have been used if you had not entered your own file name.

NOTE	If the filename you entered ends with _dddd, where d=any digit, making it look just like an auto file name, then the next auto file name picks up where you left off with the suffix being dddd + 1.

Quick Save Mode

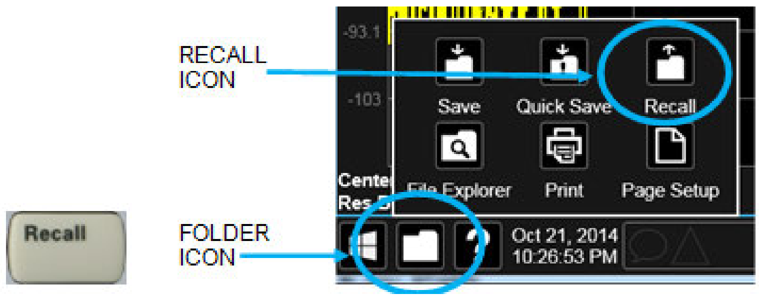
Quick Save can be operated in the Normal mode and in a special “Prompt” mode. There is a switch on the User Interface page of the **System** menus that lets you control this.

When Quick Save Mode is in Normal (the default setting), the instrument does an immediate save of a new file of the same type and to the same directory as the previous Save action. When Quick Save Mode is in the Prompt state, instead of immediately performing a Save, the Alpha Keyboard pops up with the proposed auto-filename in the entry area. The user can then press Enter to accept the auto filename, or edit the name and press Enter. This allows you to easily save a file with a custom file name.

Notes	No remote command for this key specifically

7.2 Recall

The **Recall** dialog lets you recall previously saved states, traces and other items to the instrument from files on the instrument's internal storage, from removable devices, and from directories on the network. You access the Recall dialog by pressing the **Recall** hardkey, or by pressing the folder icon at the bottom of the display and then pressing the **Recall** icon.



The dialog has section tabs running down the left side, which you use to specify what you want to recall, similar to the **Save** dialog. You choose the recall item and then complete the recall by choosing a register or file location from which to recall the item.

Notes	No remote command for this key specifically, but :MMEM:LOAD is available for specific file types. For example: :MMEM:LOAD:STATe <filename> If you try to recall a State file for a mode that is not licensed or not available in the instrument, an error message will occur and the state will not change
Backwards Compatibility Notes	In legacy analyzers, it was possible to load a state without affecting the trace data, limit lines or correction data. Similarly (since User Preset is actually loading a state), it was possible to do a User Preset without affecting the trace data, limit lines or correction data In the X-Series, "state" always includes all of this data; so, whenever state is loaded, all of the traces, limit lines and corrections are affected. Although this differs from previous behavior, it is desirable behavior, and should not cause adverse issues for users Recall for the X-Series supports backward compatibility in the sense that you can recall a state file from any X-Series model number and any version of X-Series software. This is only possible if part of the recalling process goes through a limiting step after recalling the mode settings, at least for settings that may vary with version number, model number, option and license differences. If you try to recall a state file onto an instrument with less capability than what was available on the instrument during the save, the recall will ignore the state it doesn't support, and it will limit the recalled setting to what it allows Example: if the saved state includes preamp ON, but the recalling instrument does not have a preamp; the preamp is limited to OFF. Conversely, if you save a state without a preamp, the preamp is OFF in the state file. When this saved file is recalled on an instrument with a licensed preamp, the preamp is changed to OFF. Another example is if the saved state has center frequency set to 20 GHz, but the instrument recalling the saved state is a different model and only supports 13.5 GHz. In this case, the

center frequency is limited along with any other frequency-based settings. Since the center frequency can't be preserved in this case, the recall limiting tries to at least preserve span to keep the measurement setup as intact as possible

Note that there is no state file compatibility outside of the X-Series. For example, you cannot recall a state file from ESA or PSA

7.2.1 Recall From File / Open

For every Recall type, a button appears called **Recall From File** or **Open**. "Recall From File" appears for recall types that also include registers (like State and Trace+State), and "Open" appears for all other recall types.

When you push the "Recall From File" or "Open" button, a dialog slides in from the right which allows you to see what files are saved in the current directory. See the "Save to File/Save As" section (3.1) for a depiction of this screen for the Save menu, which is similar to Recall.

The default directory is the internal directory for the current Mode and save type, on the D: drive. You may also change to another Mode's state directory by pressing the dropdown in the upper right corner labeled "Mode". Once you have chosen a directory, the files in that directory whose extension matches the current data type (e.g., .state or .trace) are displayed in the right-hand window of the dialog. You can sort this list by name, date, file size or extension by tapping the Name, Date, Size, or Content header at the top of each column. A second tap toggles the sort order between Ascending and Descending.

Also displayed is a path depiction showing the path to the current directory. In the example shown, the path is D:\Users\Instrument\Documents\SA\screen. Tapping any element of this path lets you select an alternate route. Tapping the "Computer" arrow lets you select a different drive.

Tapping the "back" arrow navigates to the previously selected directory.

If you plug in a removable drive (e.g., a thumb drive), the browser immediately navigates to the root of that drive. Furthermore, if you had a thumb drive in and you were in a directory on the thumb, and then you exit the browser, when you come back in you are still in the same directory on that removable drive. If you remove the thumb drive, you return to the directory you had been in before the thumb drive was plugged in.

Note that for each data type there is a "current" directory, and it is the last directory used by either Save or Recall for that Mode. For example, if in SA Mode you save a Corrections file to a particular directory, then when you go to recall a Correction in SA Mode, you should be pointing at that directory. Or if in EMC Mode you recall a Limit from a particular directory then when in EMC Mode you go to save a Limit, it should be pointing at that same directory. There is one “current” directory for each data type for each Mode (not one for Save and one for Recall).

The Filename field, just below the Path field, shows the filename that will be used. The **File Name** field is loaded with the name of the selected file. You may edit the filename by tapping it, which brings up the onscreen alpha keyboard. Press the “Done” button on this keyboard when you are done editing.

Select a file to load and press Recall. After a successful recall, a message "File <filename> recalled" or "State Register <register number> recalled" is displayed in an info box for a few seconds.

The **Files of Type** field shows the file suffix for the type of file you have selected to recall. This field only appears for files which have multiple file types that can be recalled. These file types are:

Amplitude Corrections:

- Amplitude Corrections (`*.csv`)
- Legacy Cable Corrections (`*.cbl`)
- Legacy User Corrections (`*.amp`)
- Legacy Other Corrections (`*.oth`)
- Legacy Antenna Corrections (`*.ant`)

Limits:

- Limit Data (`*.csv`)
- Legacy Limit Data (`*.lim`)

7.2.2 State

Lets you choose a register or file from which to recall the state.

See the Save State description for information on state files and their contents and the default paths. State files have the extension “.state”.

For rapid recall, the State menu lists 16 registers from which you can recall states. Pressing a Register button initiates the recall. You can also select a file from which to recall by pressing “Recall From File”.

Since each state file is only for one Mode, the settings for other Modes are unaffected when it is loaded. Recall State will cause a mode switch if the state being recalled is not from the current active mode.

NOTE In products that run multiple simultaneous instances of the X-Series Application, all instances share the same registers and file directories, so make sure you know from what instance a file or register was saved before recalling it.

Remote Command	`:MMEMory:LOAD:STATe <filename>`
Example	Load the state file data (on the default file directory path) into the instrument state: `:MMEM:LOAD:STAT "MyStateFile.state"`
Notes	When you pick a file to recall, the instrument first verifies that the file is recallable in the current instrument by checking the software version and model number of the instrument. If there is a mismatch between the file and the instrument, the recall function tries to recall as much as possible. It may limit settings that differ based on model number, licensing or version number. In general, variables in the instrument which are not contained in the state file will be unaffected, and variables in the state file which are not contained in the instrument will be ignored The recall proceeds by aborting the currently running measurement, clearing any pending operations, and then loading the State from the saved state file. You can open state files from any Mode, so recalling a State file switches the instrument to the Mode that was active when the save occurred. After switching to the Mode of the saved state file, Mode settings and data (if any for the Mode) become those from the saved file. The active measurement becomes the measurement which was running when the state file was saved and the data relevant to the measurement (if there is any) is recalled After recalling the state, the Recall State function does the following: – Clears the input and output buffers – Status Byte is set to 0 – Executes `*CLS` If the file specified is empty an error is generated. If the specified file does not exist, another error is generated. If there is a mismatch between the file and the proper file type, an error is generated. If there is a mismatch between file version or model number or instrument version or model number, a warning is displayed. Then it returns to the State menu and File Open dialog goes away After the Recall, the instrument exits the Recall menu and returns to the previous menu
Backwards Compatibility SCPI	`:MMEMory:LOAD:STATe 1,<filename>` The "1" is simply ignored

7.2.2.1 Recall Type

If you have a built-in Source in your instrument, you may wish, when recalling State, to recall only the part of the State file that applies to the instrument, and leave the Source unaffected. Or you may wish to recall only the part of the State file that applies to the Source, and leave the instrument unaffected.

Lets you choose whether you wish to recall the entire Analyzer + Source state (`ALL`), just the Analyzer State `ANALyzer`), or just the Source State (`SOURce`).

Remote Command	`:MMEMory:LOAD:RTYPe ALL | ANALyzer | SOURce`
Example	`:MMEM:LOAD:RTYP ALL`
Dependencies	Only available in models with a built-in source, such as VXT models
Preset	`ALL`
Range	`ALL|ANALyzer|SOURce`

7.2.2.2 Register 1 thru Register 16

Selecting any one of these register buttons causes the State to be recalled from the specified Register. The registers are provided for rapid saving and recalling, since you do not need to specify a filename or navigate to a file. Each of the register menu keys annotates whether it is empty or at what date and time it was last modified. In addition, you can edit any of the register names to enter custom names for any register.

Although these 16 registers are the only registers available from the front panel, there are 128 state registers available in the instrument. Registers 17-128 are only available from the SCPI interface, using the `*RCL` command.

There is one set of 128 state registers in the instrument, not one set for each Mode. When a state is saved, the Mode it was saved from is saved with it; then when it is recalled, the instrument switches to that Mode.

NOTE	**In products that run multiple simultaneous instances of the X-Series Application, all instances share the same registers and file directories, so make sure you know from what instance a file or register was saved before recalling it.**

The date displayed follows the format specified in the **Date Format** setting in the **Control Panel**. The time shows hours and minutes.

After the recall completes, the message "Register <register number> recalled" is displayed.

If you are in the Spectrum Analyzer Mode, and you are recalling a register that was saved in the Spectrum Analyzer Mode, then after the recall, you will still be in the Recall Register menu. If the Recall causes you to switch modes, then after the Recall, you will be in the Frequency menu.

If a requested register is empty an error is generated.

Example	`*RCL 1`
Range	1-16 from front panel, 1-128 from SCPI

7.2.2.3 Edit Register Names

You may enter a custom name on any of the **Register** keys, to help you remember what you are using that state to recall. To do this, press the **Name** field for the register you want to rename, which brings up the onscreen alpha keyboard. Press the **Done** button on this keyboard when you are done editing.

The maximum number of characters for a register name is 30. If you delete all the characters in the custom name, it restores the default (time and date).

For more information and the SCPI command, see "Edit Register Names" on page 2535 under **Save, State**.

7.2.3 Trace+State

Lets you choose a register or file for recalling the state.

See **Save**, "State" on page 2534 for information on state files and their contents and the default paths. State files have the extension "`.state`".

For rapid recall, the **Trace+State** menu lists 16 registers from which you can recall trace+state files. Pressing a **Register** control initiates the recall. You can also select a file from which to recall by pressing **Recall From File**.

Since each trace+state file is only for one Mode, the settings for other Modes are unaffected when it is loaded. **Recall Trace+State** will cause a mode switch if the trace+state being recalled is not from the current active Mode.

NOTE	**In products that run multiple simultaneous instances of the X-Series Application, all instances share the same registers and file directories, so make sure you know from what instance a file or register was saved before recalling it.**

Trace+State files have the extension `.trace`.

The Trace+State selection only appears for measurements that support trace saves. It is blanked for modes that do not support trace saves. Saving Trace is identical to saving State, except that a `.trace` extension is used on the file instead of `.state`, and internal flags are set in the file indicating which trace was saved.

Remote Command	`:MMEMory:LOAD:TRACe TRACE1 | … | TRACE6,<filename>` `:MMEMory:LOAD:TRACe:REGister TRACE1 | … | TRACE6,<integer>`
Example	Loads the trace file data (on the default file directory path) into the specified trace; if it is a "single trace" save file, that trace is loaded to trace 2, and is set to be not updating: `:MMEM:LOAD:TRAC TRACE2,"MyTraceFile.trace"` Restore the trace data in register 2 to Trace 1:

	`:MMEM:LOAD:TRAC:REG TRACE1,2`

Notes	When you perform the recall, the recalling Trace function must first verify the file is recallable in this instrument by checking instrument software version and model number, since it includes State. If everything matches, a full recall proceeds by aborting the currently running measurement, and loading the state from the saved state file to as close as possible to the context in which the save occurred. You can open .trace files from any mode that supports them, so recalling a Trace file switches to the mode that was active when the save occurred. After switching to the mode of the saved state file, mode settings and data (if any for the mode) are loaded with values from the saved file and the saved measurement of the mode becomes the newly active measurement, and the data relevant to the measurement (if there is any) is recalled
	Once the state is loaded, the trace data must be loaded. The internal flags are consulted to see which trace to load and the "To Trace" setting to see where to load it. Trace data is always loaded with the specified trace set to View, so that the data is visible and not updating (so as not to erase the recalled data). If the file is an "all trace" file, all traces are loaded with the saved data (to the original trace the data was saved from) and set to View. Traces whose data is not loaded are restored to the update state that existed when they were saved
	After recall, the instrument exits the **Recall** menu and returns to the previous menu
	Some Modes and measurements do not have 6 available traces. For example, Phase Noise Mode:
	`:MMEMory:LOAD:TRACe TRACE1|TRACE2|TRACE3,<filename>`
	Some Modes and measurements have more than 6 traces. For example, Realtime SA Mode:
	`:MMEMory:STORe:TRACe TRACE1 | TRACE2 | TRACE3 | TRACE4 | TRACE5 | TRACE6 | TRACE7 | TRACE8 | TRACE9 | TRACE10 | TRACE11 | TRACE12 | ALL,<filename>`

7.2.3.1 Recall To Trace

Lets you select which Trace to recall to. Not all Modes have the same number of available traces. The default is the currently selected trace, selected in this or any other menu with **Trace** selection. If you have selected `ALL`, then that remains selected until you specifically change it to a single trace, regardless of the trace selected in the **Trace** menu.

If the `.trace` file is an "all trace" type, **To Trace** is ignored, and the traces each go back to the trace from which they were saved.

7.2.3.2 Register 1 thru Register 16

Selecting any one of these register buttons causes the specified trace(s) and the state of the currently active mode to be recalled from the specified Register. The registers are provided for rapid saving and recalling, since you do not need to specify a filename or navigate to a file. Each of the register menu keys annotates whether it is empty or at what date and time it was last modified. In addition, you can edit any of the register names to enter custom names for any register.

There is one set of 16 trace+state registers in the instrument, not one set for each Mode. When trace+state is saved, the Mode it was saved from is saved with it; then when it is recalled, the instrument switches to that Mode.

NOTE	**In products that run multiple simultaneous instances of the X-Series Application, all instances share the same registers and file directories, so make sure you know from what instance a file or register was saved before recalling it.**

The date displayed follows the format specified in the **Date Format** setting under the **Control Panel**. The time shows hours and minutes.

After the recall completes, the message `Register <register number> recalled` is displayed. If a requested register is empty, an error is generated.

Recalling state from a Register is the same as recalling state from a **Trace+State** File.

Example	`*RCL 1`
Range	1-16

7.2.3.3 Edit Register Names

You may enter a custom name on any of the **Register** keys, to help you remember what you are using that state to recall. To do this, press the **Name** field for the register you want to rename, which brings up the onscreen alpha keyboard. Press the **Done** button on this keyboard when you are done editing

The maximum number of characters for a register name is 30. If you delete all the characters in the custom name, it restores the default (time and date).

For more information and the SCPI command, see "Edit Register Names" on page 2535 under **Save, State**.

7.2.4 Screen Config + State

Lets you load the complete configuration of all your screens from a file which you specify.

Note that recalling a screen config file wipes out your current screen configuration; you do not see a warning before it loads, but there is a note on the **Recall** page letting you know what is going to happen.

The filenames are of the form:

`State_0001.screen`

Remote	`:MMEMory:LOAD:SCONfig <filename>`

Command	
Example	Load the screen configuration from the file `MyScreenConfig.screen` in the default directory: `:MMEM:LOAD:SCON "myScreenConfig.screen"`

7.2.5 Measurement Data

Lets you specify a data type (for example, trace data) and choose a file from which to import the data.

Measurement Data files are comma-separated value (CSV) files, and contain the requested data in a form that can be imported into Excel or other spreadsheets, as well as header data that gives information on relevant instrument settings at the time the save occurred.

For more on **Measurement Data** files, see "Measurement Data" on page 2540 under **Save**.

Since the commonly exported data files are in CSV format, you can edit the data prior to importing it. This allows you to export a data file, manipulate the data in Excel (for example) and then import it.

7.2.5.1 Data Type

Lets you select the data type to recall.

Notes	There is no SCPI command for Data Type, as the type is implied in the SCPI command for each item
Dependencies	The **Data Type** menu for any given measurement only contains data types that are supported by that measurement. Data types that are not importable do not appear, even if they *do* appear in the corresponding **Save** menu

Trace

Allows you to import Trace files in the PC-readable CSV format.

Trace data files have the extension `.csv`. The trace file contains a “metadata” header which describes the state of the instrument when the file was saved. This metadata is compared to the current state of the instrument when the file is recalled; if it does not match the current state, the “invalid data indicator” (*) is displayed.

The metadata is detailed in "Trace File Contents" on page 2543 in the **Save** section.

Remote Command	`:MMEMory:LOAD:TRACe:DATA TRACE1 | … | TRACE6,<filename>`
Example	Import the 2nd trace from the file `myTrace2.csv` in the current path. For SA Mode, the default path is:

	`My Documents\SA\data\traces` `:MMEM:LOAD:TRAC DATA TRACE2,"myTrace2.csv"`
Dependencies	For SA measurements, a trace cannot be recalled from a trace file that was exported with `ALL` traces selected A trace cannot be imported if the number of trace points in the file do not match the number of sweep points currently set for the measurement. If this happens, an error message is generated Errors are reported if the file is empty or missing, or if the file type does not match, or if there is a mismatch between the file type and the destination data type
Couplings	When a trace is imported, **Trace Update** is always turned `OFF` for that trace and **Trace Display** is always turned `ON`
Annotation	After recall is complete, an advisory is displayed in the message bar confirming which trace file was loaded
Status Bits/OPC dependencies	Sequential - aborts the current measurement

Spectrogram

Only available in SA Mode, RTSA Mode, and EMI Mode RTSC (Real Time Scan) measurement.

Allows you to import Spectrogram files in the PC-readable CSV format.

Spectrogram files have the extension `.csv`. The default filename is `MeasResult_0000.csv`, where the 4-digit number is the lowest number that does not conflict with any filename in the current directory.

Remote Command	`:MMEMory:LOAD:RESults:SPECtrogram <filename>`
Example	Import the results from the file `MeasResult_0001.csv` using the default path: `:MMEM:LOAD:RES:SPEC "MeasResult_0001.csv"`
Dependencies	Requires **Spectrogram** view and **Single** mode when recalling spectrogram, otherwise the error message “Spectrogram view and Single mode must be on to recall Spectrogram Meas Results file” is reported Errors are also reported if the file is empty or missing, or if the file type does not match, or if there is a mismatch between the file type and the destination data type, or the measurement is in **Continuous** mode

7.2.6 Limit

Lets you select a file from which to import the **Limit** data.

Limit files are CSV files, and contain the limit data in a form that can be imported into Excel or similar spreadsheets, as well as header data that provides information on the limit.

See the **Save Limit** description ("Limit" on page 2588) for information on Limit files and their contents and the default paths. **Limit** files have the extension `.csv`.

For backwards compatibility, older limit files with the extension `.lim` can be read into the instrument, but you can only *save* limits as `.csv` files.

A set of preloaded **Limits** files can be found in the directory:

`My Documents/EMC Limits and Ampcor/Limits`

Remote Command	`:MMEMory:LOAD:LIMit LLINE1 | LLINE2 | LLINE3 | LLINE4 | LLINE5 | LLINE6,<-filename>`
Example	Import the 2nd Limit Line from the file `myLimitLine2.csv` in the current path: `:MMEM:LOAD:LIM LLINE2,"myLimitLine2.csv"`
Dependencies	Errors are reported if the file is empty or missing, or if the file type does not match, or if there is a mismatch between the file type and the destination data type In the Log Plot measurement in Phase Noise Mode, there are only three Limit Lines, so the valid parameters are `LLINE1 | LLINE2 | LLINE3` This key only appears if you have the proper option installed in your instrument
Couplings	When a limit line is loaded from mass storage, it is automatically turned on. This allows the user to see it, thus confirming the load. The Margin settings will match those when the limit was saved The instrument cannot mix **Limits** domains (X Axis Unit must be **Frequency** or **Time** for both **Limits**). So, when a **Limits** file is loaded, the instrument sets the **Limits** domain (X Axis Unit) to match that of the file. If this changes the **Limits** domain from what it was before the file was loaded, all **Limits** data in all **Limits** sets is erased before the data loads. If this operation is over the remote interface, there is no warning if this occurs, so care should be taken to know the domain of the file you are loading
Annotation	After recall is complete, an advisory is displayed in the message bar confirming which limit file was loaded
Status Bits/OPC dependencies	Sequential - aborts the current measurement

7.2.6.1 Select Limit

Selects the Limit register into which the recalled **Limit** will be placed, for example, **Limit 1**.

Preset	Not part of **Preset**, but is reset to LLINE1 by **Restore Mode Defaults** Survives shutdown

7.2.7 Correction

Allows you to import Amplitude Corrections files in the PC-readable CSV format.

Amplitude Correction files contain the correction data in a form that can be imported into Excel or similar spreadsheets, as well as header data that provides information on the correction.

For backwards compatibility, older limit files with the extensions `.amp`, `.cbl`, `.ant` and `.oth` can be read into the instrument.

A set of preloaded **Corrections** files can be found in the directory:

`My Documents\EMC Limits and Ampcor\Ampcor`

The default path for CSV files is:

`My Documents\amplitudeCorrections\`

Antenna corrections are a particular kind of Amplitude Corrections – they are distinguished in the corrections file by having **Antenna Unit** set to a value other than **None**. When the Amplitude Correction is an Antenna correction and the **Antenna Unit** in the file is not **None**, the Y-Axis Unit setting changes to match the Antenna (Transducer) Unit in the file.

Remote Command	`:MMEMory:LOAD:CORRection 1 | … | 8, <filename>`
Example	Recall the Amplitude Correction data from the file `myAmpcor.csv` in the current directory to the 2nd Amplitude Correction table, and turns on Correction 2: `:MMEM:LOAD:CORR 2, "myAmpcor.csv"`
Dependencies	Only one Transducer units can be on at any given time. Note that this means that if a correction file with a Transducer Unit is loaded into a particular Correction, all other Corrections are set to that same Transducer unit Corrections are not supported by all Measurements. If in a Mode in which some Measurements support it, this key is grayed-out in measurements that do not. The key does not show at all if no measurements in the Mode support it Errors are reported if the file is empty or missing, or if the file type does not match, or if there is a mismatch between the file type and the destination data type This key does not appear unless you have the proper option installed in your instrument This command will generate an "Option not available" error unless you have the proper option installed in your instrument
Couplings	When a correction file is loaded from mass storage, it is automatically turned on (**Correction**ON) and **Apply Corrections** is set ON. This allows you to see its effect, thus confirming the load
Annotation	After recall is complete, an advisory is displayed in the message bar confirming which file was recalled
Backwards Compatibility SCPI	`:MMEMory:LOAD:CORRection ANTenna | CABLe | OTHer | USER, <filename>` For backwards compatibility, `ANTenna` maps to 1, `CABle` maps to 2, `OTHer` maps to 3 and `USER` maps to 4

7.2.7.1 Select Correction

Selects the register into which the recalled **Correction** will be placed, for example, **Correction 1**.

Preset	Not part of **Preset**, but reset to **Correction 1** by **Restore Input/Output Defaults** Survives a shutdown

7.2.8 Complex Correction

Imports **Complex Corrections** files in the PC-readable `.s2p` format.

Complex Correction files contain amplitude and phase correction data in a form that can be imported into Excel or similar spreadsheets, as well as header data that gives information on the correction.

The default path for Complex Corrections files is:

`My Documents\complexCorrections\`

Remote Command	`:MMEMory:LOAD:CCORrection <integer>, <filename>`
Example	Recall the **Complex Correction** data from the file `mycor.s2p` in the current directory to the 2nd Complex Correction table, and turns on **Complex Correction 2**: `:MMEM:LOAD:CCOR 2, "mycor.s2p"`
Dependencies	Not supported by all measurements. The tab does not appear at all if no measurements in the Mode support it Errors are reported if the file is empty or missing, or if the file type does not match, or if there is a mismatch between the file type and the destination data type
Couplings	When a complex correction file is loaded from mass storage, it is automatically turned `ON` and **Apply Corrections** is set `ON`. This allows you to see its effect, thus confirming the load
Annotation	After recall is complete, an advisory is displayed in the message bar confirming which file was recalled

7.2.8.1 Select Complex Correction

Selects the register into which the recalled **Complex Correction** will be placed, for example, **Complex Correction 1**.

Preset	Not part of **Preset**, but is reset to Correction 1 by **Restore Input/Output Defaults** Survives a shutdown

7.2.9 Correction Group

Selects **Correction Group** as the data type to be imported. The next step is to press **Recall From** to open the file dialog. When recalling a correction group, the correction group settings, range table and correction files data will be loaded.

If there are values defined in the correction group range, and you accessed this function from the front panel, there will be a message prompt that asks for your confirmation, because the values will be overwritten during the recall.

Remote Command	`:MMEMory:LOAD:CORRection:GROup <filename>`
Example	Import the **Correction Group** and the corresponding correction tables from the file `myCorrGroup.csv`: `:MMEM:LOAD:CORR:GRO "D:\myCorrGroup.csv"`
Notes	Errors are reported if the file is empty or missing, or if the file type does not match, or if there is a mismatch between the file type and the destination data type When recall is completed, the correction group will be turned ON. If any of the correction data loaded is found out of the frequency range, Execution error is generated. Error icon appears on the status column correction group table
Dependencies	Supported in EMI Receiver Mode, and in Spectrum Analyzer Mode if Option EMC or EMI Receiver Mode is present
Annotation	After recall is complete, display an advisory in the message bar
Status Bits/OPC dependencies	Sequential – aborts the current measurement

7.2.10 Recall VDI CCD Correction

Imports VDI CCD External Mixer Correction files in the PC-readable CSV (.csv) format.

The default path for VDI CCD External Mixer Correction files is the instrument's `My Documents` folder.

Remote Command	`:MMEMory:LOAD:VCORrection <filename>`
Example	`:MMEM:LOAD:VCOR "vdi_ccd_corr.csv"`
Dependencies	Requires the EXW (External Mixing Wide Bandwidth) and Ampcor (Amplitude Correction) licenses VDI CCD Corrections are not supported by all measurements. The tab does not appear at all if no measurements in the Mode support it Errors are reported if the file is empty or missing, or if the file type does not match, or if there is a mismatch between the file type and the destination data type If the file is empty, message –250 is reported. If the file does not exist, message –256 is reported. If there is a mismatch between the file and the destination data type, message –250 is reported
Couplings	When a VDI CCD correction file is loaded into memory, if the correction matches the current external mixer setup and "Select VDI CCD Correction" on page 2348 is `NONE`, the selected VDI CCD Correction is set to the serial number of the matching correction data
Annotation	After recall is complete, an advisory is displayed in the message bar confirming which file was recalled

7.2.11 SCPI Recorder

Contains controls to let you recall SCPI recordings.

7.2.11.1 Recall From File

Recalls a previously saved SCPI Recorder file. For details of the SCPI Recording feature, see "SCPI Recorder" on page 2172.

After the file contents have been read, each of the SCPI commands or queries present in the file at the time of recall is applied to the system. If the file is from another instrument, or from a different model, some commands may cause unexpected data changes as each is applied. If any commands result in errors, the command(s) and the corresponding error(s) are displayed after playback is completed.

Recalling a SCPI recording plays the contents of the file immediately after recall. You can view the content of the file in the SCPI recorder dialog. If there are any entries in the SCPI recorder, you are prompted either to keep the previously recorded data, or let it be discarded.

If you choose to discard the data, all existing recording entries are cleared, and the SCPI recorder is populated with the recalled data.

If you choose to keep the existing recorded data, the recalled file content is appended to the existing recording.

NOTE **Some SCPI entries in the recorded file may require the presence of other files, if a command in the recorded file specifies the recall of other files.**

7.2.12 Mask

The **Mask** data type is used to import and export Mask files for measurements that use masks, such as cellular comms and real-time measurements.

7.2.13 Sequence

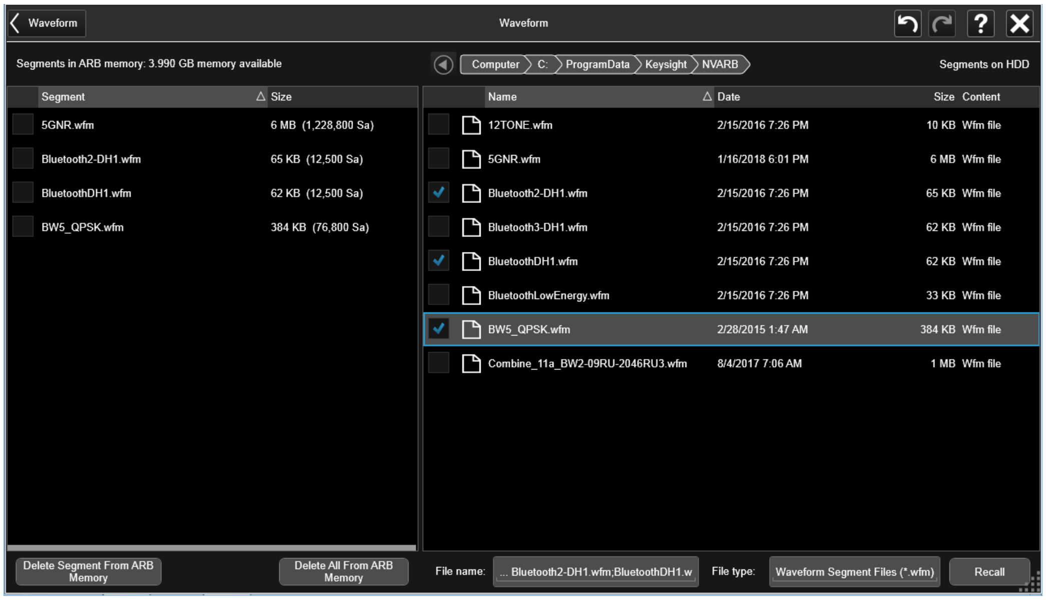
These need to be brought over for the EXT and/or Sequence Analyzer when they are available in the Touch UI

7.2.14 Waveform

Recalls waveforms into the ARB memory of an Internal Source.

When you select the **Waveform** tab in the **Save** dialog,, a hint appears saying “Recalls files from Mass Storage to the ARB and lets you manage the ARB memory at the same time.”

You then tap **Recall From File** to display the **Recall Waveform** dialog.



The left-hand window shows the files in ARB memory. The right-hand window shows the files on the hard drive.

You can select one or more waveform files in the right-hand window. Each file selected has a blue check box in it. To select a single file, tap that file's row. To select additional files, tap the check box in the row of the desired additional files.

When you have selected the file or files that you wish to recall, tap Recall. The file(s) are recalled into the ARB memory, and appear in the left-hand window.

If a file of the same name already exists within ARB memory, it is overwritten. If you wish to load two segments of the same name, you must rename one of the segments before loading it into ARB memory. To rename a segment, you can either use Windows File Explorer, or `:MMEMory:COPY`.

You can select one or more segments in the left-hand window and tap "Delete Segments from ARB memory" to delete the selected files. You can also delete all files in ARB memory by tapping "Delete All from ARB memory.

You can change the current directory by tapping on an element of the file path at the top of the screen and selecting the desired subdirectory in the list that appears, and repeating until you have the path you want. The current directory is used for manually loading waveform segments into ARB memory for playback, and as a search location for waveform segments that are required to be loaded into ARB memory for playback of a waveform sequence or a list sequence.

File Type allows you to specify a waveform format. The available file types are listed below:

Type	Extension	Notes
Waveform Files	`.wfm`	Keysight Signal Studio files
Binary Files	`.bin`	Interleaved IQ data files. They could be single precision or double precision customer created files. One-byte marker may be added
CSV Files	`.csv`	Comma-separated value file. Could be generated by Excel
Text Files	`.txt`	
Matlab Files	`.mat`	Should be Level 4, Level 5 or HDF5 MAT-files (only Level 5 Matlab file is supported in X24)

Waveforms in `.csv`, `.txt` and `.mat` formats are supported by models with a built-in source, such as VXT and EXM.

`.txt` files are formatted according to the following rules:

1. Text files only contain the IQ information. Data in the right column represents the amplitude of real(I) points, Data in the left column represents the amplitude of imaginary(Q) points
2. The amount of data should be multiple of two (IQ pairs)
3. The data range is from -1e10 to1e10, the data type should be `int`, `float` or `double`. 16 digits or fewer for every data is acceptable
4. The values are separated by comma or tab. Extra commas or tabs are ignored
5. Use **Enter** to separate IQ pairs

Example for text file data:

```
0.46425922,-0.57411048
0.47184454,-0.58435995
0.48107329,-0.59014958
0.49223323,-0.58998679
0.50419607,-0.58558843
0.51679158,-0.57721768
0.53005322,-0.56481976
0.54373011,-0.54879346
0.55759183,-0.52950807
0.57141409,-0.50732489
```

Rules 1-3 above also apply to `.csv` data.

Dependencies	Only appears if your hardware includes an Internal Source, such as in VXT

7.2.14.1 Load Segment to ARB Memory

Loads a single segment to ARB memory. Same as pressing the **Recall** button with a single waveform selected.

Remote Command	`:SOURce:RADio:ARB:LOAD <string>` `<string>` - specifies the path name of the file to load from the HDD into ARB memory. May be a <full path + filename>, or <"NVWFM" MSUS + colon + filename>

Example	`:SOUR:RAD:ARB:LOAD "D:\NVARB\testwaveform.bin"`
	or
	`:SOUR:RAD:ARB:LOAD "NVWFM:testwaveform.bin"`

Notes	Because loading the file involves a delay of unpredictable length, this command should be followed by `*OPC?`, which holds off subsequent commands until the loading operating is complete If you specify a file over SCPI, but the file is not at the specified location, an error is generatedIf you try to load a waveform file but the file contains less than 500 IQ samples, an error is generated VXT models M9410A/11A/15A/16A and M9410E/11E/15E/16E: If you try to load a waveform file but the file contains less than 1024 IQ samples, an error is generated If you try to load a Signal Studio waveform `*.wfm` that contains invalid waveform header, an error is generated If the ARB is ON when you load a file to ARB memory or delete a file from ARB memory, the playing waveform segment may not keep phase continuity during the ARB memory operation. The waveform is replayed after the ARB operation is finished ARB can be loaded into ARB memory even if required licenses are not present on the instrument. In this case, a GUI-only warning message -800, "Operation complete; Loaded <filename> successfully, but no license <required licenses> installed". You can install required licenses according to <required licenses> string to license it, or multi-pack license it When in Sequence Analyzer Mode, and **Include Source** is **Yes**, an attempt to load a file to ARB memory is rejected with an error. When **Include Source** is **No**, and if there is insufficient free ARB memory to load the selected waveform, an error is generated

Remote Command	`:SOURce:RADio:ARB:LOAD:ALL <string>` `<string>` specifies the directory on the HDD to load the files into ARB memory from
Example	`:SOUR:RAD:ARB:LOAD:ALL "D:\nvarb"`
Notes	Loads all the segment files within the currently selected directory into ARB memory. If a file of the same name already exists within ARB memory, it is overwritten. If you wish to load two segments of the same name, you must rename one of the segments before loading it into ARB memory. To rename a segment, either use Windows File Explorer, or `:MEMory:COPY` If you specify a directory over SCPI, but the directory does not exist, an error is generated If the ARB is ON, and you then load or delete a file to ARB memory, the playing waveform segment may not keep phase continuity during the ARB memory operation. The waveform is replayed after the ARB operation is finished When in Sequence Analyzer Mode, and **Include Source** is **Yes**, an attempt to load all files from a

directory to ARB memory is rejected with an error. When **Include Source** is **No** and there is insufficient free ARB memory to load all the waveforms, when the ARB memory is full, the copy ceases, and an error is generated

7.2.14.2 Delete Segment From ARB Mem

Deletes a segment from ARB memory.

Remote Command	`:SOURce:RADio:ARB:DELete <string>` `<string>` specifies the waveform to be deleted from the ARB playback memory
Example	`:SOUR:RAD:ARB:DEL "testwaveform.bin"`
Notes	It is possible to delete files from within the ARB memory when the ARB is ON. However, if you attempt to delete the file that is currently playing an error is generated It is possible to delete a file from within the ARB memory when the sequencer state is ON, and the file is not being used by the List Sequencer. If you attempt to delete a file that is being used by the list sequencer, an error is generated When the Sequencer state of the List Sequencer is **On**, even if ARB state is **On**, the selected waveform will not be played. In this case, if the selected waveform is not used in List Sequence, it can be deleted, and the ARB state is turned **Off** If the ARB is ON and you load a file to ARB memory or delete a file from ARB memory, the playing waveform segment may not keep phase continuity during the ARB memory operation. The waveform is replayed after the ARB operation is finished When in Sequence Analyzer Mode, and **Include Source** is **Yes**, an attempt to delete a file from ARB memory is rejected with an error . When **Include Source** is **No**, and you specify a file that does not exist within ARB memory, an error is generated

7.2.14.3 Delete All From ARB Memory

Removes all segments from ARB memory.

Remote Command	`:SOURce:RADio:ARB:DELete:ALL`
Example	`:SOUR:RAD:ARB:DELete:ALL`
Notes	If you attempt to delete all files from ARB memory when there are waveform files used in the Sequencer function of the List Sequencer and the Sequencer state is ON, all files except the files currently being used in list sequencer are deleted, and an error is generated If the ARB is ON and you load a file to ARB memory or delete a file from ARB memory, the playing waveform segment may not keep phase continuity during the ARB memory operation. The waveform is replayed after the ARB operation is finished When in Sequence Analyzer Mode, and **Include Source** is **Yes**, an attempt to delete all files from ARB memory is rejected with an error. When **Include Source** is **No**, and you attempt to delete all files from ARB memory when the ARB is currently playing a file, all files except the one playing are deleted and an error is generated

7.2.14.4 Set Default Directory (Remote Command Only)

Sets the default directory for loading ARB files from SCPI.

Remote Command	`:SOURce:RADio:ARB:DEFault:DIRectory <string>` `:SOURce:RADio:ARB:DEFault:DIRectory?`
Example	`:SOUR:RAD:ARB:DEF:DIR "D:\ArbFiles"` `:SOUR:RAD:ARB:DEF:DIR?`
Notes	Sets the default directory to be used as a search location for waveform segments that are required to be loaded into ARB memory for playback of a waveform sequence, and as a search location for selecting waveforms using SCPI
State Saved	Persistent, survives a power cycle and a preset but not saved in the instrument state

7.2.14.5 Query ARB Memory File List (Remote Query Only)

Queries the instrument for the list of waveform segments in the ARB memory.

NOTE: **Returns a string for waveform segment names in ARB memory. If you want a string list of waveform segments in the ARB memory, use "Query ARB Memory Full File List (Remote Query Only)" on page 2528.**

Remote Command	`:SOURce:RADio:ARB:CATalog?`
Example	`:SOUR:RAD:ARB:CATalog?`
Notes	The return data is in the following format:

`<integer>`	memory used
`<integer>`	memory free
`<string>…`	comma separated list of waveform segments within ARB memory

7.2.14.6 Query ARB Memory Full File List (Remote Query Only)

Queries the instrument for the string list of waveform segments in the ARB memory. Returns a string list for waveform segment names in the ARB memory.

Remote Command	`:SOURce:RADio:ARB:FCATalog?`
Example	`:SOUR:RAD:ARB:FCATalog?`
Notes	The return data is in the following format:

`<integer>`	Memory used
`<integer>`	Memory free
`<integer>`	File count in ARB memory
`<string>,<string>, … <string>`	Comma-separated string list of waveform segments within ARB memory

Example:

`:SOUR:RAD:ARB:FCAT?`

EXT returns: 27499,2069653,3,"c2k.wfm","gsm.wfm","wcdma.wfm"

7.2.15 Power Sensor Cal Factor

Selects a file to which to export the Power Sensor Cal factor data.

Cal Factor files are XML files, and contain the cal factor data and header data that gives information on the power sensor.

The default path for **Cal Factor** Files is:

`My Documents\<mode name>\data\PSCF`

where `<mode name>` is the parameter used to select the mode with `:INST:SEL` (for example, `MRECEIVE` for Measuring Receiver Mode). Hence, a **Cal Factor** file from any measurement in the Measuring Receiver mode would be stored in:

`My Documents\MRECEIVE\data\PSCF`

Cal Factor files have the extension `.xml`. The default filename is `<Sensor Model>_<Sensor Serial Number>_0000.xml`, where the 4-digit number is the lowest number that does not conflict with any filename in the current directory. If the sensor model or serial number is blank, the default filename is `PSCF_0000.xml`.

Remote Command	`:MMEMory:STORe:PSCFactor <file_name>`
Example	`:MMEM:STOR:PSCF "myPSCF.xml"`
Notes	If the save is initiated via SCPI, and the file already exists, the file will be overwritten Using the `C:` drive is strongly discouraged, since it runs the risk of being overwritten during an instrument software upgrade Both single and double quotes are supported for any filename parameter over SCPI
Dependencies	Only appears if you have the proper option installed in your instrument

7.2.16 Loss Comp

Sets the import file type to Loss Compensation Before DUT Table or to Loss Compensation After DUT Table.

Mode	NFIGURE
Parameter Name	Recall Loss Comp
Control Path	Recall
Parameter Type	ImmediateAction
SCPI Command	`:MMEMory:LOAD:LOSS BEFore | AFTer,<file_name>`
SCPI Example	`:MMEM:LOAD:LOSS BEF,"C:\LossBefore.csv"` `:MMEM:LOAD:LOSS AFT,"C:\LossAfter.csv"`
Notes	Three file formats are supported: – Loss Compensation file (`.csv`) – Legacy Loss Compensation file (`.loss`) – S parameter file (`.s2p`)
Soft Key Label	Loss Comp
Backwards Compatibility SCPI	:MMEMory:LOAD:LOSS
Initial S/W Revision	A.04.00

For `.s2p` files, only the `S21` component is used for the loss compensation.

The CSV format contains the following data:

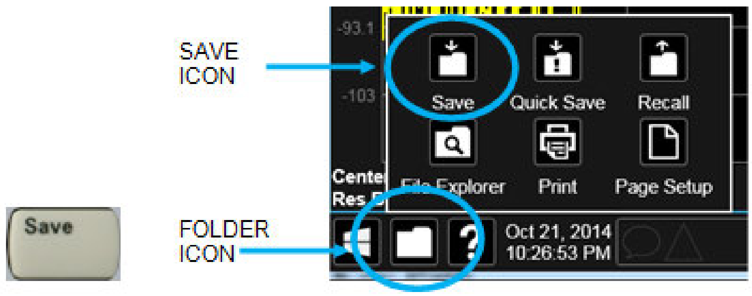
```
File Type
Application Name: Measurement Name
Version and Model Number
Loss Comp Data
```

Below is an example of a valid CSV Loss Compensation file:

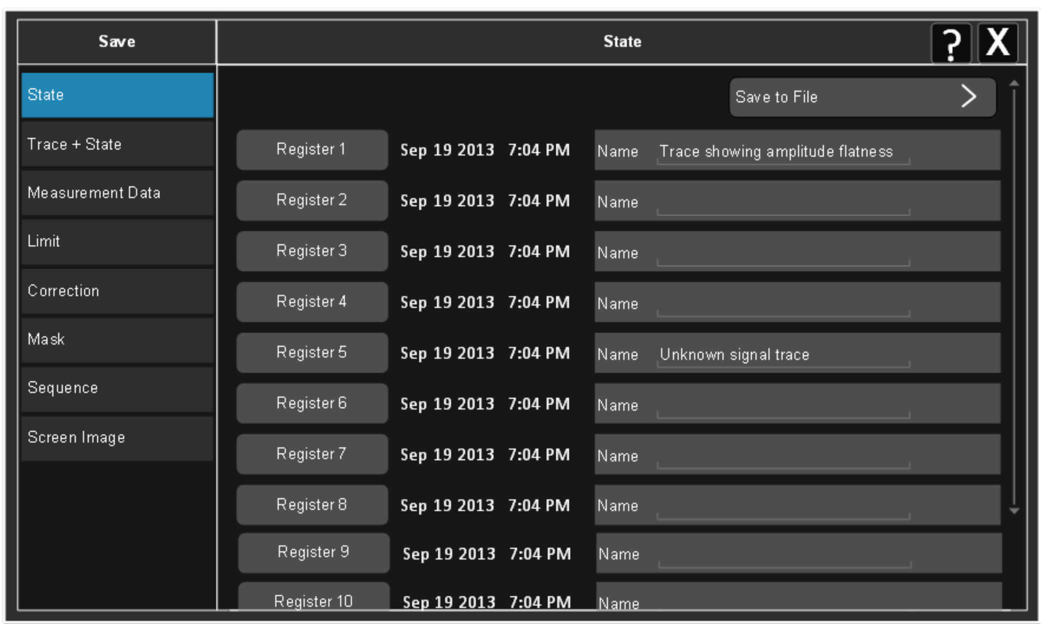
```
[Filetype LossCompensation]
[NF:NFIG]
Ver. ***, Model ***
10, 1.0000
20, 2.0000
30, 3.0000
40, 4.0000
50, 5.0000
60, 6.0000
```

7.3 Save

The **Save** dialog lets you save states, traces, screen images and other items from the instrument to files on the instrument's internal storage, to removable devices, and to directories on the network. You access the dialog by pressing the **Save** hardkey, or by pressing the folder icon at the bottom of the display and then pressing the **Save** icon.



The dialog has tabs running down the left side, which you use to specify what you want to save.



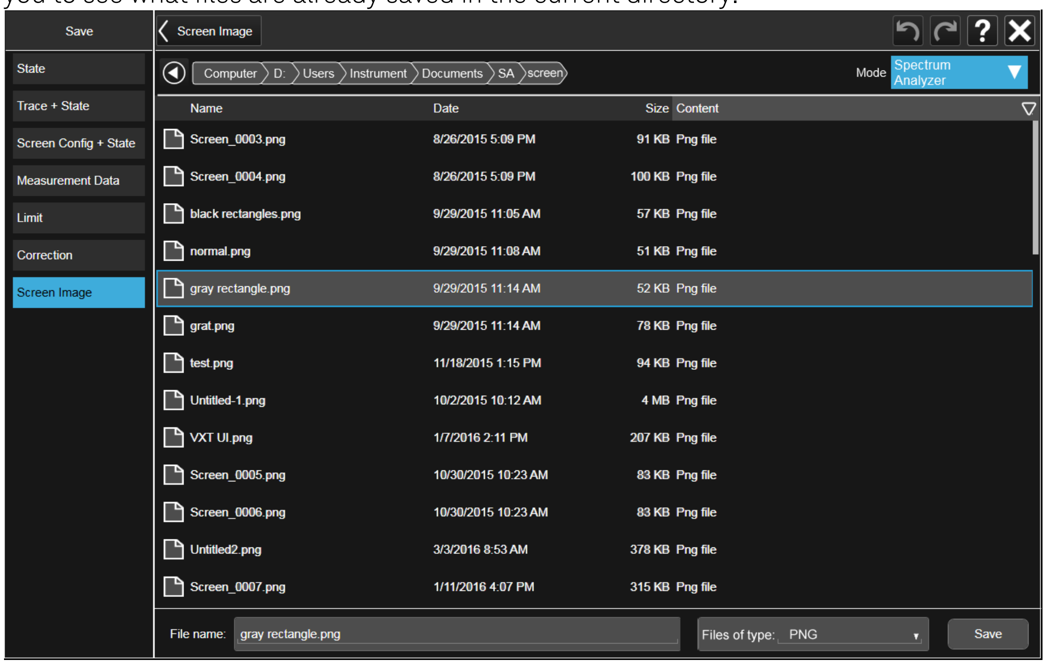
You choose the save item and then complete the save by choosing a register or file location to which to save the item.

Notes	No remote command for this key specifically, but `:MMEM:STORe` is available for specific file types Example: `:MMEM:STOR:STATe <filename>`

7.3.1 Save to File / Save As

For every Save type, a control appears labeled **Save to File** or **Save As**. **Save to File** appears for save types that also include registers (like State and Trace+State), and **Save As** appears for all other save types.

When you press **Save to File** or **Save As**, a dialog slides in from the right that allows you to see what files are already saved in the current directory.



The default directory is the internal directory for the current Mode and save type, on the `D:` drive. You may also change to another Mode's state directory by pressing the dropdown in the upper right corner labeled **Mode**. Once you have chosen a directory, the files in that directory whose extension matches the current data type (for example, `.state` or `.trace`) are displayed in the right-hand window of the dialog. You can sort this list by name, date, file size or extension by tapping the Name, Date, Size, or Content header at the top of each column. A second tap toggles the sort order between Ascending and Descending.

Also displayed is a path depiction showing the path to the current directory. In the example above, the path is `D:\Users\Instrument\Documents\SA\screen`. Tapping any element of this path lets you select an alternate route. Tapping the **Computer** arrow lets you select a different drive.

Tapping the "Back" arrow navigates to the previously selected directory.

Note: Using the C: drive is strongly discouraged, due to the risk of data being overwritten during an instrument software upgrade.

If you plug in a removable drive (for example, a thumb drive), the browser immediately navigates to the root of that drive. Furthermore, if you had a thumb drive in and you were in a directory on the thumb, and then you exit the browser, when you come back in you are still in the same directory on that removable drive. If you remove the thumb drive, you return to the directory you had been in before the thumb drive was plugged in.

Note that for each data type there is a "current" directory, and it is the last directory used by either Save or Recall for that Mode. For example, if in SA Mode you save a Corrections file to a particular directory, then when you go to recall a Correction in SA Mode, you should be pointing at that directory. Or if in EMC Mode you recall a Limit from a particular directory then when in EMC Mode you go to save a Limit, it should be pointing at that same directory. There is one "current" directory for each data type for each Mode (not one for Save and one for Recall).

The Filename field, just below the Path field, shows the filename that will be used. The **File Name** field is initially loaded with an automatically generated filename specific to the appropriate Save Type. The automatically generated filename is guaranteed not to conflict with any filename currently in the directory. You may edit the filename by tapping it, which brings up the onscreen alpha keyboard. Press the "Done" button on this keyboard when you are done editing.

Select a file to overwrite, type in a file name, or use the name suggested by the instrument (guaranteed not to conflict with any file in the current directory), and press Save. If the file specified already exists, a dialog will appear that allows you to replace the existing file by selecting **OK,** or you can Cancel the request.

After a successful save, a message "File <filename> saved" or "State Register <register number> saved" is displayed in an info box for a few seconds.

See "Quick Save" on page 2506 for details of the automatic file naming algorithm.

7.3.2 State

Selects a register or file for saving the state.

State files contain essentially all the information required to return the instrument to the measurement and settings that were in effect at the time of the save. **State** files are in a proprietary binary form (for speed) and cannot be read or edited by PC software, but can be loaded back into the instrument to restore the state.

State files contain all the settings of the **Input/Output** system as well, even though **Input/Output** variables are outside of the Mode's state and unaffected by **Mode Preset,** because these are needed to restore the complete setup.

Persistent System settings (for example, GPIB address) are affected by neither **Mode Preset** nor **Restore Mode Defaults,** nor are they included in a saved **State** file.

For rapid saving, the **State** menu lists 16 registers to which you can save states. Pressing a **Register** button initiates the save. You can also select a file to which to save by pressing **Save to File**.

The default path for all **State** files is:

`My Documents\<mode name>\state`

where `<mode name>` is the parameter used to select the Mode with `:INST:SEL` (for example, `SA` for Spectrum Analyzer Mode).

State files have the extension `.state`. The default filename is `State_0000.state`, where the 4-digit number is the lowest number that does not conflict with any filename in the current directory.

NOTE **In products that run multiple simultaneous instances of the X-Series Application, all instances share the same registers and file directories, so take care not to overwrite files and/or registers from one instance that were saved by another instance.**

Remote Command	`:MMEMory:STORe:STATe <filename>`
Example	Store the current instrument state data in the file `MyStateFile.state` in the default directory: `:MMEM:STOR:STATe "MyStateFile.state"`
Notes	Both single and double quotes are supported for any filename parameter over remote After saving to a register, that register's menu key is updated with the date the time, unless a custom label has been entered for that key After saving to a register, you remain in the **Save State** menu, so that you can see the **Register** key update. After saving to a file, the instrument automatically returns to the previous menu and any **Save As** dialog goes away

Backwards Compatibility SCPI	`:MMEMory:STORe:STATe 1,<filename>` The "1" is simply ignored. The command is sequential

7.3.2.1 Register 1 thru Register 16

Selecting any one of these register buttons causes the state of the currently active Mode to be saved to the specified **Register**. The registers are provided for rapid saving and recalling, since you do not need to specify a filename or navigate to a file. Each of the register menu keys annotates whether it is empty or at what date and time it was last modified. In addition, you can edit any of the register names to enter custom names for any register.

Although these 16 registers are the only registers available from the front panel, there are 128 state registers available in the instrument. Registers 17-128 are only available from the SCPI interface, using the `*SAV` command.

There is one set of 128 state registers in the instrument, not one set for each Mode. When a state is saved, the Mode it was saved from is saved with it; then when it is recalled, the instrument switches to that Mode.

NOTE **In products that run multiple simultaneous instances of the X-Series Application, all instances share the same registers and file directories, so take care not to overwrite files and/or registers from one instance that were saved by another instance.**

The date displayed follows the format specified in the **Date Format** setting under the **Control Panel**. The time shows hours and minutes.

After the save completes, the corresponding register menu key annotation is updated with the date and time and the message `Register <register number> saved` is displayed.

Example	`*SAV 1`
Range	1-16 from front panel, 1-128 from SCPI

7.3.2.2 Edit Register Names

You may enter a custom name for any of the **Registers**, to help you remember what you are using that state to save. To do this, press the **Name** field for the register you want to rename, which displays the onscreen alpha keyboard. Press **Done** on this keyboard when you are done editing.

The maximum number of characters for a register name is 30. If you delete all the characters in the custom name, it restores the default (time and date).

The register names are stored within the state files, but they are not part of the instrument state; that is, once you have edited a register name, loading a new state will not change that register name. Another consequence of this is that the names will be persistent through a power cycle. Also, if a named state file is transferred to another instrument, it will bring its custom name along with it.

If you try to edit the name of an empty register, the instrument first saves the state to have a file to put the name in. If you load a named state file into an instrument with older firmware, it ignores the metadata.

The `*SAV` and `*RCL` commands are not affected by the custom register names, nor are the `:MMEM` commands.

Remote Command	`:MMEMory:REGister:STATe:LABel <reg number>,"label"` `:MMEMory:REGister:STATe:LABel? <reg number>`
Example	`:MMEM:REG:STAT:LAB 1,"my label"`
Notes	`<reg number>` is an integer from 1 to 16. If the SCPI specifies an invalid register number an error message is generated, -222, "Data out of range; Invalid register label number" `“label”` is a string from 0 to 30 characters in length. If a label exceeds 30 characters, an error message is generated, -150,“String data error; Label clipped to 30 characters” `“label”` of zero length erases the custom label and restores the default (time and date) label. For example, `:MMEM:REG:STAT:LAB 1,””`
Preset	The names are unaffected by **Preset** or power cycle but are set to the default label (time and date) on **Restore System Defaults>Misc**

7.3.3 Trace+State

Selects a register or file for saving selected traces and the state.

Trace+State files contain essentially all the information required to return the instrument to the measurement and settings that were in effect at the time of the save, as well as the data for one or all traces. **Trace+State** files are in a proprietary binary form (for speed) and cannot be read or edited by PC software, but can be loaded back into the instrument to restore the state and trace(s).

Trace+State files contain all the settings of the **Input/Output** system as well, even though **Input/Output** variables are outside of the Mode’s state and unaffected by **Mode Preset**, because these are needed to restore the complete setup.

Persistent **System** settings (for example, GPIB address) are affected by neither **Mode Preset** nor **Restore Mode Defaults,** nor are they included in a saved **Trace+State** file.

For rapid saving, the **Trace+State** menu lists 16 registers to which you can save trace+state files. The **Trace+State** registers are separate registers from the **State** registers. Pressing a **Register** button initiates the save. You can also select a file to which to save by pressing **Save to File**.

The default path for all **Trace+State** files is the same as that for **State** files:

`My Documents\<mode name>\state`

where `<mode name>` is the parameter used to select the mode with `:INST:SEL` (for example, `BASIC` for IQ Analyzer Mode).

NOTE: **In products that run multiple simultaneous instances of the X-Series Application, all instances share the same registers and file directories, so take care not to overwrite files and/or registers from one instance that were saved by another instance.**

Trace+State files have the extension `.trace`. The default filename is `State_0000.trace`, where the 4-digit number is the lowest number that does not conflict with any filename in the current directory.

The **Trace+State** selection only appears for measurements that support trace saves. It is blanked for modes that do not support trace saves. Saving **Trace** is identical to saving **State** except a `.trace` extension is used on the file instead of `.state`, and internal flags are set in the file indicating which trace was saved.

See "More Information" on page 2538.

Remote Command	`:MMEMory:STORe:TRACe TRACE1 | TRACE2 | TRACE3 | TRACE4 | TRACE5 | TRACE6 | ALL,<filename>`
	
	`:MMEMory:STORe:TRACe:REGister TRACE1 | TRACE2 | TRACE3 | TRACE4 | TRACE5 | TRACE6 | ALL,<integer>`

Example	Save the file `myState.trace` on the default path and flags it as a “single trace” file with Trace 1 as the single trace (even though all of the traces are in fact stored):
	`:MMEM:STOR:TRAC TRACE1,"myState.trace"`
	
	Save the file `myState.trace` on the default path and flags it as an “all traces” file:
	`:MMEM:STOR:TRAC ALL,"myState.trace"`
	
	Store trace 1 data in trace register 2:
	`:MMEM:STOR:TRAC:REG TRACE1,2`

Notes	This command actually performs a **Save State**, which in the Swept SA measurement includes the trace data. However, it flags it (in the file) as a “save trace” file of the specified trace (or all traces)
	
	Some Modes and measurements do not have available all 6 traces. The Phase Noise Mode command, for example, is:
	`:MMEMory:STORe:TRACe TRACE1 | TRACE2 | TRACE3 | ALL,<filename>`
	
	Some modes and measurements have more than 6 traces available. The Realtime SA Mode command, for example, is:
	`:MMEMory:STORe:TRACe TRACE1 | TRACE2 | TRACE3 | TRACE4 | TRACE5 | TRACE6 | TRACE7 | TRACE8 | TRACE9 | TRACE10 | TRACE11 | TRACE12 | ALL,<filename>`
	
	The range for the register parameter is 1-5
	
	When you initiate a save, if the file already exists, a dialog will appear that allows you to replace the existing file by selecting **OK** or you can cancel the request. If you select **OK**, the file will be overwritten. Using the `C:` drive is strongly discouraged, since it runs the risk of being overwritten during an instrument software upgrade

Both single and double quotes are supported for any filename parameter over remote

After saving to a register, that register's menu key is updated with the date and time of the save

After saving to a register, you remain in the **Save Trace** menu, so that you can see the **Register** key update. After saving to a file, the instrument automatically returns to the previous menu and any **Save As** dialog goes away

More Information

In measurements that support saving **Traces**, for example, Swept SA, the **Trace** data is saved along with the **State** in the **State** file. When recalling the **State**, the **Trace** data is recalled as well. Traces are recalled exactly as they were stored, including the writing mode and update and display modes. If a Trace was updating and visible when the **State** was saved, it returns updating and visible, and its data will be rewritten right away. When you use **State** to save and recall traces, any trace whose data must be preserved should be placed in **View** or **Blank** mode before saving.

The following table describes the **Trace Save** and **Recall** possibilities:

You want to recall state and one trace's data, leaving other traces unaffected	**Save Trace+State** from 1 trace. Make sure that no other traces are updating (they should all be in View or Blank mode) when the save is performed	On recall, specify the trace you want to load the one trace's data into. This trace loads in view. All other traces' data will be unaffected, although their trace mode will be as it was when the state save was performed
You want to recall all traces	**Save Trace+State** from ALL traces	On recall, all traces come back in **View** (or **Blank** if they were in **Blank** or **Background** when saved)
You want all traces to load exactly as they were when saved	**Save State**	On recall, all traces' mode and data will be exactly as they were when saved. Any traces that were updating will have their data immediately overwritten

7.3.3.1 Save From Trace

Selects the trace to be saved. The default is the currently selected trace, selected in this this or any other menu with Trace selection. If you have chosen All then it remains chosen until you specifically change it to a single trace, regardless of the trace selected in the **Trace** menu.

When you select a trace, it makes that trace the current trace, so it displays on top of all of the other traces.

7.3.3.2 Register 1 thru Register 16

Selecting any one of these register buttons causes the specified trace(s) and the state of the currently active mode to be saved to the specified register. The registers are provided for rapid saving and recalling, since you do not need to specify a filename or navigate to a file. Each of the register menu keys annotates whether it is empty or at what date and time it was last modified. In addition, you can edit any of the register names to enter custom names for any register.

There is one set of 16 trace+state registers in the instrument, not one set for each Mode. When trace+state is saved, the Mode it was saved from is saved with it; then when it is recalled, the instrument switches to that Mode.

NOTE	In products that run multiple simultaneous instances of the X-Series Application, all instances share the same registers and file directories, so take care not to overwrite files and/or registers from one instance that were saved by another instance.

The date displayed follows the format specified in the **Date Format** setting in **Control Panel**. The time shows hours and minutes.

After the save completes, the corresponding register menu key annotation is updated with the date and time and the message `Register <register number> saved` is displayed.

Example	`*SAV 1`
Range	1-16

7.3.3.3 Edit Register Names

You may enter a custom name for any of the registers, to help you remember what you are using that trace+state to save. To do this, press the **Name** field for the register you want to rename, which displays the onscreen alpha keyboard. Press the **Done** button on this keyboard when you are done editing.

The maximum number of characters for a register name is 30. If you delete all the characters in the custom name, it restores the default (time and date).

The register names are stored within the trace+state files, but they are not part of the instrument state; that is, once you have edited a register name, loading a new state does not change that register name. Another consequence of this is that the names are persistent through a power cycle. Also, if a named state file is transferred to another instrument, it brings its custom name along with it.

If you try to edit the name of an empty register, the instrument will first save the trace+state to have a file to put the name in. If you load a named state file into an instrument with older firmware, it ignores the metadata.

Remote Command	`:MMEMory:REGister:TRACe:LABel <reg number>,"label"` `:MMEMory:REGister:TRACe:LABel? <reg number>`
Example	`:MMEM:REG:TRAC:LAB 1,"my label"`
Notes	`<reg number>` is an integer from 1 to 16. If the SCPI specifies an invalid register number an error message is generated, -222, "Data out of range; Invalid register label number" `“label”` is a string from 0 to 30 characters in length. If a label exceeds 30 characters, an error message is generated, -150, “String data error; Label clipped to 30 characters” `“label”` of zero length erases the custom label and restores the default (time and date) label, e.g., `:MMEM:REG:TRAC:LAB 1,””`
Preset	The names are unaffected by **Preset** or power cycle but are set to the default label (time and date) on **Restore System Defaults** > **Misc**

7.3.4 Screen Config + State

Saves the complete configuration of all your screens to a file. You choose a file to which to export the data.

Remote Command	`:MMEMory:STORe:SCONfig <filename>`
Example	Store the current screen configuration in the file `myScreenConfig.screen` in the default directory: `:MMEM:STOR:SCON "myScreenConfig.screen"`

7.3.5 Measurement Data

Specifies a data type (for example, trace data) and choose a file to which to export the data.

Measurement Data files are comma-separated Value (CSV) files, and contain the requested data in a form that can be imported into Excel or similar spreadsheets, as well as header data that gives information on relevant instrument settings at the time the save occurred.

The main application of **Measurement Data** files is for importing data to a PC for analysis, but in some cases **Measurement Data** files can also be imported back into the instrument to recreate the data object that existed at the time of the save. For example, most **Trace** data files can be imported back into the instrument.

The default path for **Measurement Data** Files is:

`My Documents\<mode name>\data`

with the subdirectory reflecting the data type and where `<mode name>` is the parameter used to select the Mode with `:INST:SEL` (for example, `SA` for Spectrum Analyzer Mode) and `<measurement name>` is the parameter used to select the measurement with `:CONF` (for example, `SAN` for Swept SA). For example, a Peak Table file from Swept SA in SA Mode would be stored in:

`My Documents\SA\data\SAN\results`

Measurement Data files have extension `.csv`. The default filename is `Prefix_0000.csv`, where the 4-digit number is the lowest number that does not conflict with any filename in the current directory, and "Prefix" is dependent on the data type:

Type	Default Prefix
Traces	`Trace_`
Measurement Result	`MeasR_`
Capture Buffer	`CapBuf_`

For example, the default filename for a trace data file in an empty directory would be `Trace_0000.csv`

7.3.5.1 Save From

Selects the specific item to be saved, for example, if you are exporting trace data you may specify Trace 1, Trace 2, etc.

The default for traces is the currently selected trace, selected in this this or any other menu with Trace selection. If you have chosen **All** then it remains chosen until you specifically change it to a single trace, regardless of the trace selected in the Trace menu. The **All** selection saves all six traces in one CSV file with the x-axis data in the first column and the individual trace data in succeeding columns. The header data and x-axis data in this file reflect the current settings of the measurement. Note that any traces that are in **View** or **Blank** may have different x-axis data than the current measurement settings; but this different x-axis data is *not* output to the file.

Preset	Not part of **Preset**, but is reset to by **Restore Mode Defaults** Survives shutdown

7.3.5.2 Data Type

You choose the data type to save by using the radio button selection box. Below are the specifications for Data files for each measurement.

Notes	There is no SCPI command for **Data Type**, as the type is implied in the SCPI command for each item
Dependencies	The **Data Type** menu for any given measurement only contains data types that are supported by that measurement

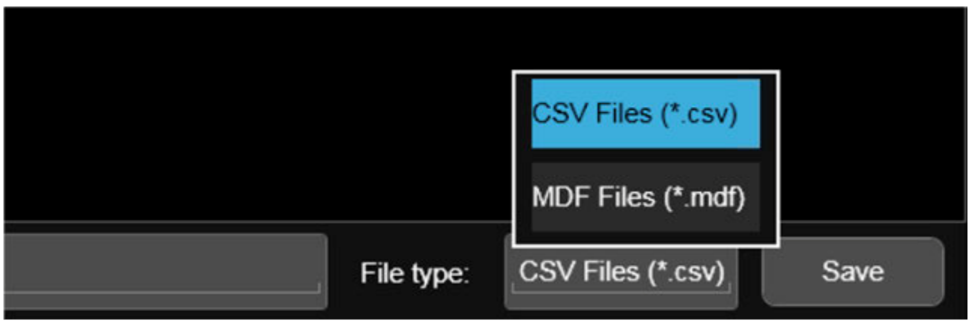
Trace

Exports **Trace** files in PC-readable `.csv` or `.mdf` formats.

By default, **Trace** files have the extension `.csv`. The default filename is `Trace_0000.csv`, where the 4-digit number is the lowest number that does not conflict with any filename in the current directory.

In the Swept SA measurement, **Trace** files can also be saved as **MDIF** files with an `.mdf` extension. The **MDIF** format is used by Keysight's ADS (Advanced Design System) software to capture circuit responses.

The selection of **CSV** or **MDF** appears as a dropdown from the **File Type** field in the **Save to File** dialog (only in the Swept SA measurement):



The default path for **Trace** data files is:

`My Documents\SA\data\traces`

The trace file contains a "meta" data header, which describes the current state of the instrument. The metadata is detailed in "Trace File Contents" on page 2543 below.

Remote Command	`:MMEMory:STORe:TRACe:DATA TRACE1 | TRACE2 | TRACE3 | TRACE4 | TRACE5 | TRACE6 | ALL,<filename>`

Example	`:MMEM:STOR:TRAC:DATA TRACE2,"myTrace2.csv"`
	Exports the 2nd trace to the file myTrace2.csv in the current path
	`:MMEM:STOR:TRAC:DATA TRACE2,"myTrace2.mdf"`
	Exports the 2nd trace to the file myTrace2.mdf in the current path in MDIF format. Only available in Swept SA measurement

Notes	In SA Mode, Traces can be saved in Swept SA, OBW and TOI measurements. The SCPI syntax for TOI and OBW has identical syntax to that for Swept SA, but only ever saves Trace 1 (since that is all there is in those measurements) If the save is initiated via SCPI, and the file already exists, the file is overwritten Using the `C:` drive is strongly discouraged, since it runs the risk of being overwritten during an instrument software upgrade

	Both single and double quotes are supported for any filename parameter over SCPI The **Recall** dialog has only CSV as the file type. You cannot load MDF files back into the instrument
Dependencies	For SA measurements, traces cannot be recalled from a trace file that was saved with *all* traces selected
Couplings	When you select which trace to save, it makes that trace the current trace, so it displays on top of all the other traces
Preset	Not part of **Preset**, but is reset to CSV by **Restore Mode Defaults**
Status Bits/OPC dependencies	Sequential - waits for previous measurement to complete

Trace File Contents

Trace data files contain the data for one or all traces.

Metadata: Trace Specific

Besides the trace data, the file contains metadata describing the context by which the trace was produced. Some of the metadata is trace specific:

- Trace Type
- Detector
- Trace math (function, operand1, operand2, offset, reference)
- Trace name/number

When importing a trace, the detector and/or trace math function specified in the metadata is imported with the trace, so that the annotation correctly shows the detector and/or math type that was used to generate the data

Metadata: Display Specific

The file also contains some display-related metadata:

- Ref Level Offset
- External Gain
- X-Axis Unit
- Y-Axis Unit

Metadata: Measurement Related

The rest of the metadata is measurement specific and reflects the state of the measurement the last time the trace was updated. These are the “measurement-related instrument settings” which, if changed, cause a measurement restart.

- Number of Points
- Sweep Time
- Start Frequency
- Stop Frequency
- Average Count (actual; not the limit for the instrument)
- Average Type
- RBW
- RBW Filter Type
- RBW Filter BW Type
- VBW
- Sweep Type (FFT vs. Swept)
- Log/Lin X Scale (sometimes called Log Sweep)
- Preamp (on/off, band)
- Trigger (source, level, slope, delay)
- Phase Noise optimization setting
- Swept IF Gain
- FFT IF Gain
- AC/DC setting (RF Coupling)
- FFT Width
- External Reference setting
- Input (which input is in use)
- RF calibrator on/off
- Attenuation

Because any inactive trace can have a value that does not match the rest of the measurement, when performing a Save the metadata for each trace is pulled from the individual trace, not from the measurement.

A revision number is also included in the trace database, to allow for future changes.

The choices for the various 1 of N and binary fields are as follows:

- Average Type: Power(RMS), Voltage, LogPower(Video)
- RBW Filter Type: Flattop, EMI, Gaussian
- RBW Filter BW : 3dB, 6dB, Noise, Impulse
- Sweep Type: Swept, FFT
- PreAmp State: On, Off
- PreAmp Band: Low, Full
- Trigger Source: Free, RFBurst, Video, Line, Periodic, Ext1, Ext2, TV
- Trigger Slope: Positive, Negative
- Phase Noise Optimization: Fast, Narrow, Wide
- Swept IF Gain: Low, High
- FFT If Gain: Autorange, Low, High
- Input: RF, ExtMix, BBIQ
- RF Calibrator: 50M, 400G, Comb, Off
- Trace Type: ClearWrite, TraceAverage, MaxHold, MinHold
- Detector: Normal, Average, Peak, NegPeak, Sample
- Trace Math: Off, PowerDifference, PowerSum, LogOffset, LogDifference
- Y Axis Unit: dBm, dBmV, dBmA, W, V, A, dBuV, dBuA, dBuV/m, dBuA/m, dBuV, dBpT, dBG, dB

(Note that saved trace data for a normalized trace uses dBm instead of dB for Y-axis unit)

After the header, just before the trace data, a line with just the word DATA on it is inserted to flag the start of the trace data.

The following file example shows the first lines of an **All Traces** file with X Axis Unit = Hz and Y Axis Unit = dBm, after importing into Excel:

AllTrace						
Swept SA						
A.19.50	N9020B					
526 B40 RBE RT2 TDS	1					
Segment	0					
Number of Points	1001					
Sweep Time	0.0664					
Start Frequency	10000000					
Stop Frequency	26500000000					
Average Count	100					
Average Type	LogPower(Video)					
RBW	3000000					
RBW Filter	Gaussian					
RBW Filter BW	3dB					
VBW	50000000					
Sweep Type	Swept					
X Axis Scale	Lin					
PreAmp State	Off					
PreAmp Band	Low					
Trigger Source	Free					
Trigger Level	1.2					
Trigger Slope	Positive					
Trigger Delay	0					
Phase Noise Optimization	Fast					
Swept If Gain	Low					
FFT If Gain	Autorange					
RF Coupling	AC					
FFT Width	411900					
Ext Ref	10000000					
Input	RF					
RF Calibrator	Off					
Attenuation	10					
Ref Level Offset	0					
External Gain	0					
Trace Type	Clearwrite	Maxhold	Minhold	Clearwrite	Clearwrite	Clearwrite
Detector	Sample	Peak	NegPeak	Normal	Normal	Normal
Trace Math	Off	Off	Off	Off	Off	Off
Trace Math Oper1	Trace5	Trace6	Trace1	Trace2	Trace3	Trace4
Trace Math Oper2	Trace6	Trace1	Trace2	Trace3	Trace4	Trace5
Trace Math Offset	0	0	0	0	0	0
Normalize	Off					
Trace Name	Trace1	Trace2	Trace3	Trace4	Trace5	Trace6
X Axis Units	Hz					
Y Axis Units	dBm					
DATA						
10000000	-79.16348868	-70.7947	-135.77	-1000	-1000	-1000
36490000	-74.61230043	-69.9289	-149.309	-1000	-1000	-1000
62980000	-94.19296354	-69.8216	-153.052	-1000	-1000	-1000
89470000	-92.70267246	-70.3467	-148.625	-1000	-1000	-1000
115960000	-79.69572853	-69.8235	-148.391	-1000	-1000	-1000

Trace files can be saved in CSV and MDF formats. Here are the `.mdf` values for this same data. The character `>` below represents a `TAB`, since `.mdf` files are *tab-separated* value files. The middle lines of this file are omitted to show the last line:

!AllTrace

!Swept SA

!A.19.50,N9020B

! 526 B40 RBE RT2 TDS,01

!Segment>0

!Number of Points>1001

!Sweep Time>0.0664

!Start Frequency>10000000

!Stop Frequency>26500000000

!Average Count>100

!Average Type>LogPower(Video)

!RBW>3000000

!RBW Filter>Gaussian

!RBW Filter BW>3dB

!VBW>50000000

!Sweep Type>Swept

!X Axis Scale>Lin

!PreAmp State>Off

!PreAmp Band>Low

!Trigger Source>Free

!Trigger Level>1.2

!Trigger Slope>Positive

!Trigger Delay>0

!Phase Noise Optimization>Fast

!Swept If Gain>Low

!FFT If Gain>Autorange

!RF Coupling>AC

!FFT Width>411900

!Ext Ref>10000000

!Input>RF

!RF Calibrator>Off

!Attenuation>10

!Ref Level Offset>0

!External Gain>0

!Trace Type>Clearwrite>Maxhold>Minhold>Clearwrite>Clearwrite>Clearwrite

!Detector>Sample>Peak>NegPeak>Normal>Normal>Normal

!Trace Math>Off>Off>Off>Off>Off>Off

!Trace Math Oper1>Trace5>Trace6>Trace1>Trace2>Trace3>Trace4

!Trace Math Oper2>Trace6>Trace1>Trace2>Trace3>Trace4>Trace5

!Trace Math Offset>0>0>0>0>0>0

!Normalize>Off

!Trace Name>Trace1>Trace2>Trace3>Trace4>Trace5>Trace6

!X Axis Units>Hz

!Y Axis Units>dBm

!DATA

BEGIN Block

% Frequency(1)> Amplitude_1(1)> Amplitude_2(1)> Amplitude_3(1)> Amplitude_4(1)> Amplitude_5(1)> Amplitude_6(1)

10000000>-77.3922178087449>-70.3954701071533>-142.740813021385>-1000>-1000>-1000

36490000>-98.2253962414322>-69.9289057177475>-149.309370760642>-1000>-1000>-1000

62980000>-83.5209663853526>-69.8215625788797>-153.051527743064>-1000>-1000>-1000

89470000>-86.9488902825994>-69.4788200918904>-154.474028353416>-1000>-1000>-1000

115960000>-100.793448113646>-69.4914511075657>-148.39144778701>-1000>-1000>-1000

--middle lines omitted--

26394040000>-68.2940105356584>-51.9151453598175>-128.331351046287>-1000>-1000>-1000

26420530000>-71.6229868558761>-52.7728693232803>-128.830336336814>-1000>-1000>-1000

26447020000>-69.7281031540491>-52.563714503452>-128.198912386619>-1000>-1000>-1000

26473510000>-79.1517864221784>-52.4394673752405>-134.379301790916>-1000>-1000>-1000

26500000000>-62.5673670497196>-52.2960264436859>-124.909720186912>-1000>-1000>-1000

END

Peak Table

Available in SA and RTSA Modes only.

Exports Peak Table files in the PC-readable CSV format.

Peak Table files have the extension `.csv`. The default filename is `MeasR_0000.csv`, where the 4-digit number is the lowest number that does not conflict with any filename in the current directory.

The default path for **Peak Table** data files is:

`My Documents\<mode name>\data\<measurement name>\results`

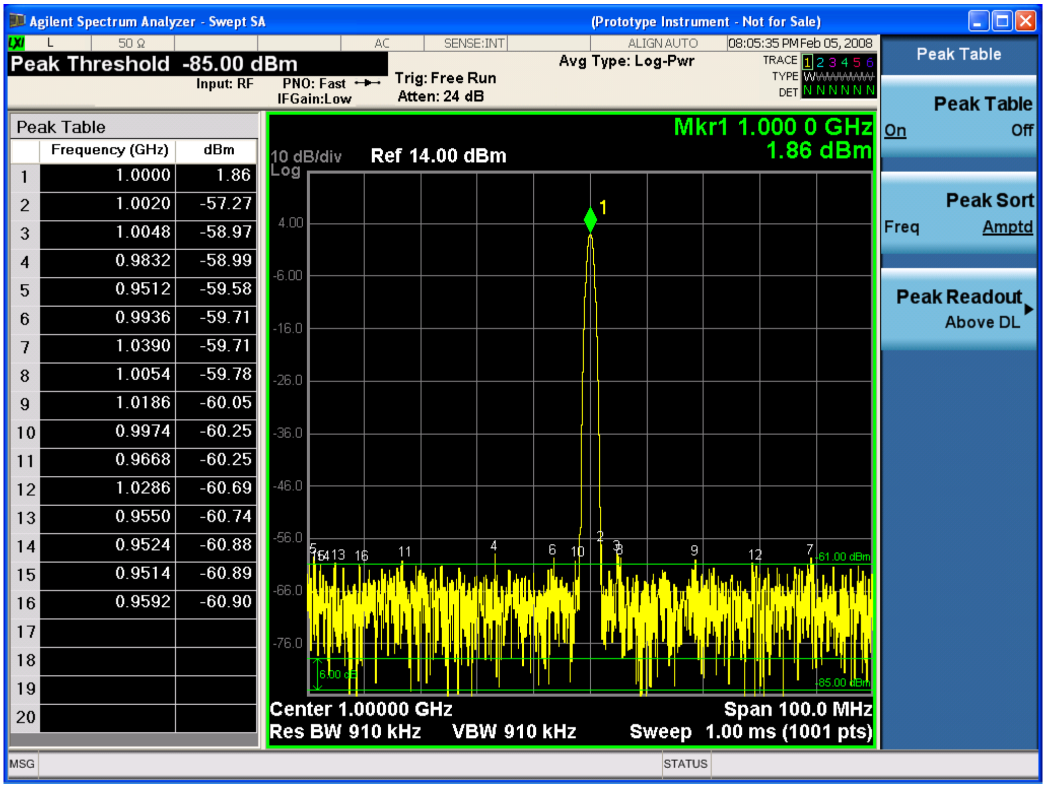
where `<mode name>` is the parameter used to select the mode with the `:INST:SEL` command (for example, `SA` for the Spectrum Analyzer Mode) and `<measurement name>` is the parameter used to select the measurement with the `:CONF`: command (for example, `SAN` for the Swept SA measurement).

The **Peak Table** file contains a metadata header that describes the current state of the instrument. The metadata is detailed below.

Remote Command	`:MMEMory:STORe:RESults:PTABle <filename>`
Example	Save the results from the current peak table to the file `myResults.csv` in the current path: `:MMEM:STOR:RES:PTAB "myResults.csv"`
Notes	If the save is initiated via SCPI, and the file already exists, the file will be overwritten Using the `C:` drive is strongly discouraged, since it runs the risk of being overwritten during an instrument software upgrade Both single and double quotes are supported for any filename parameter over SCPI
Dependencies	If a save of Peak Table results is requested, and **Peak Table** is not `ON`, no file is saved, and a message is generated

Peak Table File Contents

Suppose that, at the point where a Marker Table Meas Result is requested, the following screen is showing:



Then the Meas Results file, when opened, would show the header data (the same as for the Marker Table except that the Result Type is Peak Table) ending with a few fields of specific interest to Peak Table users:

- Peak Threshold
- Peak Threshold State (On|Off)
- Peak Excursion
- Peak Excursion State (On|Off)
- Display Line
- Peak Readout (All|AboveDL|BelowDL)
- Peak Sort (Freq|Amptd)

These fields are then followed by the data for the Peak Table itself.

Note that the label for the **Frequency** column changes to Time in 0 span.

Here is what the table for the above display looks like:

MeasurementResult	
Swept SA	
A.01.40_R0017	N9020A
526 B25 PFR P26 EA3	1
Result Type	Peak Table
Ref Level	0
Number of Points	1001
Sweep Time	0.066266667
Start Frequency	10000000
Stop Frequency	26500000000
Average Count	0
Average Type	LogPower(Video)
RBW	3000000
RBW Filter	Gaussian
RBW Filter BW	3dB
VBW	3000000
Sweep Type	Swept
X Axis Scale	Lin
PreAmp State	Off
PreAmp Band	Low
Trigger Source	Free
Trigger Level	1.2
Trigger Slope	Positive
Trigger Delay	1.00E-06
Phase Noise Optimization	Fast
Swept If Gain	Low
FFT If Gain	Autorange
RF Coupling	AC
FFT Width	411900
Ext Ref	10000000
Input	RF
RF Calibrator	Off
Attenuation	10
Ref Level Offset	0
External Gain	0
X Axis Units	Hz

Y Axis Units	dBm	
Peak Threshold	–85	
Peak Threshold State	On	
Peak Excursion	6	
Peak Excursion State	On	
Display Line	–61	
Peak Readout	AboveDL	
Peak Sort	Amptd	
DATA		
Peak	Frequency	Amplitude
1	1.0000E+06	1.86
2	1.0020E+06	–57.27
3	1.0048E+06	–58.97
4	9.8320E+05	–58.99
5	9.5120E+05	–59.58
6	9.9360E+05	–59.71
7	1.0390E+06	–59.71
8	1.0054E+06	–59.78
9	1.1086E+06	–60.05
10	9.9740E+05	–60.25
11	9.6680E+05	–60.25
12	1.0286E+06	–60.69
13	9.5500E+05	–60.74
14	9.5240E+05	–60.88
15	9.5140E+05	–60.89
16	9.5920E+05	–60.90
17		
18		
19		
20		

Marker Table

Available in SA, RTSA and Phase Noise Modes only.

Exports Marker Table files in the PC-readable CSV format.

Marker Table files have the extension `.csv`. The default filename is `MeasR_0000.csv`, where the 4-digit number is the lowest number that does not conflict with any filename in the current directory.

The default path for **Marker Table** data files is:

`My Documents\<mode name>\data\<measurement name>\results`

where `<mode name>` is the parameter used to select the mode with the `:INST:SEL` command (for example, `SA` for the Spectrum Analyzer Mode) and `<measurement name>` is the parameter used to select the measurement with the `:CONF`: command (for example, `SAN` for the Swept SA measurement).

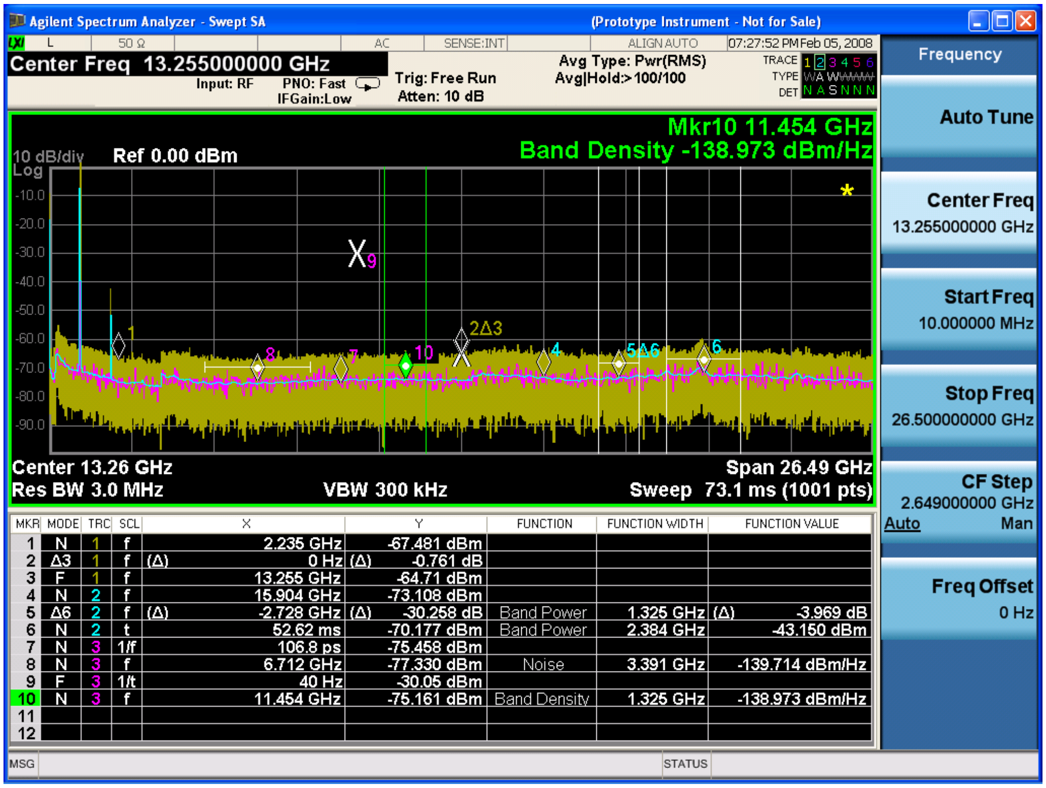
The **Marker Table** file contains a metadata header that describes the current state of the instrument. The metadata is detailed below.

Remote Command	`:MMEMory:STORe:RESults:MTABle <filename>`
Example	Save the results from the current marker table to the file `myResults.csv` in the current path: `:MMEM:STOR:RES:MTAB "myResults.csv"`
Notes	If the save is initiated via SCPI, and the file already exists, the file will be overwritten Using the `C:` drive is strongly discouraged, since it runs the risk of being overwritten during an instrument software upgrade Both single and double quotes are supported for any filename parameter over SCPI
Dependencies	If a save of **Marker Table** results is requested and **Marker Table** is not `ON`, no file is saved, and a message is generated In the Log Plot measurement, **Marker Table** is available only when Option N9068A-BFP is installed

Marker Table File Contents

This section discusses the Marker Table Meas Results file format.

Suppose that, at the point where a Marker Table Meas Result is requested, the following screen is showing:



Then the Meas Results file, when opened, would show the data below. The numbers appear in the file exactly as they appear onscreen. If it says 11.454 GHz onscreen, then in the file it is 11.454E+09.

The metadata header is very similar to the metadata used in the trace data `.csv` files. See Trace. The only differences concern the 1-of-N fields in the marker table itself.

The `FUNCTION UNIT` field requires some explanation. This field specifies the unit being used for each marker function. **Delta** marker functions, in particular, can result in complicated units, so it is of value to the user to include them in this file. In general, they should appear in this column exactly as they appear onscreen; however, when the symbol for square root appears, it should appear in the file as “root-”; for example, √Hz would appear as “root-Hz”

MeasurementResult									
Swept SA									
A.01.40_R0017	N9020A								
526 B25 PFR P26 EA3	1								
Result Type	Marker Table								
Ref Level	0								
Number of Points	1001								
Sweep Time	0.066266667								
Start Frequency	10000000								
Stop Frequency	26500000000								
Average Count	0								
Average Type	LogPower(Video)								
RBW	3000000								
RBW Filter	Gaussian								
RBW Filter BW	3dB								
VBW	3000000								
Sweep Type	Swept								
X Axis Scale	Lin								
PreAmp State	Off								
PreAmp Band	Low								
Trigger Source	Free								
Trigger Level	1.2								
Trigger Slope	Positive								
Trigger Delay	1.00E–06								
Phase Noise Optimization	Fast								
Swept If Gain	Low								
FFT If Gain	Autorange								
RF Coupling	AC								
FFT Width	411900								
Ext Ref	10000000								
Input	RF								
RF Calibrator	Off								
Attenuation	10								
Ref Level Offset	0								
External Gain	0								
X Axis Units	Hz								
Y Axis Units	dBm								
DATA									
MKR	MODE	TRC	SCL	X	Y	FUNCTION	FUNCTION WIDTH	FUNCTION VALUE	FUNCTION UNIT
1	Normal	1	Frequency	2.2350E+09	–67.481	Off	0.0000E+00	0	None
2	Delta3	1	Frequency	0.0000E+00	–0.761	Off	0.0000E+00	0	None
3	Fixed	1	Frequency	1.3255E+10	–64.71	Off	0.0000E+00	0	None
4	Normal	2	Frequency	1.5904E+10	–73.108	Off	0.0000E+00	0	None
5	Delta7	2	Frequency	–2.7280E+09	–30.258	Band Power	1.3250E+06	–3.969	dB
6	Normal	2	Time	5.2620E–02	–70.177	Band Power	2.3840E+06	–43.15	dBm
7	Normal	3	Period	1.0680E–10	–75.458	Off	0.0000E+00	0	None
8	Normal	3	Frequency	6.7120E+09	–77.33	Noise	3.3910E+06	–139.714	dBm/Hz
9	Fixed	3	Inverse Time	4.0000E+01	–30.05	Off	0.0000E+00	0	None
10	Normal	3	Frequency	1.1454E+10	–75.161	Band Density	1.3250E+06	–138.973	dBm/Hz
11	Off	1	Frequency	0.0000E+00	0	Off	0.0000E+00	0	None
12	Off	1	Frequency	0.0000E+00	0	Off	0.0000E+00	0	None

Spectrogram

Available in SA and RTSA Modes, and in EMI Mode Real Time Scan measurement only.

Exports Spectrogram files in the PC-readable CSV format.

Spectrogram files have the extension `.csv`. The default filename is `MeasR_0000.csv`, where the 4-digit number is the lowest number that does not conflict with any filename in the current directory.

The default path for **Spectrogram** data files is:

`My Documents\<mode name>\data\<measurement name>\results` where `<mode name>` is the parameter used to select the mode with the `:INST:SEL` command (for example, `SA` for Spectrum Analyzer Mode) and `<measurement name>` is the parameter used to select the measurement with the `:CONF`: command (for example, `SAN` for the Swept SA measurement).

The **Spectrogram** file contains a metadata header that describes the current state of the instrument. The metadata is detailed below.

Remote Command	`:MMEMory:STORe:RESults:SPECtrogram <filename>`
Example	Save the results from the current **Spectrogram** display to the file `myResults.csv` in the current path: `:MMEM:STOR:RES:SPEC "myResults.csv"`
Notes	If the save is initiated via SCPI, and the file already exists, the file will be overwritten Using the `C:` drive is strongly discouraged, since it runs the risk of being overwritten during an instrument software upgrade Both single and double quotes are supported for any filename parameter over SCPI
Dependencies	If a save of **Spectrogram** results is requested and **Spectrogram** is not `ON`, no file is saved, and a message is generated The **Spectrogram** choice only appears if option EDP is licensed

Spectrogram

This section discusses the **Spectrogram** Results file format. The **Spectrogram** choice only appears if option EDP is licensed.

The **Spectrogram** results are the same as a **Trace** data export, except that instead of having just one trace's data, all 300 traces appear, one after the other.

Each trace has its own data mark; the data for **Spectrogram Trace 0** follows the row marked `DATA`, the data for **Spectrogram Trace 1** follows the row marked `DATA1`, for **Spectrogram Trace 2** follows the row marked `DATA2`, and so on.

Each `DATA` row has a timestamp in the second column (as of firmware revision A.11.01). So, for example, if Trace 0 had a relative start time of 1729.523 sec, then the first `DATA` row would look like this:

```
DATA,1729.523
```

And if Trace 13 had a relative start time of 100.45 sec, then the fourteenth data row would look like:

```
DATA13,100.453
```

To find the absolute time for the relative timestamps of each trace, the last row before the first `DATA` row gives the absolute start time of the Spectrogram, in the form `YYYYMMDDHHMMSS`

So, for example, if the absolute start time is 13:23:45:678 on January 30, 2012, this row would look like:

```
Start Time,20120130132345678
```

NOTE The resolution of the absolute time stored is 1 ms, to match the fastest sweep time, which is also 1 ms. However, there is no specification for the absolute accuracy of the clock in the instrument, nor is there any way to set this time to any particular degree of accuracy.

Traces that have not yet been filled in the **Spectrogram** display are empty; there is no DATA header for them. The file ends after the last non-empty trace.

Suppose that, at the point where a **Spectrogram** Meas Result is requested, the following screen is showing:

For the purpose of this example, we have set **Average/Hold Number** to 10, thus we have only traces 0 thru 10. The **Spectrogram** was started at 02:28:08:700 pm on April 25, 2012 (that is, 700 ms after 2:28:08 pm), although the screen dump itself shows a different time, as it was taken ten minutes after the **Spectrogram** data. Trace 0 is showing a start time of 5.30 seconds, meaning 5.3 seconds after the **Spectrogram** started (trace 10 has a start time of 0, as it was the first trace taken but has now rolled up into the tenth trace slot).

The Meas Results file, when opened, shows the header data and ten traces of trace data. Below is an extract from the result file for the above display. Note the start time of 20120425142808700 showing in the last row before the first DATA row, and the relative time of 5.299231048 showing in the first DATA row:

Result Type	Spectrogram
MeasResult	
Swept SA	
A.11.00.01	N9020A
503 508 513 526 ALL ALV B1C B1X B25 B2X B40 BAB BBA CR3 CRP DP2 DRD EA3 EDP EMC EP1 ERC ESC ESP EXM FSA HBA K03 LFE MPB P03 P08 P13 P26 PFR RTL RTS S40 SB1 SEC SM1 UK6 YAS YAV	1
Segment	0
Number of Points	1001
Sweep Time	0.523333333
Start Frequency	5999984415
Stop Frequency	6000009415
Average Count	0
Average Type	LogPower(Video)
RBW	240
RBW Filter	Gaussian
RBW Filter BW	3dB
VBW	240
Sweep Type	Swept
X Axis Scale	Lin
PreAmp State	Off
PreAmp Band	Low
Trigger Source	Free
Trigger Level	1.2
Trigger Slope	Positive
Trigger Delay	0
Phase Noise Optimization	Wide
Swept If Gain	Low
FFT If Gain	Autorange
RF Coupling	AC
FFT Width	411900
Ext Ref	10000000
Input	RF
RF Calibrator	Off
Attenuation	14

Result Type	Spectrogram
Ref Level Offset	0
External Gain	0
Trace Type	Clearwrite
Detector	Normal
Trace Math	Off
Trace Math Oper1	Trace5
Trace Math Oper2	Trace6
Trace Math Offset	0
Trace Name	Trace1
X Axis Units	Hz
Y Axis Units	dBm
Start Time	20120425142808700
DATA	5.299231048
5999984415	-76.34749519
5999984440	-77.28097006
5999984465	-75.32317869
5999984490	-73.64417681
5999984515	-72.67154604
...	
6000009315	-77.94423277
6000009340	-79.51829697
6000009365	-78.46108961
6000009390	-78.46108957
6000009415	-76.59570596
DATA2	4.708697055
5999984415	-80.98197882
5999984440	-80.98197879
5999984465	-75.83142132
5999984490	-74.02712079
5999984515	-73.57213005
...	
6000009315	-75.9183103
6000009340	-79.53787488
6000009365	-78.82602191

Result Type	Spectrogram
6000009390	-78.82602188
6000009415	-76.37486709
DATA10	0
5999984415	-75.56751112
5999984440	-75.76485645
5999984465	-76.67718717
5999984490	-78.79238489
5999984515	-83.72680212
...	
6000009315	-71.3942461
6000009340	-72.28308332
6000009365	-73.92684489
6000009390	-75.45548832
6000009415	-75.17904815

Meas Results

Meas Results files contain information that describes the current state of the instrument, as detailed in Meas Result File Contents below.

This command is only available in certain measurements, such as:

- PowerSuite: Channel Power, OBW, ACP, Spectrum Emissions Mask, Spurious Emissions, Power Stat CCDF, Transmit Power, Monitor Spectrum, IQ Waveform
- IQ Analyzer: Complex Spectrum
- Phase Noise: Log Plot and Spot Frequency
- WCDMA: Code Domain, Mod Accuracy, Power Control, and QPSK EVM
- Analog Demod: AM, FM, PM and FM Stereo
- Noise Figure
- Pulse

In general, the data in the Meas Results file matches the data which is returned to a measurement data query (`:FETCh?`, `:READ?`, `:MEASure?`). These queries and the results they return are documented for each measurement, and can be found in the Help for that measurement (or in the manual for that measurement) in the section titled **Remote Command Results**.

In the `MeasResults` file, you will see a column for each value of `n`. Each column contains the value for the corresponding value of n in the **Remote Command Results** table.

For example, Complex Spectrum allows values of `n` up to 17, and the `MeasResults` file for Complex Spectrum has 17 columns. So, the data returned when you send `:FETCh:SPECtrum1?` matches the data in the column labeled `MeasResult1` of the Meas Results file. See the example below:

Response to FETCh:SPECtrum1?

2.125444221E+01,6.487077992E+07,2.050000000E+02,6.004725051E+07,3.9215 68627E+04,2.370000000E+02,0.000000000E+00,1.000000000E-07,1.000000000E+00,2.360000000E-05,2.500000000E+01

MeasResult1 column from Meas Results file

MeasResult1
-21.25444221
64870779.92
205
60047250.51
39215.68627
237
0
1.00E-07
1
2.36E-05
25

In addition, examples of the Meas Results files are given for each data type in the Help below.

Remote Command	`:MMEMory:STORe:RESults <string>`
Example	`:MMEM:STOR:RES "MeasR_0000.csv"`
Notes	If the save is initiated via SCPI and the file already exists, the file will be overwritten The SCPI command exports measurement results to the file specified as the parameter in the current path. The default path is: `My Documents\<current mode>\data\<measurement name>\results` where `<mode name>` is the parameter used to select the mode with the `:INST:SEL` command (for example, `SA` for Spectrum Analyzer Mode) and `<measurement name>` is the parameter used to select the measurement with the `:CONF`: command (for example, `SAN` for the Swept SA measurement) Using the `C:` drive is strongly discouraged, since it runs the risk of being overwritten during an

	instrument software upgrade The SCPI parameter is a quoted string, which specifies the filename. Both single and double quotes are supported for any filename parameter over SCPI
Annotation	After the save is complete, an advisory is displayed in the window so that the user can confirm which file was saved
Status Bits/OPC dependencies	Sequential – waits for the previous measurement to complete

CHP Meas Results File Contents

The file contains measurement results, preceded by the following header information.

- File ID string, which is `MeasResult`
- Mode ID: Measurement ID, for example, `SA:CHP`
- Firmware rev and model number
- Option string
- Auto Sweep Time Rules
- Average Mode
- Average Number
- Average State
- Center Frequency
- Detector
- Electrical Atten
- Electrical Atten State
- IFGain
- IFGainAuto
- Impedance
- Integ BW
- Internal Preamp

- Internal Preamp Band
- Mechanical Atten
- MechanicalAttenStepEnum
- PSD Unit
- Resolution Band Width
- Resolution Bandwidth Shape
- RRC Filter Alpha
- RRC Filter BW
- RRC Filter State
- Span
- Sweep Points
- Sweep Time
- Sweep Time Auto
- TriggerSource
- Video Bandwidth
- Y Axis Unit

Following the header entries above is a line containing only `MeasResult1` and `MeasResult2`, which flags the start of the measurement results. Each subsequent line consists of two comma-separated values, the `MeasResult1` value and the `MeasResult2` value.

- `MeasResult1` contains the same results as `:MEAS|:READ|:FETCh:CHPower1`
- `MeasResult2` contains the same results as `:MEAS|:READ|:FETCh:CHPower2`

The exported file is in CSV format. When imported into Microsoft Excel or a similar spreadsheet application, a typical file appears as follows:

MeasResult	
SA:CHP	
A.10.53	N9030A
526 ALV ATP B1X B1Y B25 B40 BBA CR3 CRP DCF DDA DP2 DRD EA3 EDP EMC EP1 ERC ESC ESP EXM FSA LFE LNP MAT MPB NFE NUL P26 PFR PNC RTL RTS S40 SB1 SEC SM1 TVT YAS YAV	1

Auto Sweep Time Rules	Normal
Average Mode	Exponential
Average Number	10
Average State	TRUE
Center Frequency	13255000000
Detector	Average
IFGain	FALSE
IFGainAuto	FALSE
Impedance	50
Integ BW	2000000
Internal Preamp	FALSE
Internal Preamp Band	Low
PSD Unit	DbmHz
Resolution Band Width	27000
Resolution Bandwidth Shape	Gaussian
RRC Filter Alpha	0.22
RRC Filter BW	3840000
RRC Filter State	FALSE
Span	3000000
Sweep Points	1001
Sweep Time	0.004933333
Sweep Time Auto	TRUE
TriggerSource	Free
Video Bandwidth	270000
Y Axis Unit	DecibelMilliwatt
MeasResult1	MeasResult2
-76.8141133132837	-95.29174
-139.824413269924	-94.99601
	-94.95281
	-95.17146

OBW Meas Results File Contents

The first lines in the OBW Meas results file consist of header information, as follows.

- File ID string, which is “MeasResult”
- Measurement ID following Mode ID, which is “SA:OBW” for example.

- Firmware rev and model number
- Option string
- Auto Sweep Time Rules
- Average Mode
- Average Number
- Average State
- Center Frequency
- Detector
- Electrical Atten
- Electrical Atten State
- IFGain
- IFGainAuto
- Internal Preamp
- Internal Preamp Band
- Limit
- Limit State
- Max Hold
- Mechanical Atten
- MechanicalAttenStepEnum
- OBW Percent Pwr
- Resolution Band Width
- Resolution Bandwidth Shape
- Span
- Sweep Points
- Sweep Time

- Sweep Time Auto
- TriggerSource
- Video Bandwidth
- x DB

The data above is followed in the file by a line containing “MeasResult1” and “MeasResult2”. This line forms a header for each set of measurement results, which appear in subsequent lines. Each line of Measurement Results consists of two comma-separated values, for MeasResult1 and MeasResult2 respectively.

The MeasResult1 set in the file corresponds to the data returned by `:MEAS|:READ|:FETCh:OBWidth`1, and the MeasResult2 set corresponds to the data returned by `:MEAS|:READ|:FETCh:OBWidth2`.

The exported file is in CSV format, with a `.csv` extension.

Meas Results File Example

When imported into Microsoft Excel, a typical Meas Results CSV file appears as shown in the example below.

MeasResult	
SA:OBW	
A.10.53	N9030A
526 ALV ATP B1X B1Y B25 B40 BBA CR3 CRP DCF DDA DP2 DRD EA3 EDP EMC EP1 ERC ESC ESP EXM FSA LFE LNP MAT MPB NFE NUL P26 PFR PNC RTL RTS S40 SB1 SEC SM1 TVT YAS YAV	1
Auto Sweep Time Rules	Normal
Average Mode	Exponential
Average Number	10
Average State	TRUE
Center Frequency	1.33E+10
Detector	Average
IFGain	FALSE
IFGainAuto	FALSE
Internal Preamp	FALSE
Internal Preamp Band	Low
Limit	5000000
Limit State	FALSE
Max Hold	FALSE
OBW Percent Pwr	99

Resolution Band Width	27000
Resolution Bandwidth Shape	Gaussian
Span	3000000
Sweep Points	1001
Sweep Time	0.004933
Sweep Time Auto	TRUE
TriggerSource	Free
Video Bandwidth	270000
x DB	-26
MeasResult1	MeasResult2
2971020.10835045	-94.3702543927405
-74.9741251886604	-94.1447790390963

ACP Meas Results File Contents

An ACP Meas Results File contains measurement results with the following header information, columns A and B unless otherwise stated:

- File ID string, which is `MeasResult`
- Mode ID: Measurement ID, for example, `SA:ACP`
- Firmware rev and model number
- Option string
- Auto Scaling
- Auto Sweep Time Rules
- Automatic Trigger Time
- Automatic Trigger Time State
- Average Mode
- Average Number
- Average State
- Bar Graph
- Carrier Coupling (columns A thru S, TRUE or FALSE)
- Carrier Pwr Present (columns A thru S, Yes or No)

- Carrier Spacing (columns A thru S, in Hz)
- Carriers
- Center Frequency
- Center Frequency Step
- Center Frequency Step State
- Detector Auto
- Detector Selection
- Electrical Atten
- Electrical Atten State
- External Array Trigger Delay (columns A thru E)
- External Array Trigger Delay State (columns A thru E)
- External Array Trigger Level (columns A thru E)
- External Array Trigger Slope (columns A thru E)
- Filter Alpha (columns A thru S)
- Filter BW
- Filter Type
- Internal Preamp
- Internal Preamp Band
- Limit Test
- Line Trigger Delay
- Line Trigger Delay State
- Line Trigger Slope
- Meas Method
- Meas Type
- Measurement Noise Bandwidth (columns A thru S, in Hz)

- Mechanical Atten
- MechanicalAttenStepEnum
- Method (columns A thru S)
- Noise Correction
- Offset Abs Limit (columns A thru G)
- Offset Fail (columns A thru G)
- Offset Filter Alpha
- Offset Filter BW (columns A thru G)
- Offset Filter Type (columns A thru G)
- Offset Freq (columns A thru G)
- Offset Freq State (columns A thru G)
- Offset Integ BW (columns A thru G)
- Offset Method
- Offset Rel Lim (Car) (columns A thru G)
- Offset Rel Lim (PSD) (columns A thru G)
- Offset Res BW (columns A thru G)
- Offset Res BW Mode (columns A thru G)
- Offset Video BW (columns A thru G)
- Offset Video BW Mode (columns A thru G)
- Periodic Timer Period
- Periodic Timer Sync Source
- Periodic Timer Trigger Delay
- Periodic Timer Trigger Delay State
- Points
- Power Ref

- Power Ref State
- Preselector Adjust
- PSD Ref
- PSD Unit
- Ref Car Freq
- Ref Car Freq State
- Ref Carrier
- Ref Carrier Mode
- Ref Position
- Ref Value
- Res BW
- Res BW Mode
- RFBurst Trigger Delay
- RFBurst Trigger Delay State
- RFBurst Trigger Level Abs
- RFBurst Trigger Level Rel
- RFBurst Trigger Level Type
- RFBurst Trigger Slope
- Scale/Div
- Span
- Sweep Time
- Sweep Time Auto
- Trigger Holdoff
- Trigger Holdoff State
- Trigger Source

- Video BW
- Video BW Auto

The file contains this header, followed by a line containing `MeasResult1`, `MeasResult2`, and `MeasResult3`. This line flags the start of the measurement results. Each line of Measurement Results consists of three comma separated values, for `MeasResult1`, `MeasResult2`, and `MeasResult3`.

`MeasResult1` contains the same result as `MEAS|READ|FETCh:ACPower1`; `MeasResult2`, `MEAS|READ|FETCh:ACPower2`; `MeasResult3`, `MEAS|READ|FETCh:ACPower3`.

The exported file is in CSV format, with a `.csv` extension. When imported into Microsoft Excel or a similar spreadsheet application, the *first three* columns of a typical file appear as follows:

Column A	Column B	Additional columns (if any)
`MeasResult`		
`SA:ACP`		
A.10.53	N9030A	
526 ALV ATP B1X B1Y B25 B40 BBA CR3 CRP DCF DDA DP2 DRD EA3 EDP EMC EP1 ERC ESC ESP EXM FSA LFE LNP MAT MPB NFE NUL P26 PFR PNC RTL RTS S40 SB1 SEC SM1 TVT YAS YAV	01	
Auto Scaling	True	
Auto Sweep Time Rules	Accy	
Automatic Trigger Time	0.1	
Automatic Trigger Time State	False	
Average Mode	Exponential	
Average Number	10	
Average State	True	
Bar Graph	True	
Carrier Coupling	True	Columns A thru S: True/False
Carrier Pwr Present	Yes	Columns A thru S: Yes/No
Carrier Spacing	5000000	Columns A thru S: Hz
Carriers	1	
Center Frequency	13255000000	

Column A	Column B	Additional columns (if any)
Center Frequency Step	800000	
Center Frequency Step State	True	
Detector Auto	True	
Detector Selection	Average	
Electrical Atten	0	
Electrical Atten State	False	
External Array Trigger Delay	1E-06	Columns A thru E
External Array Trigger Delay State	False	Columns A thru E
External Array Trigger Level	1.2	Columns A thru E
External Array Trigger Slope	Positive	Columns A thru E
Filter Alpha	0.22	Columns A thru S
Filter BW	Minus3dB	
Filter Type	Gaussian	
Internal Preamp	False	
Internal Preamp Band	Low	
Limit Test	False	
Line Trigger Delay	1E-06	
Line Trigger Delay State	False	
Line Trigger Slope	Positive	
Meas Method	IbwSpeed	
Meas Type	TPRef	
Measurement Noise Bandwidth	2000000	Columns A thru S: Hz
Mechanical Atten	10	
MechanicalAttenStepEnum	S2dB	
Method	IBW	Columns A thru S
Noise Correction	False	
Offset Abs Limit	0	0
Offset Fail	Relative	Columns A thru G
Offset Filter Alpha	0.22	
Offset Filter BW	Minus3dB	Columns A thru G
Offset Filter Type	Gaussian	Columns A thru G
Offset Freq	3000000	Columns A thru G
Offset Freq State	True	Columns A thru G
Offset Integ BW	2000000	Columns A thru G

Column A	Column B	Additional columns (if any)
Offset Method	False	
Offset Rel Lim (Car)	-45	Columns A thru G
Offset Rel Lim (PSD)	-28.87	Columns A thru G
Offset Res BW	220000	Columns A thru G
Offset Res BW Mode	True	Columns A thru G
Offset Video BW	22000	Columns A thru G
Offset Video BW Mode	True	Columns A thru G
Periodic Timer Period	0.02	
Periodic Timer Sync Source	None	
Periodic Timer Trigger Delay	1E-06	
Periodic Timer Trigger Delay State	False	
Points	1001	
Power Ref	-76.81 dBm	
Power Ref State	On	
Preselector Adjust	0	
PSD Ref	-139.82 dBm/Hz	
PSD Unit	DbmHz	
Ref Car Freq	13.255000000 GHz	
Ref Car Freq State	On	
Ref Carrier	1	
Ref Carrier Mode	On	
Ref Position	Top	
Ref Value	-30	
Res BW	220000	
Res BW Mode	False	
RFBurst Trigger Delay	1E-06	
RFBurst Trigger Delay State	False	
RFBurst Trigger Level Abs	-20	
RFBurst Trigger Level Rel	-6	
RFBurst Trigger Level Type	Absolute	
RFBurst Trigger Slope	Positive	
Scale/Div	10	
Span	8000000	
Sweep Time	0.02	
Sweep Time Auto	True	

Column A	Column B	Additional columns (if any)
Trigger Holdoff	0.1	
Trigger Holdoff State	False	
Trigger Source	Free	
Video BW	22000	
Video BW Auto	True	
`MeasResult1`	`MeasResult2`	`MeasResult3`
-76.8058517744559	0	1
0.084790019950006	-76.8058517744559	0
0.0283929128313787	-999	1
... and so on	-999	0
	-999	1

SPUR Meas Results File Contents

A Spurious Emissions Meas Results File contains measurement results with the following header information, columns A and B unless otherwise stated:

- File ID string, which is “MeasResult”
- Measurement ID following Mode ID, which is “SA:SPUR” for example.
- Firmware rev and model number
- Option string
- Abs Start Limit (columns A thru K)
- Abs Stop Limit (columns A thru K)
- Abs Stop Limit Mode (columns A thru K, TRUE or FALSE)
- Auto Scaling
- Auto Sweep Time Rules
- Automatic Trigger Time
- Automatic Trigger Time State
- Average Mode
- Average Number

- Average State
- Detector 1 (columns A thru K)
- Detector 2 (columns A thru K)
- Electrical Atten
- Electrical Atten State
- External Array Trigger Delay (columns A thru E)
- External Array Trigger Delay State (columns A thru E)
- External Array Trigger Level (columns A thru E)
- External Array Trigger Slope (columns A thru E)
- Filter Type (columns A thru K)
- IF Gain Auto (columns A thru K, TRUE or FALSE)
- IF Gain State (columns A thru K, TRUE or FALSE)
- Internal Preamp
- Internal Preamp Band
- Line Trigger Delay
- Line Trigger Delay State
- Line Trigger Slope
- Meas Type
- Mechanical Atten
- MechanicalAttenStepEnum
- Peak Excursn (columns A thru K)
- Periodic Timer Period
- Periodic Timer Sync Source
- Periodic Timer Trigger Delay
- Periodic Timer Trigger Delay State

- Pk Threshold (columns A thru K)
- Points (columns A thru K)
- Points Mode (columns A thru K)
- Range State (columns A thru K)
- Ref Value
- Res BW (columns A thru K)
- Res BW Mode (columns A thru K)
- RFBurst Trigger Delay
- RFBurst Trigger Delay State
- RFBurst Trigger Level Abs
- RFBurst Trigger Level Rel
- RFBurst Trigger Level Type
- RFBurst Trigger Slope
- Scale/Div
- Spurious Report Mode
- SpurRangeStartFrequencyArray (columns A thru K)
- SpurRangeStopFrequencyArray (columns A thru K)
- Sweep Time (columns A thru K)
- Sweep Time Mode (columns A thru K)
- Trigger Holdoff
- Trigger Holdoff State
- TriggerSource
- Video BW (columns A thru K)
- Video BW Mode (columns A thru K)

The data above is followed in the file by a line containing “MeasResult1” to “MeasResult42”. This line forms a header for each set of measurement results, which appear in subsequent lines. Each line of Measurement Results consists of 42 comma-separated values, from the MeasResult1 value to the MeasResult42 value.

The MeasResult1 set in the file corresponds to the data returned by MEAS/READ/FETCh:SPURious1; the MeasResult2 set corresponds to the data returned by MEAS/READ/FETCh:SPURious2, and so on.

The exported file is in CSV format, with a .csv extension.

Meas Results File Example

When imported into Excel, a typical Meas Results file will show the header information above followed by the data. A sample of what the data rows look like appears below. Only the columns for Meas Result 1 through 6 are shown, due to lack of space:

MeasResult 1	MeasResult 2	MeasResult 3	MeasResult 4	MeasResult 5	MeasResult 6
19	-80.27209	-80.87862	-90.94577	-89.27086	-76.77856
1	-78.28497	-80.93996	-91.00485	-90.56063	-76.33968

SEM Meas Results File Contents

SEM Meas Results Files are CSV files, with a `.csv` extension. Each file contains sets of measurement results, preceded by a header section.

The header section items are as follows. They span columns A and B, unless otherwise stated:

- File ID string, which is `MeasResult`
- Mode ID: Measurement ID, for example, `SA:SEM`
- Firmware rev and model number
- Option string
- Automatic Trigger Time
- Automatic Trigger Time State
- Center Frequency
- ChanIntegBW
- ChannelDetector
- ChannelDetectorState

– ChanPwrRefAuto
– ChanResBW
– ChanResBWAuto
– ChanSpan
– ChanSweepTime
– ChanSweepTimeAuto
– ChanSweepTypeAuto
– ChanVbwRbwRatio
– ChanVbwRbwRatioAuto
– ChanVideoBW
– ChanVideoBWAuto
– Electrical Atten
– Electrical Atten Bypass
– Electrical Atten State
– External1 Trigger Delay
– External1 Trigger Delay State
– External1 Trigger Level
– External1 Trigger Slope
– External2 Trigger Delay
– External2 Trigger Delay State
– External2 Trigger Level
– External2 Trigger Slope
– FilterAlpha
– FrontEnd Gain
– FrontEnd Gain Mode

- Input Port
- Internal Preamp
- Internal Preamp Band
- Line Trigger Delay
- Line Trigger Delay State
- Line Trigger Slope
- LowNoiseAmplifier
- Measure Trace
- Mechanical Atten
- Mechanical Atten Auto
- MergedTraceNumPoints
- OffsetAverageType
- OffsetDetector
- OffsetDetectorState
- OffsetLimit2ndFailMaskBTS
- OffsetLimit2ndFailMaskMS
- OffsetLimitAbs2ndStartBTS
- OffsetLimitAbs2ndStartMS
- OffsetLimitAbs2ndStopBTS
- OffsetLimitAbs2ndStopMS
- OffsetLimitAbsStartBTS
- OffsetLimitAbsStartMS
- OffsetLimitAbsStopBTS
- OffsetLimitAbsStopMS
- OffsetLimitFailMaskBTS

- OffsetLimitFailMaskMS
- OffsetLimitRelStartBTS
- OffsetLimitRelStartMS
- OffsetLimitRelStopBTS
- OffsetLimitRelStopMS
- OffsetMeasBWBTS
- OffsetMeasBWMS
- OffsetResolutionBWAutoBTS
- OffsetResolutionBWAutoMS
- OffsetResolutionBWBTS
- OffsetResolutionBWMS
- OffsetSideBTS
- OffsetSideMS
- OffsetStartFrequencyBTS
- OffsetStartFrequencyMS
- OffsetStateBTS
- OffsetStateMS
- OffsetStopFrequencyBTS
- OffsetStopFrequencyMS
- OffsetSweepTimeAutoBTS
- OffsetSweepTimeAutoMS
- OffsetSweepTimeBTS
- OffsetSweepTimeMS
- OffsetSweepTypeAutoBTS
- OffsetSweepTypeAutoMS

- OffsetSweepTypeBTS
- OffsetSweepTypeMS
- OffsetVbwRbwRatioAutoBTS
- OffsetVbwRbwRatioAutoMS
- OffsetVbwRbwRatioBTS
- OffsetVbwRbwRatioMS
- OffsetVideoBWAutoBTS
- OffsetVideoBWAutoMS
- OffsetVideoBWBTS
- OffsetVideoBWMS
- PeakReference
- Periodic Timer Period
- Periodic Timer Sync Source
- Periodic Timer Trigger Delay
- Periodic Timer Trigger Delay State
- PowerReference
- PSDReference
- Radio Device
- RefAverageType
- RFBurst Trigger Delay
- RFBurst Trigger Delay State
- RFBurst Trigger Level Abs
- RFBurst Trigger Level Rel
- RFBurst Trigger Level Type
- RFBurst Trigger Slope

- RrcFilter
- SemAverageNumber
- SemAverageState
- SemRbwShape
- Span
- Sweep Type
- TotalAtten
- Trace Display
- Trace Math Function
- Trace Math Log Offset
- Trace Math Log Reference
- Trace Math Operand 1
- Trace Math Operand 2
- Trace Update
- TraceTypeArray
- Trigger Holdoff
- Trigger Holdoff State
- TriggerSource
- Video Trigger Delay
- Video Trigger Delay State
- Video Trigger Level
- Video Trigger Slope
- ViewCenterFreq
- ViewSelection
- ViewSpan

- XScaleAuto
- XScalePerDiv
- XScaleRefFreq
- XScaleRefPos
- YAutoScaling
- YRefValue
- YScalePerDiv

The header section is followed by a line containing items `MeasResult1` to `MeasResult20`, which flags the start of the measurement results. Each line of Measurement Results consists of 20 comma-separated values, from `MeasResult1` through `MeasResult20`.

`MeasResult1` contains the same results as `MEAS/READ/FETCh:SEMask1`; `MeasResult2`, `MEAS/READ/FETCh:SEMask2`; `MeasResult3`, `MEAS/READ/FETCh:SEMask3`; and so on.

When imported into Microsoft Excel or a similar spreadsheet application, a typical Meas Results file displays the header information above, followed by the data section. A sample of the data rows appears below. Only the columns for `MeasResult1` through `MeasResult6` are shown, due to lack of space:

MeasResult1	MeasResult2	MeasResult3	MeasResult4	MeasResult5	MeasResult6	...etc.
-999	0	-13	999	15.59025	-999	
15.59025359	0	-13	999	-999	-999	

CCDF Meas Results File Contents

CCDF Meas Results Files are in CSV format, with a `.csv` extension. Each file contains sets of measurement results, preceded by a header section. The header section contains the following lines:

- File ID string, which is `MeasResult`
- Mode ID: Measurement ID, for example `SA:PST`
- Firmware rev and model number
- Option string

- Automatic Trigger Time
- Automatic Trigger Time State
- CcdfCurrentCounts
- Center Frequency
- Center Frequency Step
- Center Frequency Step State
- Counts
- Electrical Atten
- Electrical Atten State
- External Array Trigger Delay
- External Array Trigger Delay State
- External Array Trigger Level
- External Array Trigger Slope
- Gaussian Line
- IF Gain Auto
- IF Gain State
- Info BW
- Internal Preamp
- Internal Preamp Band
- Line Trigger Delay
- Line Trigger Delay State
- Line Trigger Slope
- Meas Cycles
- MeasInterval
- Mechanical Atten

- MechanicalAttenStepEnum
- Periodic Timer Period
- Periodic Timer Sync Source
- Periodic Timer Trigger Delay
- Periodic Timer Trigger Delay State
- Preselector Adjust
- Ref Trace
- RFBurst Trigger Delay
- RFBurst Trigger Delay State
- RFBurst Trigger Level Abs
- RFBurst Trigger Level Rel
- RFBurst Trigger Level Type
- RFBurst Trigger Slope
- Scale/Div
- Trigger Holdoff
- Trigger Holdoff State
- TriggerSource

The header section is followed by a line containing items `MeasResult1` through `MeasResult4`. This line forms a header for each set of measurement results, which are listed in subsequent lines. Each line of Measurement Results consists of 4 comma-separated values, from the `MeasResult1` value to the `MeasResult4` value.

The `MeasResult1` set in the file corresponds to the data returned by `MEAS|READ|FETCh:PSTatistic1`; the `MeasResult2` set corresponds to the data returned by `MEAS|READ|FETCh:PSTatistic2`, and so on.

Meas Results File Example

When imported into Microsoft Excel or a similar spreadsheet application, a typical Meas Results file appears as shown in the example below.

```
MeasResult
SA:PST
```

A.10.53	N9030A	
526 ALV ATP B1X B1Y B25 B40 BBA CR3 CRP DCF DDA DP2 DRD EA3 EDP EMC EP1 ERC ESC ESP EXM FSA LFE LNP MAT MPB NFE NUL P26 PFR PNC RTL RTS S40 SB1 SEC SM1 TVT YAS YAV	1	
Automatic Trigger Time	0.1	
Automatic Trigger Time State	FALSE	
CcdfCurrentCounts	6087500	
Center Frequency	1.33E+10	
Center Frequency Step	5000000	
Center Frequency Step State	TRUE	
Counts	10000000	
Electrical Atten	0	
Electrical Atten State	FALSE	
External Array Trigger Delay	1.00E-06	1.00E-06
External Array Trigger Delay State	FALSE	FALSE
External Array Trigger Level	1.2	1.2
External Array Trigger Slope	Positive	Positive
Gaussian Line	TRUE	
IF Gain AUto	FALSE	
IF Gain State	FALSE	
Info BW	5000000	
Internal Preamp	FALSE	
Internal Preamp Band	Low	
Line Trigger Delay	1.00E-06	
Line Trigger Delay State	FALSE	
Line Trigger Slope	Positive	
Meas Cycles	1600	
MeasInterval	0.001	
Mechanical Atten	10	
MechanicalAttenStepEnum	S2dB	
Periodic Timer Period	0.02	

Periodic Timer Sync Source	None		
Periodic Timer Trigger Delay	1.00E-06		
Periodic Timer Trigger Delay State	FALSE		
Preselector Adjust	0		
Ref Trace	FALSE		
RFBurst Trigger Delay	1.00E-06		
RFBurst Trigger Delay State	FALSE		
RFBurst Trigger Level Abs	-20		
RFBurst Trigger Level Rel	-6		
RFBurst Trigger Level Type	Absolute		
RFBurst Trigger Slope	Positive		
Scale/Div	2		
Trigger Holdoff	0.1		
Trigger Holdoff State	FALSE		
TriggerSource	Free		
MeasResult1	MeasResult2	MeasResult3	MeasResult4
-73.0651058869747	36.9712197125257	36.7879441171442	
36.9712197125257	36.8850431211499	36.7032368203129	

TXP Meas Results File Contents

A TXP Meas Results File contains measurement results with the following header information:

- File ID string, which is “MeasResult”
- Measurement ID following Mode ID, which is “SA:TXP” for example
- Firmware rev and model number
- Option string
- Center Frequency
- TXP_InfoBw
- TXP_Used_CaptureTime

The header data is followed by a line containing entries "MeasResult1" to "MeasResult4", which flags the start of the measurement results. Each line of Measurement Results consists of four comma separated-values, from the MeasResult1 value to the MeasResult4 value.

MeasResult1 contains the same results as `MEAS/READ/FETCh:TXPower|BPOWer1`; MeasResult2, `MEAS/READ/FETCh:TXPower|BPOWer2`; and so on.

The exported file has `.csv` extension. A typical Meas Results file, when imported into Excel, would appear as follows:

MeasResult			
SA:TXP			
A.10.53	N9030A		
526 ALV ATP B1X B1Y B25 B40 BBA CR3 CRP DCF DDA DP2 DRD EA3 EDP EMC EP1 ERC ESC ESP EXM FSA LFE LNP MAT MPB NFE NUL P26 PFR PNC RTL RTS S40 SB1 SEC SM1 TVT YAS YAV	1		
Center Frequency	1.33E+10		
TXP_InfoBw	3000000		
TXP_Used_CaptureTime	0.00064		
MeasResult1	MeasResult2	MeasResult3	MeasResult4
0			
-999			

7.3.6 Limit

Lets you choose a file to which to export the **Limit** data.

Limit files are CSV files, and contain the limit data in a form that can be imported into Excel or similar spreadsheets, as well as header data that gives information on the limit.

The default path for most Limits files is:

`My Documents\<mode name>\data\limits`

where `<mode name>` is the parameter used to select the mode with the `:INST:SEL` command (for example, `SA` for Spectrum Analyzer). Hence a **Limit** file from any measurement in Spectrum Analyzer Mode would be stored in:

`My Documents\SA\data\limits`

The default path for **Limit** files from the Log Plot measurement in Phase Noise Mode is:

`My Documents\PNOISE\data\LPL\limits`

The default filename is `Limit_0000.csv`, where the 4-digit number is the lowest number that does not conflict with any filename in the current directory.

For backwards compatibility, older limit files with the extension `.lim` can be read into the instrument, but you can only save limits as `.csv` files.

Remote Command	`:MMEMory:STORe:LIMit LLINE1 | … | LLINE6,<filename>`
Example	Save the 2nd Limit Line to the file `myLimitLine2.csv` in the current path: `:MMEM:STOR:LIM LLINE2,"myLimitLine2.csv"`
Notes	If the save is initiated via SCPI, and the file already exists, the file will be overwritten Using the `C:` drive is strongly discouraged, since it runs the risk of being overwritten during an instrument software upgrade Both single and double quotes are supported for any filename parameter over SCPI
Dependencies	Only appears if you have the proper option installed in your instrument In the Log Plot measurement in Phase Noise Mode, there are only three Limit Lines, so the valid parameters are `LLINE1 | LLINE2 | LLINE3`
Preset	1 Not part of **Preset**, but reset by **Restore Mode Defaults** Survives power cycles
State Saved	The selected Limit number is saved in instrument state
Status Bits/OPC dependencies	Sequential - waits for previous measurement to complete

Limit File Contents

Limits may be exported into a data file with a `.csv` extension. They may be imported from that data file; they may also be imported from a legacy limit file with a `.lim` extension. The `.lim` files meet the specification for limit files contained in the EMI measurement guide, HP E7415A.

.csv file format

Except for information in quotes, limit line files are not case sensitive. Information in bold is required verbatim; other text is example text, and italic text is commentary which should not be present in the file.

The first five lines are system-required header lines, and must be in the correct order:

Limit	*Data file type name*
"FCC Part 15"	*File Description*
"Class B Radiated"	*Comment*
A.01.00.R0001,N9020A	*Instrument Version, Model Number*
P13 EA3 UK6 ,01	*Option List, File Format Version*

The next few lines describe the parameters; on export they will be in the order shown, on import they can be in any order. If some parameters are missing, they will revert to the default.

Type, Upper	*Upper|Lower*
X Axis Unit, MHz	*MHz|S; other units should be converted; this also specifies the domain*
Amplitude Unit, dBm	*dBm|V; all other units should be converted appropriately*
Frequency Interpolation, Linear	*Logarithmic|Linear*
Amplitude Interpolation, Logarithmic	*Logarithmic|Linear*
X Control, Fixed	*Fixed|Relative; on input we consider only the first three characters*
Y Control, Fixed	*Fixed|Relative; on input we consider only the first three characters*
Margin, 0	*Always in dB. A 0 margin is equivalent to margin off*
X Offset, 10	*Expressed in the X axis units*
Y Offset, 5	*Expressed in the Amplitude units*

The Amplitude Unit line in the limits file may contain a transducer (formerly "antenna") factor unit, for example:

Amplitude Unit=dBuV/m

Transducer factor units are dBuV/m, dBuA/m, dBpT, and dBG. In this case, the unit is treated exactly as though it were dBuV, meaning that all of the limits are interpreted to have units of dBuV. The box does NOT change Y Axis Units when such a limit is loaded in.

The X-Axis unit also specifies the domain (time or frequency). It is not possible to have both time-domain lines and frequency-domain lines at the same time; if a time-domain line is imported while the other lines are in the frequency domain (or vice-versa), all limit lines will be deleted prior to import.

If the sign of the margin is inappropriate for the limit type (for example a positive margin for an upper limit), the sign of the margin will be changed internally so that it is appropriate.

The remaining lines describe the data. Each line in the file represents an X-Y pair. The X values should be monotonically non-decreasing, although adjacent lines in the file can have the same X value as an aid to building a stair-stepped limit line. To specify a region over which there is no limit, use +1000 dBm for upper limits or –1000 dBm for lower limits.

The data region begins with the keyword `DATA`:

```
DATA
200.000000,–10.00
300.000000,–10.00
300.000000,–20.00
500.000000,–20.00
```

.lim file format

This is a legacy format which allows files saved from older instruments to be loaded into the X-Series. *Design of files in this format is not recommended.*

Except for name and description text (which is taken verbatim), limit line files are not case sensitive.

The file may optionally start with a description block, consisting of the single line `[DESCRIPTION]` followed by arbitrary text. If there is no Limit Line Name header, the description text will be used as the limit line description in the GUI. If there is a Limit Line Name header, the Limit Line Name will be used instead.

Arbitrary text

The header block begins with the single line `[HEADER]`, followed by some or all of the following fields, each with `<parameter name>=<parameter value>`. Excess white space around the "=" is ignored. If a field is not present or the data is invalid, the value is not changed when the limit line is loaded. Ordering of the fields is unimportant.

Limit Line Name="FCC Part 15;Class B Radiated"	
Type=Upper	Upper|Lower
Frequency Unit=MHz	For time domain limits, this should say "Time Unit"
Amplitude Unit=dBm	
Frequency Interpolation=Lin	Log|Lin; on input we consider only the first three characters
Amplitude Interpolation=Log	Log|Lin; on input we consider only the first three characters
Mode=Fixed	Fixed|Relative
Margin=0	Always in dB. A 0 margin is equivalent to margin off
Domain=Frequency	Frequency|Time
Delimiter=TAB	

The data block begins with the line `[DATA]`, and consists of any number of segments.

The Data lines represent segments – X1, Y1, X2, Y2. If the list of segments includes a gap in the middle on input, the space inside the gap will be set to ensure the limit does not fail: for upper limits maxtracevalue, for lower limits mintracevalue. If two segments overlap on input, the stricter of the two segments is used – for upper limits the lower segment, for lower limits the upper segment.

Thus, the following segments indicate into a –5 dB limit from 10 MHz to 20 MHz and 30 MHz to 40MHz:

10	–5	20	–5
30	–5	40	–5

If this was an upper limit, this would be translated into the following set of limit points:

10	–5
20	–5
20	maxtracevalue

30	maxtracevalue
30	–5
40	–5

30	–29.5	88	–29.5	
88	–33	216	–33	note that we are stair-stepping the line
230	–35.6	960	–35.6	The gap between 216 MHz and 230 MHz will never fail
960	–43.5	5000	–43.5	

7.3.6.1 Select Limit

Selects the specific Limit to be saved, for example, Limit 1.

Preset	Not part of **Preset**, but reset to `LLINE1` by **Restore Mode Defaults** Survives shutdown

7.3.7 Correction

Exports Amplitude Corrections files in the PC-readable `.csv` format.

Amplitude Correction files contain the correction data in a form that can be imported into Excel or similar spreadsheets, as well as header data that gives information on the correction.

The default filename is `Ampcor_0000.csv`, where the 4-digit number is the lowest number that does not conflict with any filename in the current directory.

The default path for Corrections files is:

`My Documents\amplitudeCorrections`

For backwards compatibility, older limit files with the extensions `.amp`, `.cbl`, `.ant` and `.oth` can be read into the instrument, but you can only save corrections as `.csv` files.

See "Correction Data File" on page 2593

Remote Command	`:MMEMory:STORe:CORRection 1 | … | 8, <filename>`
Example	Save Correction 2 to the file `myAmpcor.csv` on the current path: `:MMEM:STOR:CORR 2 "myAmpcor.csv"`
Notes	If the save is initiated via SCPI, and the file already exists, the file will be overwritten Using the `C:` drive is strongly discouraged, since it runs the risk of being overwritten during an instrument software upgrade Both single and double quotes are supported for any filename parameter over SCPI

Dependencies	Corrections are not supported by all measurements. If in a Mode in which some measurements support it, this key is grayed-out in measurements that do not. Does not appear at all if no measurements in the Mode support it Does not appear unless you have the proper option installed in your instrument
Annotation	After save is complete, an advisory is displayed in the message bar confirming which file was saved
Backwards Compatibility SCPI	`:MMEMory:STORe:CORRection ANTenna | CABLe | OTHer | USER, <filename>` For backwards compatibility, `ANTenna` maps to 1, `CABle` maps to 2, `OTHer` maps to 3 and `USER` maps to 4

Correction Data File

A Correction Data File contains a copy of one of the instrument correction tables. Corrections provide a way to adjust the trace display for predetermined gain curves (such as for cable loss).

Corrections files are text files in `.csv` (Comma-Separated Values) form, to make them importable into Excel or other spreadsheet programs. The format for Corrections files is as follows:

Line #	Type of field	Example	Notes
1	File type, must be "Amplitude Correction"	Amplitude Correction	May not be omitted
2	File Description (in quotes)	"Correction Factors for 11966E"	60 characters max; may be empty but may not be omitted. If exceeds 60 characters, error -233 Too much data reported
3	Comment (in quotes)	"Class B Radiated"	60 characters max; may be empty but may not be omitted. . If exceeds 60 characters, error -233 Too much data reported
4	Instrument Version, Model #	A.02.06,N9020A	May be empty but may not be omitted
5	Option List, File Format Version	K03 LFE EXM ,01	May be empty but may not be omitted
6	Freq Unit to be used for all frequency values in the file	Frequency Unit, MHz	assumed to be Hz if omitted
7	Transducer Unit	Antenna Unit, None	If omitted leaves the Transducer unit unchanged. The amplitude unit in the Transducer Unit field is a conversion factor that is used to adjust the Y Axis Units of the current mode, if the mode supports Transducer Units. For more details

Line #	Type of field	Example	Notes
			on transducer correction data, refer to the Input/Output, Corrections key description. Allowable values: dBuV/m, dBuA/m, dBG, dBpT, None
8	Freq Interpolation	Frequency Interpolation, Linear	if omitted leaves the Freq Interpolation unchanged. Allowable values: Linear, Logarithmic
9	Bias value in mA	Bias,0.00	If omitted leaves the Bias value unchanged (added as of A.08.50)
10	Bias State	Bias State,On	If omitted leaves the Bias State unchanged. Allowable values: On, Off (added as of A.08.50)
11	Overlap, two values, Freq1 and Freq2, separated by commas	Overlap,33500,40000	Uses Freq Unit from line 6. Thus, in this example Freq1=33.5 GHz, Freq2= 40.0 GHz (see note below). If omitted leaves the overlap unchanged (added as of A.08.50)
12	DATA marker	DATA	Corrections data begins in the next line

Lines 2 through 5 can be empty but must appear in the file. Lines 6 through 11 are optional, the lines can be left out of the file altogether.

The Overlap row and the two Bias rows apply only to external mixing. Both are read-only, they are never written by the instrument. The only way to insert or modify these rows is to edit the file with a text editor or a spreadsheet editor. These rows are intended for use by mixer manufacturers, as they allow the manufacturer to insert data about how the mixer corrections were generated and how they should be applied. The Bias rows allow you to specify whether to turn Bias on or off when the Correction is turned on and to specify a Bias value (turning off the Correction does not change the Bias, but turning it back on again sets it to the value specified in the file). The Overlap row allows you to specify an overlap region in which two different corrections may be applied. It is expected that in the corrections data itself, there will be TWO corrections values exactly at Max Freq, otherwise Overlap is ignored. The way the overlap is processed is as follows: if at any given time the current instrument Start Freq is greater than Freq 1 and lower than Freq 2, and the current Stop Freq is greater than Freq 2, extend the first correction point at or above Freq 2 down to Freq 1, rather than using the correction data between Freq1 and Freq2.

Only one Transducer units can be on at any given time. Note that this means that if a correction file with a Transducer Unit is loaded into a particular Correction, all other Corrections are set to that same Transducer unit. Note that the legacy term “Antenna Unit” is still used in the correction file, even though the more modern term “Transducer Unit” is used in the user interface.

Similarly, the Bias rows can only be used in Correction register 1, because there can only be one setting for Bias at any given time. If a Correction file with a Bias or Bias State row is loaded into any Correction register but 1, an error is generated: Mass storage error; Can only load Bias Settings into Correction 1

The data follows the DATA row, as comma separated X, Y pairs; one pair per line.

For example, suppose you have an Antenna to correct for on an N9020A version A.02.06 and the correction data is:

- 0 dB at 200 MHz
- 17 dB at 210 MHz
- 14.8 dB at 225 MHz

Then the file will look like:

- Amplitude Correction
- "Correction Factors for 11966E"
- "Class B Radiated"
- A.02.06,N9020A
- P13 EA3 UK6,01
- Frequency Unit, MHz
- Antenna Unit, dBuV/m
- Frequency Interpolation, Linear
- DATA
- 200.000000,0.00
- 210.000000,17.00
- 225.000000,14.80

The choices for the 1 of N fields in the metadata are as follows:

- Frequency Unit: Hz, kHz, MHz, GHz
- Antenna Unit: dBuV/m, dBuA/m, dBG, dBpT, None
- Frequency Interpolation: Logarithmic, Linear

7.3.7.1 Select Correction

Selects the specific Correction to be saved, for example, Correction 1.

Preset	Not part of a **Preset**, but reset to **Correction 1** by **Restore Input/Output Defaults** Survives a shutdown

7.3.8 Correction Group

Selects **Correction Group** as the data type to be exported with a save request. The next step is to select the **Save As** key in the **Save Data** menu.

Remote Command	`:MMEMory:STORe:CORRection:GROup <filename>`
Example	Save Correction Group to the file `myAmpcorGroup.csv`: `:MMEM:STOR:CORR:GRO "D:\myAmpcorGroup.csv"`
Notes	If the save is initiated via SCPI, and the file already exists, the file and the directory will be overwritten Using the `C:` drive is strongly discouraged, since it runs the risk of being overwritten during an instrument software upgrade Both single and double quotes are supported for any filename parameter over SCPI
Dependencies	This file type is supported in EMI Receiver and Spectrum Analyzer Modes, if Option EMC or EMI Receiver mode is present
Annotation	After save is complete, an advisory is displayed in the message bar confirming which file was saved

Correction Group File

A **Correction Group** file contains the correction group settings (that is, Antenna unit, break, description, and comment) range table and correction files data. Corrections files are text files in `.csv` (comma-separated value) format, to make them importable into Excel or other spreadsheet programs.

7.3.9 SCPI Recorder

Contains controls to allow you to save SCPI recordings.

7.3.9.1 Save To File

Saves SCPI recording content to a file. For details of the SCPI Recording feature, see "SCPI Recorder" on page 2172.

There are two possible file formats:

Type	Extension	Details
Text	`.txt`	Default
Python Script	`.py`	Generates a Python script that can be executed in Python environment.. For details, see "Saving a SCPI Recording as a Python Script" on page 2597

The saved file content does not include the label of each recorded entry, just the SCPI mnemonics. The file is saved to the following folder:

`<user_name>:\Documents\Keysight\Infrastructure\ScpiRecording folder`

Saving a SCPI Recording as a Python Script

To execute the generated Python script:

- Install the Python version required by PyVisa
- Download the PyVisa library from: `https://pypi.org/project/PyVISA/`
- Modify the connection string, to specify *your* instrument's connection string

Example Script

An example of the generated script is shown below.

_install location: https://pypi.org/project/PyVISA/

import pyvisa

import re

connected instrument

_inst = ''

SCPI Recording commands and queries

Add/Modify the instrument address to execute the script

_connectionString = 'your instrument connection string here'

#Example SCPI Recording Entries

_recordingEntries = ['Active Mode & Measurement'|':INST:CONF:SA:SANalyzer',

'Query Operation Complete'|'*OPC?',

'Active Mode & Measurement'|':INST:CONF:SA:SANalyzer',

'Query Operation Complete'|'*OPC?',

'Center Frequency'|':SENSe:FREQuency:CENTer 12000000000',

'Freq Offset'|':SENSe:FREQuency:OFFSet 10',

```
'Ref Level'|':DISPlay:WINDow:TRACe:Y:SCALe:RLEVel 5']
def ConnecToInstrument():
   rm = pyvisa.ResourceManager()
   _inst = rm.open_resource(_connectionString)
   _inst.read_termination = '\n'
   _inst.write_termination = '\n'
   idn = _inst.query('IDN?')
   print("Sending Recording Entries to: " + idn)
def CheckError()
   err = _inst.query('SYST:ERR?')
   return err.lower.find("no error")
def SendCommand(recordingEntry):
   # split the recording entry into label and mnemonic
   labelAndMnemonic = recordingEntry.split('|')
   label = labelAndMnemonic[0]
   mnemonic = labelAndMnemonic[1]
   # check and see if this is OPC query
   opcIndex = mnemonic.find('OPC?')
   #if OPC query send the query and get OPC query value
   if opcIndex >= 0:
      opcQueryValue = _inst.query(mnemonic)
      print(opcQueryValue)
   else:
   print(mnemonic)
      _inst.write(mnemonic)
   err = CheckError()
   # publish any errors from the previous command
   if err:
      print('Error for command ' + label + ': ' + err)
for entry in _recordingEntries
```

SendCommand(entry)

7.3.10 Mask

The **Mask** data type is used to import and export Mask files for measurements that use masks, such as cellular comms and real-time measurements.

7.3.11 Waveform Sequence

Saves waveform sequences from the ARB memory of an Internal Source. When you open the Save **Waveform Sequence** dialog and press **Save**, the current waveform sequence is saved to the selected directory.

Notes	No remote command, front panel only
Dependencies	Only appears if your hardware includes an Internal Source, such as in VXT

7.3.12 Screen Image

Selects a file for saving the contents of the display.

Screen Image files are PNG (Portable Network Graphics) files with the same resolution as the data display. They contain the image that was on the screen before you opened the **Save** dialog. When the **Screen Image** key is pressed, a "thumbnail" of the captured image is displayed, with the note "This is the image that will be saved" below it.

After you have completed the save, a message "File image.png saved" (assuming `image.png` was the filename you used).

NOTE As of firmware release A.17.50, sending `*CLS` (Clear Status) removes any message displayed on the screen. If you do not want to see the "File saved" message after sending `:MMEM:STOR:SCR` (described below), send the following sequence (substituting your file name for `filename.png`): `:MMEM:STOR:SCR "filename.png";*CLS`

NOTE As of firmware release A.19.50, saving a screen image removes any informational message displayed on the screen before it captures the screen. This is useful if you are sending "save image" commands in rapid sequence, as it keeps the "File saved" message from one screen capture from appearing in the next screen capture. Error messages are still captured.

If you send a succession of screen image commands *too* rapidly, the system may not have time to remove the previous message before the next screen

capture. Sending screen image commands more rapidly than twice per second is not advised.

The default path for State Files is:

`My Documents\<mode name>\screen`

where `<mode name>` is the parameter used to select the mode with `:INST:SEL`, for example, `SA` for Spectrum Analyzer Mode.

Screen Image files have extension `.png`. The default filename is `Screen_0000.png`, where the 4-digit number is the lowest number that does not conflict with any filename in the current directory.

After you have completed the save, the **Quick Save** front-panel key lets you quickly repeat the last save performed, using an auto-named file, with new current screen data.

Remote Command	`:MMEMory:STORe:SCReen <filename>`
Example	Store the current screen image in the file `MyScreenFile.png` in the default directory: `:MMEM:STOR:SCR "myScreen.png"`
Backwards Compatibility SCPI	`:HCOPy:SDUMp:DATA?` returns the screen image in a `<DEFINITE LENGTH ARBITRARY RESPONSE DATA>` element. The response data is IEEE Block format; the controlling computer can strip the header and store the result as a `.png` file

Blocking Screen Capture (Remote Command Only)

This command works *only* when the measurement is in **Single** mode (see "Sweep/Measure" on page 2016). When the command is sent, it blocks the SCPI client, waits for the current refresh to complete, then captures the screen shot and saves it. In some instances, a single measurement is taken, and a screen shot of that measurement is captured.

This command ensures that the last-measured data is refreshed on the screen before it is captured, by blocking the command and waiting for refresh to complete. The command may time out, in which case it must be re-sent.

If timeout occurs, or if the active measurement is in **Continuous** mode, an error is returned.

Remote Command	`:MMEMory:STORe:SCReen:BLOCked <filename>`
Example	Wait for the current screen refresh to complete before capturing the screen shot, then store the current screen image in the file `MyScreenFile.png` in the default directory: `:MMEM:STOR:SCR:BLOC "myScreen.png"`

7.3.12.1 Theme

Accesses a menu of functions that enable you to choose the theme to be used when saving the screen image. You can choose between themes to be used when saving the screen image.

See "More Information" on page 2601 for examples of the themes.

Remote Command	`:MMEMory:STORe:SCReen:THEMe FILLed | OUTLine` `:MMEMory:STORe:SCReen:THEMe?`
Example	`:MMEM:STOR:SCR:THEM OUTL`
Preset	`FILLed`; not part of **Preset**, but reset by **Restore Misc Defaults** or **Restore System Defaults All**
Backwards Compatibility SCPI	`:MMEMory:STORe:SCReen:THEMe TDColor | TDMonochrome | FCOLor | FMONochrome`

Backwards Compatibility Notes	To permit code compatibility with A-model X-Series Signal Analyzer instruments, the command parameters from the A-models are mapped as follows:
	`TDColor` and `TDMonochrome` are both mapped to `FILLed`
	(exact full color representation of what is on the screen)
	`FCOLor` and `FMONochrome` are both mapped to `OUTLine`
	(uses color for traces and other items, but most filled areas are white)
	There is no Monochrome theme in B-models, so the A-models monochrome commands yield color
	`:MMEM:STOR:SCR:THEM?` always returns `FILLed` or `OUTLine`, never `FCOLor`, `FMONochrome`, `TDColor`, or `TDMonochrome`
	There is no monochrome theme in the X-Series Touch UI

More Information

- The `FILLed` theme is an exact representation of the information on the display
- The `OUTLine` theme eliminates most of the filled areas, in order to save ink when the image is printed. In addition, the yellow trace color is changed to be more orange, to improve visibility against a white background. Note that some objects remain filled. In particular, the selected marker remains filled with the green marker color, in order to distinguish it from the other markers. This is important, as it is the selected marker whose readout appears in the upper right corner of the display

7.3.13 Power Sensor Cal Factor

Selects a file to which to export the Power Sensor Cal factor data.

Cal Factor files are XML files, and contain the cal factor data and header data that gives information on the power sensor.

The default path for **Cal Factor** Files is:

`My Documents\<mode name>\data\PSCF`

where `<mode name>` is the parameter used to select the mode with `:INST:SEL` (for example, `MRECEIVE` for Measuring Receiver Mode). Hence, a **Cal Factor** file from any measurement in the Measuring Receiver mode would be stored in:

`My Documents\MRECEIVE\data\PSCF`

Cal Factor files have the extension `.xml`. The default filename is `<Sensor Model>_<Sensor Serial Number>_0000.xml`, where the 4-digit number is the lowest number that does not conflict with any filename in the current directory. If the sensor model or serial number is blank, the default filename is `PSCF_0000.xml`.

Remote Command	`:MMEMory:STORe:PSCFactor <file_name>`
Example	`:MMEM:STOR:PSCF "myPSCF.xml"`
Notes	If the save is initiated via SCPI, and the file already exists, the file will be overwritten Using the `C:` drive is strongly discouraged, since it runs the risk of being overwritten during an instrument software upgrade Both single and double quotes are supported for any filename parameter over SCPI
Dependencies	Only appears if you have the proper option installed in your instrument

7.3.14 Remote Only Commands

The following commands execute file system operations such as move, copy, and transfer data from a file.

7.3.14.1 Mass Storage Catalog (Remote Command Only)

Remote Command	`:MMEMory:CATalog? [<directory_name>]` The string `<directory_name>` must be a valid logical path. If no string then it uses the current directory
Example	`:MMEM:CAT? "C:\"`

Notes	Queries disk usage information (drive capacity, free space available) and obtains a list of files and directories in a specified directory in the following format:
	`<numeric_value>,<numeric_value>,\{<file_entry>\}`
	It returns two numeric parameters and as many strings as there are files and directories
	The first parameter indicates the total amount of storage currently used in bytes
	The second parameter indicates the total amount of storage available, also in bytes. `<file_entry>` is a string. Each `<file_entry>` indicates the name, type, and size of one file in the directory list:
	`<file_name>,<file_type>,<file_size>`
	As the Windows file system has an extension that indicates file type, `<file_type>` is always empty. `<file_size>` provides the size of the file in bytes. For directories, `<file_entry>` is surrounded by square brackets and both `<file_type>` and `<file_size>` are empty

7.3.14.2 Mass Storage Change Directory (Remote Command Only)

Remote Command	`:MMEMory:CDIRectory [<directory_name>]`
	`<directory_name>` must be a valid logical path
	`:MMEMory:CDIRectory?`

Example	`:MMEM:CDIR "C:\Program Files"`
Notes	Changes the current directory for a mass memory file system. The `<directory_name>` parameter is a string. If no parameter is specified, the directory is set to the `*RST` value At `*RST`, this value is set to the default user data storage area, that is defined as System.Environment.SpecialFolder.Personal Query returns full path of the current directory as a quoted string

7.3.14.3 Mass Storage Copy (Remote Command Only)

Remote Command	`:MMEMory:COPY <string>,<string>[,<string>,<string>]` `<string>` must be a valid logical path
Example	`:MMEM:COPY "C:\TEMP\Screen_0000.png","C:\"`
Notes	Copies an existing file to a new file or an existing directory to a new directory If no directory is specified, uses the current directory Two forms of parameters are allowed. The first form has two parameters. In this form, the first parameter specifies the source, and the second parameter specifies the destination The second form has four parameters. In this form, the first and third parameters specify the source. The second and fourth parameters specify the directories. The first pair of parameters specifies the source. The second pair specifies the destination. An error is generated if the source doesn't exist or the destination file already exists This command will generate an "access denied" error if the destination is a restricted folder (for example, `C:\Windows`) and you do not have Power User or Administrator privileges

7.3.14.4 Mass Storage Device Copy (Remote Command Only)

Transfers data to/from a file and a peripheral device.

Remote Command	`:MMEMory:COPY:DEVice <source_string>,<dest_string>` `<source_string>` and `<dest_string>` must be valid logical paths
Notes	The strings must be a valid logical path or a valid device keyword. If `dest_string` is a device keyword, the data is copied from the source file to the device. If `source_string` is a device keyword, the data is copied to the source file from the device Valid device keywords are: `SNS` (smart noise source) An error is generated if the file or device is not found

7.3.14.5 Mass Storage Delete (Remote Command Only)

Remote Command	`:MMEMory:DELete <file_name>[,<directory_name>]` `<file_name>` and `<directory_name>` must be valid logical paths
Example	`:MMEM:DEL "Screen_0000.png"`
Notes	If no directory is specified, uses the current directory Removes a file from the specified directory. `<file_name>` specifies the file name to be removed. This command generates an “access denied” error if the file is in a restricted folder (for example, `C:\Windows`) and you do not have Power User or Administrator privileges

7.3.14.6 Mass Storage Data (Remote Command Only)

Creates a file containing the specified data *or* queries the data from an existing file.

Remote Command	`:MMEMory:DATA <file_name>, <data>`
	`<file_name>` must be a valid logical path
	`:MMEMory:DATA? <file_name>`

Example	`:MMEM:DATA? "MyFile.txt"`
Notes	If no directory is specified, uses the current directory The command form `:MMEMory:DATA <file_name>,<data>` loads `<data>` into the file `<file_name>`. `<data>` is in 488.2 block format. `<file_name>` is string data The response to `:MMEMory:DATA? <file_name>` is the associated `<data>` in block format

7.3.14.7 Mass Storage Make Directory (Remote Command Only)

Remote Command	`:MMEMory:MDIRectory <directory_name>` `<directory_name>` must be a valid logical path
Example	`:MMEM:MDIR "C:\TEMP\NewDir"`
Notes	Creates a new directory. `<directory_name>` specifies the name to be created Generates an “access denied” error if the new directory would be in a restricted folder (for example, `C:\Windows`) and you do not have Power User or Administrator privileges

7.3.14.8 Mass Storage Move (Remote Command Only)

Remote Command	`:MMEMory:MOVE <string>,<string>[,<string>,<string>]` `<string>` must be valid logical paths
Example	`:MMEM:MOVE "C:\TEMP\Screen_0000.png","C:\"`
Notes	Moves an existing file to a new file or an existing directory to a new directory

	Two forms of parameters are allowed. The first form has two parameters. In this form, the first parameter specifies the source, and the second parameter specifies the destination The second form has four parameters. In this form, the first and third parameters specify the source. The second and fourth parameters specify the directories. The first pair of parameters specifies the source. The second pair specifies the destination. An error is generated if the source doesn't exist or the destination file already exists This command generates an "access denied" error if the destination is a restricted folder (for example, `C:\Windows`) and you do not have Power User or Administrator privileges

7.3.14.9 Mass Storage Remove Directory (Remote Command Only)

Remote Command	`:MMEMory:RDIRectory <directory_name>` `<directory_name>` must be a valid logical path
Example	`:MMEM:RDIR "C:\TEMP\NewDir"`
Notes	Removes a directory. The `<directory_name>` parameter specifies the directory name to be removed. All files and directories under the specified directory will also be removed This command generates an "access denied" error if the folder is a restricted folder (for example, `C:\Windows`) or is in a restricted folder and you do not have Power User or Administrator privileges

7.3.14.10 Mass Storage Determine Removable Media (Remote Query Only)

Used to determine whether any removable media devices are connected to the instrument. Primarily, these are USB memory devices plugged-in to the front panel or rear panel USB ports. On instruments with PC6 or PC7 CPUs, one SD card slot is available for removable media. The instrument's primary disk drive is *not* a removable media device.

Remote Command	`:MMEMory:RMEDia:LIST?`
Example	`:MMEM:RMED:LIST?`
Notes	The return value is a string containing a list of partition identifiers, which are removable media devices. Each identifier will be separated by a comma. If no removable media is present, an empty string is returned Examples: – One removable device present results in a return string of "F:" – Two removable devices present results in a return string of "F:,G:" No removable devices present results in a return string of ""

7.3.14.11 Mass Storage Determine Removable Media Label (Remote Command Only)

Used to set or query a removable media device's label.

Remote Command	`:MMEMory:RMEDia:LABel <partition>,<string>` `:MMEMory:RMEDia:LABel? <partition>`
Example	`:MMEM:RMED:LAB "F:","My Device"`
Notes	If the `<partition>` specified does not exist or is not a removable media device, the error -252, "Missing Media" is generated Setting the removable media label requires Administrative privileges. If the currently logged-in user does not have appropriate privileges, error "-221, Settings conflict; Administrator privileges required" is generated

7.3.14.12 Mass Storage Determine Removable Media Write-protect status (Remote Query Only)

Used to query a removable media device's write-protect status.

Remote Command	`:MMEMory:RMEDia:WPRotect? <partition>`
Example	`:MMEM:RMED:WPR? "F:"`
Notes	The return value is 1 if the device is write-protected, and 0 if the device is write-enabled If the `<partition>` specified does not exist or is not a removable media device the error -252, "Missing Media" is generated
Preset	The return value depends on the SD card installed

7.3.14.13 Mass Storage Determine Removable Media size (Remote Query Only)

Queries a removable media device's total memory size (not available memory size).

Remote Command	`:MMEMory:RMEDia:SIZE? <partition>`
Example	`:MMEM:RMED:SIZE? "F:"`
Notes	The return value is integer value in GBytes. Any device that is less than 1 GB returns 0 GB If the `<partition>` specified does not exist or is not a removable media device, the error -252,"Missing Media" is generated

7.3.14.14 :SYSTem:SET (Remote Command Only)

Obtains the state of the currently active mode in a form that can then be loaded back into the instrument quickly.

Remote Command	`:SYSTem:SET <instrument state in IEEE Block>` `:SYSTem:SET?`
Notes	The query returns current instrument state of the active mode in IEEE Block data format. The state is in

a machine-readable format only, as follows:

`<syst set preamble><state block data>`

Where:

`<syst set preamble>` is the format:

`#NMMM`

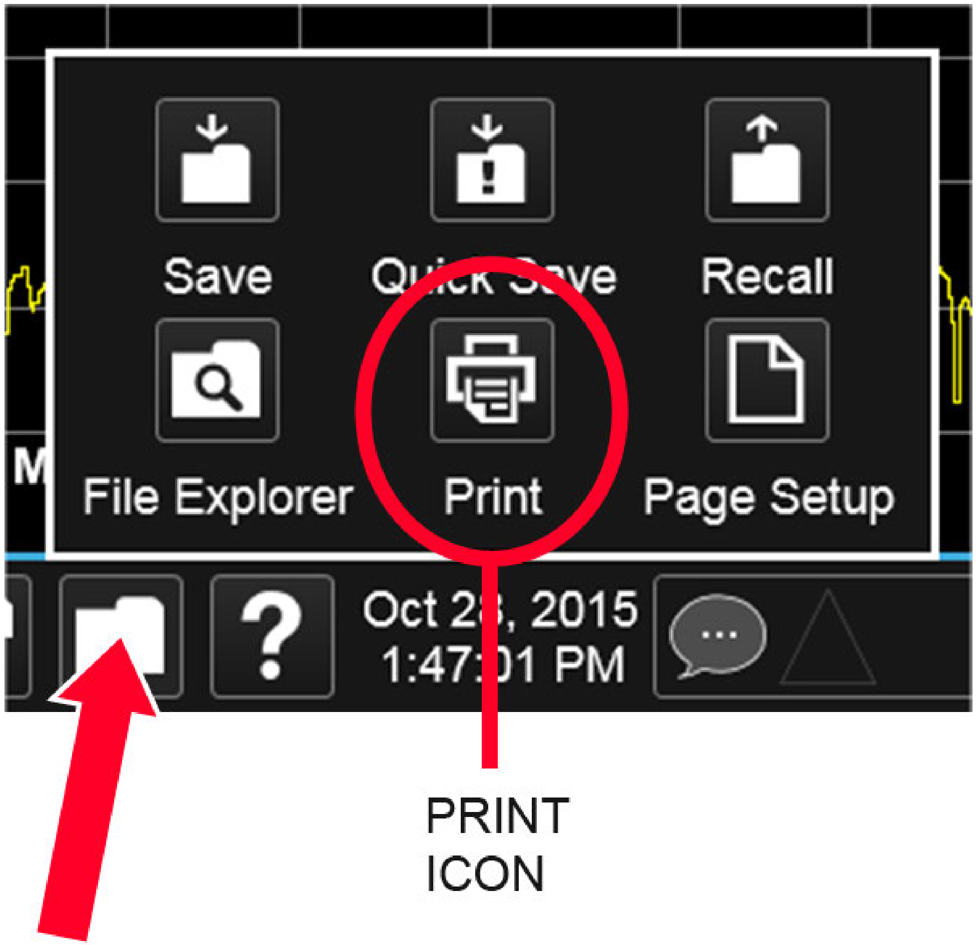
- `N` = number of digits that comprise `MMM`
- `MMM` = length in bytes of following data

`<state block data>` is machine readable state data

Example response: `#42016<state data>`

The state is recalled by sending the `:SYST:SET?` response data to the instrument. From example above:`:SYST:SET #42016<state data>`

7.4 Print

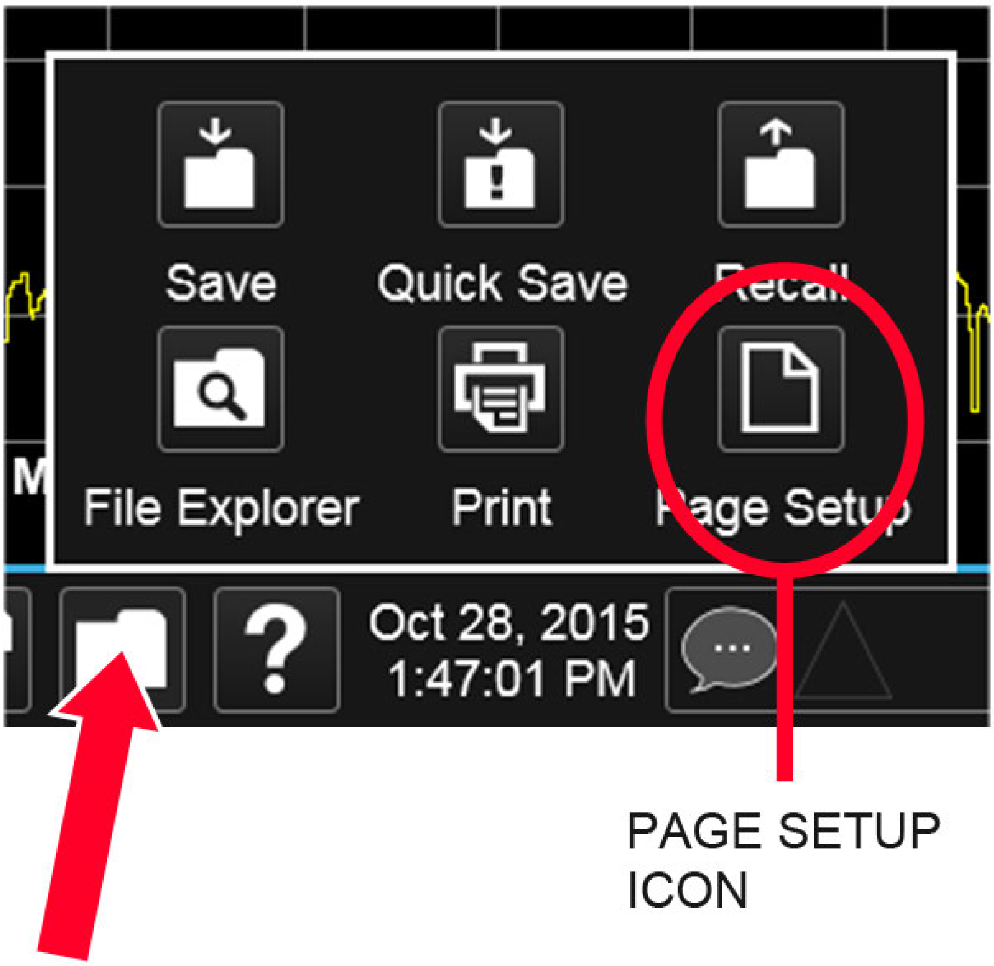


Opens a dialog for configuring printing (to the printer of your choice).

The `:HCOPy` command is equivalent to pressing the **PRINT** key.

Remote Command	`:HCOPy[:IMMediate]`
	`:HCOPy:ABORt` can be used to abort a print that is already in progress. Sending `:HCOPy:ABORt` causes the instrument to stop sending data to the printer, although the printer may continue or even complete the print, depending on how much data was sent to the printer before you sent the `:ABORt` command.
Remote Command	`:HCOPy:ABORt`

7.5 Page Setup



Opens a Windows Page Setup dialog that allows you to control aspects of the pages sent to the printer when the **PRINT** hardkey is pressed.

Depending on the abilities of the attached printer, paper size, paper source, page orientation and margins may all be set. There are no SCPI commands for controlling these parameters.

The dialog also has a dropdown control to let you select the Display Theme to use when printing. **Page Setup** themes are the same as those for **Screen Image** "Theme" on page 2601.

The **Theme** control has a corresponding SCPI command:

Remote Command	`:SYSTem:PRINt:THEMe FILLed | OUTLine` `:SYSTem:PRINt:THEMe?`
Example	`:SYST:PRIN:THEM OUTL`
Preset	`OUTL`; not part of **Preset**, but reset by **Restore Misc Defaults** or **Restore System Defaults All** and survives subsequent running of the modes
State Saved	No
Backwards Compatibility SCPI	`:SYSTem:PRINt:THEMe TDColor | TDMonochrome | FCOLor | FMONochrome`
Backwards Compatibility Notes	To permit code compatibility with A-model X-Series Signal Analyzer instruments, the command parameters from A-models are mapped as follows: `TDColor` and `TDMonochrome` are both mapped to `FILLed`: Exact full color representation of what is on the screen `FCOLor` and `FMONochrome` are both mapped to `OUTLine`: Uses color for traces and other items, but most filled areas are white There is no Monochrome theme in B-models, so the A-models' monochrome commands yield color `:SYST:PRINT:THEM?` always returns `FILLed` or `OUTLine`; never `FCOLor`, `FMONochrome`, `TDColor`, or `TDMonochrome`

8 Trigger

Controls the **Trigger** system of the instrument. In general, these are functions associated with internal triggers or trigger inputs. Trigger Output functions are configured under **Input/Output**.

Trigger functions are common across multiple Modes and Measurements, although some controls appear only in certain Modes and/or certain Measurements. Additionally, some of the tabs on the **Trigger** menu are only available in certain Modes.

Many of the Trigger functions can be set graphically using the Trigger Setting Diagram. For more information see: "Trigger Optimization" on page 2659

In general, each Measurement can have a different Trigger, and each Measurement remembers its previous-trigger setting.

8.1 Trigger

Contains controls that let you select the trigger source, and setup of each of the trigger sources. The instrument is designed to allow triggering from many sources, for example, Free Run, Video, External, RF Burst, etc.

In general, each Measurement can have a different Trigger Source, and each Measurement remembers its previous-Trigger Source.

8.1.1 Select Trig Source

Specifies the trigger source for the currently selected instrument input (RF or I/Q). If you change inputs, the new input remembers the trigger source it was last programmed to for the current measurement and uses that trigger source. When in External Mixing, the instrument uses the RF trigger source. You can directly set the trigger source for the RF Input and for the I/Q input using SCPI commands; see "Trigger Source Presets" on page 2620, "RF Trigger Source (Remote Command Only)" on page 2622 ,and "I/Q Trigger Source (Remote Command Only)" on page 2624.

In general, each Measurement can have a different Trigger Source, and each Measurement remembers its previously-set Trigger Source. Not every Trigger Source is available for every Measurement, so the available choices for Select Trig Source may vary from Mode to Mode and Measurement to Measurement. The trigger sources that are available for each measurement are shown in the “List of Available Trigger sources” dropdown below.

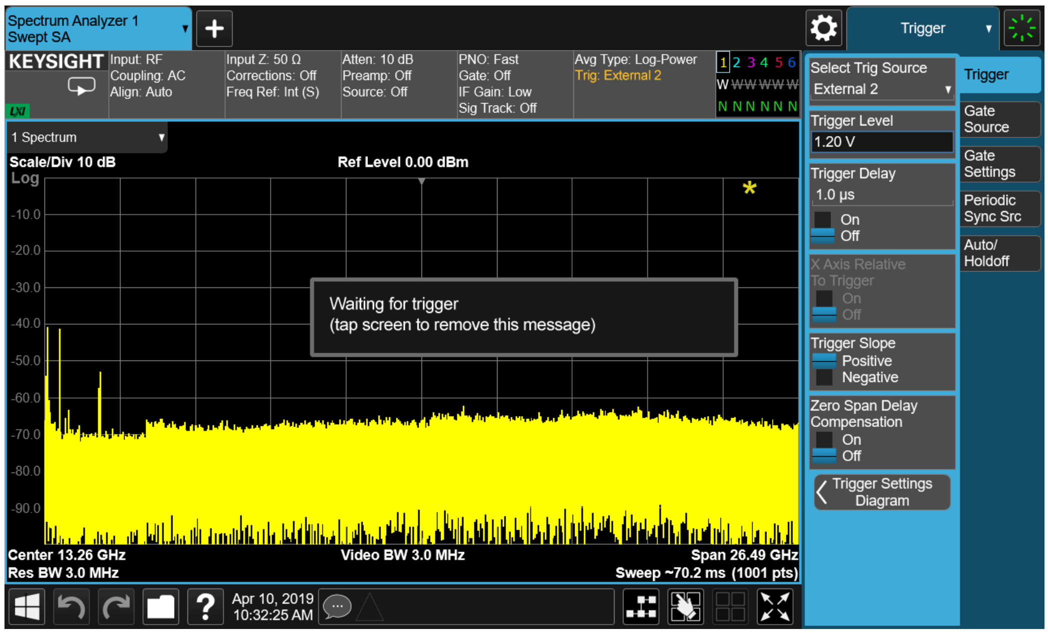
Note that the controls available on the Trigger Tab change depending on which trigger source is selected. Tap each trigger source in the table in the “List of Available Trigger sources” dropdown to see what parameters are available for that trigger source.

Note that most measurements require the inclusion of a <measurement> parameter in the Trigger Source command. However, for the Swept SA measurement and RTSA this is not the case; for backwards compatibility, no <measurement> parameter is used when setting the Trigger Source for the Swept SA measurement or RTSA.

Waiting for Trigger

After you select a trigger source, the instrument will start its next measurement when that trigger source is satisfied. For example, if you choose External 1, the next measurement will start when the appropriate signal appears at the Trigger 1 In connector.

If the trigger source is not satisfied (for example, if no signal at the appropriate level appears at the Trigger 1 In connector), after approximately 2 seconds a popup message will appear that says, “Waiting for trigger”. The trigger annotation in the Meas Bar will also turn amber, as shown below:



Tap anywhere on the screen (except on the message itself) to clear the popup. The annotation will remain amber until the trigger conditions are satisfied.

List of available Trigger sources

The tables show which Trigger sources are available for which Modes and Measurements, with the following exceptions:

- the Noise Figure Mode does not support Triggering at all
- the Disturbance Analyzer measurement in the EMI Mode does not support Triggering
- the Tx Band Spur measurement in the GSM/EDGE Mode does not support Triggering
- For some models (like N9042B) with ADC trigger: some IF Paths do not support Video trigger, instead they support ADC trigger

"Free Run" on page 2625	`IMMediate`	All Modes and measurements, except those measurements that support no triggers at all
"Video/ADC" on page 2625	`VIDeo`	All Modes except RTSA and Pulse
		In Spectrum Analyzer Mode, all measurements except ACP and List Sweep
		In WCDMA, MSR, Short Range Comms, VMA and LTE, all measurements

		except ACP In WLAN, all measurements In Phase Noise, all measurements except Log Plot and Spot Frequency
"ADC Trigger" on page 2626	ADC	All Modes and measurements supporting Video or Level, except Spectrum Analyzer mode Only supported in certain model's IF Paths
"Line" on page 2627	LINE	All Modes except EMI, Avionics and Analog Demod In Spectrum Analyzer, all measurements except List Sweep In WLAN and GSM/EDGE, all measurements except Power vs. Time In LTE and 5G NR, all measurements except Transmit On/Off Power In Short Range Comms, all measurements except Modulation Analysis In MSR, all measurements
Level [Mode: RTSA, PULSEX]	LEVel	RTSA and Pulse Modes only
FMT [Mode: RTSA, PULSEX]	FMT	RTSA and Pulse Modes only
"External 1" on page 2627	EXTernal1	All Modes and measurements
"External 2" on page 2628	EXTernal2	All Modes and measurements
"External 3" on page 2629	EXTernal3	See "External 3 Support" on page 2615
"RF Burst" on page 2630	RFBurst	All Modes except EMI In Spectrum Analyzer, all measurements except List Sweep
"Periodic" on page 2631	FRAMe	All Modes except EMI In Spectrum Analyzer, all measurements except List Sweep
"TV" on page 2633	TV	Spectrum Analyzer Mode only, and only in the Swept SA measurement

I/Q Triggers

"I/Q Mag" on page 2634	IQMag	All Modes except EMI, Avionics, RTSA, Analog Demod and Pulse
		In Spectrum Analyzer, only in Power Stat CCDF and Burst Power
"Input I" on page 2635	IINPut	In WCDMA, only in Power Stat CCDF and IQ Waveform
"Input Q" on page 2635	QINPut	In GSM/EDGE, only in EVM, GMSK Phase & Freq Error, Transmit Power and IQ Waveform
		In Phase Noise, only in IQ Waveform
"I (Demodulated)" on page 2636	IDEMod	In Bluetooth, only in Transmit Analysis
		In LTE, only in Power Stat CCDF, Modulation Analysis, Conformance EVM, and IQ Waveform
"Q (Demodulated)" on page 2636	QDEMod	In WLAN, only in Power Stat CCDF, Modulation Analysis, Spectral Flatness, and IQ Waveform
		In Short Range Comms, only in Power Stat CCDF and Modulation Analysis
"Aux I/Q Mag" on page 2637	AIQMag	In VMA, only in Power Stat CCDF, Digital Demod and IQ Waveform
		In CQM, only in Group Delay, Power Stat CCDF, and IQ Waveform
"PXI" on page 2637	PXI	All Modes and measurements (only found in modular analyzers)
"Internal" on page 2638	INTernal	All Modes and measurements (only found in modular analyzers)
"Audio External" on page 2630	AEXTernal	Via the TRIG IN connector on the M9260A Audio Analyzer module
"Prot Channel Detection" on page 2638	PRTChandet	Base Station Emulation; valid UL signal detected (PUSCH/PUCCH/PRACH/SRS)
"Prot Frame Aligned" on page 2639	PRTFrame	Base Station Emulation; periodic technology format radio frame with data frame aligned to the BSE timing
"Prot Event" on page 2639	PRTEvent	Base Station Emulation events

External 3 Support

Trigger Source **External 3** is available only in certain Modes and measurements, as follows:

5GNR	Transmit On|Off, Modulation Analysis, Power Stat CCDF, and IQ Waveform measurements only
ADEMOD	Not supported
AVIONICS	Not supported
BT	Not supported
CQM	Group Delay, Power Stat CCDF, and IQ Waveform measurements only
EMI	Not supported
GSMEDGE	IQ Waveform and Transmit Power measurements only
LTEAFDD,	Power Stat CCDF, IQ Waveform, and Transmit On|Off measurements only

LTEATDD	
MSR	Power Stat CCDF, and IQ Waveform measurements only
PA	Power Amplifier measurement
PNOISE	IQ Waveform measurement only
PULSEX	Pulse measurement only
SA	Power Stat CCDF and Burst Power measurements only
SRCOMMS	Modulation Analysis, Power Stat CCDF, and IQ Waveform measurements only
VMA	Digital Demod, Custom OFDM, IQ Waveform, and Power Stat CCDF measurements only
WCDMA	QPSK EVM, Power Stat CCDF, and IQ Waveform measurements only
WLAN	Spectral Flatness, Modulation Analysis, Power Vs Time, Power Stat CCDF, and IQ Waveform measurements only

Backwards Compatibility SCPI

The following SCPI commands are provided for Backwards Compatibility:

Backwards Compatibility SCPI	`:TRIGger[:SEQuence]:SOURce EXTernal`
	For backward compatibility, the parameter `EXTernal` is mapped to `EXTernal1`
	`[:SENSe]:<measurement>:TRIGger:SOURce`
	This backwards compatibility alias command is provided for ESA/PSA compatibility
	This backwards compatibility command does not apply to the Swept SA measurement, for that just use `:TRIGger:SOURce`
	This backwards compatibility command does not apply to the monitor spectrum, log plot and spot frequency measurements
	`[:SENSe]:<measurement>:TRIGger:SOURce IF`
	In earlier instruments, the parameter IF was used by apps for the video trigger, so using the IF parameter selects `VIDeo` triggering. Sending IF in the command causes `VID` to be returned to a query
	`[:SENSe]:ACPR:TRIGger:SOURce`
	This backwards Compatibility SCPI command is provided to support the same functionality as `[:SENSe]:ACPr:TRIGger:SOURce` (PSA W-CDMA, PSA cdma2000 and PSA 1xEVDO) due to the fact that the `ACPr` node conflicts with the `ACPower` node
	The legacy command:
	`:TRIGger[:SEQuence]:RFBurst:FSELectivity[:STATe] OFF | ON | 0 | 1`
	is not supported in the X-Series, as the hardware to do Frequency Selective burst triggers does not exist in X-Series

More Information

The **Trigger** menus let you select the trigger source and trigger settings for a sweep or measurement. In triggered operation (basically, any trigger source other than Free Run), the instrument will begin a sweep or measurement only when the selected trigger conditions are met, generally when your trigger source signal meets the specified trigger level and polarity requirements. (In FFT measurements, the trigger controls when the data acquisition begins for FFT conversion.)

For each of the trigger sources, you may define a set of operational parameters or settings, which will be applied when that source is selected as the current trigger source. Examples of these settings are Trigger Level, Trigger Delay, and Trigger Slope. You may apply different settings for each source; so, for example, you could have a Trigger Level of 1v for External 1 trigger and –10 dBm for Video trigger.

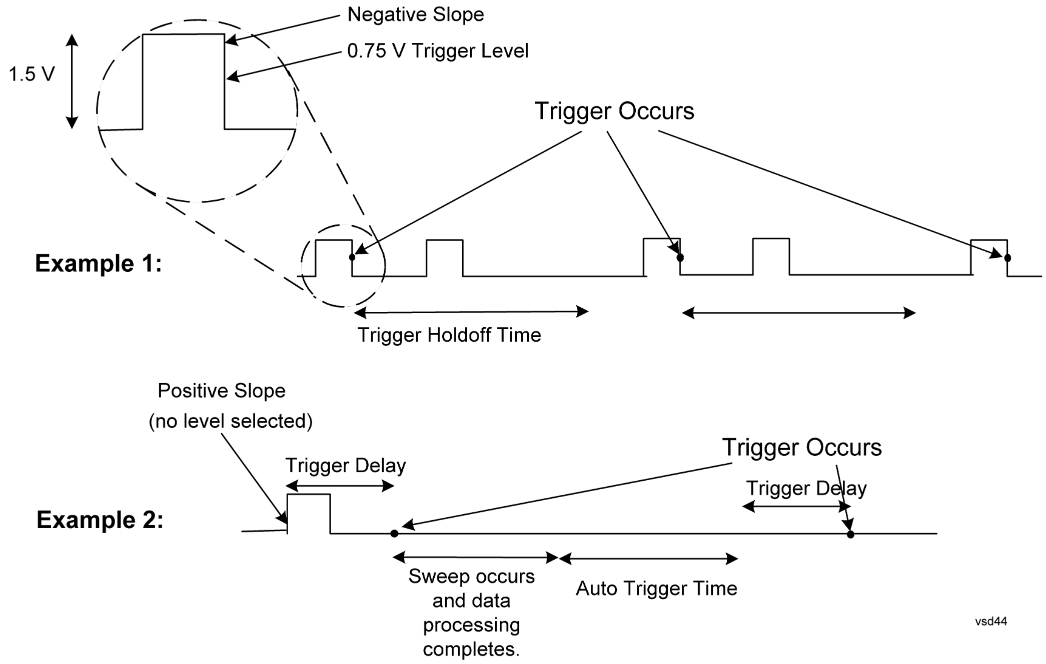
Once you have established the settings for a given trigger source, they generally will remain unchanged for that trigger source as you go from measurement to measurement within a Mode (although the settings can change as you go from Mode to Mode). Furthermore, the trigger settings within a Mode are the same for the **Trigger** menu, the **Gate Source** menu, and the **Periodic Sync Src** menu. That is, if **Ext1** trigger level is set to 1v in the **Trigger** menu, it will appear as 1v in both the **Gate Source** and the **Periodic Sync Src** menus. For these reasons the trigger settings commands are not qualified with the measurement name, the way the trigger source commands are.

Trigger Setup Parameters:

The following examples show trigger setup parameters using an external trigger source.

Example 1 illustrates the trigger conditions with negative slope and no trigger occurs during trigger Holdoff time.

Example 2 illustrates the trigger conditions with positive slope, trigger delay, and auto trigger time.



Remote Command	Swept SA and RTSA measurements:
	`:TRIGger[:SEQuence]:SOURce EXTernal1 | EXTernal2 | EXTernal3 | IMMediate | LINE | FRAMe | RFBurst | VIDeo | TV | PXI | INTernal`
	`:TRIGger[:SEQuence]:SOURce?`
	All other measurements
	`:TRIGger:<measurement>[:SEQuence]:SOURce EXTernal1 | EXTernal2 | EXTernal3 | AEXTernal | IMMediate | LEVel | FMT | LINE | ADC | FRAMe | RFBurst | VIDeo | IQMag | IDEMod | QDEMod | IINPut | QINPut | AIQMag | PXI | INTernal | PRTChandet | PRTFrame | PRTEvent`
	`:TRIGger:<measurement>[:SEQuence]:SOURce?`

Example	The following commands set the External 1 trigger input for various measurements
	Swept SA and RTSA measurements:
	`:TRIG:SOUR EXT1`
	Other Spectrum Analyzer Mode measurements:
	Harmonics:
	`:TRIG:HARM:SOUR EXT1`
	Power Suite measurements (appear in many Modes):
	Channel Power:
	`:TRIG:CHP:SOUR EXT1`
	Occupied BW, Output Spectrum BW:
	`:TRIG:OBW:SOUR EXT1`

Notes	For some of the trigger parameters, the tie-in to the parameter is not obvious. These are: `IMMediate`, selects Free Run `FRAMe` , selects Periodic Trigger `FMT`, selects Frequency Mask Trigger `AEXTernal`, selects Audio External trigger, using the TRIG IN connector on the M9260A Audio Analyzer module For most measurements, the `<measurement>` keyword follows `TRIGger`. For Swept SA and RTSA Modes, do *not* use the `<measurement>` keyword. Using the wrong command form will result in an Undefined Header error Other trigger-related commands are found in the `:INITiate` and `:ABORt` SCPI command subsystems `*OPC` should be used after requesting data. This will hold off any subsequent changes to the selected trigger source, until after the sweep is completed and the data is returned Available ranges and presets can vary from mode to mode **FMT (Pulse and RTSA apps):** The amplitude resolution of the Frequency Mask is coupled to the Scale/Division. There are 256 vertical points therefore the amplitude resolution is computed using the algorithm: (10 * Scale/Div) / # Vertical Points

Dependencies	Not all trigger sources are available for each input. See the "RF Trigger Source (Remote Command Only)" on page 2622 and "I/Q Trigger Source (Remote Command Only)" on page 2624 commands for detailed information on which trigger sources are available for each input
	In some models, there is no second External input. In these models, the External 2 selection is not shown and the `EXTernal2` parameter will generate a "Hardware missing; Not available for this model number" message
	`EXTernal3` is available only when Option H1G is installed
	For the E7760 the only available selections are:
	`EXTernal1|IMMediate|INTernal|RFBurst|VIDeo`
	For UXM the only available selections are:
	`EXTernal1|IMMediate|PRTChandet|PRTFrame|PRTEvent`
	In the Pulse app, when Option B2X and H1G are installed and Digital IF BW is greater than 255.176 MHz, only three trigger sources, `IMMediate`, `LEVel`, and `EXTernal3` are available
	Level Trigger (Pulse and RTSA apps):
	Level trigger is allowed in average detector mode
	When Level Trigger is the selected Trigger Source in the Spectrum measurement, Spectrum minimum Acquisition Time is limited to the PVT minimum Acquisition Time. If the Spectrum Acquisition Time changed as a result of going into Level Trigger, a message is posted "Min Acq Time is 200 usec when Level Trigger is ON". When Level Trigger is no longer the selected Trigger Source, Spectrum minimum Acquisition Time is restored
	FMT (Pulse and RTSA apps):
	If you were not in Free Run when you entered the FMT Setup View, you can change Trigger Source to Free Run while in the editor. This will allow you to configure the mask with a continually updating trace. When exiting FMT Setup View, the Trigger Source will be changed back to FMT

	For Power Stat CCDF and IQ Waveform in 5G NR and LTEATDD, switching the radio direction changes this parameter to the preset value
	In Transmit On|Off Power in 5G NR and LTEATDD, the value changes as follows
	– If changed to uplink: Periodic
	– If changed to downlink: External 1 except for models with the H1G option. With the H1G option, it changes as follows
	  – External 1, when Info BW ≤ 255 MHz
	  – External 3, when Info BW ≥ 256 MHz

Couplings	**FMT (Pulse and RTSA apps):** A remote user can enter or access FMT data via `:TRIGger[:SEQuence]:FMT[1]|2:DATA` The upper and lower masks can have different freq/ampl pairs therefore subop code 1 is for the upper mask and subop code 2 is for the lower mask
Preset	See "Trigger Source Presets" below
Status Bits/OPC dependencies	The Status Operation Register bit 5 "Waiting for Trigger" is set at the same time as the Sweeping or Measuring bit is set. It is cleared when the trigger actually occurs (that is, after the trigger event occurs and all the applicable trigger criteria have been met). A corresponding pop-up message ("Waiting for trigger") is generated if no trigger signal appears after approximately 2 sec. This message goes away when a trigger signal appears

Trigger Source Presets

The following Trigger Source presets are used for these measurements after a Mode Preset or Meas Preset:

Meas	Mode	Preset for RF	Preset for IQ
Swept SA	`SA`	`IMM`	IQ not supported
CHP	`SA, WCDMA, MSR,SRCOMMS, 5GNR, WLAN`	`IMM`	IQ not supported
OBW	`SA, WCDMA, LTEAFDD, LTEATDD, BT, 5GNR, WLAN`	1xEVDO: `EXT1` Others: `IMM`	IQ not supported
Transmit Analysis	`BT`	`RFB`	`IQM`
Adjacent Channel Power	`BT`	`IMM`	IQ not supported
LE In-band Emissions	`BT`	`IMM`	IQ not supported
EDR In-band Spurious Emissions	`BT`	RF Burst	IQ not supported
CCDF	`SA, WCDMA, LTEAFDD, LTEATDD, MSR,SRCOMMS, 5GNR, WLAN, CQM`	LTEATDD:	LTEATDD: - BTS: `EXT1`

Meas	Mode	Preset for RF	Preset for IQ
		– BTS: External 1 – MS: Periodic Timer Others: IMM	- MS: FRAM Others: IMM
ACP	SA, WCDMA, LTEAFDD, LTEATDD, MSR,SRCOMMS, 5GNR	IMM	IQ not supported
Tx Power	SA, GSM	RFBurst	IMM
SPUR	SA, WCDMA, MSR, LTEAFDD, LTEATDD, 5GNR, WLAN	IMM	IQ not supported
SEM	SA, WCDMA, MSR, LTEAFDD, LTEATDD, SRCOMMS, 5G NR, WLAN	IMM	IQ not supported
CDP	WCDMA	IMM	IMM
RHO	WCDMA	IMM	IMM
PCON	WCDMA	IMM	IMM
QPSK	WCDMA	EXT1	IMM
MON	All except: SA, BASIC	IMM	IQ not supported
WAV	All except: SA	LTEATDD: – BTS: External 1 – MS: Periodic Timer GSM/EDGE: RFBurst All others: IMM	LTEATDD: - BTS: EXT1 - MS: FRAM GSM/EDGE: IQM All others: IMM
EVM	LTEAFDD, LTEATDD, SRCOMMS, 5GNR, WLAN	IMM	IMM
PVT	WLAN	RFB	IQ not supported
Spectral Flatness	WLAN	IMM	IMM
SPEC	BASIC	IMM	IMM
LOG Plot	PN	IMM	IQ not supported
Spot Freq	PN	IMM	IQ not supported
GMSK PVT	EDGE/GSM	RFB	IMM
GMSK PFER	EDGE/GSM	RFB	IQM
GMSK ORFS	EDGE/GSM	RFB	IQ not supported
EDGE PVT	EDGE/GSM	RFB	IMM

Meas	Mode	Preset for RF	Preset for IQ
EDGE EVM	EDGE/GSM	RFB	IQM
EDGE ORFS	EDGE/GSM	Periodic Timer	IQ not supported
Combined WCDMA	WCDMA	IMM	IQ not supported
Combined GSM	EDGE/GSM	RFB	IQ not supported
List Power Step	WCDMA, EDGE/GSM	IMM	IQ not supported
Transmit On/Off Power	LTETDD, LTEATDD, 5GNR	BTS: External 1 (External3 when IFBW ≥ 256 MHz with H1G option) MS: Periodic Timer	BTS: EXT1 MS: FRAM
Transmit Analysis	BLUETOOTH	RFB	IQ not supported
Adjacent Channel Power	BLUETOOTH	IMM	IQ not supported
LE In-band Emissions	BLUETOOTH	IMM	IQ not supported
EDR In-band Spurious Emissions	BLUETOOTH	Periodic Timer	IQ not supported
Conformance EVM	LTEAFDD, LTEATDD, MSR	IMM	IMM
Spectrum & PvT	RTSA	IMM	IQ not supported
Pulse	PULSEX	IMM	IQ not supported
AM, FM, PM, FM Stereo	ADEMOD	IMM	IQ not supported
PAvT	SA, 5GNR, VMA	IMM	IMM
Group Delay	CQM	IMM	IMM

RF Trigger Source (Remote Command Only)

Selects the trigger to be used for the specified measurement when RF is the selected input. The RF trigger source can be queried and changed even while another input is selected, but it is inactive until RF becomes the selected input.

Note the inclusion of the <measurement> parameter in the command below. Because each measurement remembers its own Trigger Source, the command must be qualified with the measurement name. Note that for the Swept SA measurement this is not the case; for backwards compatibility, no <measurement> parameter is used when setting the Trigger Source for the Swept SA measurement.

Remote Command	`:TRIGger:<measurement>[:SEQuence]:RF:SOURce EXTernal1 | EXTernal2 | IMMediate | LEVel | FMT | LINE | FRAMe | RFBurst | VIDeo | IF | TV | PXI | INTernal | PRTChandet | PRTFrame | PRTEvent`
	`:TRIGger:<measurement>[:SEQuence]:RF:SOURce?`
	Note that the available parameters are model number and hardware dependent

Example	Select the external 1 trigger input for the ACP measurement and the RF input:
	`:TRIG:ACP:RF:SOUR EXT1`
	Select video triggering for the `SANalyzer` measurement and the RF input. For `SAN`, do not use the `<measurement>` keyword:
	`:TRIG:RF:SOUR VID`

Notes	Not all measurements have all the trigger sources available to them. Check the trigger source documentation for your specific measurement to see what sources are available Note that not all trigger sources are available for each input, and that the available parameters are model number and hardware dependent For the **RF Trigger Source,** the following trigger sources are available:

`IMMediate`	free run triggering
`VIDeo`	triggers on the video signal level
`LEVel`	triggers on the video signal level with time qualified triggering
`FMT`	triggers on the amplitude spectrum with frequency mask triggering
`LINE`	triggers on the power line signal
`EXTernal1` or `EXTernal`	triggers on an externally connected trigger source marked “Trigger 1 In” on the rear panel of standalone instruments, “Trigger 3” on the front panel of EXM and VXT model M9421A, and “Trigger 1” on the front panel of VXT models M9410A/11A/15A/16A
`EXTernal2`	triggers on an externally connected trigger source marked “Trigger 2 In” on the front panel of standalone instruments, and “Trigger 1” on the front panel of EXM and VXT model M9421A, and “Trigger 2” on the front panel of VXT models M9410A/11A/15A/16A. In some models, there is no second External input. In these models, the External 2 selection is not shown and the `EXTernal2` parameter will generate a “Hardware missing; Not available for this model number” message
`RFBurst`	triggers on the bursted frame
`FRAMe`	triggers on the periodic timer
`IF` (video)	same as video, for backwards compatibility only
`PRTChandet`	triggers on Base Station Emulation detecting a valid UL signal (PUSCH/PUCCH/PRACH/SRS)

	`PRTFrame`	triggers on the Base Station Emulation periodic technology format radio frame with data frame aligned to the BSE timing
	`PRTEvent`	triggers on the Base Station Emulation events
	`INTernal`	triggers on the internal source trigger output, for models with an internal source such as VXT
	`PXI` trigger	only supported in PXI (modular) instruments
	`*OPC` should be used after requesting data. This will hold off any subsequent changes to the selected trigger source, until after the sweep is completed and the data is returned Available ranges, and presets can vary from mode to mode	
Dependencies	The available choices for VXT are: Free Run, Video, Internal, External 1, External 2, RF Burst, Periodic and PXI In VXT, Internal is only in VXT models M9410A/11A/15A/16A, not in models M9420/21A, and Internal and Periodic are not available in Spectrum Analyzer Mode `PXI` is only found in VXT The available choices for EXM are Free Run, Video, Internal, External 1, External 2, RF Burst, and Periodic The available choices for UXM are Free Run, External 1, Prot Channel Detection, Prot Frame Aligned, and Prot Event Prot Channel Detection, Prot Frame Aligned, and Prot Event are only available in UXM The available choices for E7760 are Free Run, External 1, Internal, Video and RF Burst In some models, there is no second External input. In these models, the External 2 selection is not shown and the `EXTernal2` parameter will generate a “Hardware missing; Not available for this model number” error	
Status Bits/OPC dependencies	The Status Operation Register bit 5 "Waiting for Trigger" is set at the same time as the Sweeping or Measuring bit is set. It is cleared when the trigger actually occurs (that is, after the trigger event occurs and all the applicable trigger criteria have been met). A corresponding pop-up message ("Waiting for trigger") is generated if no trigger signal appears after approximately 2 seconds. This message goes away when a trigger signal appears	

I/Q Trigger Source (Remote Command Only)

Selects the trigger to be used for the specified measurement when I/Q (which requires option BBA) is the selected input. The I/Q trigger source can be queried and changed even while another input is selected, but it is inactive until I/Q becomes the selected input.

Remote Command	`:TRIGger:<measurement>[:SEQuence]:IQ:SOURce EXTernal1 | EXTernal2 | IMMediate | IQMag | IDEMod | QDEMod | IINPut | QINPut | AIQMag` `:TRIGger:<measurement>[:SEQuence]:IQ:SOURce?`
Example	`:TRIG:WAVeform:SOUR IQM` Selects I/Q magnitude triggering for the IQ Waveform measurement and the I/Q input

Notes	Not all measurements have all the trigger sources available to them. Check the trigger source documentation for your specific measurement to see what sources are available Note that not all trigger sources are available for each input, and that the available parameters are model number and hardware dependent For the **I/Q Trigger Source,** the following trigger sources are available: `IMMediate` — free run triggering `EXTernal1` or EXTernal — triggers on an externally connected trigger source on the rear panel `EXTernal2` — triggers on an externally connected trigger source on the front panel `IQMag` — triggers on the magnitude of the I/Q signal `IDEMod` — triggers on the I/Q signal's demodulated I voltage `QDEMod` — triggers on the I/Q signal's demodulated Q voltage `IINPut` — triggers on the I channel's ADC voltage `QINPut` — triggers on the Q channel's ADC voltage `AIQMag` — triggers on the magnitude of the auxiliary receiver channel I/Q signal `*OPC` should be used after requesting data. This will hold off any subsequent changes to the selected trigger source, until after the sweep is completed and the data is returned Available ranges, and from mode-to-mode presets can vary
Status Bits/OPC dependencies	The Status Operation Register bit 5 "Waiting for Trigger" is set at the same time as the Sweeping or Measuring bit is set. It is cleared when the trigger actually occurs (that is, after the trigger event occurs and all the applicable trigger criteria have been met). A corresponding pop-up message ("Waiting for trigger") is generated if no trigger signal appears after approximately 2 sec. This message goes away when a trigger signal appears

8.1.1.1 Free Run

Free Run triggering occurs immediately after the sweep/measurement is initiated.

Example	Swept SA measurement:
	`:TRIG:SOUR IMM`
	Measurements other than Swept SA:
	`:TRIG:<meas>:SOUR IMM`

Annunciation	Free Run (in the Meas Bar)

8.1.1.2 Video/ADC

The Video trigger condition is met when the video signal at the left edge of the graticule (the filtered and detected version of the input signal, including both RBW and VBW filtering) crosses the video trigger level with the chosen slope.

The Video trigger level is shown as a labeled line on the display. The line is displayed as long as Video is the selected trigger source. The Trigger Level line can be adjusted using the step keys, knob, or numeric keypad. It can also be dragged on the display with your finger or with a mouse.

When the detector selected for all active traces is the average detector, the video signal for triggering does not include any VBW filtering.

Log Plot and Spot Frequency measurements, in the Phase Noise Mode, do not support Video Trigger.

The **Trigger** tab contains the following Trigger Source dependent controls when Video Trigger is selected:

– "Prot Frame Aligned" on page 2639

– "Trigger Delay" on page 2642

– "Trigger Slope" on page 2646

Additional controls are also present, which are not dependent on the selected Trigger Source.

Note that Video Trigger is a software trigger of the acquired trace for some measurements and a hardware trigger of the IF envelope for others. Most measurements support one method or the other, although some (like ACP) don't support Video Trigger at all. For those measurements that support Video Trigger as a software trigger, the Trigger Level units will be dependent on the current Y Axis Unit for the measurement; for those that support Video Trigger as an IF Envelope trigger, the units are typically in dBm.

Example	Swept SA measurement:
	`:TRIG:SOUR VID`
	Measurements other than Swept SA:
	`:TRIG:<meas>:SOUR VID`

Annunciation	Video (in the Meas Bar)

8.1.1.3 ADC Trigger

Some IF Paths in certain models (like N9042B) in IQ Measurements have an ADC trigger. ADC is like the Video trigger, but with 2 limitations due to a lack of post-processing.

First, the trigger is not limited to the current measurement's setup IF BW. The trigger sees everything in the passband, so measurements like IQA Complex Spectrum can be triggered outside of the current Digital IF BW.

The final limitation is, due to lack of post-processing, the amplitude accuracy of the ADC trigger is less than the video trigger.

If ADC trigger is available for at least one IF Path on a model, then the ADC trigger will always be seen as a trigger option in IQ Measurements. However, it will only be available (not grayed out) to select when using IF Paths that support it.

If Video Trigger is selected and measurement setup (IF Path or IF BW) is changed to a path that only supports the ADC trigger instead, then ADC trigger will be selected and *vice versa*.

Example	Measurements other than Swept SA: `:TRIG:<meas>:SOUR ADC`
Annunciation	ADC (in the Meas Bar)

8.1.1.4 Line

When **Line** is selected, start of a new sweep/measurement will be synchronized with the next cycle of the line voltage.

Line trigger is not available when operating from a "dc power source", for example, when the instrument is powered from batteries.

Line trigger is not available when using modular instruments like the VXT.

The **Trigger** tab contains the following Trigger Source dependent controls when **Line** Trigger is selected:

– "Trigger Delay" on page 2642

– "Trigger Slope" on page 2646

Additional controls are also present that are not dependent on the selected Trigger Source.

Example	`:TRIG:SOUR LINE`
	Swept SA measurement
	`:TRIG:<meas>:SOUR LINE`
	Measurements other than Swept SA

Annunciation	LINE (in the Meas Bar)

8.1.1.5 External 1

When **External 1** is selected, a new sweep/measurement starts when the external trigger condition is met using the TRIGGER 1 IN input connector on the rear panel.

Grayed-out if Ext 1 is in use by Point Trigger in the Source Setup menu of Swept SA. Forced to "Free Run" on page 2625 if already selected and Point Trigger is set to External 1.

The **Trigger** tab contains the following Trigger Source dependent controls when External 1 Trigger is selected:

- "Prot Frame Aligned" on page 2639
- "Trigger Delay" on page 2642
- "Trigger Slope" on page 2646

Additional controls are also present that are not dependent on the selected Trigger Source.

Example	`:TRIG:SOUR EXT1`
	Swept SA measurement
	`:TRIG:<meas>:SOUR EXT1`
	Measurements other than Swept SA

Annunciation	External 1 (in the Meas Bar)

8.1.1.6 External 2

When **External 2** is selected, a new sweep/measurement starts when the external trigger condition is met using the TRIGGER 2 IN input connector on the rear panel.

Grayed-out if Ext 2 is in use by Point Trigger in the Source Setup menu of Swept SA. Forced to "Free Run" on page 2625 if already selected and Point Trigger is set to External 2.

The **Trigger** tab contains the following Trigger Source dependent controls when External 2 Trigger is selected:

- "Prot Frame Aligned" on page 2639
- "Trigger Delay" on page 2642
- "Trigger Slope" on page 2646

Additional controls are also present that are not dependent on the selected Trigger Source.

Example	`:TRIG:SOUR EXT2`
	Swept SA measurement
	`:TRIG:<meas>:SOUR EXT2`
	Measurements other than Swept SA

Annunciation	External 2 (in the Meas Bar)

8.1.1.7 External 3

When **External 3** is selected, a new sweep/measurement starts when the external trigger condition is met using the TRIGGER 3 IN input connector on the rear panel.

This control only appears in certain instrument and option combinations, as follows.

- For N9042B, selects the Precision External Trigger, but available only when IF Path is 255 MHz or wider. The resolution will be within one sample count of the 4.8 GHz ADC sampling rate for 255 ~ 2 GHz IF Paths, and within one sample count of the 10.2 GHz sampling rate for the 4 GHz IF Path
- For all other instruments, available only if Option H1G is installed. It is only available when the 1 GHz path is chosen, either directly or indirectly; in all other paths it is visible but grayed-out. Direct and indirect selection of the 1 GHz path occurs as follows:
  - **Direct**: Measurements that directly support the 1 GHz path have a 1 GHz selection in the **IF Path** menu in **Meas Setup**
  - **Indirect**: Certain measurements, such as Power Statistics CCDF (`PST`), always choose the widest available path, and so will choose the 1 GHz path if it is available, even if there is no **IF Path** menu for the measurement. **External 3** will be visible when this results in the 1 GHz path being selected, even if there is no control or readout indicating that the 1 GHz path has been selected

For a full list of Modes and measurements that support **External 3**, see "External 3 Support" on page 2615 in the section "Select Trig Source" on page 2612.

When **External 3** is set, and then becomes disabled because you switched away from the 1 GHz path, the Trigger Source selection reverts to the default ("Free Run" on page 2625).

When **External 3** Trigger is selected, the **Trigger** tab displays the following Trigger Source dependent controls:

- "Prot Frame Aligned" on page 2639
- "Trigger Delay" on page 2642
- "Trigger Slope" on page 2646

Additional controls are also present that are not dependent on the selected Trigger Source.

Example	`:TRIG:SPEC:SOUR EXT3` Sets External 3 as the trigger source for the Complex Spectrum measurement
Annunciation	External 3 (in the Meas Bar)

8.1.1.8 Audio External

When **Audio External** is selected, a new sweep/measurement starts when the external trigger condition is met using the TRIG IN input connector on the front panel of the M9260A Audio Analyzer module. This is a TTL level input (not analog) that supports both rising edge and falling edge triggers.

Only appears in modular instruments, and only when the M9260A Audio Analyzer module is installed, such as in M8920A.

The **Trigger** tab contains the following Trigger Source dependent controls when Audio External Trigger is selected:

– "Trigger Delay" on page 2642

– "Trigger Slope" on page 2646

Additional controls are also present that are not dependent on the selected Trigger Source.

Example	`:TRIG:RTES:SOUR AEXT` Sets Audio External as the trigger source for the Radio Test measurement
Annunciation	Audio Ext (in the Meas Bar)

8.1.1.9 RF Burst

When **RF Burst** is selected, a new sweep/measurement starts when an RF burst envelope signal is identified from the signal at the RF Input connector.

In some models, a variety of burst trigger circuitry is available, resulting in various available burst trigger bandwidths. The instrument automatically chooses the appropriate trigger path based on the hardware configuration and other settings of the instrument.

The **Trigger** tab contains the following Trigger Source dependent controls when RF Burst is selected:

– "Trigger Level Absolute/Relative" on page 2647

– "Absolute Trigger Level" on page 2647

– "Relative Trigger Level" on page 2648

– "Trigger Delay" on page 2642

– "Trigger Slope" on page 2646

Additional controls are also present that are not dependent on the selected Trigger Source.

Example	`:TRIG:SOUR RFB`
	Swept SA measurement
	`:TRIG:<meas>:SOUR RFB`
	Measurements other than Swept SA

Annunciation	RF Burst (in the Meas Bar)

8.1.1.10 Periodic

When **Periodic** is selected, the instrument uses a built-in periodic timer signal as the trigger. Trigger occurrences are set by the **Periodic Timer** parameter, which is modified by the **Offset** and Periodic Sync Src.

Use this trigger when there is a periodic signal but no reliable signal on which to trigger. You can synchronize the periodic signal with outside events (using the Periodic Sync Src) to get closer to a reliable trigger signal (see "More Information" on page 2632 below).

If you do not have a sync source selected (`OFF`), then the internal timer will not be synchronized with any external timing events.

The **Trigger** tab contains the following Trigger Source dependent controls when Periodic Trigger is selected:

– "Period" on page 2650
– "Offset" on page 2650
– "Reset Offset Display" on page 2651
– "Sync Source" on page 2652
– "Trigger Delay" on page 2642

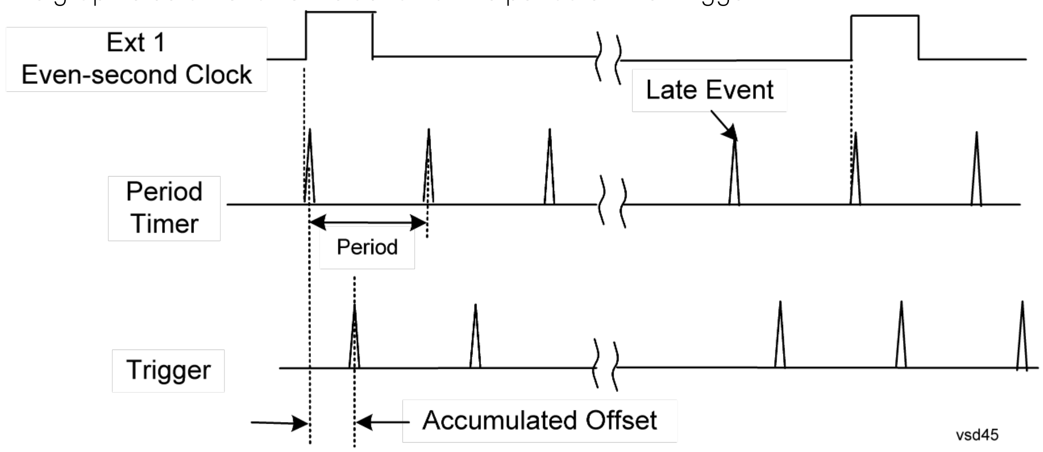
Additional controls are also present that are not dependent on the selected Trigger Source.

Example	`:TRIG:SOUR FRAM`
	Swept SA measurement
	`:TRIG:<meas>:SOUR FRAM`
	Measurements other than Swept SA

Annunciation	Periodic (in the Meas Bar)

More Information

The graphic below shows the action of the periodic timer trigger.



A common application is measuring periodic burst RF signals for which a trigger signal is not easily available. For example, we might be measuring a TDMA radio that bursts every 20 ms. Let's assume that the 20 ms period is very consistent. Let's also assume that we do not have an external trigger source available that is synchronized with the period, and that the signal-to-noise ratio of the signal is not high enough to provide a clean RF burst trigger at all of the analysis frequencies. For example, we might want to measure spurious transmissions at an offset from the carrier that is larger than the bandwidth of the RF burst trigger. In this application, we can set the Periodic Timer to a 20.00 ms period and adjust the offset from that timer to position our trigger just where we want it. If we find that the 20.00 ms is not exactly right, we can adjust the period slightly to minimize the drift between the period timer and the signal to be measured.

A second way to use this feature would be to use **Sync Source** temporarily, instead of **Offset**. In this case, we might tune to the signal in a narrow span and use the RF Burst trigger to synchronize the periodic timer. Then we would turn the sync source off so that it would not miss-trigger. Miss-triggering can occur when we are tuned so far away from the RF burst trigger that it is no longer reliable.

A third example would be to synchronize to a signal that has a reference time element of much longer period than the period of interest. In some CDMA applications, it is useful to look at signals with a short periodicity, by synchronizing that periodicity to the "even-second clock" edge that happens every two seconds. Thus, we could connect the even-second clock trigger to Ext1 and use then Ext1 as the sync source for the periodic timer.

The figure below illustrates this third example. The top trace represents the even-second clock. It causes the periodic timer to synchronize with the leading edge shown. The instrument trigger occurs at a time delayed by the accumulated offset from the period trigger event. The periodic timer continues to run, and triggers continue to occur, with a periodicity determined by the instrument time base. The timer output (labeled "late event") will drift away from its ideal time due to imperfect matching between the time base of the signal being measured and the time base of the instrument, and also because of imperfect setting of the period parameter. But the synchronization is restored on the next even-second clock event. ("Accumulated offset" is described in the in the **Offset** function section.)

8.1.1.11 TV

When **TV** Trigger is selected, a new sweep/measurement starts synchronized with the next occurrence of the synchronizing pulse of the selected TV line number.

TV Trigger is used when triggering on analog TV signals. It is only available in the Swept SA measurement.

The **Trigger** tab contains the following Trigger Source dependent controls when TV Trigger is selected:

- "TV Line" on page 2653
- "Field" on page 2654
- "Standard" on page 2654

Additional controls are also present that are not dependent on the selected Trigger Source.

See "More Information" on page 2633

Example	`:TRIG:SOUR TV`
Annunciation	TV (in the Meas Bar)

More Information

Pressing this key, when it is not selected, selects the TV input signal as the trigger.

Pressing this key, when it is already selected, opens a menu of TV Trigger setup functions. The default active function in this menu is the TV line number on which you want to trigger.

The Frame and Field options enable you to determine how the fields of the TV picture signal will be affected by the trigger system. One complete TV image consists of one frame of 525 or 625 horizontal lines depending on the TV standard being used. Each frame is composed of two fields of interlacing lines, each consisting of 262 1/2 lines (or 312 1/2 lines). The fields are called Field One and

Field Two. Field One is viewed as having 263 lines (or 313 lines) and Field Two is viewed as having 262 lines (or 312 lines).

For the 525-line NTSC video standard, we refer to TV lines as follows (these are the Field Modes):

- Entire Frame, lines 1 to 525
- Field One, lines 1 to 263
- Field Two, lines 1 to 262 (note that this really refers to "actual" lines 264 to 525)

For the 625-line PAL and SECAM video standards, we refer to TV lines as follows:

- Entire Frame, lines 1 to 625
- Field One, lines 1 to 313
- Field Two, lines 314 to 625

As the Field is changed, the appropriate value for Line is chosen to keep triggering on the same line as before, or if this is not possible, the corresponding line in the new Field. For example, suppose line 264 is selected while in the NTSC-M standard and the Entire Frame mode. This is the first line in Field Two. If Field Two is then selected, the Line number changes to Line 1, the same actual line in the TV signal. If Field One is then selected, the line number stays at 1, but now we are triggering in the first line in Field One. The only exception to this is if we are on the last line of Field One and change to Field Two. In this case, we go to the last line in Field Two.

8.1.1.12 I/Q Mag

When **I/Q Mag** is selected, the trigger condition is met when the I/Q magnitude crosses the I/Q magnitude trigger level. The magnitude is measured at the output of the main I/Q digital receiver.

This trigger type is only valid for measurements that support the I/Q inputs.

The **Trigger** tab contains the following Trigger Source dependent controls when I/Q Mag Trigger is selected:

- "Prot Frame Aligned" on page 2639
- "Trigger Delay" on page 2642
- "Trigger Slope" on page 2646

Additional controls are also present that are not dependent on the selected Trigger Source.

Example	`:TRIG:<meas>:SOUR IQM`
Annunciation	I/Q Mag (in the Meas Bar)

8.1.1.13 Input I

When **Input I** is selected, the condition is met when the voltage at the I Input crosses the trigger level.

This trigger type is only valid for measurements that support the I/Q inputs.

The **Trigger** tab contains the following Trigger Source dependent controls when Input I Trigger is selected:

- "Prot Frame Aligned" on page 2639
- "Trigger Delay" on page 2642
- "Trigger Slope" on page 2646

Additional controls are also present that are not dependent on the selected Trigger Source.

Example	`:TRIG:<meas>:SOUR IINP`
Annunciation	Input I (in the Meas Bar)

8.1.1.14 Input Q

When **Input Q** is selected, the condition is met when the voltage at the I Input crosses the trigger level.

This trigger type is only valid for measurements that support the I/Q inputs.

The **Trigger** tab contains the following Trigger Source dependent controls when Input Q Trigger is selected:

- "Prot Frame Aligned" on page 2639
- "Trigger Delay" on page 2642
- "Trigger Slope" on page 2646

Additional controls are also present that are not dependent on the selected Trigger Source.

Example	`:TRIG:<meas>:SOUR QINP`
Annunciation	Input Q (in the Meas Bar)

8.1.1.15 I (Demodulated)

When **I (Demodulated)** is selected, the trigger condition is met when the I voltage crosses the I voltage trigger level.

This trigger type is only valid for measurements that support the I/Q inputs.

The **Trigger** tab contains the following Trigger Source dependent controls when I (Demodulated) Trigger is selected:

– "Prot Frame Aligned" on page 2639

– "Trigger Delay" on page 2642

– "Trigger Slope" on page 2646

Additional controls are also present that are not dependent on the selected Trigger Source.

Example	`:TRIG:<meas>:SOUR IDEM`
Annunciation	I (Demod) (in the Meas Bar)

8.1.1.16 Q (Demodulated)

When **Q (Demodulated)** is selected, the trigger condition is met when the Q voltage crosses the Q voltage trigger level.

This trigger type is only valid for measurements that support the I/Q inputs.

The **Trigger** tab contains the following Trigger Source dependent controls when Q (Demodulated) Trigger is selected:

– "Prot Frame Aligned" on page 2639

– "Trigger Delay" on page 2642

– "Trigger Slope" on page 2646

Additional controls are also present that are not dependent on the selected Trigger Source.

Example	`:TRIG:<meas>:SOUR QDEM`
Annunciation	Q (Demod) (in the Meas Bar)

8.1.1.17 Aux I/Q Mag

When **Aux I/Q Mag** is selected, the trigger condition is met when the auxiliary receiver's I/Q magnitude output crosses the Auxiliary I/Q magnitude trigger level.

This trigger type is only valid for measurements that support the I/Q inputs.

The **Trigger** tab contains the following Trigger Source dependent controls when Aux I/Q Mag Trigger is selected:

– "Prot Frame Aligned" on page 2639
– "Trigger Delay" on page 2642
– "Trigger Slope" on page 2646
– "Trigger Center Frequency" on page 2655
– "Trigger BW" on page 2655

Additional controls are also present that are not dependent on the selected Trigger Source.

Example	`:TRIG:<meas>:SOUR AIQM`
Annunciation	Aux I/Q Mag (in the Meas Bar)

8.1.1.18 PXI

When **PXI** is selected, a new sweep/measurement will start when detecting the signal from the PXI backplane trigger line.

This trigger type is only found in the modular instrument products.

The **Trigger** tab contains the following Trigger Source dependent controls when PXI Trigger is selected:

– "Select PXI Line" on page 2658
– "Trigger Delay" on page 2642
– "Trigger Slope" on page 2646

Additional controls are also present that are not dependent on the selected Trigger Source.

Example	Swept SA measurement: `:TRIG:SOUR PXI`

	Measurements other than Swept SA: `:TRIG:<meas>:SOUR PXI`
Annunciation	PXI (in the Meas Bar)

8.1.1.19 Internal

When **Internal** is selected, the trigger condition is met when detecting the signal from the internal RF Source module.

This trigger type is only found in the modular instrument products.

The **Trigger** tab contains the following Trigger Source dependent controls when Aux I/Q Mag Trigger is selected:

- "Prot Frame Aligned" on page 2639
- "Trigger Delay" on page 2642
- "Trigger Slope" on page 2646

Additional controls are also present that are not dependent on the selected Trigger Source.

For an Internal trigger to occur, there must be a trigger output from the internal RF source. This means that you must configure the Source Trigger Output before selecting Internal as the Trigger Source. To enable the Source Trigger Output, output trigger should not be off if internal source works as list sequence mode and Trig 2 Out should not be off if internal source works as MXG mode. Otherwise, no trigger occurs, and measurement does not start.

Example	Swept SA measurement:
	`:TRIG:SOUR INTernal`
	Measurements other than Swept SA:
	`:TRIG:<meas>:SOUR INTernal`

Annunciation	Internal (in the Meas Bar)

8.1.1.20 Prot Channel Detection

Selects a protocol channel detection Base Station Emulation as the trigger. When Prot Channel Detection is selected, a new sweep/measurement will start when the protocol channel detection trigger condition is met.

Protocol Channel Detection Trigger is defined as the Base Station Emulation protocol channel detection event of PUSCH, PUCCH, PRACH or SRS. With this trigger, the IQ data, and therefore the measurement, is aligned at the beginning of the LTE sub-frame where the particular event was detected. Channel transmission is aligned to the sub-frame boundary; therefore, the measurement is aligned with its transmission with the exception of SRS, which might not start at the beginning of the sub-frame containing the SRS as it might have an offset from the start of the sub-frame base on the SRS configuration, In this case, the trigger and measurement are aligned to the beginning of the sub-frame containing SRS as defined by this trigger type (which is not the beginning of the SRS itself due to the offset).

This trigger type is only available in UXM.

Example	`:TRIG:<meas>:SOUR PRTC`
Annunciation	Prot Chan Det (in the Meas Bar)

8.1.1.21 Prot Frame Aligned

Selects a protocol frame aligned Base Station Emulation as the trigger. When Prot Frame Aligned is selected, a new sweep/measurement will start when the protocol frame aligned data trigger condition is met.

Prot Frame Aligned Trigger is aligned with the Base Station Emulation Protocol uplink frame timing boundary. It depends on the technology format of the base station call processing.

This trigger type is only available in UXM.

Example	`:TRIG:<meas>:SOUR PRTF`
Annunciation	Prot Frame (in the Meas Bar)

8.1.1.22 Prot Event

Selects a protocol frame aligned Base Station Emulation as the trigger. When Prot Frame Aligned is selected, a new sweep/measurement will start when the protocol frame aligned data trigger condition is met.

Prot Event Trigger is defined as the Base Station Emulation protocol internal event such as the starting of a predefined uplink pattern for a relative power control ramp. With this trigger, the IQ data, and therefore the measurement, is aligned with the start of the desired uplink pattern.

This trigger type is only available in UXM.

Example	`:TRIG:<meas>:SOUR PRTF`
Annunciation	Prot Frame (in the Meas Bar)

8.1.2 Trigger Level

Sets the amplitude level for Trigger and Gate sources that use level triggering. When the video signal crosses this level, with the chosen slope, the trigger occurs.

For any given Trigger, Gate, or Periodic Sync Src, the same Trigger Level is used for the Trigger source in the Trigger menu, for the Gate source in the Gate Source menu, and for the Periodic Sync source in the Periodic Sync Src menu.

If **Video** is the selected trigger source, the trigger level displays as a green horizontal line with the label TRIG LVL just above it on the right:

If the value of trigger level is off screen low this line displays along the bottom of the graticule. If the value of trigger level is off screen high this line displays above the graticule but no farther above than 1.5 % of the graticule height (the same as the trace itself). Note that the TRIG LVL label cannot display above the graticule so the label itself stops at the top of the graticule.

For the I/Q Triggers, the I/Q reference impedance is used for converting between power and voltage.

Trigger Level Parameters

Source	Example	Min	Max	Preset	Resolution	Step Key Incr	Knob Incr
Video	`TRIG:VID:LEV -40 dBm`	-170 dBm	+30 dBm	-25 dBm	.01 dB	Scale/Div (Log), 1 dB (Lin)	Step/10, but never < 0.1 dB
Level	`TRIG:LEV:LEV -40 dBm`	-170 dBm	+30 dBm	-25 dBm	.01 dB	Scale/Div (Log), 1 dB (Lin)	Step/10, but never < 0.1 dB
External 1|2	`TRIG:EXT1:LEV 0.4 V`	-5 V VXT models M9410A/11A/15A/16A: 0 V	5 V VXT models M9410A/11A/15A/16A: 2.5 V	1.2 V	10 mV	0.5 V	0.1 V
I/Q Mag	`TRIG:IQM:LEV -30 dBm`	-200 dBm	100 dBm	-25 dBm	.1 dB	Scale/Div (Log),	Step/10, but

Source	Example	Min	Max	Preset	Resolution	Step Key Incr	Knob Incr
						1 dB (Lin)	never < 0.1 dB
I (Demod)	`TRIG:IDEM:LEV 0.5 V`	-1 V	1 V	0.25 V	4 significant digits	Scale/Div	Step/100, but never < 1 µV
Q (Demod)	`TRIG:QDEM:LEV 0.5 V`	-1 V	1 V	0.25 V	4 significant digits	Scale/Div	Step/100, but never < 1 µV
Input I	`TRIG:IINP:LEV 0.5 V`	-1 V	1 V	0.25 V	4 significant digits	Scale/Div	Step/100, but never < 1 µV
Input Q	`TRIG:QINP:LEV 0.5 V`	-1 V	1 V	0.25 V	4 significant digits	Scale/Div	Step/100, but never < 1 µV
Aux Chan I/Q Mag	`TRIG:AIQM:LEV -30 dBm`	-200 dBm	100 dBm	-25 dBm	.1 dB	Scale/Div (Log), 1 dB (Lin)	Step/10, but never < 0.1 dB
Internal	`TRIG:INT:LEV 1.2 V`	-5 V VXT models M9410A/11A/15A/16A: 0 V	5 V VXT models M9410A/11A/15A/16A: 2.5 V	1.2 V	10 mV	.5 V	.1 V
ADC	`TRIG:ADC:LEV -30 dBm`	-170 dBm	30 dBm	-25 dBm	.01 dB	Scale/Div (Log), 1 dB (Lin)	Step/10, but never < 0.1 dB

More Information

For Video Trigger Level, when sweep type = FFT, the video trigger uses the amplitude envelope in a bandwidth wider than the FFT width as a trigger source. This can be useful but does not have the same relationship between the displayed trace and the trigger level as in swept triggering.

For Video Trigger Level the settable resolution of the function is 0.01 dB, even when the Y Axis Unit is linear. In Linear Y Axis Unit (for example, Volts) this requires 4 significant digits to display on the control.

For the Level trigger source, used in RTSA and other measurements, External Gain and Ref Level Offset modify the actual trace data as it is taken and are taken into account by Trig Level.

Remote Command	`:TRIGger[:SEQuence]:<trig_source>:LEVel <ampl>`
	`:TRIGger[:SEQuence]:<trig_source>:LEVel?`
	where `<trig_source>` is one of:
	`EXTernal1 | EXTernal2 | EXTernal3 | VIDeo | ADC | LEVel | IQMag | IDEMod | QDEMod | IINPut | QINPut | AIQMag | INTernal`

Example	`:TRIG:VID:LEV -40 dBm`
Dependencies	Only appears when Video, External 1|2, or an I/Q trigger is selected as the Trigger Source
State Saved	Saved in instrument state

Backwards Compatibility SCPI	`:TRIGger[:SEQuence]:IF:LEVel`
	taken as video trigger level
	`:TRIGger[:SEQuence]:IF:LEVel?`
	taken as video trigger level query
	`:TRIGger[:SEQuence]:EXTernal:LEVel`
	the parameter EXTernal is mapped to EXTernal1
	`:TRIGger[:SEQuence]:FRAMe:EXTernal1:LEVel`

8.1.3 Trigger Delay

Controls a time delay that the instrument will wait to begin a sweep after meeting the trigger criteria, for Trigger and Gate sources that support Trigger Delay.

For any given Trigger, Gate, or Periodic Sync source, the same Trigger Delay is used for the Trigger source in the Trigger menu, for the Gate source in the Gate Source menu, and for the Periodic Sync source in the Periodic Sync Src menu.

Negative trigger delays can be used. Negative trigger delay makes intuitive sense in time domain and works well in FFT mode where the bandwidth of the filter before the video trigger is about 1.25 span. You can use negative delay to pre-trigger the instrument in the time domain or FFT, but not in swept spans. Video trigger delay may be set to negative values, in time domain, FFT and even swept, but in swept spans, negative settings of Trig Delay are treated as a zero setting within the internal hardware and the advisory message "Neg. Trig Delay unavailable in Swept Mode, zero delay used." is generated when such a delay is set.

Remote Command	`:TRIGger[:SEQuence]:<trig_source>:DELay <time>`
	`:TRIGger[:SEQuence]:<trig_source>:DELay?`
	where `<trig_source>` is one of:
	LINE | EXTernal1 | EXTernal2 | EXTernal3 | AEXTernal | VIDeo | ADC | RFBurst | FRAMe | LEVel | FMT |

	IQMag | IDEMod | QDEMod | IINPut | QINPut | AIQMag | PXI | INTernal
Example	`:TRIG:VID:DEL:STAT ON` `:TRIG:VID:DEL 100 ms`
Dependencies	Only appears when Video, Line, External 1|2, RF Burst, Periodic Timer or an I/Q trigger is selected as the Trigger Source
Couplings	When FMT Trigger Criteria is `INSIDE` or `OUTSIDE`, FMT Trigger Delay State is forced to `OFF` FMT Trigger Delay MaxValue is dependent on the current AcquisitionTime. The equation is: MaxValue = 2^16 x AcqTime, but never to exceed 70 sec. Ex: In PVT View with a min PVT Acq Time of 200 us, this Trigger Delay MaxValue is 13.26 sec. In RT Spectrum and Spectrogram with a min Acq Time of 100 us, this Trigger Delay MaxValue is 6.55 sec. When the Acq Time is increased, this MaxValue also increases
State Saved	Saved in instrument state
Annotation	Trig Delay (in the Measurement Bar)

Backwards Compatibility Notes	For backward compatibility with VSA/PSA comms apps
	`:TRIGger[:SEQuence]:IF:DELay`
	`:TRIGger[:SEQuence]:DELay`
	The legacy `:TRIGger[:SEQuence]:DELay` command affects the delay for the `VID`, `LINE`, `EXT1`, `EXT2`, and `RFB` triggers

Auto Function

Remote Command	`:TRIGger[:SEQuence]:<trig_source>:DELay:STATe OFF | ON | 0 | 1`
	`:TRIGger[:SEQuence]:<trig_source>:DELay:STATe?`
	where `<trig_source>` is one of:
	`LINE | EXTernal1 | EXTernal2 | EXTernal3 | AEXTernal | VIDeo | ADC | RFBurst | FRAMe | LEVel | FMT | IQMag | IDEMod | QDEMod | IINPut | QINPut | AIQMag | PXI | INTernal`

Preset	`OFF`

Backwards Compatibility Commands

Example	`:TRIG:DEL 1 ms`
Preset	1 us
State Saved	Saved in instrument state

Backwards Compatibility SCPI	`:TRIGger[:SEQuence]:DELay <time>`
	`:TRIGger[:SEQuence]:DELay?`
	`:TRIGger[:SEQuence]:DELay:STATe OFF | ON | 0 | 1`
	`:TRIGger[:SEQuence]:DELay:STATe?`

Example	`:TRIG:OFFS ON` `:TRIG:OFFS -100 ms`

Notes	ESA commands for trigger offset, which allowed you to use a positive or negative delay when in zero span and in a Res BW >= 1 kHz. For ESA compatibility, X-series instruments keep track of this offset and adds it to the Trigger Delay for VIDeo, LINE, EXTernal1 or EXTernal2 whenever the value is sent to the hardware, if in Zero Span and RBW >= 1 kHz
Preset	Off, 0 s
State Saved	Saved in instrument state
Min	-11 s
Max	+11 s
Backwards Compatibility SCPI	`:TRIGger[:SEQuence]:OFFSet <time>` `:TRIGger[:SEQuence]:OFFSet?`

Auto Function

Remote Command	`:TRIGger[:SEQuence]:OFFSet:STATe OFF | ON | 0 | 1` `:TRIGger[:SEQuence]:OFFSet:STATe?`
Preset	`OFF`

Trigger Delay Parameters

Note: in Swept SA, when transitioning from Zero Span to Swept spans, the trigger delay is clipped to -150 ms if it had been longer in Zero Span.

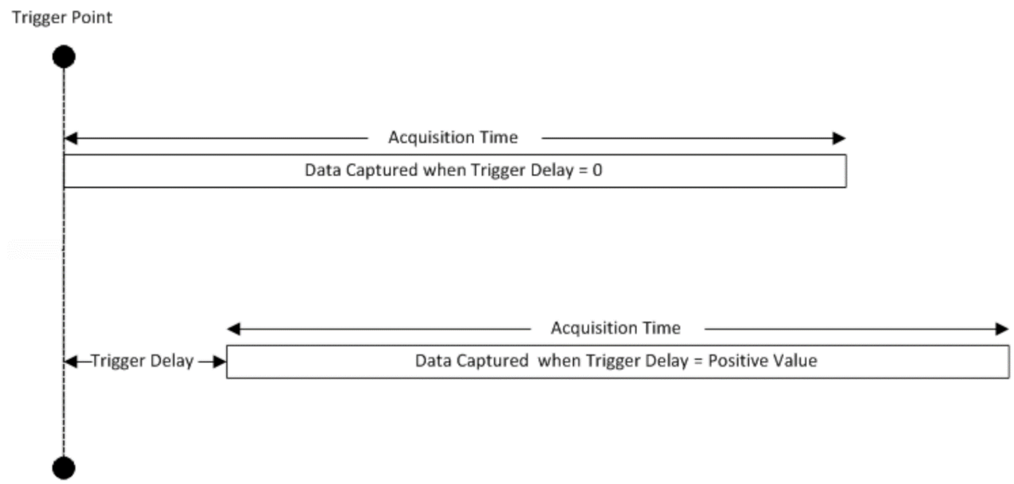
Source	Example	Preset	Min	Max	Resolution
Video	`TRIG:VID:DEL:STAT ON` `TRIG:VID:DEL 100 ms`	Off, 1 us	-150 ms (-10s in Swept SA Zero Span)	+500 ms	100 ns
Level	`TRIG:LEV:DEL:STAT ON` `TRIG:LEV:DEL 100 ms`	Off, 30 ms	0 ms	70 sec (but dependent on Acq Time like FMT)	Multiple of Acq Time (as is FMT)
FMT	`TRIG:FMT:DEL:STAT ON` `TRIG:FMT:DEL 100 ms`	Off, 30 ms	0 ms	70 sec (but dependent on Acq Time like FMT)	Multiple of Acq Time (as is FMT)
External 1|2	`TRIG:EXT1:DEL:STAT ON` `TRIG:EXT2:DEL 100 ms`	Off, 1 us	-150 ms (-10s in Swept SA Zero Span)	+500 ms	100 ns
Line	`TRIG:LINE:DEL:STAT ON` `TRIG:LINE:DEL 100 ms`	Off, 1 us	-150 ms (-10s in Swept SA Zero Span)	+500 ms	100 ns
RF Burst	`TRIG:RFB:DEL:STAT ON`	Off, 1 us	-150 ms	+500 ms	100 ns

Source	Example	Preset	Min	Max	Resolution
	`TRIG:RFB:DEL 100 ms`		(-10s in Swept SA Zero Span)		
Periodic Timer	`TRIG:FRAM:DEL:STAT ON` `TRIG:FRAM:DEL 100 ms`	Off, 1 us	-150 ms (-10s in Swept SA Zero Span)	+500 ms	100 ns
I/Q Mag	`TRIG:IQM:DEL:STAT ON` `TRIG:IQM:DEL 10 ms`	Off, 1 us	-2.5 s	+10 s	10 ns
I (Demod)	`TRIG:IDEM:DEL:STAT ON` `TRIG:IDEM:DEL 10 ms`	Off, 1 us	-2.5 s	+10 s	10 ns
Q (Demod)	`TRIG:QDEM:DEL:STAT ON` `TRIG:QDEM:DEL 10 ms`	Off, 1 us	-2.5 s	+10 s	10 ns
Input I	`TRIG:IINP:DEL:STAT ON` `TRIG:IINP:DEL 10 ms`	Off, 1 us	-2.5 s	+10 s	10 ns
Input Q	`TRIG:QINP:DEL:STAT ON` `TRIG:QINP:DEL 10 ms`	Off, 1 us	-2.5 s	+10 s	10 ns
Aux Chan I/Q Mag	`TRIG:AIQM:DEL:STAT ON` `TRIG:AIQM:DEL 10 ms`	Off, 1 us	-2.5 s	+10 s	10 ns
PXI	`TRIG:PXI:DEL:STAT ON` `TRIG:PXI:DEL 10 ms`	Off, 1 us	-150 ms	+500 ms	100 ns
Internal	`TRIG:INT:DEL:STAT ON` `TRIG:INT:DEL 10 ms`	Off, 1 us	-150 ms	+500 ms	100 ns
Prot Channel Detection	`TRIG:PRTC:DEL:STAT ON` `TRIG:PRTC:DEL 1 ms`	Off, 1 ms	-10 ms	+10 ms	100 ns
Prot Frame Aligned	`TRIG:PRTF:DEL:STAT ON` `TRIG:PRTF:DEL 1 ms`	Off, 1 ms	-10 ms	+10 ms	100 ns
Prot Event	`TRIG:PRTE:DEL:STAT ON` `TRIG:PRTE:DEL 1 ms`	Off, 1 ms	-10 ms	+10 ms	100 ns

Note: in Bluetooth Mode, the preset value of Trigger Delay is always (On, -20us).

More Information

Here is the diagram for Frequency Mask Trigger (FMT) Trigger Delay:



8.1.4 Trigger Slope

Sets the trigger polarity for Trigger and Gate sources that support Trigger Slope. It is set positive to trigger on a rising edge and negative to trigger on a falling edge.

For any given Trigger, Gate, or Periodic Sync source, the same Trigger Slope is used for the Trigger source in the Trigger menu, for the Gate source in the Gate Source menu, and for the Periodic Sync source in the Periodic Sync Src menu.

Remote Command	`:TRIGger[:SEQuence]:<trig_source>:SLOPe POSitive | NEGative`
	`:TRIGger[:SEQuence]:<trig_source>:SLOPe?`
	where `<trig_source>` is one of:
	`LINE | EXTernal1 | EXTernal2 | EXTernal3 | AEXTernal | VIDeo | ADC RFBurst | IQMag | IDEMod | QDEMod | IINPut | QINPut | AIQMag | PXI | INTernal`

Example	`:TRIG:VID:SLOP NEG`
	`:TRIG:VID:SLOP?`
	`:TRIG:EXT1: SLOP NEG`

Dependencies	Only appears when Video, Line, External 1|2, RF Burst or an I/Q trigger is selected as the Trigger Source
Preset	`POSitive`
State Saved	Saved in instrument state

Backwards Compatibility SCPI	`:TRIGger[:SEQuence]:IF:SLOPe NEGative | POSitive`
	`:TRIGger[:SEQuence]:IF:SLOPe?`
	For backward compatibility with VSA/PSA comms apps
	`:TRIGger[:SEQuence]:EXTernal:SLOPe`

	For backward compatibility, the parameter EXTernal is mapped to EXTernal1 :TRIGger[:SEQuence]:FRAMe:EXTernal1:SLOPe :TRIGger[:SEQuence]:FRAMe:EXTernal2:SLOPe

Example	:TRIG:SLOP NEG
Preset	POSitive
State Saved	Saved in instrument state
Backwards Compatibility SCPI	:TRIGger[:SEQuence]:SLOPe POSitive | NEGative :TRIGger[:SEQuence]:SLOPe?

Note: when transitioning from Zero Span to Swept spans, the trigger delay is clipped to -150 ms if it had been longer in Zero Span.

8.1.5 Trigger Level Absolute/Relative

Selects either Absolute or Relative Burst Triggering.

Remote Command	:TRIGger[:SEQuence]:RFBurst:LEVel:TYPE ABSolute | RELative :TRIGger[:SEQuence]:RFBurst:LEVel:TYPE?
Example	Set the trigger level type of the RF burst trigger to Relative: :TRIG:RFB:LEV:TYPE REL
Dependencies	Only appears when RF Burst is selected as the Trigger Source
Preset	ABSolute
State Saved	Saved in instrument state

8.1.6 Absolute Trigger Level

Sets the absolute trigger level for the RF burst envelope.

NOTE **When using the External Mixing path, the Absolute Trigger Level is uncalibrated because the factory default was set to accommodate the expected IF levels for the RF path.**

Remote Command	:TRIGger[:SEQuence]:RFBurst:LEVel:ABSolute <ampl> :TRIGger[:SEQuence]:RFBurst:LEVel:ABSolute?
Example	Set the trigger level of the RF burst envelope signal to the absolute level of 10 dBm: :TRIG:RFB:LEV:ABS 10 dBm
Notes	Sending this command does not switch the setting from relative to absolute; to switch it you need to send :TRIGger[:SEQuence]:RFBurst:LEVel:TYPE For Bluetooth Mode, the default value is -50 dBm

Dependencies	Only appears when RF Burst is selected as the Trigger, Gate or Periodic Sync Source
Couplings	This same level is used for the RF Burst trigger source in the Trigger menu, for the RF Burst selection in the Gate Source menu, and also for the RF Burst selection in the Periodic Sync Src menu
Preset	LTEA FDD/TDD modes: -40 dBm or -50 dBm depending on the hardware 5G NR mode: -40 dBm All other modes: -20 dBm
State Saved	Saved in instrument state
Min	-200 dBm
Max	100 dBm
Backwards Compatibility SCPI	`:TRIGger[:SEQuence]:FRAMe:RFBurst:LEVel:ABSolute`

8.1.7 Relative Trigger Level

Sets the relative trigger level for the RF burst envelope.

In some models, the relative burst trigger function is implemented in hardware. In other models, without the advanced triggering hardware required, the relative burst trigger function is implemented in software in some measurements, and is unavailable in other measurements.

When implemented in software, the relative RF Burst trigger function is implemented as follows:

1. The measurement starts with the absolute RF Burst trigger setting. If it cannot get a trigger with that level, auto trigger fires and the acquisition starts anyway. After the acquisition, the measurement searches for the peak in the acquired waveform and saves it
2. In the next cycle of the measurement, the measurement determines a new absolute RF Burst level based on the peak value from the first measurement and the Relative RF Burst Trigger Level (always 0 or negative dB) set by the user. The following formula is used: absolute RF Burst level = peak level of the previous acquisition + relative RF Burst level
3. If the new absolute RF Burst level differs from the previous by more than 0.5 dB, the new level is sent to the hardware; otherwise, it is not updated (to avoid slowing down the acquisition)

Steps 2 and 3 repeat for subsequent measurements.

Remote Command	`:TRIGger[:SEQuence]:RFBurst:LEVel:RELative <rel_ampl>` `:TRIGger[:SEQuence]:RFBurst:LEVel:RELative?`
Example	Set the trigger level of the RF burst envelope signal to the relative level of -10 dB: `:TRIG:RFB:LEV:REL -10 dB`

Notes	Sending this command does not switch the setting from absolute to relative; to switch it you need to send `:TRIGger[:SEQuence]:RFBurst:LEVel:TYPE` The relative trigger level is not available in some measurements. In those measurements the `RELative` parameter, and `:TRIGger[:SEQuence]:RFBurst:LEVel:TYPE` generates an error if sent
Dependencies	This control is grayed-out and Absolute Trigger Level selected if the required hardware is not present in your instrument and the current measurement does not support Relative triggering Only appears when RF Burst is selected as the Trigger Source
Preset	-6 dB GSM: -25 dB
State Saved	Saved in instrument state
Min	-45 dB
Max	0 dB

Backwards Compatibility SCPI	`:TRIGger[:SEQuence]:RFBurst:LEVel`
	This legacy command is aliased to
	`:TRIGger[:SEQuence]:RFBurst:LEVel:RELative`
	because PSA had *only* relative burst triggering

In some models, a variety of burst trigger circuitry is available, resulting in various available burst trigger bandwidths. The instrument automatically chooses the appropriate trigger path based on the hardware configuration and other settings of the instrument. Here is the RF Burst Trigger Bandwidth table for Swept SA Measurement in SA mode:

Model	Option	Span	Swp Type	FFT Width	Trigger BW, –10 dB	Notes
EXA	any	All	all	all	16 MHz	
MXA	w/o B25	All	all	all	16 MHz	
MXA	B25	Zero	N/A	N/A	16 MHz	
MXA	B25	All	Swept	N/A	16 MHz	
MXA	B25	< 8 MHz	FFT	all	16 MHz	
MXA	B25	≥ 8 MHz	FFT	25 MHz	30 MHz	
PXA	any	all	all	all	> 80 MHz	Exceptions(*)

(*) Exceptions: When the RF Burst Trigger Level Type is Absolute, the start frequency is below 300 MHz, and the sweep type is either Swept or FFT with an FFT width of less than 25 MHz, then the RF Burst Trigger Bandwidth is not >80 MHz. It would be 16 MHz except in the subcase of Sweep Type = FFT and FFT Width between 8 and 25 MHz inclusive, where it would be 30 MHz.

8.1.8 Period

Sets the period of the internal periodic timer clock. For digital communications signals, this is usually set to the frame period of your current input signal. In the case that sync source is not set to OFF, and the external sync source rate is changed for some reason, the periodic timer is synchronized at every external synchronization pulse by resetting the internal state of the timer circuit.

Remote Command	`:TRIGger[:SEQuence]:FRAMe:PERiod <time>` `:TRIGger[:SEQuence]:FRAMe:PERiod?`
Example	`:TRIG:FRAM:PER 100 ms`
Dependencies	The invalid data indicator turns on when the period is changed, until the next sweep/measurement completes Only appears when Periodic Timer is selected as the Trigger or Gate Source
Couplings	The same period is used in the Gate Source selection of the period timer
Preset	20 ms unless noted below: GSM: 4.615383 ms 5G NR: 10 ms
State Saved	Saved in instrument state
Min	100.000 ns
Max	559.0000 ms

8.1.9 Offset

Adjusts the accumulated offset between the periodic timer events and the trigger event. Adjusting the accumulated offset is different than setting an offset and requires explanation.

The periodic timer is usually not synchronized with any external events, so the timing of its output events has no absolute meaning. Since the timing relative to external events (RF signals) is important, you need to be able to adjust (offset) it. However, you have no direct way to see when the periodic timer events occur. All that you can see is the trigger timing. When you want to adjust the trigger timing, you will be changing the internal offset between the periodic timer events and the trigger event. Because the absolute value of that internal offset is unknown, we will just call that the accumulated offset. Whenever the Offset parameter is changed, you are changing that accumulated offset. You can reset the displayed offset using Reset Offset Display. Changing the display does not change the value of the accumulated offset, and you can still make additional changes to accumulated offset.

To avoid ambiguity, we define that an increase in the "offset" parameter, either from the knob or the SCPI adjust command, serves to delay the timing of the trigger event.

Remote Command	`:TRIGger[:SEQuence]:FRAMe:OFFSet <time>` `:TRIGger[:SEQuence]:FRAMe:OFFSet?`
Example	`:TRIG:FRAM:OFFS 1.2 ms`
Notes	The front panel interface (for example, the knob), and this command, adjust the accumulated offset, which is shown on the control However, the actual amount sent to the hardware each time the offset is updated is the delta value, that is, the current accumulated offset value minus the previous accumulated offset value. Note that the accumulated offset value is essentially arbitrary; it represents the accumulated offset from the last time the offset was zeroed (with the Reset Offset Display key) Note that this command does not change the period of the trigger waveform. Note also that Offset is used only when the sync source is set to `OFF`, otherwise delay is used, see "Trigger Delay" on page 2642 An increase in the "offset" parameter, either from the knob or the SCPI adjust command, serves to delay the timing of the trigger event When the SCPI command is sent the value shown on the control is updated with the new value. However, the actual amount sent to the hardware is the delta value, that is, the current accumulated offset value minus the previous accumulated offset value The SCPI query simply returns the value currently showing on the key
Dependencies	The invalid data indicator turns on when the offset is changed, until the next sweep/measurement completes Only appears when Periodic Timer is selected as the Trigger or Gate Source
Couplings	The same offset is used in the Gate Source selection of the period timer
Preset	0 s
State Saved	Saved in instrument state
Min	-10.000 s
Max	10.000 s

8.1.10 Reset Offset Display

Resets the value of the periodic trigger offset display setting to 0.0 seconds. The current displayed trigger location may include an offset value defined with the **Offset** key. Pressing this control redefines the currently displayed trigger location as the new trigger point that is 0.0 s offset. The **Offset** control can then be used to add offset relative to this new timing.

Remote Command	`:TRIGger[:SEQuence]:FRAMe:OFFSet:DISPlay:RESet`
Example	`:TRIG:FRAM:OFFS:DISP:RES`
Dependencies	Only appears when Periodic Timer is selected as the Trigger or Gate Source

8.1.11 Offset Adjust (Remote Command Only)

Lets you advance the phase of the frame trigger by the amount you specify. It does *not* work in the same way as the related front panel keys.

The command does not change the period of the trigger waveform. If the command is sent multiple times, it advances the phase of the frame trigger an additional amount each time it is sent. Negative numbers are permitted.

Remote Command	`:TRIGger[:SEQuence]:FRAMe:ADJust <time>`
Example	`:TRIG:FRAM:ADJ 1.2 ms`
Notes	Note also that Offset is used only when the sync source is set to OFF, otherwise delay is used, see section "Trigger Delay" on page 2642 An increase in the "offset" parameter, either from the knob or the SCPI adjust command, serves to delay the timing of the trigger event The front panel interface (for example, the knob) and the `:TRIG:FRAM:OFFS` command adjust the accumulated offset, which is shown on the active function display. However, the actual amount sent to the hardware is the delta value, that is, the current offset value minus the previous offset value When the SCPI command is sent the value shown on the control (and the Active Function, if this happens to be the active function) is updated by increasing it (or decreasing it if the value sent is negative) by the amount specified in the SCPI command This is no query for this command
Dependencies	The invalid data indicator turns on when the offset is changed, until the next sweep/measurement completes
Couplings	The same offset is used in the Gate Source selection of the period timer
Preset	0 s
State Saved	Saved in instrument state
Min	-10.000 s
Max	10.000 s

8.1.12 Sync Source

For convenience, you can select the Periodic Timer Sync Source using this dropdown. You can also select it from the Periodic Sync Src tab, which also contains controls that let you configure the Sync Source.

Selects a signal source for you to synchronize your periodic timer trigger to, otherwise you might be triggering at some arbitrary location in the frame. Synchronization reduces the precision requirements on the setting of the period.

Example	`:TRIG:FRAM:SYNC EXT1` `:TRIG:FRAM:SYNC EXT2`

	`:TRIG:FRAM:SYNC RFB` `:TRIG:FRAM:SYNC OFF`
Dependencies	Only appears when Periodic Timer is selected as the Trigger or Gate Source
Preset	`OFF`
State Saved	Saved in instrument state

8.1.13 TV Line

Selects the **TV Line** number on which to trigger. Line number range is dependent on the settings of the "Standard" on page 2654 and **"Field" on page 2654**menus within the TV trigger setup functions. When the line number is incremented beyond the upper limit, the value will change to the lower limit and continue incrementing from there. When the line number is decremented below the lower limit, the value will change to the upper limit and continue decrementing from there.

Remote Command	`:TRIGger[:SEQuence]:TV:LINE <integer>` `:TRIGger[:SEQuence]:TV:LINE?`
Example	`:TRIG:TV:LINE 20` `:TRIG:TV:LINE?`
Dependencies	Only available in the Swept SA measurement Only appears when **TV** is selected as the Trigger Source
Preset	17
State Saved	Saved in instrument state
Min	1 The minimum value is the minimum line and rolls over to the maximum value. The minimum line number depends on which Field and standard are selected
Max	The maximum value is the maximum line and rolls over to the minimum value. The maximum line number depends on which Field and standard are selected Field 1 (`ODD`): – Maximum line is 263 for formats NTSC-M, NTSC-Japan, NTSC-4.43, PAL-M and PAL-60 – Maximum line is 313 for formats PAL-B, D, G, H, I, PAL-N, PAL-N Combin, and SECAM-L Field 2 (`EVEN`): – The maximum line 262 for formats NTSC-M, NTSC-Japan, NTSC-4.43, PAL-M and PAL-60 – The maximum line is 312 for formats PAL-B, D, G, H, I, PAL-N, PAL-N Combin, and SECAM-L Field = `ENTire` Frame: – 525, for formats NTSC-M, NTSC-Japan, NTSC-4.43, PAL-M and PAL-60 – 625, for formats PAL-B, D, G, H, I, PAL-N, PAL-N Combin, and SECAM-L

8.1.14 Field

Selects the **Field** on which to trigger:

Entire Frame	`ENTire`	Causes the selected line number to be viewed as an offset into the entire frame starting with line 1, the first line in Field One
Field One	`ODD`	Causes the selected line number to be viewed as an offset into the first field starting with Line 1, the first line in Field One
Field Two	`EVEN`	Causes the selected line number to be viewed as an offset into the second field. If Line 1 is selected, it is the 264th line of the frame (NTSC-M, NTSC-Japan, NTSC-4.43, PAL-M, PAL-60) or the 314th line of the frame (PAL-B,D,G,H,I, PAL-N, PAL-N-Combin, SECAM-L)

Remote Command	`:TRIGger[:SEQuence]:TV:FMODe ENTire | ODD | EVEN` `:TRIGger[:SEQuence]:TV:FMODe?`

Example	`:TRIG:TV:FMOD ENT`
	`:TRIG:TV:FMOD EVEN`
	`:TRIG:TV:FMOD ODD`

Dependencies	Only available in the Swept SA measurement Only appears when TV is selected as the Trigger Source This command is available only when Option B7B (TV trigger) is installed
Preset	`ENTire`
Range	`ENTire|ODD|EVEN`

8.1.15 Standard

Accesses the **Standard** menu keys, which select from the following TV standards:

NTSC-M	`MNTSc`
NTSC-Japan	`JNTSc`
NTSC-4.43	`NTSC443`
PAL-M	`MPAL`
PAL-B,D,G,H,I	`BPAL`
PAL-N	`NPAL`
PAL-N-Combin	`CPAL`
PAL-60	`PAL60`
SECAM-L	`LSEC`

As the TV standard is changed, the current line value is clipped as necessary to keep it valid for the chosen standard and field mode. For example, line 600 is selected in

Entire Frame mode in PAL-N; if NTSC-M is selected, the line number is clipped to 525. Or, if line 313 is selected in Field 1 mode in PAL-N and NTSC-M is selected, the line number is clipped to 263. Changing back to the PAL-N standard will leave the line number at 263.

Remote Command	`:TRIGger[:SEQuence]:TV:STANdard MNTSc | JNTSc | NTSC443 | MPAL | BPAL | NPAL | CPAL | PAL60 | LSEC` `:TRIGger[:SEQuence]:TV:STANdard?`

Example	Sets NTSC-M
	`:TRIG:TV:STAN MNTS`
	Queries Standard
	`:TRIG:TV:STAN?`

Dependencies	Only available in the Swept SA measurement Only appears when **TV** is selected as the Trigger Source
Preset	`MNTS`
State Saved	Saved in instrument state
Range	`MNTSc|JNTSc|NTSC443|MPAL|BPAL|NPAL|CPAL|PAL60|LSEC`

8.1.16 Trigger Center Frequency

Sets the center frequency to be used by the auxiliary receiver for the **Auxiliary Channel I/Q Magnitude** trigger.

Remote Command	`:TRIGger[:SEQuence]:AIQMag:CENTer <freq>` `:TRIGger[:SEQuence]:AIQMag:CENTer?`
Example	`:TRIG:AIQM:CENT 10 MHz`
Notes	Trigger CF + 1/2 Trigger BW < Max Trigger CF - 1/2 Trigger BW > Min
Dependencies	Only appears when Aux Channel I/Q Mag is selected as the Trigger Source
Preset	0 Hz
State Saved	Saved in instrument state
Range	-40 MHz to 40 MHz
Min	-40 MHz
Max	40 MHz

8.1.17 Trigger BW

Sets the information bandwidth used by the auxiliary receiver for the Auxiliary Channel I/Q Magnitude trigger.

Remote Command	`:TRIGger[:SEQuence]:AIQMag:BANDwidth <freq>` `:TRIGger[:SEQuence]:AIQMag:BANDwidth?`
Example	`:TRIG:AIQM:BAND 8 MHz`
Notes	The combined sample rate for the main and auxiliary receivers cannot exceed 100 MSa/sec. The bandwidth available to **Trigger BW** is limited to what is available after the main receiver's bandwidth (Info BW, sometimes pre-FFT BW) is set. Because of this limitation, the Max is not always achievable The combination of "Trigger Center Frequency" on page 2655 and **Trigger BW** is also limited: – Trigger CF + 1/2 Trigger BW < Max – Trigger CF - 1/2 Trigger BW > Min
Dependencies	Only appears when Aux Channel I/Q Mag is selected as the Trigger Source
Preset	Bandwidth option dependent: – No Opt: 10 MHz – Opt B25: 25 MHz – Opt S40: 40 MHz
State Saved	Saved in instrument state
Range	10 Hz to Maximum
Min	10 Hz
Max	Bandwidth option & I/Q input path-dependent: – No Opt, I or Q Only: 10 MHz, I+jQ: 20 MHz – Opt B25, I or Q Only: 25 MHz, I+jQ: 50 MHz – Opt S40, I or Q Only: 40 MHz, I+jQ: 80 MHz

8.1.18 X Axis Relative to Trigger

For triggers that support Trigger Delay, it is beneficial that in time-domain displays (like Zero Span), X-axis values should be referenced to the Trigger point, that is, the zero value on the X Axis should be wherever the trigger point appears on the X Axis (including to the left or right of the X Axis). For negative trigger delays this means the zero point can actually appear on the X Axis.

Traditionally the zero point is at the left edge of the X Axis, and this behavior is retained for backwards compatibility, but if you turn on **X Axis Relative to Trigger**, the zero point moves to the trigger point and all X Axis values change to be relative to the trigger point.

When the **X Axis Relative to Trigger** switch is On, the trigger point on the X-axis will be marked with a vertical line and an annotation of “TRIG”. Additionally, when the switch is ON, values that are tied to the X-axis, such as trace data and markers, will have their X values adjusted to be referenced to the trigger point.

This switch only appears in the Swept SA measurement. It is grayed-out and OFF unless in Zero Span.

Remote Command	`:TRIGger[:SEQuence]:XRELative ON | OFF | 1 | 0` `:TRIGger[:SEQuence]:XRELative?`
Example	`:TRIG:XREL ON`
Notes	Although shown in all **Trigger** menus that have Trig Delay, the function is global to all of them and has the same value in all
Dependencies	Grayed-out unless in **Zero Span**. When grayed-out, shows as **Off**
Preset	OFF
State Saved	Yes

8.1.19 Zero Span Delay Compensation On/Off

In **Zero Span**, there is a natural delay in the signal path, which comes from the RBW filter. This is usually desirable, as it lets you trigger on events and also see those events, because the signal is delayed from the trigger event. However, in some cases it is desirable to eliminate this delay, so that trigger events line up exactly with the zero-time point in **Zero Span**. You can use the **Zero Span Delay Comp On/Off** feature to enable or disable zero span delay compensation.

Remote Command	`:TRIGger[:SEQuence]:EXTernal1|EXTernal2|RFBurst:DELay:COMPensation OFF | ON | 0 | 1` `:TRIGger[:SEQuence]:EXTernal1|EXTernal2|RFBurst:DELay:COMPensation?`

Example	`:TRIG:EXT1:DEL:COMP ON`
	`:TRIG:EXT1:DEL:COMP?`
	`:TRIG:EXT2:DEL:COMP ON`
	`:TRIG:RFB:DEL:COMP ON`

Dependencies	No effect except in zero-span, but not locked out in nonzero spans **Zero Span Delay Compensation** only appears in the Swept SA and List Power Step measurements. Only External and RF Burst triggers support it Does not appear in VXT If the SCPI command is sent when the control is not shown, an error is returned: -221, “Settings conflict; Feature not supported for this measurement” Only appears when External 1|2 or RF Burst is selected as the Trigger, Gate or Periodic Sync Source
Preset	OFF
State Saved	Saved in instrument state

8.1.20 Select PXI Line

Controls which `PXI_TRIG[0..7]` backplane line is used for the trigger source.

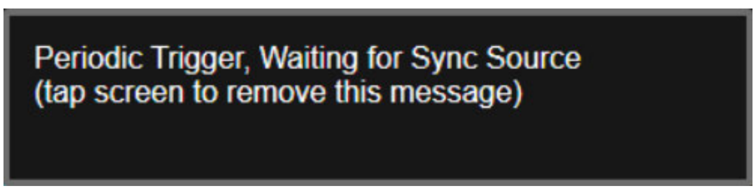
Only found in modular analyzer products.

Remote Command	`:TRIGger[:SEQuence]:PXI:LINE <line>` `:TRIGger[:SEQuence]:PXI:LINE?`
Example	`:TRIG:PXI:LIN 2`
Preset	0
State Saved	Saved in instrument state
Range	[0,7]

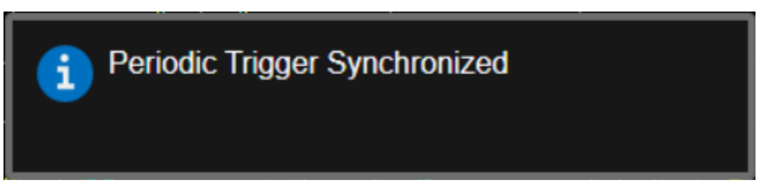
8.1.21 Reset Sync Monitor

Lets you reset the status of Synchronization for **Periodic** trigger This control works together with bit 6 “Waiting for Periodic Sync Source” in the `:STATus:OPERation:CONDition` status register.

When you first switch to periodic trigger, RF Burst is the default Sync Source. The register will be set immediately. A “Periodic Trigger, Waiting for Sync Source” message will be generated after 2 seconds (if the instrument is not synchronized). The system is waiting for a RF Burst signal. You can tap the screen to remove the message.



Once RF burst signal is provided and the hardware synchronized, the register will be cleared and a “Periodic Trigger Synchronized” message will be generated.



When change to a new Sync Source other than Off, take External1 as an example. You’ll get the condition register set to 1 and a pop-up message again. There are the possible following conditions:

- External1 is provided: the register is cleared, message is updated.
- External1 is not provided, you set the Sync Source to Off: the register is cleared, message is cleared.
- External1 is not provided, you set the Sync Source to External2: the register and message keep the same.
- External1 is not provided, you set the Sync Source back to RF Burst: the register is cleared, message is also cleared. That's because the instrument is synchronized to RF Burst already. If you want to make a new synchronization, you have to press "Reset Sync Monitor" you send SCPI command ":TRIG:FRAM:SMON:RES".

Remote Command	`:TRIGger[:SEQuence]:FRAMe:SMONitor:RESet`
Example	`:TRIG:FRAM:SMON:RES`
Notes	This control works together with bit 1 "Waiting for Periodic Sync Source" in the `:STATus:OPERation:INSTrument:CONDition` status register A "Periodic Trigger, Waiting for Sync Source" message will be generated after pressing this control, and the status bit will be set A "Periodic Trigger Synchronized" message will be generated after successfully synchronizing to Sync Source, and the status bit will be cleared
Dependencies	Only functional when Periodic Trigger is selected as the Trigger or Gate Source, and Sync Source is not Off Only available in VXT models M9410A/11A/15A/16A
Status Bits/OPC dependencies	Bit 6 of `:STATus:OPERation:CONDition` will be set after pressing this control

8.1.22 Trigger Optimization

Sets the trigger behavior for various desired operation conditions.

Remote Command	`:TRIGger[:SEQuence]:OPTimize:MODE NORMal | MJITter`
	For option details, see "Options" on page 2660
	`:TRIGger[:SEQuence]:OPTimize:MODE?`

Example	Select trigger optimization for minimum jitter: `:TRIG:OPT:MOD MJIT`
Dependencies	Only appears in VXT models M9410A/11A/15A/16A Minimum jitter is functional only when digital IF BW is lower than 300 MHz. When **Trigger Optimization** is set to `MJITter` and it is not in effect, the following warning message appears in the status bar: `Settings Alert; Minimum Jitter is not available`
Preset	`NORMal`

State Saved	Yes
Range	NORMal|MJITter

Options

Trigger optimization options are:

Trigger Optimization	SCPI	Notes
Normal	NORMal	No optimization
Minimum Jitter	MJITter	Optimizes trigger for minimum jitter. A software resample method is provided to reduce jitter, at the expense of some measurement speed The acquisition jitter depends on the digital IF BW, the jitter will be smaller when digital IF BW gets larger. For example, when the digital IF BW is 98.3 MHz in 5GNR, the jitter varies under 15ns. When set MJITter as trigger optimization type, the jitter will be reduced to 1ns This setting apples to all the Trigger Sources

8.1.23 Trigger Settings Diagram

Lets you configure the **Trigger** system using a visual utility.

First, select what you want to configure (the Trigger, Gate or Periodic Sync Source) by tapping the box for **Trigger**, **Gate** or **Periodic Sync Source**.

Next, tap any box in the gray row to choose a Trigger Source to connect to. For **Periodic Sync Source**, you can also tap **Off**.

The **Trigger Settings Diagram** changes depending on context. The Trigger Sources that are available change depending on which input you have selected.

8.2 Gate Source

Contains controls that let you select and configure Gate control signals.

This tab appears in the **Trigger** menu panel for measurements that support gating. In measurements that do not support gating, this tab does not appear.

The menus under the **Gate Source** tab are the same as those under the **Trigger** tab, with these exceptions:

A smaller set of sources is available for gating.

The Free Run and Video selections are not provided for Gate

- The Trig Delay controls are not present
- Relative RF Burst Triggering is not available, just Absolute
- There is an additional control, Sync Holdoff, under Gate Source

Any changes to the settings in the setup menus under each Gate Source selection (for example: Trigger Level, Trigger Delay, etc.) also affect the corresponding settings under the Trigger menu keys. The gate system uses the Trigger SCPI commands for the setup functions, since each setting affects both Gate and Trigger.

Example: to set the Trigger Level for External 1 Trigger you use the command `:TRIG:EXT1:LEV`; to set the Trigger Level for External 1 Gate you use the same command, `:TRIG:EXT1:LEV`. By the same token, once you set the External 1 Trigger Level to 1v, it is 1v whether External 1 is being used as a Gate Source or a Trigger Source.

If a command is sent to the `TRIG` node to set the functions that are omitted from the **Gate Source** menus (Auto Trig, Holdoff, Trig Delay), it is accepted and the values stored, but the values are not visible from the **Gate Source** menus.

8.2.1 Select Gate Source

Selects the source of the Gate signal for doing Gated Trigger measurements.

This version of the **Select Gate Source** function is used in all measurements except the Pulse measurement application.

For the selection of the gate source the SCPI node, `:TRIGger[:SEQuence]:` is replaced by `[:SENSe]:SWEep:EGATe:` as shown in the remote command below. Because you can independently set the Gate Source and the Trigger Source, there is a separate SCPI command for the Gate Source.

Remote Command	`[:SENSe]:SWEep:EGATe:SOURce EXTernal1 | EXTernal2 | LINE | FRAMe | RFBurst`

	| TV | VIDeo | PXI | INTernal [:SENSe]:SWEep:EGATe:SOURce?
Example	:SWE:EGAT:SOUR EXT1 :SWE:EGAT:SOUR?
Dependencies	Available selections differ depending on models as below Benchtop: Line, External 1, External 2, RF Burst, Periodic, TV (Swept SA only) VXT: Video, Internal, External 1, External 2, RF Burst, Periodic, PXI Internal and Periodic are not available in Spectrum Analyzer Mode – Internal is available only in M9410A/11A/15A/16A and unavailable in M9420/21A EXM: Video, Internal, External 1, External 2, RF Burst, Periodic Not available in E7760 In some models, there is no second External input. In these models, the External 2 selection is not shown and the EXTernal2 parameter will generate a “Hardware missing; Not available for this model number” error
Preset	GSM/EDGE, Phase Noise: FRAM MSR: EXT1 LTEATDD, 5G NR: – Direction is Downlink: EXT1 – Direction is Uplink: FRAM All Others: EXT1

8.2.2 Sync Holdoff

Applies only to the Periodic Timer. Specifies the duration that the sync source signal for the Periodic Timer must be kept false before the transition to true to be recognized as the sync timing. The periodic timer phase is aligned when the sync source signal becomes true, after the Holdoff time is satisfied.

A holdoff of 2 ms works with most WiMAX signals, but there may be cases where the burst off duration is less than 1 ms and this value will need to be changed.

Remote Command	:TRIGger[:SEQuence]:FRAMe:SYNC:HOLDoff <time> :TRIGger[:SEQuence]:FRAMe:SYNC:HOLDoff?
Example	:TRIG:FRAM:SYNC:HOLD 5 :TRIG:FRAM:SYNC:HOLD?
Dependencies	Only appears if **Periodic** is the selected Gate Source Does not appear in all Measurements. For example, does not appear in Swept SA

Preset	LTEATDD: ON, 1 ms 5G NR: ON, 250.0 us 1xEVDO: OFF, 0 ms (SCPI only) Other than above: OFF, 4 msec
State Saved	Saved in instrument state
Min	0 ms
Max	+500 ms

Auto Function

Remote Command	`:TRIGger[:SEQuence]:FRAMe:SYNC:HOLDoff:STATe OFF | ON | 0 | 1` `:TRIGger[:SEQuence]:FRAMe:SYNC:HOLDoff:STATe?`
Preset	LTEATDD, 5G NR: ON Others: OFF

8.3 Gate Settings

Contains controls that let you control the gating function. The Gate functionality is used to view signals best viewed by qualifying them with other events.

This tab appears in the **Trigger** menu panel for measurements that support gating. In measurements that do not support gating, this tab does not appear.

In the Swept SA measurement, the Gate controls, and all SCPI under the `[:SENSe]:SWEep:EGATe` SCPI node are unavailable when Source Mode is set to Tracking. This is because the Gate circuitry is used to sync the external source. If the Tracking Source is turned on, the Gate is turned off.

Gate setup parameters are the same for all measurements – they do not change as you change measurements. Settings like these are called “Meas Global” and are unaffected by Meas Preset.

Note that Sweep Time auto coupling rules and annotation are changed when Gate is on.

8.3.1 Gate On/Off

Turns the gate function on or off.

When the Gate Function is `ON`, the selected Gate Method is used along with the gate settings and the signal at the gate source to control the sweep and video system with the gate signal. Not all measurements allow every type of Gate Methods.

If the Gate were to be turned `ON` without a gate signal present, Marker Count operation would be unreliable, so it is locked out whenever Gate is on for measurements that support Marker Count.

Remote Command	`[:SENSe]:SWEep:EGATe[:STATe] OFF | ON | 0 | 1` `[:SENSe]:SWEep:EGATe[:STATe]?`
Example	`:SWE:EGAT ON` `:SWE:EGAT?`
Dependencies	The function is unavailable (grayed-out) and `OFF` when: – Gate Method is LO or Video and FFT Sweep Type is manually selected – Gate Method is FFT, and Swept Sweep Type is manually selected – Marker Count is ON The following are unavailable whenever Gate is on: – FFT under Sweep Type when Method=LO or Video or Swept under Sweep Type when Method=FFT

	– Marker Count While Gate is on, the Auto Rules for Sweep Type are modified so that the choice agrees with the Gate Method: i.e., FFT for Method = FFT and Swept for Method = LO or Video When in the ACP measurement: – When Meas Method is RBW or FAST, this function is unavailable, and the control is grayed-out – Whenever Gate is on, Meas Method, RBW, or FAST is unavailable and keys for those are grayed-out – When Gate is on, Offset Res BW and Offset Video BW are ignored (if you set these values) and the measurement works as if all Offset Res BW and all Offset Video BW are coupled with the Res BW and the Video BW under the BW menu. When Gate is on, the Offset BW control in the Offset/Limit menu is grayed-out
Preset	LTEATDD Mode: `ON` Other modes: `OFF`
State Saved	Saved in instrument state
Range	`OFF|ON`
Annunciation	Annunciated in the Meas Bar ; if Gate is on, the word "Gate:" followed by the gate type appears, where – LO = Gated LO – Vid = Gated Video – FFT = Gated FFT

Backwards Compatibility SCPI	`[:SENSe]:SWEep:TIME:GATE[:STATe]`
	`Available in SA and SCPILC Modes`
	ESA compatibility

Backwards Compatibility Notes	In ESA, Trig Delay (On) and Gate (On) could not be active at the same time. This dependency does not exist in PSA or in the X-Series

8.3.2 Gate View On/Off

Turning on Gate View puts the instrument into Gate View. When in Gate View, the regular view of the current measurement traces and results are reduced vertically to about 70% of the regular height. The Zero Span window, showing the positions of the Gate, is shown between the Measurement Bar and the reduced measurement window. By reducing the height of the measurement window, some of the annotation on the Data Display may not fit and is not shown.

Remote Command	`[:SENSe]:SWEep:EGATe:VIEW ON | OFF | 1 | 0` `[:SENSe]:SWEep:EGATe:VIEW?`
Example	Turn on the gate view:

	`:SWE:EGAT:VIEW ON`
Dependencies	In the Swept SA measurement: In Gate View, the regular Sweep Time (or Acquisition Time) control is grayed out, to avoid confusing the user who wants to set Gate View Sweep Time. When pressed, the grayed-out control puts up the informational message "Use Gate View Sweep Time in the Gate menu" In other measurements: When you turn Gate View on, the lower window takes on the current state of the instrument. Upon leaving Gate View, the instrument takes on the state of the lower window When you turn Gate View on, the upper window Sweep Time (or Acquisition Time) is set to Gate View Sweep Time (or Gate View Acquisition Time)
Couplings	These couplings apply to the Swept SA measurement: – When Gate View is turned on, the instrument is set to Zero Span – Gate View automatically turns off whenever a Span other than Zero is selected – Gate View automatically turns off if you press the Swept Span toggle under Freq while in Gate View, and the instrument returns to the Span it was in before entering Gate View (even if that is Zero Span) – When Gate View is turned on, the sweep time used is the Gate View Sweep Time. This is set according to the rules in "Gate View Sweep Time" on page 2672 – When Gate View is turned off, Sweep Time is set to the normal Swept SA measurement sweep time – If Gate View is on and Gate is off, then turning on Gate turns off Gate View
Preset	`OFF`
State Saved	Saved in instrument state
Range	`ON|OFF`
Annunciation	For Gate View to work properly, a gate signal must be present at the selected Gate Source. Therefore, in Gate View, any time more than 2 seconds passes with no gate signal, a pop-up message "Waiting for gate input" appears. This message goes away when a gate signal appears

Turning Gate View off returns the instrument to the Normal measurement view.

In Swept SA, the normal measurement view is the single-window Swept SA view. When returning to this view, the Swept SA measurement returns to the Span it was in before entering **Gate View** (even if that is Zero Span).

The **Gate View** window is triggered from the Gate Source, with zero trigger delay. Also, when updating the **Gate View** window, the Gate itself must not operate. So, it is internally shut off while the gate view window is being updated. For the Swept SA measurement, this means that the Gate is internally shut off whenever the gate view window is displayed. The measurement bar and controls continue to show the Trigger source for the main sweep window and give no indication that the Gate is shut off or that the Gate View window is triggered from the Gate Source.

When in **Gate View**, vertical lines are displayed in the Gate View window as follows:

Green lines labeled GATE START and GATE STOP are displayed at the gate edges as follows: in Edge Gate, a line is shown for Delay and one for the end of the Gate period, defined by Length. In Level Gate a line is shown only for Delay. You can adjust the position of the green lines by adjusting the gate length and the gate delay or by dragging them with your finger or the mouse.. These lines update in the Gate View window as the active function changes, even if the window is not being updated. In Gated LO and Gated Video, these lines are positioned relative to the delay reference line (not relative to 0 time). In Gated FFT, their location is relative to the left edge of the screen.

A blue line is displayed showing the delay reference, that is, the reference point for the Gate Delay within the Zero Span window. The blue line represents where (in time) the effective location of the gate start would be if the gate were programmed to zero delay.

- A second blue line is displayed at the location that represents the boundary between "compensated IF" and "compensated LO" operating modes.The second blue line is labeled "MIN FAST" because it represents the minimum Gate Delay for fast Gated LO operation. This line is only displayed in Gated LO. You cannot scroll (knob) or decrement (down key) the Gate Delay to less than that represented by the position of this line, it can only be set below this position manually, although once there it can be moved freely with the knob while below the line.

A yellow line in the Gated Video case only, is displayed at B_{length}, where B_{length} is the display point (bucket) length for the swept trace, which is given by the Sweep Time (or Acquisition Time) for that trace divided by number of Points - 1. So, it is referenced to 0 time, not to the delay reference. This line is labeled NEXT PT (it is not shown in the figure above because the figure above is for Gated LO). The yellow line represents the edge of a display point (bucket). Normally in Gated Video, the bucket length must be selected so that it exceeds the off time of the burst. There is another way to use the instrument in Gated Video measurements, and that is to set the bucket width much shorter than the off time of the burst. Then use the Max Hold trace function to fill in "missing" buckets more slowly. This allows you to see some of the patterns of the Gated Video results earlier, though seeing a completely filled-in spectrum later.

8.3.3 Gate Delay

Controls the length of time from the time the gate condition goes True until the gate is turned on.

Remote Command	`[:SENSe]:SWEep:EGATe:DELay <time>` `[:SENSe]:SWEep:EGATe:DELay?`
Example	`:SWE:EGAT:DELay 500ms` `:SWE:EGAT:DELay?`

Notes	Units of time are required, or no units; otherwise, an invalid suffix error message is generated
Preset	WiMAX OFDMA: 71 us GSM/EDGE: 600 us WLAN: 500 us 5G NR: 5 ms Others: 57.7 us
State Saved	Saved in instrument state
Min	0.0 us
Max	100 s

Backwards Compatibility SCPI	`[:SENSe]:SWEep:TIME:GATE:DELay`
	`This backward compatibility command is available in SA and SCPILC Modes`
	ESA compatibility

8.3.4 Gate Length

Controls the length of time that the gate is on after it opens.

Remote Command	`[:SENSe]:SWEep:EGATe:LENGth <time>` `[:SENSe]:SWEep:EGATe:LENGth?`
Example	`:SWE:EGAT:LENG 1` `:SWE:EGAT:LENG?`
Notes	Units of time are required, or no units; otherwise, an invalid suffix error message is generated
Dependencies	Grayed-out when Gate Method is set to `FFT`, in which case the label changes to that shown below  The control is also grayed-out if Gate Control = `LEVel`
Preset	WiMAX OFDMA: 50 us GSM/EDGE: 200 us WLAN: 1.54 ms Others: 461.6 us
State Saved	Saved in instrument state
Min	100 ns
Max	5 s
Backwards Compatibility SCPI	`[:SENSe]:SWEep:TIME:GATE:LENGth` `This backward compatibility command is available in SA and SCPILC Modes`

	ESA compatibility

8.3.5 Gate Method

Lets you choose one of the three different types of gating. Not all types of gating are available for all measurements.

Remote Command	`[:SENSe]:SWEep:EGATe:METHod LO | VIDeo | FFT`
	For option details, see "LO" on page 2669, "Video" on page 2669 or "FFT" on page 2670
	`[:SENSe]:SWEep:EGATe:METHod?`

Example	`:SWE:EGAT:METH FFT`
Dependencies	This function is only available in the Swept SA measurement in Spectrum Analyzer Mode This control is unavailable when Gate is On and FFT Sweep Type manually selected When selected, Sweep Type is forced to Swept, and the FFT selection in Sweep Type is grayed-out Only the `FFT` method is supported in non-SA products Only the `FFT` method is supported by VXT models M9410A/11A/15A/16A
Preset	`LO`
State Saved	Saved in instrument state
Range	`Video|LO|FFT`
Annunciation	In Meas Bar

LO

In `LO` gating, when Gate is `ON`, the LO sweeps whenever the gate conditions as specified in the Gate menu are satisfied by the signal at the Gate Source.

This form of gating is more sophisticated, and results in faster measurements. With Gated LO, the instrument only sweeps while the gate conditions are satisfied. This means that a sweep could take place over several gate events. It would start when the gate signal goes true and stop when it goes false, and then continue when it goes true again. But since the LO is sweeping as long as the gate conditions are satisfied, the sweep typically finishes much more quickly than with Gated Video.

When in zero span, there is no actual sweep performed. But data is only taken while the gate conditions are satisfied. So even though there is no sweep, the gate settings will impact when data is acquired.

Video

In `Video` gating, when Gate is `ON`, the video signal is allowed to pass through whenever the gate conditions as specified in the Gate menu are satisfied by the signal at the Gate Source.

This form of gating may be thought of as a simple switch, which connects the signal to the input of the spectrum analyzer. When the gate conditions are satisfied, the switch is closed, and when the gate conditions are not satisfied, the switch is open. So we only look at the signal while the gate conditions are satisfied.

With this type of gating, you usually set the instrument to sweep very slowly. In fact, a general rule is to sweep slowly enough that the gate is guaranteed to be closed at least once per data measurement interval (bucket). Then if the peak detector is used, each bucket will represent the peak signal as it looks with the gate closed.

FFT

In `FFT` gating, when Gate is `ON`, an FFT is performed whenever the gate conditions as specified in the Gate menu are satisfied by the signal at the Gate Source. This is an FFT measurement that begins when the gate conditions are satisfied. Since the time period of an FFT is approximately 1.83/RBW, you get a measurement that starts under predefined conditions and takes place over a predefined period. So, in essence, this is a gated measurement. You have limited control over the gate length, but it works in FFT sweeps, which the other two methods do not.

Gated FFT is not possible in zero span since the instrument is not sweeping, so in zero span the Gated LO method is used. Data is still only taken while the gate conditions are satisfied, so the gate settings do impact when data is acquired.

The Gate Length will be 1.83/RBW.

This is a convenient way to make a triggered FFT measurement under control of an external gating signal.

8.3.6 Control Edge/Level

Sets the method of controlling the gating function from the gating signal.

`EDGE`	The gate opens (after the Delay) on the selected edge (for example, positive) of the gate signal and closes on the alternate edge (for example, negative)
`LEVel`	The gate opens (after the Delay) when the gate signal has achieved a certain level and stays open as long as that level is maintained

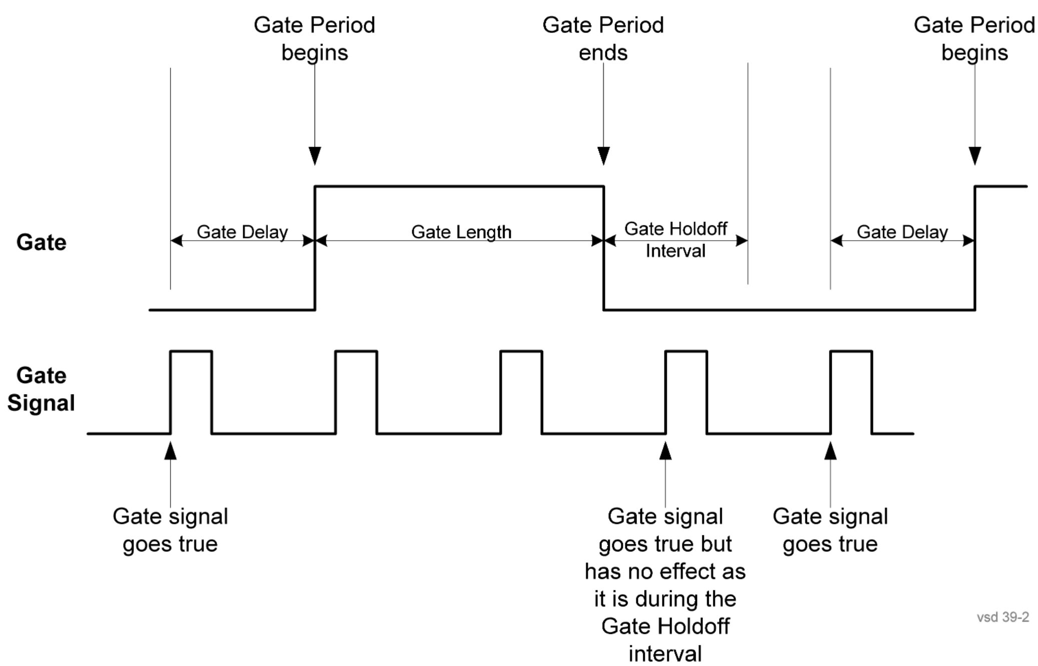
Remote Command	`[:SENSe]:SWEep:EGATe:CONTrol EDGE | LEVel` `[:SENSe]:SWEep:EGATe:CONTrol?`
Example	`:SWE:EGAT:CONT EDGE`
Dependencies	If the Gate Method is `FFT`, this control is grayed-out and `EDGE` is selected If the Gate Source is TV, Frame, or Line, this control is grayed-out and `EDGE` is selected

Preset	EDGE
State Saved	Saved in instrument state
Backwards Compatibility SCPI	[:SENSe]:SWEep:EGATe:TYPE This backwards-compatibility command is available when the primary command is available [:SENSe]:SWEep:TIME:GATE:TYPE This backwards-compatibility command is available in SA and SCPILC Modes ESA Compatibility

8.3.7 Gate Holdoff

Lets you increase or decrease the wait time after a gate event ends before the instrument will respond to the next gate signal.

After any Gate event finishes, the instrument must wait for the sweep system to settle before it can respond to another Gate signal. The instrument calculates a "wait time," taking into account a number of factors, including RBW and Phase Noise Optimization settings. The goal is to achieve the same accuracy when gated as in ungated operation. The figure below illustrates this concept:



When **Gate Holdoff** is Auto, the wait time calculated by the instrument is used. When Gate Time is in Manual, the user may adjust the wait time, usually decreasing it in order to achieve greater speed, but at the risk of decreasing accuracy.

When the **Method** control is set to **Video** or **FFT**, the **Gate Holdoff** function has no effect.

In measurements that do not support "Auto Function" on page 2672, the value shown when Auto is selected is "---" and the manually set holdoff is returned to a query.

Remote Command	`[:SENSe]:SWEep:EGATe:HOLDoff <time>` `[:SENSe]:SWEep:EGATe:HOLDoff?`
Example	`:SWE:EGAT:HOLD 0.0002` `:SWE:EGAT:HOLD?`
Couplings	When **Gate Holdoff** is **Auto**, the **Gate Holdoff** control shows the value calculated by the instrument for the wait time Pressing the **Gate Holdoff** control while it is in **Auto** and not selected, causes the control to become selected and allows the user to adjust the value. If the value is adjusted, the setting changes to **Man** Pressing the **Gate Holdoff** key, while it is in **Auto** and selected, does not change the value of **Gate Holdoff**, but causes the setting to change to **Man.** Now the user can adjust the value Pressing the control while it is in **Man** and selected, cause the value to change back to **Auto** Pressing the control while it is in **Man** and not selected, causes the control to become selected and allows the user to adjust the value When **Method** is set to **Video** or **FFT**, the **Gate Holdoff** function has no effect
Preset	Auto
State Saved	Saved in instrument state
Min	1 µsec
Max	1 sec

Auto Function

Remote Command	`[:SENSe]:SWEep:EGATe:HOLDoff:AUTO OFF | ON | 0 | 1` `[:SENSe]:SWEep:EGATe:HOLDoff:AUTO?`
Example	`:SWE:EGAT:HOLD:AUTO ON` `:SWE:EGAT:HOLD:AUTO?`
Preset	Auto/On
State Saved	Saved in instrument state
Range	Auto|Man

8.3.8 Gate View Sweep Time

Controls the Sweep Time in the Gate View window. To provide an optimal view of the gate signal, the instrument initializes **Gate View Sweep Time** based on the current settings of Gate Delay and Gate Length.

NOTE Since **Gate View Sweep Time** is used to calculate Gate Delay and Gate Length increments, it is maintained even when not in **Gate** View.

NOTE In instruments without sweeping hardware such as some modular analyzers, this control may be labeled **Gate View Acquisition Time**

Remote Command	`[:SENSe]:SWEep:EGATe:TIME <time>` `[:SENSe]:SWEep:EGATe:TIME?`
Example	`:SWE:EGAT:TIME 500 ms`
Dependencies	Gate View Sweep Time is initialized: – On Preset (after initializing delay and length) – Every time the Gate Method is set/changed Additionally, in the Swept SA measurement, whenever you do a Preset, or leave Gate View, the instrument remembers the Gate Delay and Gate Length settings. Then, when returning to Gate View, if the current Gate Delay and/or Gate Length do not match the remembered values Gate View Sweep Time is re-initialized
Preset	WiMAX OFDMA: 5 ms GSM/EDGE: 1 ms 5G NR: 10 ms Others: 800 µs
State Saved	Saved in instrument state
Min	1 µs
Max	6000 s
Annotation	The gate view Sweep Time is displayed in the lower-right corner of the gate view window

8.3.9 Gate View Start Time

Controls the time at the left edge of the Gate View.

Remote Command	`[:SENSe]:SWEep:EGATe:VIEW:STARt <time>` `[:SENSe]:SWEep:EGATe:VIEW:STARt?`
Example	`:SWE:EGAT:VIEW:STAR 10ms`
Notes	Units of time are required or no units; otherwise, an invalid suffix error message is generated
Preset	0 ms
State Saved	Saved in instrument state
Min	0
Max	500 ms

8.3.10 Gate Delay Compensation

Allows you to select an RBW-dependent value by which to adjust the gate delay, to compensate for changes in the delay caused by RBW effects. Youcan select between uncompensated operation and two types of compensation:

Uncompensated	OFF
Delay Until RBW Settled	SETTled
Compensate for RBW Group Delay	GDELay

For full details of these options, see "More Information" on page 2674

Remote Command	[:SENSe]:SWEep:EGATe:DELay:COMPensation:TYPE OFF | SETTled | GDELay [:SENSe]:SWEep:EGATe:DELay:COMPensation:TYPE?
Example	:SWE:EGAT:DEL:COMP:TYPE SETT :SWE:EGAT:DEL:COMP:TYPE?
Notes	Although this function is Meas Global, there are some measurements that do not support this function. In those measurements the control is not displayed, and the operation will be Uncompensated If some but not all measurements in a Mode support this function, then selecting a measurement that does not support it will not change the Meas Global selection; it will simply be “Uncompensated” while in that measurement. The SCPI command is still accepted while in that measurement If Gate Delay Compensation is not supported at all within a particular mode, the control is not displayed, and if the SCPI command is sent while in a measurement within that mode, an “Undefined Header” message is generated Note that, for modular products such as EXM and VXT, this function is not supported. In those products the control is not displayed and the SCPI is ignored, although it is accepted without error
Preset	TD-SCDMA, LTEA FDD/TDD, 5G NR Modes: GDELay All other Modes: SETTled
State Saved	Saved in instrument state
Range	OFF|SETTled|GDELay

More Information

Selecting **Uncompensated** means that the actual gate delay is as you set it.

Selecting **Delay Until RBW Settled** causes the gate delay to be increased above the user setting by an amount equal to 3.06/RBW. This compensated delay causes the GATE START and GATE STOP lines on the display to move by the compensation amount, and the actual hardware gate delay to be increased by the same amount. All the other gate lines (for example, MIN FAST) are unaffected. If the RBW subsequently changes, the compensation is readjusted for the new RBW. The value shown on the **Gate Delay** control does *not* change.

Delay Until RBW Settled allows excellent measurements of gated signals, by allowing the IF to settle following any transient that affects the burst. Excellent measurements also require that the analysis region not extend into the region affected by the falling edge of the burst. Thus, excellent measurements can only be made over a width that declines with narrowing RBWs, which is achieved by decreasing the gate length below the user setting by an amount equal to 2.53/RBW. Therefore, for general purpose compensation, you will still want to change the gate length with changes in RBW even if the gate delay is compensated. The compensated Gate Length is limited by the instrument so that it will never go below 10% of the value shown on the Gate Length key, as otherwise the sweep times could get very long. Anytime the **Gate Length** and **RBW** values combine in such a way that this limiting takes place, a warning is displayed . For measurements that contain multiple sweeps with different RBW like SEM and SPUR, the smallest RBW is used for this limiting.

Selecting **Compensate for RBW Group Delay** causes the gate delay to be increased above the user setting by an amount equal to 1.81/RBW. This compensated delay causes the GATE START, GATE STOP lines on the display to move by the compensation amount, and the actual hardware gate delay to be increased by the same amount. All the other gate lines (for example, MIN FAST) are unaffected. If the RBW subsequently changes, the compensation is readjusted for the new RBW. The value shown on the **Gate Delay** control does *not* change. **Compensate for RBW Group Delay** also includes gate length compensation; the gate length itself is adjusted as necessary to attempt to compensate for delay effects imposed by the RBW.

Compensate for RBW Group Delay is similar to **Delay Until RBW Settled** but compensates for the group delay of the RBW filter, rather than the filter settling time. As the RBW gets narrow, this can allow the settling tail of the RBW to affect the beginning part of the gated measurement and allow the beginning of the RBW settling transient to affect the end of the gated measurement. These two effects are symmetric because the RBW response is symmetric. Because the gate length is not automatically compensated, some users might find this compensation to be more intuitive than compensation for RBW settling.

8.3.11 Min Fast Position Query (Remote Query Only)

Queries the position of the MIN FAST line, relative to the delay reference (REF) line. See "Gate View On/Off" on page 2665. If this query is sent while not in Gate view, the MinFast calculation is performed based on the current values of the appropriate parameters and the result is returned. Reading this value lets you set an optimal gate delay value for the current measurement setup.

Example	`:SWE:EGAT:MIN?`
Backwards Compatibility SCPI	`[:SENSe]:SWEep:EGATe:MINFast?`

8.3.12 Gate Preset (Remote Command Only)

Presets the time-gated spectrum analysis capability.

This command sets gate parameter values to the ESA preset values, as follows:

- Gate trigger type = edge
- Gate polarity = positive
- Gate delay = 1 us
- Gate length = 1 us

Backwards Compatibility SCPI	[:SENSe]:SWEep:TIME:GATE:PRESet ESA Compatibility

8.3.13 Gate Level (Remote Command Only)

Sets the gate input transition point level for the external **TRIGGER** inputs on the front and rear panel. This is a legacy command for PSA compatibility. It is simply an alias to the equivalent trigger level command.

Notes	This command is simply an alias to :TRIGger[:SEQuence]:EXTernal[1]|2:LEVel
Backwards Compatibility SCPI	[:SENSe]:SWEep:EGATe:EXTernal[1]|2:LEVel <voltage> [:SENSe]:SWEep:EGATe:EXTernal[1]|2:LEVel?

8.3.14 Gate Polarity (Remote Command Only)

Sets the polarity for the gate signal. This setup is now done using the gate trigger's slope setting.

When `POSitive` is selected, a positive-going edge (Edge) or a high voltage (Level) will satisfy the gate condition, after the delay set with the Gate Delay key. When `NEGative` is selected, a negative-going edge (Edge) or a low voltage (Level) will satisfy the gate condition after the delay.

Example	:SWE:EGAT:POL NEG :SWE:EGAT:POL?
Preset	POSitive
State Saved	Saved in instrument state

Backwards Compatibility SCPI	`[:SENSe]:SWEep:EGATe:POLarity NEGative | POSitive`
	`[:SENSe]:SWEep:EGATe:POLarity?`
	This backwards-compatibility command is available in Modes that support Gate Polarity parameter
	`[:SENSe]:SWEep:TIME:GATE:POLarity`
	This backwards-compatibility command is available in SA and SCPILC Modes
	ESA compatibility

Preset	HIGH

Backwards Compatibility SCPI	`[:SENSe]:SWEep:TIME:GATE:LEVel HIGH | LOW`
	`[:SENSe]:SWEep:TIME:GATE:LEVel?`
	ESA compatibility

8.4 Enables the hardware accelerated stepped FFT gating feature (Display only)

Enables or disables the hardware-accelerated stepped FFT gating feature:

- Enabling the Hardware Acceleration feature means that the Stepped FFT algorithm will run on the FPGA for configurations where speed improvements are possible
- Disabling the hardware-accelerated stepped FFT gating means the Stepped FFT software algorithm will always run on the CPU instead of the FPGA

When enabled it is only used when applicable and determined by the current sweep configuration.

The default value is `ON` and its value is power-on persistent.

Remote Command	`[:SENSe]:SWEep:EGATe:HACCelerate:ENABle OFF | ON | 0 | 1`
Example	`:SWEep:EGATe:HACCelerate:ENABle ON`
Notes	Value `ON` means the hardware accelerated stepped FFT gating is used intelligently Value `OFF` means the hardware accelerated stepped FFT gating is always disabled
Dependencies	Only valid in ACP, CHP and SEM mesurements
State Saved	Saved in instrument state

8.5 Periodic Sync Src

Contains controls that let you select and configure the sync signal for the **Periodic Timer** Trigger.

For convenience controls for adjusting the level and slope of the selected sync source are provided here. Note that these settings match those in the **Trigger** and **Gate Source** menus; that is, each trigger source has only one value of level and slope, regardless of which menu it is accessed from.

8.5.1 Select Periodic Timer Sync Source

Selects a signal source for you to synchronize your periodic timer trigger to, otherwise you are triggering at some arbitrary location in the frame. Synchronization reduces the precision requirements on the setting of the period.

Note that, with Sync Source `OFF`, the timing will drift unless the signal source frequency is locked to the instrument frequency reference.

Remote Command	`:TRIGger[:SEQuence]:FRAMe:SYNC EXTernal1 | EXTernal2 | RFBurst | PXI | INTernal | OFF` `:TRIGger[:SEQuence]:FRAMe:SYNC?`

Example	`:TRIG:FRAM:SYNC EXT1`
	`:TRIG:FRAM:SYNC EXT2`
	`:TRIG:FRAM:SYNC RFB`
	`:TRIG:FRAM:SYNC OFF`

Dependencies	`PXI` and `INTernal` triggers are only found in modular analyzers such as VXT Not available in E7760 or UXM In some models, there is no second External input. In these models, the External 2 selection is not shown, and the `EXTernal2` parameter generates a "Hardware missing; Not available for this model number" message
Preset	`OFF` GSM/EDGE, LTE, LTETDD, 5G NR: `RFBurst`
State Saved	Saved in instrument state
Backwards Compatibility SCPI	`:TRIGger[:SEQuence]:FRAMe:SYNC EXTernal` For backwards-compatibility, the parameter `EXTernal` is mapped to `EXTernal1`

8.6 Auto/Holdoff

Contains controls that let you adjust Auto Trigger and Trigger Holdoff parameters

This tab does not appear in Spectrum Analyzer Mode in VXT model M9421A.

8.6.1 Trig Holdoff

Sets the holdoff time between triggers. When the trigger condition is satisfied, the trigger occurs, the delay begins, and the holdoff time begins. New trigger conditions will be ignored until the holdoff time expires. For a free-running trigger, the holdoff value is the minimum time between triggers.

Remote Command	`:TRIGger[:SEQuence]:HOLDoff <time>` `:TRIGger[:SEQuence]:HOLDoff?`
Example	`:TRIG:HOLD:STAT ON` `:TRIG:HOLD 100 ms`
Dependencies	Unavailable if the selected Input is `BBIQ`. If this is the case, the control is grayed-out if it is pressed the informational message “Feature not supported for this Input” is displayed. If the SCPI command is sent, the error “Settings conflict; Feature not supported for this Input” is generated
Preset	All modes except GSM/EDGE, LTEAFDD/TDD and 5G NR: 100 ms GSM/EDGE, Bluetooth: 10 µs LTEATDD: 19 ms 5G NR: 4 ms
State Saved	Saved in instrument state
Min	0 s
Max	0.5 s VXT models M9410A/11A/15A/16A: 2.86 s

Auto Function

Remote Command	`:TRIGger[:SEQuence]:HOLDoff:STATe OFF | ON | 0 | 1` `:TRIGger[:SEQuence]:HOLDoff:STATe?`
Preset	All modes but GSM/EDGE: `OFF` GSM/EDGE mode: `ON`

8.6.2 Auto Trig

Sets the time that the instrument will wait for the trigger conditions to be met. If they are not met after that much time, then the instrument is triggered anyway.

Remote Command	`:TRIGger[:SEQuence]:ATRigger <time>` `:TRIGger[:SEQuence]:ATRigger?`
Example	`:TRIG:ATR:STAT ON` `:TRIG:ATR 100 ms`
Notes	The "time that the instrument will wait" starts when the instrument is ready for a trigger, which may be hundreds of ms after the data acquisition for a sweep is done. The "time" ends when the trigger condition is satisfied, not when the delay ends
Dependencies	Not available in Real Time Spectrum Analyzer Mode
Preset	Off, 100 ms
State Saved	Saved in instrument state
Min	1 ms
Max	100 s

Auto Function

Remote Command	`:TRIGger[:SEQuence]:ATRigger:STATe OFF | ON | 0 | 1` `:TRIGger[:SEQuence]:ATRigger:STATe?`
Preset	`OFF`

8.6.3 Holdoff Type

Enables you to set the Trigger **Holdoff Type**.

NOTE **Holdoff Type** is not supported by all measurements. If the current measurement does not support it, this control does not appear, and **Holdoff Type** is Normal. If **Holdoff Type** SCPI is sent while in such a measurement, the SCPI is accepted and the setting remembered, but it has no effect until a measurement is in force that supports **Holdoff Type**.

Trigger Holdoff Type functionality

`NORMal`	This is the "oscilloscope" type of trigger holdoff and is the setting when the **Holdoff Type** control does not appear. In this type of holdoff, no new trigger will be accepted until the holdoff interval has expired after the previous trigger
`ABOVe`	If the trigger slope is positive, a trigger event is generated only if the signal characteristic of interest crosses the trigger threshold (with positive slope) and then remains above the threshold for at least the holdoff time. For negative slope, the trigger event is generated if the signal characteristic crosses the threshold (with negative slope) after having been above the threshold for at least the holdoff time. In either case, the trigger event is associated with the time the level was crossed
`BELow`	If the trigger slope is positive, a trigger event is generated only if the signal characteristic of interest crosses the trigger threshold (with positive slope) after

having been below the threshold for at least the holdoff time. For negative slope, the trigger event is generated if the signal characteristic crosses the threshold (with negative slope) and then remains below the threshold for at least the holdoff time. In either case, the trigger event is associated with the time the level was crossed

Remote Command	`:TRIGger[:SEQuence]:HOLDoff:TYPE NORMal | ABOVe | BELow` `:TRIGger[:SEQuence]:HOLDoff:TYPE?`
Example	`:TRIG:HOLD:TYPE NORM`
Preset	see table below
State Saved	Saved in instrument state

Modes	Setting
GSM/EDGE Bluetooth	BELow
All others	NORMal

9 Programming the Instrument

This section provides information about the instrument's SCPI programming interface. You can also operate the instrument remotely using some legacy programming languages by running the N9061C Remote Language Compatibility measurement application and the N9062C SCPI Language Compatibility measurement application.

9.1 List of Supported SCPI Commands

The SCPI commands available while using this application are listed below.

To find a command in the list, search according to its first alphanumeric character, ignoring any leading ":" or "[" characters. The sole exception to this is the asterisk [*] prefix, identifying IEEE 488.2 Common commands and queries; all these appear at the start of the list.

Note that most commands also have query forms. In cases where a command and its query are described in the same topic, the list below includes the command and query as a *single* item, with no suffix.

Suffix	Interpretation
No suffix	Command & Query, *or* Command only
	For details, click the link to view the command definition
?	Query only

*

```
*CAL
*CAL
*CLS
*ESE
*ESR?
*IDN?
*OPC
*OPT?
*RCL
*RST
*SAV
*SRE
*STB?
*TRG
*TST?
*WAI
```

A

```
ABORt
```

C

```
CALCulate:<meas>:MARKer[1]|2|…|12:MAXimum:LEFT
```

```
CALCulate:<meas>:MARKer[1]|2|…|12:MAXimum:RIGHt
CALCulate:<meas>:MARKer[1]|2|…|12:MINimum
CALCulate:<meas>:MARKer[1]|2|…|12:PTPeak
CALCulate[:<meas>]:MATH?
CALCulate:<meas>:MATH
CALCulate:<meas>:MTRace
CALCulate:ACPower:LIMit:STATe
CALCulate:ACPower:MARKer[1]|2|…|12:MAXimum
CALCulate:ACPower:MARKer[1]|2|…|12:MAXimum:LEFT
CALCulate:ACPower:MARKer[1]|2|…|12:MAXimum:NEXT
CALCulate:ACPower:MARKer[1]|2|…|12:MAXimum:RIGHt
CALCulate:ACPower:MARKer[1]|2|…|12:MINimum
CALCulate:ACPower:MARKer[1]|2|…|12:MODE
CALCulate:ACPower:MARKer[1]|2|…|12:PTPeak
CALCulate:ACPower:MARKer[1]|2|…|12:REFerence
CALCulate:ACPower:MARKer[1]|2|…|12:TRACe
CALCulate:ACPower:MARKer[1]|2|…|12:X
CALCulate:ACPower:MARKer[1]|2|…|12:X:POSition
CALCulate:ACPower:MARKer[1]|2|…|12:Y?
CALCulate:ACPower:MARKer:AOFF
CALCulate:ACPower:MARKer:COUPle[:STATe]
CALCulate:ACPower:OFFSet[1]|2[:OUTer]:LIST:LIMit:NEGative
[:UPPer]:DATA
CALCulate:ACPower:OFFSet[1]|2[:OUTer]:LIST:LIMit:POSitive
[:UPPer]:DATA
CALCulate:BWIDth|BANDwidth:NDB
CALCulate:BWIDth|BANDwidth:RESult?
CALCulate:BWIDth|BANDwidth:RLEFt?
CALCulate:BWIDth|BANDwidth:RRIGht?
CALCulate:BWIDth|BANDwidth[:STATe]
CALCulate:CHPower:LIMit:POWer
CALCulate:CHPower:LIMit:POWer:FAIL?
CALCulate:CHPower:LIMit:POWer:STATe
CALCulate:CHPower:LIMit:PSDensity
CALCulate:CHPower:LIMit:PSDensity:STATe
CALCulate:CHPower:LIMit:PSD:FAIL?
CALCulate:CHPower:MARKer[1]|2|…|12:MAXimum
CALCulate:CHPower:MARKer[1]|2|…|12:MODE
CALCulate:CHPower:MARKer[1]|2|…|12:REFerence
CALCulate:CHPower:MARKer[1]|2|…|12:TRACe
CALCulate:CHPower:MARKer[1]|2|…|12:X
CALCulate:CHPower:MARKer[1]|2|…|12:X:POSition
CALCulate:CHPower:MARKer[1]|2|…|12:Y?
CALCulate:CHPower:MARKer:AOFF
CALCulate:CLIMits:FAIL?
CALCulate:CLIMits:FAIL?
CALCulate:DATA<n>:COMPress?
CALCulate:DATA[1]|2|…|6:PEAKs?
CALCulate:DATA[n]:PEAKs?
CALCulate:FPOWer:POWer[1,2,…,999]?
```

```
CALCulate:FPOWer:POWer[1,2,…,999]:CONFigure
CALCulate:FPOWer:POWer[1,2,…,999]:DEFine?
CALCulate:FPOWer:POWer[1,2,…,999]:FETCh?
CALCulate:FPOWer:POWer[1,2,…,999]:INITiate
CALCulate:FPOWer:POWer[1,2,…,999]:READ?
CALCulate:FPOWer:POWer[1,2,…,999]:READ1?
CALCulate:FPOWer:POWer[1,2,…,999]:READ2?
CALCulate:FPOWer:POWer[1,2,…,999]:RESet
CALCulate:LIMit[1]|2|…|6:CLEar
CALCulate:LIMit[1]|2|…|6:CONTrol[:DATA]
CALCulate:LIMit[1]|2|…|6:CONTrol:POINts?
CALCulate:LIMit[1]|2|…|6:FAIL?
CALCulate:LIMit[1]|2|…|6:LOWer[:DATA]
CALCulate:LIMit[1]|2|…|6:LOWer:POINts?
CALCulate:LIMit[1]|2|…|6:UPPer[:DATA]
CALCulate:LIMit[1]|2|…|6:UPPer:POINts?
CALCulate:LLINe[1]|2|…|6:AMPLitude:CMODe:RELative
CALCulate:LLINe[1]|2|…|6:AMPLitude:INTerpolate:TYPE
CALCulate:LLINe[1]|2|…|6:BUILd
CALCulate:LLINe[1]|2|…|6:COMMent
CALCulate:LLINe[1]|2|…|6:CONTrol:INTerpolate:TYPE
CALCulate:LLINe[1]|2|…|6:COPY
CALCulate:LLINe[1]|2|…|6:DELete
CALCulate:LLINe[1]|2|…|6:DESCription
CALCulate:LLINe[1]|2|…|6:DISPlay
CALCulate:LLINe[1]|2|…|6:FAIL?
CALCulate:LLINe[1]|2|…|6:FREQuency:CMODe:RELative
CALCulate:LLINe[1]|2|…|6:MARGin
CALCulate:LLINe[1]|2|…|6:MARGin:STATe
CALCulate:LLINe[1]|2|…|6:OFFSet:UPDate
CALCulate:LLINe[1]|2|…|6:OFFSet:X
CALCulate:LLINe[1]|2|…|6:OFFSet:Y
CALCulate:LLINe[1]|2|…|6:TRACe
CALCulate:LLINe[1]|2|…|6:TYPE
CALCulate:LLINe:ALL:DELete
CALCulate:LLINe:CONTrol:DOMain
CALCulate:LLINe:TEST
CALCulate:MAMarker:COUPling
CALCulate:MAMarker:DETector[1]|2|3
CALCulate:MAMarker:DETector[1]|2|3:DWELl
CALCulate:MAMarker:PCENter
CALCulate:MARKer[1]|2|…|12:CPSearch[:STATe]
CALCulate:MARKer[1]|2|…|12:FCOunt:GATetime
CALCulate:MARKer[1]|2|…|12:FCOunt:GATetime:AUTO
CALCulate:MARKer[1]|2|…|12:FCOunt[:STATe]
CALCulate:MARKer[1]|2|…|12:FCOunt:X?
CALCulate:MARKer[1]|2|…|12:FUNCtion
CALCulate:MARKer[1]|2|…|12:FUNCtion:BAND:LEFT
CALCulate:MARKer[1]|2|…|12:FUNCtion:BAND:RIGHt
CALCulate:MARKer[1]|2|…|12:FUNCtion:BAND:SPAN
```

```
CALCulate:MARKer[1]|2|…|12:FUNCtion:BAND:SPAN:AUTO
CALCulate:MARKer[1]|2|…|12:FUNCtion:MAMarker?
CALCulate:MARKer[1]|2|…|12:LINes[:STATe]
CALCulate:MARKer[1]|2|…|12:MAXimum
CALCulate:MARKer[1]|2|…|12:MAXimum:ALL
CALCulate:MARKer[1]|2|…|12:MAXimum:LEFT
CALCulate:MARKer[1]|2|…|12:MAXimum:NEXT
CALCulate:MARKer[1]|2|…|12:MAXimum:RIGHt
CALCulate:MARKer[1]|2|…|12:MINimum
CALCulate:MARKer[1]|2|…|12:MODE
CALCulate:MARKer[1]|2|…|12:PTPeak
CALCulate:MARKer[1]|2|…|12:REFerence
CALCulate:MARKer[1]|2|…|12[:SET]:CENTer
CALCulate:MARKer[1]|2|…|12[:SET]:DELTa:CENTer
CALCulate:MARKer[1]|2|…|12[:SET]:DELTa:SPAN
CALCulate:MARKer[1]|2|…|12[:SET]:DTRAce
CALCulate:MARKer[1]|2|…|12[:SET]:MTRAce
CALCulate:MARKer[1]|2|…|12[:SET]:RLEVel
CALCulate:MARKer[1]|2|…|12[:SET]:STARt
CALCulate:MARKer[1]|2|…|12[:SET]:STEP
CALCulate:MARKer[1]|2|…|12[:SET]:STOP
CALCulate:MARKer[1]|2|…|12[:SET]:TZOom:CENTer
CALCulate:MARKer[1]|2|…|12[:SET]:ZSPan:CENTer
CALCulate:MARKer[1]|2|…|12:TRACe
CALCulate:MARKer[1]|2|…|12:TRACe:AUTO
CALCulate:MARKer[1]|2|…|12:X
CALCulate:MARKer[1]|2|…|12:X:POSition
CALCulate:MARKer[1]|2|…|12:X:READout
CALCulate:MARKer[1]|2|…|12:X:READout:AUTO
CALCulate:MARKer[1]|2|…|12:Y
CALCulate:MARKer[1]|2|…|12:Z?
CALCulate:MARKer[1]|2|…|12:Z:POSition
CALCulate:MARKer[1]|2|…|4:FCOunt:RESolution:AUTO
CALCulate:MARKer:AOFF
CALCulate:MARKer:COUPle[:STATe]
CALCulate:MARKer:PEAK:EXCursion
CALCulate:MARKer:PEAK:EXCursion:AUTO[:STATe]
CALCulate:MARKer:PEAK:EXCursion:STATe
CALCulate:MARKer:PEAK:MPEaks
CALCulate:MARKer:PEAK:SEARch:MODE
CALCulate:MARKer:PEAK:SORT
CALCulate:MARKer:PEAK:TABLe:DTLimit
CALCulate:MARKer:PEAK:TABLe:DTLimit:STATe
CALCulate:MARKer:PEAK:TABLe:READout
CALCulate:MARKer:PEAK:TABLe:STATe
CALCulate:MARKer:PEAK:THReshold
CALCulate:MARKer:PEAK:THReshold:AUTO[:STATe]
CALCulate:MARKer:PEAK:THReshold:LINE[:STATe]
CALCulate:MARKer:PEAK:THReshold:STATe
CALCulate:MARKer:TABLe[:STATe]
CALCulate:MARKer:TRCKing[:STATe]
```

```
CALCulate:MATH
CALCulate:NTData[:STATe]
CALCulate:OBWidth:LIMit:FBLimit
CALCulate:OBWidth:LIMit[:TEST]
CALCulate:OBWidth:MARKer[1]|2|…|12:MAXimum
CALCulate:OBWidth:MARKer[1]|2|…|12:MODE
CALCulate:OBWidth:MARKer[1]|2|…|12:REFerence
CALCulate:OBWidth:MARKer[1]|2|…|12:TRACe
CALCulate:OBWidth:MARKer[1]|2|…|12:X
CALCulate:OBWidth:MARKer[1]|2|…|12:X:POSition
CALCulate:OBWidth:MARKer[1]|2|…|12:Y?
CALCulate:OBWidth:MARKer:AOFF
CALCulate:PSTatistic:MARKer[1]|2|…|12:MODE
CALCulate:PSTatistic:MARKer[1]|2|…|12:REFerence
CALCulate:PSTatistic:MARKer[1]|2|…|12:TRACe
CALCulate:PSTatistic:MARKer[1]|2|…|12:X
CALCulate:PSTatistic:MARKer[1]|2|…|12:Y?
CALCulate:PSTatistic:MARKer:AOFF
CALCulate:PSTatistic:MARKer:COUPle[:STATe]
CALCulate:PSTatistic:RANGe[:PROBability]:MINimum
CALCulate:PSTatistic:STORe:REFerence
CALCulate:SEMask:LLINe:STATe
CALCulate:SEMask:MARKer[1]|2|…|12:MODE
CALCulate:SEMask:MARKer[1]|2|…|12:TRACe
CALCulate:SEMask:MARKer[1]|2|…|12:X
CALCulate:SEMask:MARKer[1]|2|…|12:X:POSition
CALCulate:SEMask:MARKer[1]|2|…|12:Y?
CALCulate:SEMask:MARKer:AOFF
CALCulate:SEMask:MARKer:COUPle[:STATe]
CALCulate:SPURious:MARKer[1]|2|…|12:MAXimum
CALCulate:SPURious:MARKer[1]|2|…|12:MAXimum:LEFT
CALCulate:SPURious:MARKer[1]|2|…|12:MAXimum:NEXT
CALCulate:SPURious:MARKer[1]|2|…|12:MAXimum:RIGHt
CALCulate:SPURious:MARKer[1]|2|…|12:MINimum
CALCulate:SPURious:MARKer[1]|2|…|12:MODE
CALCulate:SPURious:MARKer[1]|2|…|12:PTPeak
CALCulate:SPURious:MARKer[1]|2|…|12:REFerence
CALCulate:SPURious:MARKer[1]|2|…|12:TRACe:ATTached
CALCulate:SPURious:MARKer[1]|2|…|12:X
CALCulate:SPURious:MARKer[1]|2|…|12:X:POSition
CALCulate:SPURious:MARKer[1]|2|…|12:Y?
CALCulate:SPURious:MARKer:AOFF
CALCulate:SPURious:MARKer:COUPle[:STATe]
CALCulate:SPURious:MTRace
CALCulate:SPURious[:RANGe][:LIST]:LIMit:ABSolute[:UPPer]:DATA
[:STARt]
CALCulate:SPURious[:RANGe][:LIST]:LIMit:ABSolute
[:UPPer]:DATA:STOP
CALCulate:SPURious[:RANGe][:LIST]:LIMit:ABSolute
[:UPPer]:DATA:STOP:AUTO
```

```
CALCulate:TRACe[1]|2|…|6:FAIL?
CALCulate:TXPower:MARKer[1]|2|...|12:MAXimum
CALCulate:TXPower:MARKer[1]|2|...|12:MODE
CALCulate:TXPower:MARKer[1]|2|...|12:REFerence
CALCulate:TXPower:MARKer[1]|2|...|12:TRACe
CALCulate:TXPower:MARKer[1]|2|...|12:X
CALCulate:TXPower:MARKer[1]|2|...|12:X:POSition
CALCulate:TXPower:MARKer[1]|2|...|12:Y?
CALCulate:TXPower:MARKer:AOFF
CALCulate:TXPower:MARKer:COUPle[:STATe]
CALibration[:ALL]
CALibration[:ALL]:NPENding
CALibration:AUTO
CALibration:AUTO:ALERt
CALibration:AUTO:MODE
CALibration:AUTO:TIME:OFF?
CALibration:DATA:BACKup
CALibration:DATA:DEFault
CALibration:DATA:INTernal:BACKup
CALibration:DATA:INTernal:RESTore
CALibration:DATA:RESTore
CALibration:EMIXer
CALibration:EXPired
CALibration:FREQuency:REFerence:COARse
CALibration:FREQuency:REFerence:FINE
CALibration:FREQuency:REFerence:MODE
CALibration:INTernal:ASFRanges?
CALibration:INTernal:ASFRanges:EXTend[:STATe]
CALibration:INTernal:ASFRanges:FRANges
CALibration:INTernal:ASFRanges[:STATe]
CALibration:INTernal:EMPath
CALibration:INTernal:FAST[:ALL]
CALibration:INTernal:HBANd[:ALL]
CALibration:INTernal:LBANd[:ALL]
CALibration:INTernal:LOLeakage
CALibration:INTernal:RECeiver[:ALL]
CALibration:INTernal:RRHead:AMPLitude
CALibration:INTernal:RRHead:AMPLitude:FAST
CALibration:INTernal:RRHead:IFCable
CALibration:INTernal:RRHead:LOPower
CALibration:INTernal:RRHead:LOSync
CALibration:INTernal:SOURce[:ALL]
CALibration:INTernal:SOURce[:ALL]:NPENding
CALibration:INTernal:VXT:TRANsceiver
CALibration:IQ:FLATness:I
CALibration:IQ:FLATness:I|IBAR|Q|QBAR:TIME?
CALibration:IQ:FLATness:IBAR
CALibration:IQ:FLATness:Q
CALibration:IQ:FLATness:QBAR
CALibration:IQ:ISOLation
CALibration:IQ:ISOLation:TIME?
```

```
CALibration:IQ:PROBe:I
CALibration:IQ:PROBe:I|:TIME?
CALibration:IQ:PROBe:IBar
CALibration:IQ:PROBe:IBAR:TIME?
CALibration:IQ:PROBe:I:CLEar
CALibration:IQ:PROBe:Q
CALibration:IQ:PROBe:QBar
CALibration:IQ:PROBe:QBAR:TIME?
CALibration:IQ:PROBe:Q:CLEar
CALibration:IQ:PROBe:Q:TIME?
CALibration:NFLoor
CALibration:NRF
CALibration:NRF:NPENding
CALibration:NRFPselector
CALibration:PDELay:CORRection
CALibration:PDELay:SOURce
CALibration:PRESelector
CALibration:REFerence:CLOCk?
CALibration:REFerence:CLOCk:END?
CALibration:REFerence:CLOCk:INITialize?
CALibration:RF
CALibration:RF:NPENding
CALibration:RFPSelector:ALERt
CALibration:RFPSelector:CONDucted
CALibration:RFPSelector:FULL
CALibration:RFPSelector:ONLY
CALibration:RFPSelector:RADiated
CALibration:RFPSelector:SCHeduler:RECurrence
CALibration:RFPSelector:SCHeduler:RECurrence:DAY
CALibration:RFPSelector:SCHeduler:RECurrence:WEEK
CALibration:RFPSelector:SCHeduler:STATe
CALibration:RFPSelector:SCHeduler:TASK
CALibration:RFPSelector:SCHeduler:TIME:NEXT?
CALibration:RFPSelector:SCHeduler:TIME:STARt
CALibration:TDS
CALibration:TEMPerature:AGO?
CALibration:TEMPerature:CURRent?
CALibration:TEMPerature:CURRent:RRHead?
CALibration:TEMPerature:CURRent:RRHead:LO?
CALibration:TEMPerature:INTernal:EMPath?
CALibration:TEMPerature:INTernal:FAST?
CALibration:TEMPerature:INTernal:HBANd?
CALibration:TEMPerature:INTernal:LBANd?
CALibration:TEMPerature:INTernal:LOLeakage?
CALibration:TEMPerature:INTernal:RECeiver?
CALibration:TEMPerature:INTernal:RRHead:AMPLitude?
CALibration:TEMPerature:INTernal:RRHead:AMPLitude:FAST?
CALibration:TEMPerature:INTernal:RRHead:IFCable?
CALibration:TEMPerature:INTernal:RRHead:LOPower?
CALibration:TEMPerature:INTernal:RRHead:LOSync?
```

```
CALibration:TEMPerature:INTernal:SOURce?
CALibration:TEMPerature:INTernal:VXT:TRANsceiver?
CALibration:TEMPerature:LALL?
CALibration:TEMPerature:LIF?
CALibration:TEMPerature:LPReselector?
CALibration:TEMPerature:LRF?
CALibration:TEMPerature:MAXimum?
CALibration:TEMPerature:MINimum?
CALibration:TEMPerature:NFLoor?
CALibration:TEMPerature:OLDest:SEConds?
CALibration:TEMPerature:OLDest[:TEMPerature]?
CALibration:TEMPerature:PDELay:SOURce?
CALibration:TEMPerature:RFPSelector:LCONducted?
CALibration:TEMPerature:RFPSelector:LRADiated?
CALibration:TEMPerature:UPDown:CONVerter?
CALibration:TIME:ELAPsed:NFLoor?
CALibration:TIME:INTernal:EMPath?
CALibration:TIME:INTernal:FAST?
CALibration:TIME:INTernal:HBAN?
CALibration:TIME:INTernal:LBANd?
CALibration:TIME:INTernal:LOLeakage?
CALibration:TIME:INTernal:RECeiver?
CALibration:TIME:INTernal:RRHead:AMPLitude?
CALibration:TIME:INTernal:RRHead:AMPLitude:FAST?
CALibration:TIME:INTernal:RRHead:IFCable?
CALibration:TIME:INTernal:RRHead:LOPower?
CALibration:TIME:INTernal:RRHead:LOSync?
CALibration:TIME:INTernal:SOURce?
CALibration:TIME:INTernal:VXT:TRANsceiver?
CALibration:TIME:LALL?
CALibration:TIME:LIF?
CALibration:TIME:LPReselector?
CALibration:TIME:LRF?
CALibration:TIME:NFLoor?
CALibration:TIME:PDELay:SOURce?
CALibration:TIME:REFerence:CLOCk?
CALibration:TIME:RFPSelector:LCONducted?
CALibration:TIME:RFPSelector:LRADiated?
CALibration:TIME:UPDown:CONVerter?
CALibration:UPDown:CONVerter
CALibration:YTF
CALibration:YTF:NPENding
CONFigure?
CONFigure?
CONFigure?
CONFigure:<measurement>[:NDEFault]
CONFigure:ACPower
CONFigure:ACPower
CONFigure:ACPower:NDEFault
CONFigure:CATalog?
CONFigure:CHPower
```

CONFigure:CHPower
CONFigure:CHPower:NDEFault
CONFigure:HARMonics
CONFigure:HARMonics
CONFigure:HARMonics:NDEFault
CONFigure:LIST
CONFigure:OBWidth
CONFigure:OBWidth
CONFigure:OBWidth:NDEFault
CONFigure:PAVTime
CONFigure:PAVTime
CONFigure:PAVTime:NDEFault
CONFigure:PSTatistic
CONFigure:PSTatistic
CONFigure:PSTatistic:NDEFault
CONFigure:SANalyzer
CONFigure:SANalyzer
CONFigure:SANalyzer:NDEFault
CONFigure:SEMask
CONFigure:SEMask
CONFigure:SEMask:NDEFault
CONFigure:SPURious
CONFigure:SPURious
CONFigure:SPURious:NDEFault
CONFigure:TOI
CONFigure:TOI
CONFigure:TOI:NDEFault
CONFigure:TXPower
CONFigure:TXPower|BPOWer
CONFigure:TXPower|BPOWer:NDEFault
CONTrol:COMPatible:DETector
CONTrol:COMPatible:RST
CONTrol:COMPatible:TRACe
COUPle

D

DISPlay:<meas>:WINDow[1]:TRACe:Y[:SCALe]:RANGe
DISPlay:ACPower:VIEW[1]:WINDow[1]:TRACe:X[:SCALe]:COUPle
DISPlay:ACPower:VIEW:NSELect
DISPlay:ACPower:VIEW[:SELect]
DISPlay:ACPower:WINDow[1]:BGRaph
DISPlay:ACPower:WINDow[1]:TRACe:Y[:SCALe]:COUPle
DISPlay:ACPower:WINDow[1]:TRACe:Y[:SCALe]:PDIVision
DISPlay:ACPower:WINDow[1]:TRACe:Y[:SCALe]:RLEVel
DISPlay:ACPower:WINDow[1]:TRACe:Y[:SCALe]:RPOSition
DISPlay:ACTivefunc[:STATe]
DISPlay:ANNotation:FREQuency[:STATe]
DISPlay:ANNotation:MBAR[:STATe]

```
DISPlay:ANNotation:SCReen[:STATe]
DISPlay:ANNotation:TRACe[:STATe]
DISPlay:BACKlight
DISPlay:CHPower:VIEW:NSELect
DISPlay:CHPower:VIEW[:SELect]
DISPlay:CHPower:WINDow[1]:BGRaph
DISPlay:CHPower:WINDow[1]:TRACe:Y[:SCALe]:COUPle
DISPlay:CHPower:WINDow[1]:TRACe:Y[:SCALe]:PDIVision
DISPlay:CHPower:WINDow[1]:TRACe:Y[:SCALe]:RLEVel
DISPlay:CHPower:WINDow[1]:TRACe:Y[:SCALe]:RPOSition
DISPlay:ENABle
DISPlay:FSCReen[:STATe]
DISPlay:GRATicule[:STATe]
DISPlay:HARMonics:VIEW:WINDow:TRACe:Y[:SCALe]:PDIVision
DISPlay:HARMonics:VIEW:WINDow:TRACe:Y[:SCALe]:RLEVel
DISPlay:HARMonics:VIEW:WINDow:TRACe:Y[:SCALe]:RPOSition
DISPlay:OBWidth:VIEW:NSELect
DISPlay:OBWidth:VIEW[:SELect]
DISPlay:OBWidth:WINDow[1]:TRACe:Y[:SCALe]:COUPle
DISPlay:OBWidth:WINDow[1]:TRACe:Y[:SCALe]:PDIVision
DISPlay:OBWidth:WINDow[1]:TRACe:Y[:SCALe]:RLEVel
DISPlay:OBWidth:WINDow[1]:TRACe:Y[:SCALe]:RPOSition
DISPlay:OBWidth:WINDow[1]:XDB
DISPlay:OBWidth:WINDow2:BOUNdaries:FREQuency
DISPlay:PAVTime:TYPE
DISPlay:PAVTime:VIEW[1]:WINDow[1]:TRACe:Y[:SCALe]
DISPlay:PAVTime:VIEW[1]:WINDow[1]:TRACe:Y
[:SCALe]:AMPLitude:PDIVision
DISPlay:PAVTime:VIEW[1]:WINDow[1]:TRACe:Y
[:SCALe]:AMPLitude:RLEVel
DISPlay:PAVTime:VIEW[1]:WINDow[1]:TRACe:Y
[:SCALe]:AMPLitude:RPOSition
DISPlay:PAVTime:VIEW[1]:WINDow[1]:TRACe:Y[:SCALe]:PHASe:PDIVision
DISPlay:PAVTime:VIEW[1]:WINDow[1]:TRACe:Y[:SCALe]:PHASe:RLEVel
DISPlay:PAVTime:VIEW[1]:WINDow[1]:TRACe:Y[:SCALe]:PHASe:RPOSition
DISPlay:PSTatistic:GAUSsian[:STATe]
DISPlay:PSTatistic:RTRace[:STATe]
DISPlay:PSTatistic:VIEW[1]:WINDow2:TRACe:X[:SCALe]:PDIVision
DISPlay:SEMask:OFFSet:SABSolute
DISPlay:SEMask:VIEW:NSELect
DISPlay:SEMask:VIEW[:SELect]
DISPlay:SEMask:WINDow[1]:TRACe:X[:SCALe]:COUPle
DISPlay:SEMask:WINDow[1]:TRACe:X[:SCALe]:PDIVision
DISPlay:SEMask:WINDow[1]:TRACe:X[:SCALe]:RLEVel
DISPlay:SEMask:WINDow[1]:TRACe:X[:SCALe]:RPOSition
DISPlay:SEMask:WINDow[1]:TRACe:Y[:SCALe]:COUPle
DISPlay:SEMask:WINDow[1]:TRACe:Y[:SCALe]:PDIVision
DISPlay:SEMask:WINDow[1]:TRACe:Y[:SCALe]:RLEVel
DISPlay:SEMask:WINDow[1]:TRACe:Y[:SCALe]:RPOSition
DISPlay:SPURious:VIEW:RANGe:TABLe:FMODe
```

```
DISPlay:SPURious:VIEW[:SELect]
DISPlay:SPURious:WINDow[1]:TRACe:Y[:SCALe]:COUPle
DISPlay:SPURious:WINDow[1]:TRACe:Y[:SCALe]:PDIVision
DISPlay:SPURious:WINDow[1]:TRACe:Y[:SCALe]:RLEVel
DISPlay:THEMe
DISPlay:TOI:VIEW[1]:WINDow[1]:TRACe:Y[:SCALe]:RPOSition
DISPlay:TOI:VIEW:WINDow:TRACe:Y[:SCALe]:PDIVision
DISPlay:TOI:VIEW:WINDow:TRACe:Y[:SCALe]:RLEVel
DISPlay:TXPower:BARGraph[:STATe]
DISPlay:TXPower:VIEW[1]:WINDow[1]:TRACe:Y[:SCALe]:RPOSition
DISPlay:TXPower:WINDow[1]:TRACe:MAXHold[:STATe]
DISPlay:TXPower:WINDow[1]:TRACe:MINHold[:STATe]
DISPlay:TXPower:WINDow[1]:TRACe:X[:SCALe]:COUPle
DISPlay:TXPower:WINDow[1]:TRACe:X[:SCALe]:PDIVision
DISPlay:TXPower:WINDow[1]:TRACe:X[:SCALe]:RLEVel
DISPlay:TXPower:WINDow[1]:TRACe:X[:SCALe]:RPOSition
DISPlay:TXPower:WINDow[1]:TRACe:Y[:SCALe]:COUPle
DISPlay:TXPower:WINDow[1]:TRACe:Y[:SCALe]:PDIVision
DISPlay:TXPower:WINDow[1]:TRACe:Y[:SCALe]:RLEVel
DISPlay:UINTerface:CSIZe
DISPlay:UINTerface:HTABs
DISPlay:UINTerface:STAB
DISPlay:UINTerface:STFScreen
DISPlay:UINTerface:TYPE?
DISPlay:VIEW:ADVanced:CATalog?
DISPlay:VIEW:ADVanced:DELete
DISPlay:VIEW:ADVanced:DELete:ALL
DISPlay:VIEW:ADVanced:NAME
DISPlay:VIEW:ADVanced:REName
DISPlay:VIEW:ADVanced:SELect
DISPlay:VIEW:ADVanced:USER:CATalog?
DISPlay:VIEW[:SELect]
DISPlay:VIEW[:SELect]
DISPlay:VIEW:SPECtrogram:AADJust
DISPlay:VIEW:SPECtrogram:BOTTom
DISPlay:VIEW:SPECtrogram:HUE
DISPlay:VIEW:SPECtrogram:REFerence
DISPlay:VIEW:SPECtrogram:TRACe:COUPle
DISPlay:WINDow[1]:ANNotation[:ALL]
DISPlay:WINDow[1]:TRACe:X:FLINe[1]|2|…|4
DISPlay:WINDow[1]:TRACe:X:FLINe[1]|2|…|4:STATe
DISPlay:WINDow[1]:TRACe:X[:SCALe]:SPACing
DISPlay:WINDow[1]:TRACe:X:TLINe[1]|2|…|4
DISPlay:WINDow[1]:TRACe:X:TLINe[1]|2|…|4:STATe
DISPlay:WINDow[1]:TRACe:Y:DLINe[1]|2|…|4
DISPlay:WINDow[1]:TRACe:Y:DLINe[1]|2|…|4:STATe
DISPlay:WINDow[1]:TRACe:Y[:SCALe]:NDIVision
DISPlay:WINDow[1]:TRACe:Y[:SCALe]:NRLevel
DISPlay:WINDow[1]:TRACe:Y[:SCALe]:NRPosition
DISPlay:WINDow[1]:TRACe:Y[:SCALe]:PDIVision
```

```
DISPlay:WINDow[1]:TRACe:Y[:SCALe]:RLEVel
DISPlay:WINDow[1]:TRACe:Y[:SCALe]:RLEVel:OFFSet
DISPlay:WINDow[1]:TRACe:Y[:SCALe]:RLEVel:OFFSet
DISPlay:WINDow[1]:TRACe:Y[:SCALe]:RLEVel:OFFSet
DISPlay:WINDow[1]:TRACe:Y[:SCALe]:RLEVel:OFFSet
DISPlay:WINDow[1]:TRACe:Y[:SCALe]:RLEVel:OFFSet
DISPlay:WINDow[1]:TRACe:Y[:SCALe]:RLEVel:OFFSet
DISPlay:WINDow[1]:TRACe:Y[:SCALe]:RLEVel:OFFSet
DISPlay:WINDow[1]:TRACe:Y[:SCALe]:RLEVel:OFFSet
DISPlay:WINDow[1]:TRACe:Y[:SCALe]:RLEVel:OFFSet
DISPlay:WINDow[1]:TRACe:Y[:SCALe]:RLEVel:OFFSet
DISPlay:WINDow[1]:TRACe:Y[:SCALe]:RLEVel:OFFSet:STATe
DISPlay:WINDow[1]:TRACe:Y[:SCALe]:RLEVel:OFFSet:STATe
DISPlay:WINDow[1]:TRACe:Y[:SCALe]:RLEVel:OFFSet:STATe
DISPlay:WINDow[1]:TRACe:Y[:SCALe]:RLEVel:OFFSet:STATe
DISPlay:WINDow[1]:TRACe:Y[:SCALe]:RLEVel:OFFSet:STATe
DISPlay:WINDow[1]:TRACe:Y[:SCALe]:RLEVel:OFFSet:STATe
DISPlay:WINDow[1]:TRACe:Y[:SCALe]:RLEVel:OFFSet:STATe
DISPlay:WINDow[1]:TRACe:Y[:SCALe]:RLEVel:OFFSet:STATe
DISPlay:WINDow[1]:TRACe:Y[:SCALe]:RLEVel:OFFSet:STATe
DISPlay:WINDow[1]:TRACe:Y[:SCALe]:RLEVel:OFFSet:STATe
DISPlay:WINDow[1]:TRACe:Y[:SCALe]:SPACing
DISPlay:WINDow4:TRACe:TIME
DISPlay:WINDow:MAMarker[:STATe]
```

F

```
FETCh:<measurement>[n]?
FETCh:ACPower?
FETCh:CHPower:DENSity[n]?
FETCh:CHPower[n]?
FETCh:HARMonics:AMPLitude:ALL?
FETCh:HARMonics:AMPLitude[n]?
FETCh:HARMonics:DISTortion?
FETCh:HARMonics:FREQuency:ALL?
FETCh:HARMonics:FREQuency[n]?
FETCh:HARMonics:FUNDamental?
FETCh:HARMonics[n]?
FETCh:LIST?
FETCh:OBWidth:FERRor?
FETCh:OBWidth[n]?
FETCh:OBWidth:OBWidth?
FETCh:OBWidth:XDB?
FETCh:PAVTime[n]?
FETCh:PSTatistic?
FETCh:SANalyzer[n]?
FETCh:SEMask[n]?
FETCh:SPURious[n]?
FETCh:TOI:IP3?
```

FETCh:TOI[n]?
FETCh:TXPower|BPOWer[n]?
FORMat:BORDer
FORMat[:TRACe][:DATA]

H

HCOPy:ABORt
HCOPy[:IMMediate]

I

INITiate:<measurement>
INITiate:ACPower
INITiate:CHPower
INITiate:CONTinuous
INITiate:HARMonics
INITiate[:IMMediate]
INITiate:LIST
INITiate:OBWidth
INITiate:PAUSe
INITiate:PAVTime
INITiate:PSTatistic
INITiate:RESTart
INITiate:RESume
INITiate:SANalyzer
INITiate:SEMask
INITiate:SPURious
INITiate:TOI
INITiate:TXPower|BPOWer
INPut[1]:IQ[:I]:IMPedance
INPut[1]:IQ:Q:IMPedance
INPut:COUPling
INPut:COUPling:I
INPut:COUPling:Q
INPut:FEXTender:CABLe:CORRection
INPut:IMPedance:REFerence
INPut:IQ[:I]:DIFFerential
INPut:IQ:MIRRored
INPut:IQ:Q:DIFFerential
INPut:OFFSet:I
INPut:OFFSet:Q
INSTrument:CATalog?
INSTrument:CONFigure:<mode_id>:<meas>
INSTrument:COUPle:DEFault
INSTrument:COUPle:EMC:STANdard
INSTrument:COUPle:FREQuency:BAND:EXTend
INSTrument:COUPle:FREQuency:CENTer

```
INSTrument:COUPle:LLINe
INSTrument:COUPle:SCReen:INPut
INSTrument:DEFault
INSTrument:NSELect
INSTrument:SCReen:CATalog?
INSTrument:SCReen:CREate
INSTrument:SCReen:DELete
INSTrument:SCReen:DELete:ALL
INSTrument:SCReen:MULTiple?
INSTrument:SCReen:MULTiple[:STATe]
INSTrument:SCReen:ORIentation
INSTrument:SCReen:REName
INSTrument:SCReen:SELect
INSTrument:SCReen:STAB?
INSTrument[:SELect]
INSTrument[:SELect]
INSTrument[:SELect]
INSTrument[:SELect]
INSTrument[:SELect]
INSTrument[:SELect]
INSTrument[:SELect]
INSTrument:SOURce[:SELect]
INSTrument:UNLoad
```

L

```
LXI:IDENtify[:STATe]
```

M

```
MEASure:<measurement>[n]?
MEASure:ACPower[n]?
MEASure:CHPower:DENSity[n]?
MEASure:CHPower[n]?
MEASure:HARMonics:AMPLitude:ALL?
MEASure:HARMonics:AMPLitude[n]?
MEASure:HARMonics:DISTortion?
MEASure:HARMonics:FREQuency:ALL?
MEASure:HARMonics:FREQuency[n]?
MEASure:HARMonics:FUNDamental?
MEASure:HARMonics[n]?
MEASure:OBWidth:FERRor?
MEASure:OBWidth[n]?
MEASure:OBWidth:OBWidth?
MEASure:OBWidth:XDB?
MEASure:PAVTime[n]?
MEASure:PSTatistic[n]?
MEASure:SANalyzer[n]?
```

```
MEASure:SEMask[n]?
MEASure:SPURious[n]?
MEASure:TOI:IP3?
MEASure:TOI[n]?
MEASure:TXPower|BPOWer[n]?
MMEMory:CATalog?
MMEMory:CDIRectory
MMEMory:COPY
MMEMory:COPY:DEVice
MMEMory:DATA
MMEMory:DELete
MMEMory:HEADer:ID?
MMEMory:LOAD:CCORrection
MMEMory:LOAD:CORRection
MMEMory:LOAD:CORRection:GROup
MMEMory:LOAD:LIMit
MMEMory:LOAD:LOSS
MMEMory:LOAD:RESults:SPECtrogram
MMEMory:LOAD:RTYPe
MMEMory:LOAD:SCONfig
MMEMory:LOAD:STATe
MMEMory:LOAD:TRACe
MMEMory:LOAD:TRACe:DATA
MMEMory:LOAD:TRACe:REGister
MMEMory:LOAD:VCORrection
MMEMory:MDIRectory
MMEMory:MOVE
MMEMory:RDIRectory
MMEMory:REGister:STATe:LABel
MMEMory:REGister:TRACe:LABel
MMEMory:RMEDia:LABel
MMEMory:RMEDia:LIST?
MMEMory:RMEDia:SIZE?
MMEMory:RMEDia:WPRotect?
MMEMory:STORe:CORRection
MMEMory:STORe:CORRection:GROup
MMEMory:STORe:LIMit
MMEMory:STORe:PSCFactor
MMEMory:STORe:PSCFactor
MMEMory:STORe:QSAVe
MMEMory:STORe:RESults
MMEMory:STORe:RESults:MTABle
MMEMory:STORe:RESults:PTABle
MMEMory:STORe:RESults:SPECtrogram
MMEMory:STORe:SCONfig
MMEMory:STORe:SCReen
MMEMory:STORe:SCReen:BLOCked
MMEMory:STORe:SCReen:THEMe
MMEMory:STORe:STATe
MMEMory:STORe:TRACe
```

MMEMory:STORe:TRACe:DATA
MMEMory:STORe:TRACe:REGister

O

OUTPut:ANALog
OUTPut:ANALog:AUTO
OUTPut:ANALog:SVIDeo
OUTPut:AUX
OUTPut:AUX:AIF
OUTPut:AUX:IO
OUTPut:AUX:IO:DATA<n>
OUTPut:DBUS[1][:STATe]
OUTPut:DBUS2:DATA
OUTPut:DBUS2[:STATe]
OUTPut:EIF
OUTPut:EREFerence:OUTPut
OUTPut[:EXTernal]
OUTPut[:EXTernal][:STATe]
OUTPut:IF2
OUTPut:IQ:OUTPut
OUTPut:MODulation[:STATe]
OUTPut:ROSCillator:LO:OUTPut

R

READ:<measurement>[n]?
READ:ACPower[n]?
READ:CHPower:DENSity[n]?
READ:CHPower[n]?
READ:HARMonics:AMPLitude:ALL?
READ:HARMonics:AMPLitude[n]?
READ:HARMonics:DISTortion?
READ:HARMonics:FREQuency:ALL?
READ:HARMonics:FREQuency[n]?
READ:HARMonics:FUNDamental?
READ:HARMonics[n]?
READ:LIST?
READ:OBWidth:FERRor?
READ:OBWidth[n]?
READ:OBWidth:OBWidth?
READ:OBWidth:XDB?
READ:PAVTime[n]?
READ:PSTatistic[n]?
READ:SANalyzer[n]?
READ:SEMask[n]?
READ:SPURious[n]?
READ:TOI:IP3?

READ:TOI[n]?
READ:TXPower|BPOWer[n]?

S

[:SENSe]:<meas>:SWEep:ACQuisition:TIME
[:SENSe]:<meas>:SWEep:ACQuisition:TIME:AUTO
[:SENSe]:<meas>:SWEep:ETIMe?
[:SENSe]:<meas>:SWEep:TIME
[:SENSe]:<meas>:SWEep:TIME:AUTO
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[:SENSe]:ACPower:CARRier[1]|2:LIST:COUPle
[:SENSe]:ACPower:CARRier[1]|2:LIST:FILTer:ALPHa
[:SENSe]:ACPower:CARRier[1]|2:LIST:FILTer[:RRC][:STATe]
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[:SENSe]:ACPower:CARRier[1]|2:LIST:WIDTh
[:SENSe]:ACPower:CARRier[1]|2[:POWer]
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[:SENSe]:ACPower:CARRier[1]|2:RCARrier:ZBASe
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[:SENSe]:ACPower:CARRier[1]|2:RCFRequency:AUTO
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[:SENSe]:ACPower:DETector[:FUNCtion]
[:SENSe]:ACPower:FILTer:BANDwidth[:INTegration]
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[:SENSe]:ACPower:FREQuency:SYNThesis:AUTO[:STATe]
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[:SENSe]:ACPower:METHod
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[:SENSe]:ACPower:OFFSet[1]|2[:OUTer]:LIST:BANDwidth[:INTegration]

```
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[:SENSe]:ACPower:OFFSet[1]|2
[:OUTer]:LIST:BANDwidth:RESolution:AUTO
[:SENSe]:ACPower:OFFSet[1]|2[:OUTer]:LIST:BANDwidth:SHAPe
[:SENSe]:ACPower:OFFSet[1]|2[:OUTer]:LIST:BANDwidth:TYPE
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[:SENSe]:ACPower:OFFSet[1]|2[:OUTer]:LIST:BANDwidth:VIDeo:AUTO
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[:SENSe]:AFINput[1]|2:LOW
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[:SENSe]:BANDwidth|BWIDth:VIDeo:RATio:AUTO
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[:SENSe]:CCORrection:DATA?
```

```
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[:SENSe]:CHPower:BANDwidth:VIDeo:AUTO
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[:RESolution]:AUTO
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[:SENSe]:HARMonics:TONE[1]|2|…|10:STATe
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[:SENSe]:HARMonics:TONE[1]|2|…|10:SWEep:TIME:AUTO
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```

```
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[:SENSe]:OBWidth:BANDwidth:VIDeo:AUTO
```

```
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[:SENSe]:OBWidth:PERCent
[:SENSe]:OBWidth:PREFerence
[:SENSe]:OBWidth:SAVoid[:STATe]
[:SENSe]:OBWidth:SWEep:POINts
[:SENSe]:OBWidth:SWEep:TIME:AUTO:RULes
[:SENSe]:OBWidth:XDB
[:SENSe]:PAVTime:FERRor
[:SENSe]:PAVTime:FERRor:CORRection[:STATe]
[:SENSe]:PAVTime:FERRor:IMMediate
[:SENSe]:PAVTime:FERRor:TIME
[:SENSe]:PAVTime:IF:GAIN:AUTO[:STATe]
[:SENSe]:PAVTime:IF:GAIN[:STATe]
[:SENSe]:PAVTime:MTIMe?
[:SENSe]:PAVTime:SEGMents
[:SENSe]:PAVTime:SEGMents:INTerval
[:SENSe]:PAVTime:SEGMents:OFFSet
[:SENSe]:PAVTime:SEGMents:TRANsient
[:SENSe]:PAVTime:SYNC
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[:SENSe]:POWer:IQ:Q:RANGe[:UPPer]
[:SENSe]:POWer:IQ:RANGe:AUTO
[:SENSe]:POWer[:RF]:ATTenuation
[:SENSe]:POWer[:RF]:ATTenuation:AUTO
[:SENSe]:POWer[:RF]:ATTenuation:STEP[:INCRement]
[:SENSe]:POWer[:RF]:EATTenuation
[:SENSe]:POWer[:RF]:EATTenuation:STATe
[:SENSe]:POWer[:RF]:FRATten
[:SENSe]:POWer[:RF]:GAIN:BAND
[:SENSe]:POWer[:RF]:GAIN:LNA[:STATe]
[:SENSe]:POWer[:RF]:GAIN[:STATe]
[:SENSe]:POWer[:RF]:MIXer:RANGe[:UPPer]
[:SENSe]:POWer[:RF]:MIXer:RULEs
[:SENSe]:POWer[:RF]:MW:PATH
[:SENSe]:POWer[:RF]:MW:PATH:AUTO
[:SENSe]:POWer[:RF]:PADJust
[:SENSe]:POWer[:RF]:PCENter
[:SENSe]:POWer[:RF]:RANGe
[:SENSe]:POWer[:RF]:RANGe:MIXer:OFFSet
[:SENSe]:POWer[:RF]:RANGe:OPTimize
[:SENSe]:POWer[:RF]:RANGe:OPTimize
[:SENSe]:POWer[:RF]:RANGe:OPTimize:ATTenuation
[:SENSe]:POWer[:RF]:RANGe:OPTimize:ATTenuation
```

```
[:SENSe]:POWer[:RF]:RANGe:OPTimize:TYPE
[:SENSe]:POWer[:RF]:RANGe:PARatio
[:SENSe]:POWer[:RF]:RFPSelector:NFILter[:STATe]
[:SENSe]:POWer[:RF]:RFPSelector[:STATe]
[:SENSe]:POWer[:RF]:SWPResel
[:SENSe]:POWer[:RF]:SWPResel:BW
[:SENSe]:POWer[:RF]:SWPresel:STAT?
[:SENSe]:POWer[:RF]:SWPResel:STATe
[:SENSe]:PSTatistic:BANDwidth
[:SENSe]:PSTatistic:BANDwidth:AUTO
[:SENSe]:PSTatistic:COUNts
[:SENSe]:PSTatistic:IF:GAIN:AUTO[:STATe]
[:SENSe]:PSTatistic:IF:GAIN[:STATe]
[:SENSe]:PSTatistic:SWEep:CYCLes
[:SENSe]:PSTatistic:SWEep:TIME
[:SENSe]:PSTatistic:URATio
[:SENSe]:RADio:STANdard:BAND:CLASs
[:SENSe]:RADio:STANdard:DEVice
[:SENSe]:RADio:STANdard:EAMeas
[:SENSe]:RADio:STANdard:PACKet
[:SENSe]:RADio:STANdard[:SELect]
[:SENSe]:ROSCillator:BANDwidth
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[:SENSe]:ROSCillator:EXTernal:FREQuency:DEFault
[:SENSe]:ROSCillator:LO:INPut
[:SENSe]:ROSCillator:PXIReference:EXTernal:FREQuency
[:SENSe]:ROSCillator:PXIReference:EXTernal:LOCK?
[:SENSe]:ROSCillator:PXIReference:SELect
[:SENSe]:ROSCillator:PXIReference:SOURce
[:SENSe]:ROSCillator:SOURce?
[:SENSe]:ROSCillator:SOURce:TYPE
[:SENSe]:SEMask:AVERage:CARRier:TYPE
[:SENSe]:SEMask:AVERage:COUNt
[:SENSe]:SEMask:AVERage:OFFSet:TYPE
[:SENSe]:SEMask:AVERage[:STATe]
[:SENSe]:SEMask:BANDwidth[1]|2:INTegration
[:SENSe]:SEMask:BANDwidth[1]|2[:RESolution]
[:SENSe]:SEMask:BANDwidth[1]|2[:RESolution]:AUTO
[:SENSe]:SEMask:BANDwidth[1]|2:VIDeo
[:SENSe]:SEMask:BANDwidth[1]|2:VIDeo:AUTO
[:SENSe]:SEMask:BANDwidth[1]|2:VIDeo:RATio
[:SENSe]:SEMask:BANDwidth[1]|2:VIDeo:RATio:AUTO
[:SENSe]:SEMask:BANDwidth:SHAPe
[:SENSe]:SEMask:CARRier:AUTO[:STATe]
[:SENSe]:SEMask:CARRier:CPSD
[:SENSe]:SEMask:CARRier:PEAK[:POWer]
[:SENSe]:SEMask:CARRier[:POWer]
[:SENSe]:SEMask:DETector:CARRier:AUTO
[:SENSe]:SEMask:DETector:CARRier[:FUNCtion]
[:SENSe]:SEMask:DETector:OFFSet:AUTO
```

```
[:SENSe]:SEMask:DETector:OFFSet[:FUNCtion]
[:SENSe]:SEMask:FILTer[:RRC]:ALPHa
[:SENSe]:SEMask:FILTer[:RRC][:STATe]
[:SENSe]:SEMask:FREQuency[1]|2:SPAN
[:SENSe]:SEMask:FREQuency[1]|2:SPAN:AUTO
[:SENSe]:SEMask:NCONtiguous:REGion
[:SENSe]:SEMask:OFFSet[1]|2:INNer:CMASk:FREQuency:STOP
[:SENSe]:SEMask:OFFSet[1]|2:INNer:CMASk[:STATe]
[:SENSe]:SEMask:OFFSet[1]|2:INNer:LIST:BANDwidth:IMULti
[:SENSe]:SEMask:OFFSet[1]|2:INNer:LIST:BANDwidth[:RESolution]
[:SENSe]:SEMask:OFFSet[1]|2:INNer:LIST:BANDwidth
[:RESolution]:AUTO
[:SENSe]:SEMask:OFFSet[1]|2:INNer:LIST:BANDwidth:VIDeo
[:SENSe]:SEMask:OFFSet[1]|2:INNer:LIST:BANDwidth:VIDeo:AUTO
[:SENSe]:SEMask:OFFSet[1]|2:INNer:LIST:FREQuency:STARt
[:SENSe]:SEMask:OFFSet[1]|2:INNer:LIST:FREQuency:STOP
[:SENSe]:SEMask:OFFSet[1]|2:INNer:LIST:SIDE
[:SENSe]:SEMask:OFFSet[1]|2:INNer:LIST:STARt:ABSolute
[:SENSe]:SEMask:OFFSet[1]|2:INNer:LIST:STARt:RCARrier
[:SENSe]:SEMask:OFFSet[1]|2:INNer:LIST:STARt:SABSolute
[:SENSe]:SEMask:OFFSet[1]|2:INNer:LIST:STATe
[:SENSe]:SEMask:OFFSet[1]|2:INNer:LIST:STOP:ABSolute
[:SENSe]:SEMask:OFFSet[1]|2:INNer:LIST:STOP:ABSolute:COUPle
[:SENSe]:SEMask:OFFSet[1]|2:INNer:LIST:STOP:RCARrier
[:SENSe]:SEMask:OFFSet[1]|2:INNer:LIST:STOP:RCARrier:COUPle
[:SENSe]:SEMask:OFFSet[1]|2:INNer:LIST:STOP:SABSolute
[:SENSe]:SEMask:OFFSet[1]|2:INNer:LIST:STOP:SABSolute:COUPle
[:SENSe]:SEMask:OFFSet[1]|2:INNer:LIST:SWEep:ACQuisition:TIME
[:SENSe]:SEMask:OFFSet
[1]|2:INNer:LIST:SWEep:ACQuisition:TIME:AUTO
[:SENSe]:SEMask:OFFSet[1]|2:INNer:LIST:SWEep:ETIMe?
[:SENSe]:SEMask:OFFSet[1]|2:INNer:LIST:SWEep:TIME
[:SENSe]:SEMask:OFFSet[1]|2:INNer:LIST:SWEep:TIME:AUTO
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[:SENSe]:SEMask:OFFSet[1]|2:INNer:LIST:SWEep:TYPE:AUTO
[:SENSe]:SEMask:OFFSet[1]|2:INNer:LIST:TEST
[:SENSe]:SEMask:OFFSet[1]|2:INNer:LIST:TEST:SABSolute
[:SENSe]:SEMask:OFFSet[1]|2:INNer:TYPE
[:SENSe]:SEMask:OFFSet[1]|2[:OUTer]:LIST:BANDwidth:IMULti
[:SENSe]:SEMask:OFFSet[1]|2[:OUTer]:LIST:BANDwidth[:RESolution]
[:SENSe]:SEMask:OFFSet[1]|2[:OUTer]:LIST:BANDwidth
[:RESolution]:AUTO
[:SENSe]:SEMask:OFFSet[1]|2[:OUTer]:LIST:BANDwidth:VIDeo
[:SENSe]:SEMask:OFFSet[1]|2[:OUTer]:LIST:BANDwidth:VIDeo:AUTO
[:SENSe]:SEMask:OFFSet[1]|2[:OUTer]:LIST:BANDwidth:VIDeo:RATio
[:SENSe]:SEMask:OFFSet[1]|2
[:OUTer]:LIST:BANDwidth:VIDeo:RATio:AUTO
[:SENSe]:SEMask:OFFSet[1]|2[:OUTer]:LIST:FREQuency:STARt
[:SENSe]:SEMask:OFFSet[1]|2[:OUTer]:LIST:FREQuency:STOP
[:SENSe]:SEMask:OFFSet[1]|2[:OUTer]:LIST:SIDE
```

```
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[:SENSe]:SEMask:OFFSet[1]|2[:OUTer]:LIST:STARt:RCARrier
[:SENSe]:SEMask:OFFSet[1]|2[:OUTer]:LIST:STARt:SABSolute
[:SENSe]:SEMask:OFFSet[1]|2[:OUTer]:LIST:STATe
[:SENSe]:SEMask:OFFSet[1]|2[:OUTer]:LIST:STOP:ABSolute
[:SENSe]:SEMask:OFFSet[1]|2[:OUTer]:LIST:STOP:ABSolute:COUPle
[:SENSe]:SEMask:OFFSet[1]|2[:OUTer]:LIST:STOP:RCARrier
[:SENSe]:SEMask:OFFSet[1]|2[:OUTer]:LIST:STOP:RCARrier:COUPle
[:SENSe]:SEMask:OFFSet[1]|2[:OUTer]:LIST:STOP:SABSolute
[:SENSe]:SEMask:OFFSet[1]|2[:OUTer]:LIST:STOP:SABSolute:COUPle
[:SENSe]:SEMask:OFFSet[1]|2[:OUTer]:LIST:SWEep:ACQuisition:TIME
[:SENSe]:SEMask:OFFSet[1]|2
[:OUTer]:LIST:SWEep:ACQuisition:TIME:AUTO
[:SENSe]:SEMask:OFFSet[1]|2[:OUTer]:LIST:SWEep:ETIMe?
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[:SENSe]:SEMask:OFFSet[1]|2[:OUTer]:LIST:SWEep:TIME:AUTO
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[:SENSe]:SEMask:OFFSet[1]|2[:OUTer]:LIST:SWEep:TYPE:AUTO
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[:SENSe]:SEMask:OFFSet[1]|2[:OUTer]:LIST:TEST:SABSolute
[:SENSe]:SEMask:OFFSet[1]|2[:OUTer]:TYPE
[:SENSe]:SEMask:OFFSet[1]|2:TYPE
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[:SENSe]:SEMask:SWEep[1]|2:TIME:AUTO
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[:SENSe]:SEMask:SWEep:ACQuisition:TIME:AUTO
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[:SENSe]:SEMask:TYPE
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[:SENSe]:SIDentify[:STATe]
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[:SENSe]:SPURious:AVERage[:STATe]
[:SENSe]:SPURious:AVERage:TCONtrol
[:SENSe]:SPURious:AVERage:TYPE
[:SENSe]:SPURious:FSMeas
[:SENSe]:SPURious:IF:GAIN:AUTO[:STATe]
[:SENSe]:SPURious:IF:GAIN[:STATe]
[:SENSe]:SPURious[:RANGe]:ALL:SWEep:TYPE:AUTO
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[:SENSe]:SPURious[:RANGe][:LIST]:ATTenuation:AUTO
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[:SENSe]:SPURious[:RANGe][:LIST]:BANDwidth[:RESolution]
[:SENSe]:SPURious[:RANGe][:LIST]:BANDwidth[:RESolution]:AUTO
[:SENSe]:SPURious[:RANGe][:LIST]:BANDwidth:SHAPe
```

```
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[:SENSe]:SPURious[:RANGe][:LIST]:BANDwidth:VIDeo:AUTO
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[:SENSe]:SPURious[:RANGe][:LIST]:FREQuency:STARt
[:SENSe]:SPURious[:RANGe][:LIST]:FREQuency:STOP
[:SENSe]:SPURious[:RANGe][:LIST]:FREQuency:STOP
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[:SENSe]:SPURious[:RANGe][:LIST]:OFFSet:FREQuency:STOP
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[:SENSe]:SPURious[:RANGe][:LIST]:PEAK:THReshold
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[:SENSe]:SPURious[:RANGe][:LIST]:SWEep:POINts
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[:SENSe]:SWEep:ACQuisition:TIME:AUTO
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[:SENSe]:SWEep:EGATe[:STATe]
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[:SENSe]:SWEep:EGATe:VIEW:STARt
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[:SENSe]:SWEep:FFT:WIDTh:AUTO
[:SENSe]:SWEep:IF:DITHer
[:SENSe]:SWEep:IF:DITHer
[:SENSe]:SWEep:IF:DITHer
[:SENSe]:SWEep:IMAGeprot
[:SENSe]:SWEep:IMAGeprot
[:SENSe]:SWEep:IMAGeprot
[:SENSe]:SWEep:POINts
[:SENSe]:SWEep:TIME
[:SENSe]:SWEep:TIME:ANNotation
```

[:SENSe]:SWEep:TIME:ANNotation:AUTO
[:SENSe]:SWEep:TIME:AUTO
[:SENSe]:SWEep:TIME:AUTO:RULes
[:SENSe]:SWEep:TIME:AUTO:RULes:AUTO[:STATe]
[:SENSe]:SWEep:TYPE
[:SENSe]:SWEep:TYPE:AUTO
[:SENSe]:SWEep:TYPE:AUTO:RULes
[:SENSe]:SWEep:TYPE:AUTO:RULes:AUTO[:STATe]
[:SENSe]:SWEep:TZOom:POINts
[:SENSe]:SWEep:TZOom:TIME
[:SENSe]:SWEep:TZO:TIME?
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[:SENSe]:TOI:AVERage[:STATe]
[:SENSe]:TOI:AVERage[:STATe]
[:SENSe]:TOI:AVERage:TCONtrol
[:SENSe]:TOI:BANDwidth|BWIDth[:RESolution]
[:SENSe]:TOI:BANDwidth|BWIDth[:RESolution]:AUTO
[:SENSe]:TOI:BANDwidth|BWIDth:VIDeo
[:SENSe]:TOI:BANDwidth:VIDeo:AUTO
[:SENSe]:TOI:BANDwidth:VIDeo:RATio
[:SENSe]:TOI:BANDwidth:VIDeo:RATio:AUTO
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[:SENSe]:TOI:FREQuency:BASE:LOWer:AUTO
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[:SENSe]:TOI:FREQuency:BASE:UPPer:AUTO
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[:SENSe]:TOI:FREQuency:SPAN:BANDwidth[:RESolution]:RATio
[:SENSe]:TOI:FREQuency:SPAN:BANDwidth[:RESolution]:RATio:AUTO
[:SENSe]:TOI:FREQuency:TUNE:IMMediate
[:SENSe]:TOI:SWEep:POINts
[:SENSe]:TOI:SWEep:TIME
[:SENSe]:TOI:SWEep:TIME:AUTO
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[:SENSe]:TOI:ZSPan:BANDwidth|BWIDth:AUTO
[:SENSe]:TOI:ZSPan:STATe
[:SENSe]:TOI:ZSPan:SWEep:TIME
[:SENSe]:TOI:ZSPan:SWEep:TIME:AUTO
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[:SENSe]:TXPower:AVERage[:STATe]
[:SENSe]:TXPower:AVERage:TCONtrol
[:SENSe]:TXPower:AVERage:TYPE
[:SENSe]:TXPower:BANDwidth[:RESolution]
[:SENSe]:TXPower:BANDwidth:TYPE
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[:SENSe]:TXPower:BURSt:WIDTh
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[:SENSe]:TXPower:IF:GAIN[:STATe]
[:SENSe]:TXPower:METHod
[:SENSe]:TXPower:SWEep:TIME
[:SENSe]:TXPower:THReshold

```
[:SENSe]:TXPower:THReshold:TYPE
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[:SENSe]:VCORrection:SELect
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[:SENSe]:VOLTage:IQ:Q:RANGe[:UPPer]
[:SENSe]:VOLTage:IQ:RANGe:AUTO
SERVice[:PRODuction]:SOURce:MCONtrol:MPLicense[:STATe]
SOURce:AM[:DEPTh][:LINear]
SOURce:AM:INTernal:FREQuency
SOURce:AM:INTernal:FREQuency:STEP[:INCRement]
SOURce:AM:STATe
SOURce:CORRection:OFFSet
SOURce[:EXTernal]:POWer[:LEVel][:IMMediate][:AMPLitude]
SOURce:FM[:DEViation]
SOURce:FM:INTernal:FREQuency
SOURce:FM:INTernal:FREQuency:STEP[:INCRement]
SOURce:FM:STATe
SOURce:FREQuency:CHANnels:BAND
SOURce:FREQuency:CHANnels:NUMBer
SOURce:FREQuency:COUPling
SOURce:FREQuency:COUPling:OFFSet
SOURce:FREQuency[:CW]
SOURce:FREQuency[:MULTiplier]:DENominator
SOURce:FREQuency[:MULTiplier]:NUMerator
SOURce:FREQuency:OFFSet
SOURce:FREQuency:OFFSet
SOURce:FREQuency:OFFSet:STATe
SOURce:FREQuency:REFerence
SOURce:FREQuency:REFerence:SET
SOURce:FREQuency:REFerence:STATe
SOURce:FREQuency:SSReverse
SOURce:FREQuency:STEP[:INCRement]
SOURce:LIST:INITiation:ARMed?
SOURce:LIST:NUMBer:STEPs
SOURce:LIST:REPetition:TYPE
SOURce:LIST:SETup:AMPLitude
SOURce:LIST:SETup:CLEar
SOURce:LIST:SETup:CNFRequency
SOURce:LIST:SETup:DURation:TYPE
SOURce:LIST:SETup:INPut:TRIGger
SOURce:LIST:SETup:OUTPut:TRIGger
SOURce:LIST:SETup:RADio:BAND
SOURce:LIST:SETup:RADio:BAND:LINK
SOURce:LIST:SETup:TOCount
SOURce:LIST:SETup:TRANsition:TIME
SOURce:LIST:SETup:WAVeform
SOURce:LIST[:STATe]
SOURce:LIST:STEP[1]|2|…|1000:SETup
SOURce:LIST:STEP[1]|2|…|1000:SETup:AMPLitude
SOURce:LIST:STEP[1]|2|…|1000:SETup:CNFRequency
```

```
SOURce:LIST:STEP[1]|2|…|1000:SETup:DURation:TCOunt
SOURce:LIST:STEP[1]|2|…|1000:SETup:DURation:TCOunt
SOURce:LIST:STEP[1]|2|…|1000:SETup:DURation:TYPE
SOURce:LIST:STEP[1]|2|…|1000:SETup:INPut:TRIGger
SOURce:LIST:STEP[1]|2|…|1000:SETup:OUTPut:TRIGger
SOURce:LIST:STEP[1]|2|…|1000:SETup:RADio:BAND
SOURce:LIST:STEP[1]|2|…|1000:SETup:RADio:BAND:LINK
SOURce:LIST:STEP[1]|2|…|1000:SETup:TRANsition:TIME
SOURce:LIST:STEP[1]|2|…|1000:SETup:WAVeform
SOURce:LIST:TRIGger[:IMMediate]
SOURce:LIST:TRIGger:INITiate[:IMMediate]
SOURce:LIST:TRIGger:OUTPut:TYPE
SOURce:LIST:TRIGger:OUTPut:TYPE:MARKer
SOURce:NOISe:SNS:ATTached?
SOURce:NOISe[:STATe]
SOURce:NOISe:TYPE
SOURce:PM[:DEViation]
SOURce:PM:INTernal:FREQuency
SOURce:PM:INTernal:FREQuency:STEP[:INCRement]
SOURce:PM:STATe
SOURce:POWer[:LEVel][:IMMediate][:AMPLitude]
SOURce:POWer[:LEVel][:IMMediate][:AMPLitude]:UNIT
SOURce:POWer[:LEVel][:IMMediate]:OFFSet
SOURce:POWer:REFerence
SOURce:POWer:REFerence:STATe
SOURce:POWer:STEP:AUTO
SOURce:POWer:STEP[:INCRement]
SOURce:POWer:STEP[:INCRement]
SOURce:POWer:SWEep
SOURce:POWer:SWEep:STATe
SOURce:POWer:TRCKing
SOURce:POWer:TRCKing:PEAK
SOURce:PRESet
SOURce:PRESet
SOURce:RADio:ARB:BASeband:FREQuency:OFFSet
SOURce:RADio:ARB:BASeband:POWer
SOURce:RADio:ARB:CATalog?
SOURce:RADio:ARB:CATalog?
SOURce:RADio:ARB:DEFault:DIRectory
SOURce:RADio:ARB:DELete
SOURce:RADio:ARB:DELete:ALL
SOURce:RADio:ARB:FCATalog?
SOURce:RADio:ARB:FCATalog?
SOURce:RADio:ARB:HEADer:CLEar
SOURce:RADio:ARB:HEADer:INFormation?
SOURce:RADio:ARB:HEADer:SAVE
SOURce:RADio:ARB:IQADjustment:DELay
SOURce:RADio:ARB:IQADjustment:GAIN
SOURce:RADio:ARB:IQADjustment:[STATe]
SOURce:RADio:ARB:LOAD
```

SOURce:RADio:ARB:LOAD:ALL
SOURce:RADio:ARB:MDEStination:ALCHold
SOURce:RADio:ARB:MDEStination:PULSe
SOURce:RADio:ARB:MPLicensed:NAME:LOCKed?
SOURce:RADio:ARB:MPLicensed:UID:LOCKed?
SOURce:RADio:ARB:MPOLarity:MARKer1|…|4
SOURce:RADio:ARB:NR5G:PHASe:FILTer:BANDwidth
SOURce:RADio:ARB:NR5G:PHASe:FILTer[:STATe]
SOURce:RADio:ARB:NR5G:PHASe:SCS
SOURce:RADio:ARB:NR5G:PHASe[:STATe]
SOURce:RADio:ARB:RETRigger
SOURce:RADio:ARB:RMS
SOURce:RADio:ARB:RMS:CALCulate
SOURce:RADio:ARB:RMS:CALCulation:MODE
SOURce:RADio:ARB:RSCaling
SOURce:RADio:ARB:SCLock:RATE
SOURce:RADio:ARB:SEQuence[:MWAVeform]
SOURce:RADio:ARB:SEQuence:SYNC
SOURce:RADio:ARB[:STATe]
SOURce:RADio:ARB:TRIGger:INITiate
SOURce:RADio:ARB:TRIGger[:SOURce]
SOURce:RADio:ARB:TRIGger[:SOURce]:EXTernal:DELay
SOURce:RADio:ARB:TRIGger[:SOURce]:EXTernal:DELay:STATe
SOURce:RADio:ARB:TRIGger[:SOURce]:EXTernal:SLOPe
SOURce:RADio:ARB:TRIGger[:SOURce]:PXI:DELay
SOURce:RADio:ARB:TRIGger[:SOURce]:PXI:DELay:STATe
SOURce:RADio:ARB:TRIGger[:SOURce]:PXI:LINE
SOURce:RADio:ARB:TRIGger[:SOURce]:PXI:SLOPe
SOURce:RADio:ARB:TRIGger:SYNC[:STATe]
SOURce:RADio:ARB:TRIGger:TYPE
SOURce:RADio:ARB:TRIGger:TYPE:CONTinuous[:TYPE]
SOURce:RADio:ARB:TRIGger:TYPE:SADVance[:TYPE]
SOURce:RADio:ARB:WAVeform
SOURce:RADio:BAND:LINK
SOURce:SETtings?
SOURce:STATe:RESTore
SOURce:SYNC:CONFig
SOURce:SYNC:CONNected?
SOURce:SYNC:REMote:ADDRess
SOURce:SYNC:REMote:ADDRess:ADD
SOURce:SYNC:REMote:ADDRess:DELete
SOURce:SYNC:REMote:IPPort
SOURce:SYNC:REMote:SEC<integer>?
SOURce:SYNC:REMote:SECondary<integer>
SOURce:SYNC:RTSetting:STATe
SOURce:SYNC:SETTings:ENABle
SOURce:SYNC:SETTings:SEGMent2:ENABle
SOURce:SYNC:SETTings:SEGMent2:FREQuency
SOURce:SYNC:STARt
SOURce:SYNC:STOP
SOURce:SYNC:TYPE

```
SOURce:TRIGger:TYPE
STATus:OPERation:CONDition?
STATus:OPERation:ENABle
STATus:OPERation:ENABle
STATus:OPERation[:EVENt]?
STATus:OPERation:INSTrument:CONDition?
STATus:OPERation:INSTrument:ENABle
STATus:OPERation:INSTrument[:EVENt]?
STATus:OPERation:INSTrument:NTRansition
STATus:OPERation:INSTrument:PTRansition
STATus:OPERation:NTRansition
STATus:OPERation:PTRansition
STATus:PRESet
STATus:QUEStionable:CALibration:CONDition?
STATus:QUEStionable:CALibration:ENABle
STATus:QUEStionable:CALibration[:EVENt]?
STATus:QUEStionable:CALibration:EXTended:FAILure:CONDition?
STATus:QUEStionable:CALibration:EXTended:FAILure:ENABle
STATus:QUEStionable:CALibration:EXTended:FAILure[:EVENt]?
STATus:QUEStionable:CALibration:EXTended:FAILure:NTRansition
STATus:QUEStionable:CALibration:EXTended:FAILure:PTRansition
STATus:QUEStionable:CALibration:EXTended:NEEDed:CONDition?
STATus:QUEStionable:CALibration:EXTended:NEEDed:ENABle
STATus:QUEStionable:CALibration:EXTended:NEEDed[:EVENt]?
STATus:QUEStionable:CALibration:EXTended:NEEDed:NTRansition
STATus:QUEStionable:CALibration:EXTended:NEEDed:PTRansition
STATus:QUEStionable:CALibration:NTRansition
STATus:QUEStionable:CALibration:PTRansition
STATus:QUEStionable:CALibration:SKIPped:CONDition?
STATus:QUEStionable:CALibration:SKIPped:ENABle
STATus:QUEStionable:CALibration:SKIPped[:EVENt]?
STATus:QUEStionable:CALibration:SKIPped:NTRansition
STATus:QUEStionable:CALibration:SKIPped:PTRansition
STATus:QUEStionable:CONDition?
STATus:QUEStionable:ENABle
STATus:QUEStionable[:EVENt]?
STATus:QUEStionable:FREQuency:CONDition?
STATus:QUEStionable:FREQuency:ENABle
STATus:QUEStionable:FREQuency[:EVENt]?
STATus:QUEStionable:FREQuency:NTRansition
STATus:QUEStionable:FREQuency:PTRansition
STATus:QUEStionable:INTegrity:CONDition?
STATus:QUEStionable:INTegrity:ENABle
STATus:QUEStionable:INTegrity[:EVENt]?
STATus:QUEStionable:INTegrity:NTRansition
STATus:QUEStionable:INTegrity:OUTPut:CONDition?
STATus:QUEStionable:INTegrity:OUTPut:ENABle
STATus:QUEStionable:INTegrity:OUTPut[:EVENt]?
STATus:QUEStionable:INTegrity:OUTPut:NTRansition
STATus:QUEStionable:INTegrity:OUTPut:PTRansition
```

```
STATus:QUEStionable:INTegrity:PTRansition
STATus:QUEStionable:INTegrity:SIGNal:CONDition?
STATus:QUEStionable:INTegrity:SIGNal:ENABle
STATus:QUEStionable:INTegrity:SIGNal[:EVENt]?
STATus:QUEStionable:INTegrity:SIGNal:NTRansition
STATus:QUEStionable:INTegrity:SIGNal:PTRansition
STATus:QUEStionable:INTegrity:UNCalibrated:CONDition?
STATus:QUEStionable:INTegrity:UNCalibrated:ENABle
STATus:QUEStionable:INTegrity:UNCalibrated[:EVENt]?
STATus:QUEStionable:INTegrity:UNCalibrated:NTRansition
STATus:QUEStionable:INTegrity:UNCalibrated:PTRansition
STATus:QUEStionable:NTRansition
STATus:QUEStionable:POWer:CONDition?
STATus:QUEStionable:POWer:ENABle
STATus:QUEStionable:POWer[:EVENt]?
STATus:QUEStionable:POWer:NTRansition
STATus:QUEStionable:POWer:PTRansition
STATus:QUEStionable:POWer:PTRansition?>
STATus:QUEStionable:PTRansition
STATus:QUEStionable:TEMPerature:CONDition?
STATus:QUEStionable:TEMPerature:ENABle
STATus:QUEStionable:TEMPerature[:EVENt]?
STATus:QUEStionable:TEMPerature:NTRansition
STATus:QUEStionable:TEMPerature:PTRansition
SYSTem:APPLication:CATalog[:NAME]?
SYSTem:APPLication:CATalog[:NAME]:COUNt?
SYSTem:APPLication:CATalog:OPTion?
SYSTem:APPLication:CATalog:REVision?
SYSTem:APPLication[:CURRent][:NAME]?
SYSTem:APPLication[:CURRent]:OPTion?
SYSTem:APPLication[:CURRent]:REVision?
SYSTem:APPLication:LOADed?
SYSTem:CALibration:ABORt
SYSTem:CALibration:CGRoup
SYSTem:CALibration:CGRoup:APPLy
SYSTem:CALibration:CGRoup:APPLy:AOFF
SYSTem:CALibration:CGRoup:COPY
SYSTem:CALibration:CGRoup:COPY:FROM
SYSTem:CALibration:DELete:ALL
SYSTem:CALibration:DESCription
SYSTem:CALibration:FREQuency:OFFSet
SYSTem:CALibration:INITiate:SELected
SYSTem:CALibration:INPut
SYSTem:CALibration:MODule[1]|2|...|10:SNUMber?
SYSTem:CALibration:MODule:SELect
SYSTem:CALibration:REFerence
SYSTem:CALibration:ROW[1]|2|…|100:APPLy:STATe
SYSTem:CALibration:ROW[1]|2|…|100:ATTenuation:STARt
SYSTem:CALibration:ROW[1]|2|…|100:ATTenuation:STEP
SYSTem:CALibration:ROW[1]|2|…|100:ATTenuation:STOP
SYSTem:CALibration:ROW[1]|2|…|100:ATTenuation:TYPE
```

```
SYSTem:CALibration:ROW[1]|2|…|100:CALibrate:STATe
SYSTem:CALibration:ROW[1]|2|…|100:CAPPlied?
SYSTem:CALibration:ROW[1]|2|…|100:COUPling
SYSTem:CALibration:ROW[1]|2|…|100:DELete
SYSTem:CALibration:ROW[1]|2|…|100:DUPLicate
SYSTem:CALibration:ROW[1]|2|…|100:EATTenuation:STARt
SYSTem:CALibration:ROW[1]|2|…|100:EATTenuation:STEP
SYSTem:CALibration:ROW[1]|2|…|100:EATTenuation:STOP
SYSTem:CALibration:ROW[1]|2|…|100:EATTenuation:TYPE
SYSTem:CALibration:ROW[1]|2|…|100:FATTenuation:STARt
SYSTem:CALibration:ROW[1]|2|…|100:FATTenuation:STOP
SYSTem:CALibration:ROW[1]|2|…|100:FATTenuation:TYPE
SYSTem:CALibration:ROW[1]|2|…|100:FEATtenuation:STARt
SYSTem:CALibration:ROW[1]|2|…|100:FEATtenuation:STEP
SYSTem:CALibration:ROW[1]|2|…|100:FEATtenuation:STOP
SYSTem:CALibration:ROW[1]|2|…|100:FEATtenuation:TYPE
SYSTem:CALibration:ROW[1]|2|…|100:FREQuency:POINts
SYSTem:CALibration:ROW[1]|2|…|100:FREQuency:STARt
SYSTem:CALibration:ROW[1]|2|…|100:FREQuency:STEP
SYSTem:CALibration:ROW[1]|2|…|100:FREQuency:STOP
SYSTem:CALibration:ROW[1]|2|…|100:FREQuency:SYNThesis:ALL[:STATe]
SYSTem:CALibration:ROW[1]|2|…|100:FREQuency:SYNThesis[:STATe]
SYSTem:CALibration:ROW[1]|2|…|100:IF:GAIN[:STATe]?
SYSTem:CALibration:ROW[1]|2|…|100:IF:GAIN
[:STATe]AUTO|HIGH|LOW|ALL
SYSTem:CALibration:ROW[1]|2|…|100:IF:PATH
SYSTem:CALibration:ROW[1]|2|…|100:INSert
SYSTem:CALibration:ROW[1]|2|…|100:LAST?
SYSTem:CALibration:ROW[1]|2|…|100:LO:MMODe
SYSTem:CALibration:ROW[1]|2|…|100:MATCh[:STATe]
SYSTem:CALibration:ROW[1]|2|…|100:NAME
SYSTem:CALibration:ROW[1]|2|…|100:POWer:GAIN:BAND?
SYSTem:CALibration:ROW[1]|2|…|100:POWer[:RF]:GAIN:BAND
SYSTem:CALibration:ROW[1]|2|…|100:POWer[:RF]:GAIN:LNA[:STATe]
SYSTem:CALibration:ROW[1]|2|…|100:POWer[:RF]:MW:PATH
SYSTem:CALibration:ROW[1]|2|…|100:STATus?
SYSTem:CALibration:ROW[1]|2|…|100:TYPE
SYSTem:CALibration:ROW[1]|2|…|100:UCMeas
SYSTem:CALibration:STATus:ALL?
SYSTem:CALibration:TUNE:FREQuency
SYSTem:CALibration:TUNE:OUTput[:STATe]
SYSTem:CALibration:TUNE:REFerence
SYSTem:CALibration:TUNE[:SELected]
SYSTem:CALibration:TUNE:SPACing
SYSTem:CALibration:TUNE:TYPE
SYSTem:COMMunicate:GPIB[1][:SELF]:ADDRess
SYSTem:COMMunicate:GPIB[1][:SELF]:CONTroller[:ENABle]
SYSTem:COMMunicate:LAN:INSTrument:PORT?
SYSTem:COMMunicate:LAN:IPV4:CONFig
SYSTem:COMMunicate:LAN:IPV6:CONFig
```

```
SYSTem:COMMunicate:LAN:MULTiple:NIC:ENABled?
SYSTem:COMMunicate:LAN:PHYSical:IPADdress:LIST?
SYSTem:COMMunicate:LAN:SCPI:EOSession:DCLEar:ENABle
SYSTem:COMMunicate:LAN:SCPI:HISLip:ENABle
SYSTem:COMMunicate:LAN:SCPI:SICL:ENABle
SYSTem:COMMunicate:LAN:SCPI:SOCKet:CONTrol?
SYSTem:COMMunicate:LAN:SCPI:SOCKet:ENABle
SYSTem:COMMunicate:LAN:SCPI:TELNet:ENABle
SYSTem:COMMunicate:SOURce[1]:ADDRess
SYSTem:COMMunicate:USB:CONNection?
SYSTem:COMMunicate:USB:PACKets?
SYSTem:COMMunicate:USB:STATus?
SYSTem:CONFigure[:SYSTem]?
SYSTem:CSYStem?
SYSTem:DATE
SYSTem:DEFault
SYSTem:DISPlay:BACKlight:INTensity
SYSTem:DISPlay:CFORmat
SYSTem:DISPlay:HINTs?
SYSTem:DISPlay:HINTs[:STATe]
SYSTem:DISPlay:LANGuage
SYSTem:DISPlay:MPPosition
SYSTem:DISPlay:MPTab
SYSTem:DISPlay:NEPimmediate
SYSTem:ERRor[:NEXT]?
SYSTem:ERRor:OVERload[:STATe]
SYSTem:ERRor:PUP?
SYSTem:ERRor:VERBose
SYSTem:HELP:HEADers?
SYSTem:HID?
SYSTem:IDN
SYSTem:IDN:CONFigure
SYSTem:KLOCk
SYSTem:LICense[:FPACk]:WAVeform:ADD
SYSTem:LICense[:FPACk]:WAVeform:CLEar
SYSTem:LICense[:FPACk]:WAVeform:FREE?
SYSTem:LICense[:FPACk]:WAVeform:LOCK
SYSTem:LICense[:FPACk]:WAVeform:NAME?
SYSTem:LICense[:FPACk]:WAVeform:REPLace
SYSTem:LICense[:FPACk]:WAVeform:STATus?
SYSTem:LICense[:FPACk]:WAVeform:UID?
SYSTem:LICense[:FPACk]:WAVeform:USED?
SYSTem:LKEY
SYSTem:LKEY?
SYSTem:LKEY:BORRow
SYSTem:LKEY:BORRow:LIST?
SYSTem:LKEY:BORRow:NETWork:COUT:ENABle
SYSTem:LKEY:BORRow:RETurn
SYSTem:LKEY:COUT?
SYSTem:LKEY:COUT:LIST?
SYSTem:LKEY:DELete
```

```
SYSTem:LKEY:LIST?
SYSTem:LKEY:SOFTware:SUPPort:EXPiration:DATE?
SYSTem:LKEY:WAVeform:ADD
SYSTem:LKEY:WAVeform:CLEar
SYSTem:LKEY:WAVeform:FREE?
SYSTem:LKEY:WAVeform:LOCK
SYSTem:LKEY:WAVeform:NAME?
SYSTem:LKEY:WAVeform:REPLace
SYSTem:LKEY:WAVeform:STATus?
SYSTem:LKEY:WAVeform:UID?
SYSTem:LKEY:WAVeform:USED?
SYSTem:LOCK:NAME?
SYSTem:LOCK:OWNer?
SYSTem:LOCK:RELease
SYSTem:LOCK:REQuest?
SYSTem:LOFF
SYSTem:LWSTation
SYSTem:METRics:FPANel?
SYSTem:METRics:SCPI?
SYSTem:METRics:STIMe?
SYSTem:MRELay:COUNt?
SYSTem:OPTions?
SYSTem:PDOWn
SYSTem:PERSona:DEFault
SYSTem:PERSona:MANufacturer
SYSTem:PERSona:MANufacturer:DEFault
SYSTem:PERSona:MODel
SYSTem:PERSona:MODel:DEFault
SYSTem:PON:APPLication:LLISt
SYSTem:PON:APPLication:VMEMory[:AVAilable]?
SYSTem:PON:APPLication:VMEMory:TOTal?
SYSTem:PON:APPLication:VMEMory:USED?
SYSTem:PON:APPLication:VMEMory:USED:NAME?
SYSTem:PON:ETIMe?
SYSTem:PON:FPGA:LOAD
SYSTem:PON:FPGA:PREFerence
SYSTem:PON:MODE
SYSTem:PON:TIME?
SYSTem:PON:TYPE
SYSTem:PRESet
SYSTem:PRESet:FULL
SYSTem:PRESet:TYPE
SYSTem:PRESet:USER
SYSTem:PRESet:USER:ALL
SYSTem:PRESet:USER:SAVE
SYSTem:PRINt:THEMe
SYSTem:PUP
SYSTem:PUP:PROCess
SYSTem:SECurity:USB:WPRotect[:ENABle]
SYSTem:SEQuencer
```

SYSTem:SET
SYSTem:SHOW
SYSTem:SOFTware:VERSion:DATE?
SYSTem:TEMPerature:HEXTreme?
SYSTem:TEMPerature:LEXTreme?
SYSTem:TIME
SYSTem:VERSion?

T

TRACe[:<meas>]:CLEar:ALL
TRACe:<meas>:COPY
TRACe:<meas>:EXCHange
TRACe[:<meas>]:PRESet:ALL
TRACe[1]|2|…|6:DISPlay[:STATe]
TRACe[1]|2|…|6:TYPE
TRACe[1]|2|…|6:UPDate[:STATe]
TRACe[1]|2|3:<meas>:DISPlay[:STATe]
TRACe[1]|2|3:<meas>:TYPE
TRACe[1]|2|3:<meas>:UPDate[:STATe]
TRACe:CLEar
TRACe:COPY
TRACe[:DATA]
TRACe:DISPlay:VIEW:SPECtrogram:POSition
TRACe:EXCHange
TRACe:TOI:TYPE
TRIGger:<measurement>[:SEQuence]:IQ:SOURce
TRIGger:<measurement>[:SEQuence]:RF:SOURce
TRIGger:<measurement>[:SEQuence]:SOURce
TRIGger[1]|2|…|4[:SEQuence]:OUTPut
TRIGger[1]|2|…|4[:SEQuence]:OUTPut:DIRection
TRIGger[1]|2|…|4[:SEQuence]:OUTPut:POLarity
TRIGger:PXIE:ANALyzer[:SEQuence]:OUTPut
TRIGger:PXIE:ANALyzer[:SEQuence]:OUTPut:LINE
TRIGger:PXIE:ANALyzer[:SEQuence]:OUTPut:POLarity
TRIGger:PXIE:SOURce[:SEQuence]:OUTPut
TRIGger:PXIE:SOURce[:SEQuence]:OUTPut:LINE
TRIGger:PXIE:SOURce[:SEQuence]:OUTPut:POLarity
TRIGger[:SEQuence]:<trig_source>:DELay
TRIGger[:SEQuence]:<trig_source>:DELay:STATe
TRIGger[:SEQuence]:<trig_source>:LEVel
TRIGger[:SEQuence]:<trig_source>:SLOPe
TRIGger[:SEQuence]:AIQMag:BANDwidth
TRIGger[:SEQuence]:AIQMag:CENTer
TRIGger[:SEQuence]:ATRigger
TRIGger[:SEQuence]:ATRigger:STATe
TRIGger[:SEQuence]:EXTernal1|EXTernal2|RFBurst:DELay:COMPensation
TRIGger[:SEQuence]:FRAMe:ADJust
TRIGger[:SEQuence]:FRAMe:OFFSet

```
TRIGger[:SEQuence]:FRAMe:OFFSet:DISPlay:RESet
TRIGger[:SEQuence]:FRAMe:PERiod
TRIGger[:SEQuence]:FRAMe:SMONitor:RESet
TRIGger[:SEQuence]:FRAMe:SYNC
TRIGger[:SEQuence]:FRAMe:SYNC:HOLDoff
TRIGger[:SEQuence]:FRAMe:SYNC:HOLDoff:STATe
TRIGger[:SEQuence]:HOLDoff
TRIGger[:SEQuence]:HOLDoff:STATe
TRIGger[:SEQuence]:HOLDoff:TYPE
TRIGger[:SEQuence]:INTernal:SOURce:OUTPut
TRIGger[:SEQuence]:INTernal:SOURce:OUTPut:POLarity
TRIGger[:SEQuence]:OFFSet:STATe
TRIGger[:SEQuence]:OPTimize:MODE
TRIGger[:SEQuence]:PXI:LINE
TRIGger[:SEQuence]:RFBurst:LEVel:ABSolute
TRIGger[:SEQuence]:RFBurst:LEVel:RELative
TRIGger[:SEQuence]:RFBurst:LEVel:TYPE
TRIGger[:SEQuence]:SOURce
TRIGger[:SEQuence]:TV:FMODe
TRIGger[:SEQuence]:TV:LINE
TRIGger[:SEQuence]:TV:STANdard
TRIGger[:SEQuence]:XRELative
```

U

```
UNIT:ACPower:POWer:PSD
UNIT:CHPower:POWer:PSD
UNIT:POWer
```

9.2 IEEE 488.2 Common Commands

The instrument supports the following subset of IEEE 488.2 Common Commands, as defined in Chapter 10 of IEEE Standard 488.2–1992. As indicated below, some of these commands correspond directly to instrument front-panel functionality, while others are available only as remote commands.

- "*CAL? - Calibration Query" on page 2723 (Align Now All equivalent)
- "*CLS - Clear Status" on page 2724
- "*ESE - Standard Event Status Enable" on page 2724
- "*ESR? - Standard Event Status Register Query" on page 2725
- "*IDN? - Identification Query" on page 2725
- "*OPC? - Operation Complete" on page 2726
- "*OPT? - Query Instrument Options" on page 2727
- "*RCL - Recall Instrument State" on page 2727 (Recall State equivalent)
- "*RST - Reset" on page 2727 (Mode Preset equivalent)
- "*SAV - Save Instrument State" on page 2728 (Save State equivalent)
- "*SRE - Service Request Enable" on page 2728
- "*STB? - Status Byte Query" on page 2729
- "*TRG - Trigger" on page 2729
- "*TST? - Self Test Query" on page 2729
- "*WAI - Wait-to-Continue" on page 2730

9.2.1 *CAL? - Calibration Query

`*CAL?` Performs a full alignment and returns a number indicating the success of the alignment. A zero is returned if the alignment is successful. A one is returned if any part of the alignment fails. The equivalent SCPI command is `:CALibrate[:ALL]?`

See "Align Now All" on page 2089

Remote Command	`*CAL`

Example	`*CAL?` Runs a full alignment and returns 0 if no problems encountered
Status Bits/OPC dependencies	See "Align Now All" on page 2089

9.2.2 *CLS - Clear Status

Clears the "Status Byte Register" on page 2760, by emptying the error queue and clearing all bits in all of the event registers, and consequently all bits in the Status Byte Register.

The Status Byte Register summarizes the states of the other registers. It is also responsible for generating service requests.

Remote Command	`*CLS`
Example	`*CLS` Clears the error queue and the Status Byte Register
Notes	For related commands, see `:SYSTem:ERRor[:NEXT]?` See also `:STATus:PRESet` and all commands in the "Status Register System & STATus Subsystem" on page 2751
Status Bits/OPC dependencies	Resets all bits in all event registers to 0, which resets all the status byte register bits to 0 also

9.2.3 *ESE - Standard Event Status Enable

Sets the desired bits in the Event Enable sub-register of the "Standard Event Status Register" on page 2764, which enables the corresponding bits in the Standard Event Status Register. This register monitors I/O errors and synchronization conditions such as operation complete, request control, query error, device-dependent error, status execution error, command error, and power on. The selected bits are `ORed` to become a summary bit (bit 5) in the "Status Byte Register" on page 2760, which can be queried.

The query returns the state of this register.

Numeric values for bit patterns can be entered using decimal or hexadecimal representations (0 to 32767, equivalent to `#H0` to `#H7FFF`).

Remote Command	`*ESE <integer>` `*ESE?`
Example	`*ESE 36` Enables the Standard Event Status Register to monitor query and command errors (bits 2 and 5)

	`*ESE?` Returns a 36 indicating that the query and command status bits are enabled
Notes	For related commands, see the "Status Register System & STATus Subsystem" on page 2751 and `:SYSTem:ERRor[:NEXT]?`
Preset	255
State Saved	Not saved in state
Min	0
Max	255

9.2.4 *ESR? - Standard Event Status Register Query

Queries and clears the "Standard Event Status Register" on page 2764. (This is a destructive read.) The value returned is a hexadecimal number that reflects the current state (0/1) of all the bits in the register.

Remote Command	`*ESR?`
Example	`*ESR?` Returns a 1 if there is either a query or command error, otherwise it returns a zero
Notes	For related commands, see "Status Register System & STATus Subsystem" on page 2751
Min/Max	0 / 255
Status Bits/OPC dependencies	Standard Event Status Register (bits 0 – 7)

9.2.5 *IDN? - Identification Query

Returns a string of instrument identification information. The string contains the model number, serial number, and firmware revision.

The response is organized into four fields separated by commas. The field definitions are as follows:

1. Manufacturer
2. Model
3. Serial number
4. Firmware version

Remote Command	`*IDN?`

Example	`*IDN?`
	Returns instrument identification information, such as:
	`Keysight Technologies,N9040B,US01020004,A.15.02`

Backwards Compatibility Command

Example	`:ID?`
	Returns model number, such as:
	`N9040B`

Notes	Provided for backwards compatibility: In Remote Language Compatibility Mode, `ID?` returns the model number of the emulated instrument In any other Mode, the returned model number is that of the actual instrument
Backwards Compatibility SCPI	`:ID?`

9.2.6 *OPC? - Operation Complete

Sets bit 0 in the "Standard Event Status Register" on page 2764 (SESR) to “1” when pending operations have finished, that is when all overlapped commands are complete. It does not hold off subsequent operations. You can determine when the overlapped commands have completed either by polling the OPC bit in SESR, or by setting up the status system so that a service request (SRQ) is asserted when the OPC bit is set.

`*OPC?` returns “1” after all the current overlapped commands are complete, so it holds off subsequent commands until the "1" is returned, then the program continues. This query can be used to synchronize events of other instruments on the external bus.

Remote Command	`*OPC` `*OPC?`

Example	Select single sweeping:
	`:INIT:CONT 0`
	Initiate a sweep:
	`:INIT:IMM`
	Hold off any further commands until the sweep is complete:
	`*OPC?`

Notes	Not global to all remote ports or front panel. `*OPC` only affects operations that were initiated on the same port that the `*OPC` command was issued from `*OPC` is an overlapped command, but `*OPC?` is sequential `*OPC?` does *not* holdoff the completion of GUI update commands , such as `:MMEM:LOAD:SCON "myScreenConfig.screen"`

9.2.7 *OPT? - Query Instrument Options

Returns a string of all installed instrument options. It is a comma-separated list, with quotes, for example:

`"550,B25,B40,BBA,CRP,CRW,EA3,EDP,ESC,EXM,FBP,LNP,MPB,NF2,RTS,EMC,FP2"`

Remote Command	`*OPT?`

9.2.8 *RCL - Recall Instrument State

Recalls the instrument state from the specified instrument memory register.

- If the state being loaded has a newer firmware revision than the revision of the instrument, no state is recalled and an error is reported
- If the state being loaded has an equal firmware revision than the revision of the instrument, the state will be loaded
- If the state being loaded has an older firmware revision than the revision of the instrument, then the instrument will only load the parts of the state that apply to the older revision

Remote Command	`*RCL <register #>`
Example	Recall the instrument state that is currently stored in register 7 (register 8 in the UI): `*RCL 7`
Notes	Registers 0 through 15 are accessible from the front panel in menu keys for Recall Registers. Register 0 corresponds to front panel Register 1
Min	0
Max	127
Status Bits/OPC dependencies	The command is sequential

9.2.9 *RST - Reset

`*RST` is equivalent to `:SYST:PRES;:INIT:CONT OFF`, which is a Mode Preset in the **Single** measurement state. This command is preferred over the Mode Preset command `:SYST:PRES`, because optimal remote programming occurs with the instrument in the **Single** measurement state.

`*RST` clears all pending OPC bits and sets the Status Byte to 0.

Remote Command	`*RST`
Notes	Sequential
Couplings	`*RST` causes the currently running measurement to be aborted and causes the default measurement to be active. `*RST` gets the mode to a consistent state, with all of the default couplings set
Status Bits/OPC dependencies	Clears all pending OPC bits. The "Status Byte Register" on page 2760 is set to 0

9.2.10 *SAV - Save Instrument State

Saves the current instrument state and mode to the specified instrument memory register.

Remote Command	`*SAV <register #>`
Example	Save the instrument state in register 9 (register 10 in the UI): `*SAV 9`
Notes	Registers 0 through 15 are accessible from the front panel in menu keys for Save Registers. Register 0 corresponds to the front panel Register 1
Min/Max	0 / 127
Status Bits/OPC dependencies	The command is sequential

9.2.11 *SRE - Service Request Enable

Enables the desired bits of the "Service Request Enable Register" on page 2763.

The query returns the value of the register, indicating which bits are currently enabled.

Numeric values for bit patterns can be entered using decimal or hexadecimal representations (0 to 32767, equivalent to `#H0` to `#H7FFF`).

Remote Command	`*SRE <integer>` `*SRE?`
Example	Enable bits 1, 2, and 4 in the service request enable register: `*SRE 22`
Notes	For related commands, see "Status Register System & STATus Subsystem" on page 2751 and `:SYSTem:ERRor[:NEXT]?`
Preset	0
Min/Max	0 / 255

Status Bits/OPC dependencies	Service Request Enable Register (all bits, 0 – 7)

9.2.12 *STB? - Status Byte Query

Returns the value of the "Status Byte Register" on page 2760 without erasing its contents.

Remote Command	`*STB?`
Example	Return a decimal value for the bits in the Status Byte Register: `*STB?` For example, if 16 is returned, it indicates that bit 5 is set and one of the conditions monitored in the standard event status register is set
Notes	See related command "*CLS - Clear Status" on page 2724
Status Bits/OPC dependencies	Status Byte Register (all bits, 0 – 7)

9.2.13 *TRG - Trigger

Triggers the instrument. Use `:TRIGger[:SEQuence]:SOURce` to select the trigger source.

Remote Command	`*TRG`
Example	Trigger the instrument to take a sweep or start a measurement, depending on the current instrument settings: `*TRG`
Notes	See related command `:INITiate:IMMediate`

9.2.14 *TST? - Self Test Query

Performs the internal self-test routines and returns a number indicating the success of the testing. The value returned is 0 if the test is successful, or 1 if it fails.

Remote Command	`*TST?`
Example	Run the self-test routines: `*TST?`

9.2.15 *WAI - Wait-to-Continue

Causes the instrument to wait until all overlapped commands are completed before executing any additional commands. There is no equivalent query.

Remote Command	`*WAI`
Example	Set the instrument to single sweep. Start a sweep, then wait for its completion: `:INIT:CONT OFF;INIT;*WAI`
Notes	`*WAI` does *not* wait for the completion of user-interface-related commands, such as `:MMEM:LOAD:SCON "myScreenConfig.screen"`
Status Bits/OPC dependencies	Not global to all remote ports or front panel. `*OPC` only considers operation that was initiated on the same port that the `*OPC` command was issued from

9.3 SCPI Operation and Results Query

You can use SCPI commands for remote control of measurements and querying of measurement results data. There are several alternative commands you can use to control the measurement, depending on how you wish to operate the instrument. There are also a number of queries that you can use to extract the measurement data.

In this section, “Mode” refers to a Measurement Application, for example, Spectrum Analyzer or 5G NR.

9.3.1 Mode Control

Use either `:INSTrument:SELect` or `:INSTrument:NSELect` to select the Mode. See "Mode" on page 87.

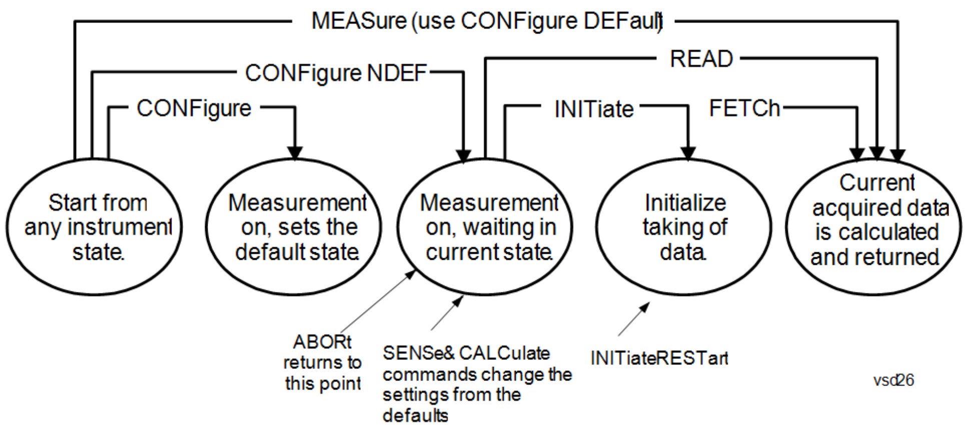
`:INSTrument:CONFigure` causes a Mode *and* Measurement switch at the same time. This results in faster overall switching than sending `:INSTrument:SELect` and `:CONFigure` separately, as described in "Mode" on page 87.

9.3.2 Measurement Control

This section describes the measurement control commands listed below, and their functions.

"CONFigure" on page 2732	Switches to the desired measurement. Presets all measurement settings to their defaults, *unless* `:NDEFault` is specified
"INITiate" on page 2733	Starts the measurement
"FETCh" on page 2733	Queries the data without starting the measurement. If a measurement is already in progress, waits for completion
"READ" on page 2734	Starts the measurement with the current settings and queries the data
"MEASure" on page 2735	Switches to the desired measurement, presets all measurement settings to their defaults, starts the measurement and queries the data

The relationship between the command forms is illustrated in the diagram below. `:FETCh`, `:READ` and `:MEASure` are queries that return measurement data.



9.3.2.1 CONFigure

Stops the current measurement (if any) and sets up the instrument for the specified measurement using the measurement's default settings. Does not initiate the collection of measurement data unless `:INIT:CONT` is `ON`. If you change any measurement settings after using `:CONFigure`, "READ" on page 2734 can be used to initiate a measurement without changing the settings back to their defaults.

Normally `:CONFigure` presets the measurement after selecting it; but, if sent with the `NDEFault` parameter, it selects it without performing a Preset.

Remote Command	`:CONFigure:<measurement>[:NDEFault]` `:CONFigure?`

Example	Select and preset the Swept SA measurement:
	`:CONF:SAN`
	Select the Swept SA measurement *without* presetting:
	`:CONF:SAN:NDEF`
	Query the current measurement:
	`:CONF?`

Remote Command	`:CONFigure:CATalog?`
Example	`:CONF:CATalog?` returns a quoted string of all licensed measurement names in the current mode. For example, `"SAN, CHP, OBW, ACP, PST, TXP, SPUR, SEM, LIST"` for the Spectrum Analyzer mode

9.3.2.2 INITiate

Initiates a trigger cycle for the specified measurement, but does not output any data. You must then use `:FETCh<meas>` to return data. If a measurement other than the current one is specified, the instrument will switch to that measurement and then initiate it.

Remote Command	`:INITiate:<measurement>`
Example	Switch to the `SANalyzer` (Swept SA) measurement if not already there, then start the measurement: `:INIT:SAN`

`:INITiate` does not change any of the measurement settings. For example, if you have already run the ACP measurement and you send `:INIT:ACP?` it initiates a new ACP measurement using the same instrument settings as the last time ACP was run.

If another measurement is running, `:INIT` switches to the specified measurement. For example, suppose you are running the channel power measurement. If you send `:INIT:ACP?` it changes from channel power to ACP and initiates an ACP measurement.

If your selected measurement is currently in the idle state, it restarts the measurement. Depending upon the measurement and the number of averages, there may be multiple data acquisitions, with multiple trigger events, for one full trigger cycle.

CAUTION **`:INIT` allows additional commands *while* the measurement is in progress.**

Be aware that such additional commands may change measurement settings. They may cause the measurement in progress to be discarded, and a new measurement may start.

To wait for the completion of a measurement after sending `:INITiate`, send "*WAI - Wait-to-Continue" on page 2730, or "*OPC? - Operation Complete" on page 2726, or use "FETCh" on page 2733.

9.3.2.3 FETCh

Places selected data from the most recent measurement into the output buffer. Use `:FETCh` if you have already made a valid measurement and you want to retrieve data. You can issue `:FETCh` multiple times with differing `[n]` values without restarting or re-making the measurement, for example, both scalars and trace data from a single measurement.

Remote Command	`:FETCh:<measurement>[n]?`

Example	Fetch item 2 (Trace 2) from the SAN (Swept SA) measurement when the measurement completes. If not in the Swept SA measurement, returns an error: `:FETCh:SAN2?`

`:FETCh` does not change any of the measurement settings, it simply reads the results of the current measurement. `:FETCh` may be used to return results other than those specified with the original `:READ` or `:MEASure` query that you sent.

You can only `:FETCh` results from the measurement that is currently active, it does not change to a different measurement. An error message is reported if a measurement other than the current one is specified.

If you need to get new measurement data, use "READ" on page 2734, which is equivalent to "INITiate" on page 2733 followed by `:FETCh`.

The measurement results for n = 1 (usually the scalar result) will be returned if the optional `[n]` value is not included, or is set to 1. If the `[n]` value is set to a value other than 1, the selected data results will be returned. See each measurement for details of what types of scalar results or trace data results are available. The binary data formats should be used for handling large blocks of data since they are smaller and transfer faster than the ASCII format. See "Format Data: Numeric Data (Remote Command Only)" on page 2739.

Note that the data returned by `:FETCh?` uses the data setting specified by "Format Data: Numeric Data (Remote Command Only)" on page 2739 and "Format Data: Byte Order (Remote Command Only)" on page 2740 commands ,and can return real or ASCII data. If the format is set to `INT,32`, it returns `REAL,32` data.

9.3.2.4 READ

Initiates a trigger cycle for the specified measurement and outputs the requested data. If a measurement other than the current one is specified, the instrument will switch to that measurement before it initiates the measurement and returns results.

Remote Command	`:READ:<measurement>[n]?`
Example	Switch to the `SANalyzer` (Swept SA) measurement if not already there, start the measurement, and return item 2 (Trace 2) from the measurement when the measurement completes: `:READ:SAN2?`

`:READ` does not change any of the measurement settings. For example, if you have already run the ACP measurement and you send `:READ:ACP?`, it initiates a new ACP measurement using the same instrument settings as the last time ACP was run.

`:READ` switches to the specified measurement if the instrument is not already there. For example, suppose you have already run the ACP measurement but now you are running the Channel Power measurement. When you send `:READ:ACP?`, it changes from Channel Power back to ACP and, using the previous ACP settings, initiates the measurement and return results.

The measurement results for n = 1 (usually the scalar result) will be returned if the optional [n] value is not included, or is set to 1. If the [n] value is set to a value other than 1, the selected data results will be returned. See each measurement for details of what types of scalar results or trace data results are available. The binary data formats should be used for handling large blocks of data since they are smaller and transfer faster than the ASCII format. See "Format Data: Numeric Data (Remote Command Only)" on page 2739.

Note that the data returned by `:READ?` uses the data setting specified by "Format Data: Byte Order (Remote Command Only)" on page 2740 and "Format Data: Numeric Data (Remote Command Only)" on page 2739, and can return real or ASCII data. If the format is set to `INT,32` it returns `REAL,32` data.

`:READ` blocks other SCPI communication, waiting until the measurement is complete before returning results.

For more details of how measurements proceed, see also "INITiate" on page 2733.

9.3.2.5 MEASure

Stops the current measurement (if any) and sets up the instrument for the specified measurement using the measurement's default settings, initiates a trigger cycle for the specified measurement, and outputs the requested data.

Remote Command	`:MEASure:<measurement>[n]?`
Example	Switch to the `SANalyzer` (Swept SA) measurement, start the measurement, and read back item 2 (Trace 2) when the measurement completes `:MEAS:SAN2?`

This is a fast single-command way to make a measurement using the measurement's default settings. These are the settings and units that conform to the Mode Setup settings (for example, Radio Standard) that you have currently selected.

Stops the current measurement (if any) and sets up the instrument for the specified measurement using the measurement's defaults.

Initiates the data acquisition for the measurement.

Blocks other SCPI communication, waiting until the measurement is complete before returning results.

Depending on the measurement and the number of avaerages, there may be multiple data acquisitions, with multiple trigger events.

After the data is valid, returns the scalar results, or the trace data, for the specified measurement. The type of data returned may be defined by an `[n]` value that is sent with the command.

If the optional `[n]` value is not included, or is set to 1, scalar measurement results will be returned. If the `[n]` value is other than 1, the selected trace data results will be returned. See each command for details of which types of scalar results or trace data results are available.

The default format for data output is ASCII. (Older versions of Spectrum Analysis and Phase Noise mode measurements only use ASCII.) The binary data formats should be used for handling large blocks of data, because transfers are smaller and faster than when using the ASCII format. See "Format Data: Numeric Data (Remote Command Only)" on page 2739 for more information.

If you need to change some of the measurement parameters from the measurement's default settings, you can set up the measurement with `:CONFigure`. Use the commands in the `:SENSe:<measurement>` and `:CALCulate:<measurement>` subsystems to change the settings, then you can use `:READ?` to initiate the measurement and query the results.

Measurement settings persist if you initiate a different measurement and then return to a previous one. Use `:READ?` if you want to use those persistent settings. If you want to go back to the default settings, use `:MEASure?`.

Note that the data returned to `:MEASure?` uses the data setting specified by "Format Data: Byte Order (Remote Command Only)" on page 2740 and "Format Data: Numeric Data (Remote Command Only)" on page 2739, and can return real or ASCII data. If the format is set to `INT,32` it returns `REAL,32` data.

9.3.3 Trace Formatting Commands

The following commands and queries are available to format and manipulate trace data.

9.3.3.1 Clear Trace (Remote Command Only)

Clears the selected trace (from the front panel) or the specified trace (from SCPI). Does not affect the state of any function or variable in the instrument. Loads mintracevalue into all of the points in the selected trace, unless the trace is in Min Hold in which case it loads maxtracevalue. This occurs even if Update = Off.

Remote Command	`:TRACe:CLEar TRACE1 | … | TRACE6`
Example	Clear Trace 1: `:TRAC:CLE TRACE1`

9.3.3.2 Send/Query Trace Data (Remote Command Only)

Allows trace data to be sent to the instrument or queried from the instrument. The response to the query is a list of the amplitude points which comprise the requested trace in the current Y Axis Unit of the instrument. The X Axis Unit is that of the destination trace (for send) or the source trace (for query).

See:

– "Query Trace Data" on page 2737

– "More Information" on page 2738

Remote Command	:TRACe[:DATA] TRACE1 | TRACE2 | TRACE3 | TRACE4 | TRACE5 | TRACE6, <data>
Notes	The TRACe[:DATA] command is of the form: :TRACe:DATA <trace>,<data> where <trace> can be one of the following parameters: TRACE1, TRACE2, TRACE3, TRACE4, TRACE5, TRACE6 and where <data> can be - ASCII data, which consists of a string of values separated by comma or - REAL or INTeger sent as a definite length block, with a header describing the data to follow
Couplings	Sweep points will affect the amount of data :FORMat:DATA describes the different types of data formats that can be used with trace data Use :FORMat:BORDer to set the byte order

Query Trace Data

Remote Command	:TRACe[:DATA]? TRACE1 | TRACE2 | TRACE3 | TRACE4 | TRACE5 | TRACE6
Example	Send five points to Trace 1. Assuming that :FORMat:DATA is set to ASCii, Y Axis Unit is set to dBm, and sweep points is set to 5, this will result in Trace 1 consisting of the five points -1 dBm, -2 dBm, -3 dBm, -4 dBm, and -5 dBm: :TRAC TRACE1,-1,-2,-3,-4,-5 Query the instrument for the contents of trace 2: :TRAC? TRACE2
Backwards Compatibility Notes	In X-Series, the legacy RAWTRACE,LLINE1,LLINE2 parameters for trace data query are no longer available

More Information

The format and byte order of the sent or received data depend on "Format Data: Numeric Data (Remote Command Only)" on page 2739 and "Format Data: Byte Order (Remote Command Only)" on page 2740. `ASCII` data consists of a string of comma separated values. `REAL` or `INTeger` data is sent as a definite length block, with a header describing the data to follow.

For example, a four point trace might look like this if in ASCII (`FORMat:DATA ASCii`):

```
-5.87350E+01, -5.89110E+01, -5.87205E+01, -5.12345E+01<NL><END>
```

and like this if in `INTeger` with 4 bytes per point (`FORMat:DATA INT,32`):

```
#216<16 bytes of data><NL><END>
```

where the 2 in the #216 means “2 digits of numeric data to follow”, and the 16 is the 2 digits and means “16 binary bytes to follow” (this is the definite length block format).

Note that the data is terminated with `<NL><END>`. (For GPIB this is newline, or linefeed, followed by EOI set true. For LAN, this is newline only.)

The data format set by "Format Data: Numeric Data (Remote Command Only)" on page 2739 and "Format Data: Byte Order (Remote Command Only)" on page 2740 is used both for sending data to the instrument and receiving data from the instrument.

When sending data to the instrument, the data block must contain exactly the number of points currently specified in **Sweep, Points** or an error message will be generated and there will be no change to the target trace.

No units terminator (for example, dB or V) is used when sending data; the data is taken as being in the current Y Axis Unit of the instrument.

When a trace is sent to the instrument, it immediately overwrites all of the data in the target trace. Consequently the trace should be inactive in order to achieve predictable results. If you send trace data while a trace is active, and particularly if a sweep or an **Average** or **Max/Min Hold** sequence is already in progress, you may end up with a trace that combines the data you sent with measurement data. Similarly, when querying trace data, it is best if the instrument is not sweeping during the query.

Therefore, it is generally advisable to be in **Single** sweep, or have the trace in **View**, when sending trace data to the instrument or querying trace data from the instrument.

9.3.3.3 Format Data: Numeric Data (Remote Command Only)

Specifies the format of the trace data input and output.

Specifies the formats used for trace data during data transfer across any remote port. Affects only the data format for setting and querying trace data for `:TRACe[:DATA]`, `:TRACe[:DATA]?`, `:CALCulate:DATA[n]?` and `:FETCh:SANalyzer[n]?`.

Remote Command	`:FORMat[:TRACe][:DATA] ASCii | INTeger,32 | REAL,32 | REAL,64` `:FORMat[:TRACe][:DATA]?`
Notes	The query response is: `ASCii`: ASC,8 `REAL,32`: REAL,32 `REAL,64`: REAL,64 `INTeger,32`: INT,32 When the numeric data format is REAL or ASCii, data is output in the current Y Axis unit. When the data format is INTeger, data is output in units of m dBm (.001 dBm) The `INT,32` format returns binary 32-bit integer values in internal units (m dBm), in a definite length block
Dependencies	Sending a data format spec with an invalid number (for example, `INT,48`) generates no error. The instrument simply uses the default (8 for `ASCii`, 32 for `INTeger`, 32 for `REAL`) Sending data to the instrument which does not conform to the current `FORMat` specified, results in an error. Sending ASCII data when a definite block is expected generates message -161 "Invalid Block Data" and sending a definite block when ASCII data is expected generates message -121 "Invalid Character in Number"
Preset	`ASCii`
Backwards Compatibility Notes	Note that the `INT,32` format is only applicable to `:TRACe:DATA`. This preserves backwards compatibility for the Swept SA measurement. For all other commands/queries that honor `:FORMat:DATA`, if `INT,32` is sent the instrument will behave as though it were set to `REAL,32`

The specifications for each output type are:

`ASCii` Amplitude values are in ASCII, in the current Y Axis Unit, one ASCII character per digit, values separated by commas, each value in the form: `SX.YYYYYEsZZ`, where:

S = sign (+ or -)

X = one digit to left of decimal point

Y = 5 digits to right of decimal point

E = E, exponent header

s = sign of exponent (+ or -)

ZZ = two digit exponent

`REAL,32`	Binary 32-bit real values in the current Y Axis Unit, in a definite length block
`REAL,64`	Binary 64-bit real values in the current Y Axis Unit, in a definite length block

9.3.3.4 Format Data: Byte Order (Remote Command Only)

Selects the binary data byte order for data transfer and other queries.

Controls whether binary data is transferred in normal or swapped mode. Affects only the byte order for setting and querying trace data for `:TRACe[:DATA]`, `:TRACe[:DATA]?` , `:CALCulate:DATA[n]?` and `:FETCh:SANalyzer[n]?`.

By definition, any command that depends on this setting uses *any* format supported by :`FORMat:DATA`.

- `NORMal` order is a byte sequence that begins with the most significant byte (MSB) first, and ends with the least significant byte (LSB) last in the sequence: 1|2|3|4
- `SWAPped` order is when the byte sequence begins with the LSB first, and ends with the MSB last in the sequence: 4|3|2|1

Remote Command	`:FORMat:BORDer NORMal | SWAPped` `:FORMat:BORDer?`
Preset	`NORMal`

9.3.3.5 Calculate/Compress Trace Data Query (Remote Command Only)

Returns compressed data for the currently selected measurement and sub-opcode `[n]`.

`n` = any valid sub-opcode for that measurement. See the `:MEASure:<measurement>?` query description of your specific measurement for information on the data that can be returned.

The data is returned in the current Y Axis Unit of the instrument. The command is used with a sub-opcode `<n>` (default = 1) to specify the trace. With trace queries, it is best if the instrument is not sweeping during the query. Therefore, it is generally advisable to be in **Single** sweep, or Update = Off.

This command is used to compress or decimate a long trace to extract and return only the desired data. A typical example would be to acquire N frames of GSM data and return the mean power of the first burst in each frame. The command can also be used to identify the best curve fit for the data.

Remote Command	`:CALCulate:DATA<n>:COMPress? BLOCk | CFIT | MAXimum | MINimum | MEAN | DMEan | RMS | SAMPle | SDEViation | PPHase [,<soffset>[,<length>[,<roffset>[,<rlimit>]]]]`

Notes	The command supports 5 parameters, but the last 4 (`<soffset>, <length>, <roffset>, <rlimit>`) are optional. The optional parameters must be entered in the specified order. For example, if you want to specify <length>, then you must also specify <soffset>. See details below for a definition of each of these parameters

This command uses the data in the format specified by "Format Data: Byte Order (Remote Command Only)" on page 2740, returning either binary or ASCII data

As an example, to query the mean power of a set of GSM bursts:

- Supply a signal that is a set of GSM bursts
- Select the IQ Waveform measurement (in IQ Analyzer Mode)
- Set the sweep time to acquire at least one burst
- Set the triggers such that acquisition happens at a known position relative to a burst
- Query the mean burst levels using, :`CALC:DATA2:COMP? MEAN,24e-6,526e-6` (These parameter values correspond to GSM signals, where 526e-6 is the length of the burst in the slot and you just want 1 burst)

BLOCk or block data

Returns all the data points from the region of the trace data that you specify. For example, it could be used to return the data points of an input signal over several timeslots, excluding the portions of the trace data that you do not want. (This is x,y pairs for trace data and I,Q pairs for complex data.)

CFIT or curve fit

Applies curve fitting routines to the data. `<soffset>` and `<length>` are required to define the data that you want. <roffset> is an optional parameter for the desired order of the curve equation. The query will return the following values: the x-offset (in seconds) and the curve coefficients ((order + 1) values).

`MIN`, `MAX`, `MEAN`, `DME`, `RMS`, `SAMP`, `SDEV` and `PPH` return one data value for each specified region (or `<length>`) of trace data, for as many regions as possible until you run out of trace data (using `<roffset>` to specify regions), or they return the number of regions you specify (using `<rlimit>`) ignoring any data beyond that.

MINimum

Returns the minimum data point (y value) for the specified region(s) of trace data. For I/Q trace data, the minimum magnitude of the I/Q pairs is returned.

MAXimum

Returns the maximum data point (y value) for the specified region(s) of trace data. For I/Q trace data, the maximum magnitude of the I/Q pairs is returned.

MEAN

Returns a single value that is the arithmetic mean of the data point values (in dB/ dBm) for the specified region(s) of trace data. For I/Q trace data, the mean of the magnitudes of the I/Q pairs is returned. See the following equations.

NOTE **If the original trace data is in dB, this function returns the arithmetic mean of those log values, not log of the mean power which is a more useful value. The mean of the log is the better measurement technique when measuring CW signals in the presence of noise. The mean of the power, expressed in dB, is useful in power measurements such as Channel Power. To achieve the mean of the power, use the RMS option.**

Equation 1: Mean Value of Data Points for Specified Region(s)

$$\mathrm{MEAN} = \frac{1}{n} \sum_{\mathrm{Xi}\ \in\ \mathrm{region(s)}} \mathrm{Xi}$$

where Xi is a data point value, and n is the number of data points in the specified region(s).

Equation 2: Mean Value of I/Q Data Pairs for Specified Region(s)

$$\mathrm{MEAN} = \frac{1}{n} \sum_{\mathrm{Xi}\ \in\ \mathrm{region(s)}} |\mathrm{Xi}|$$

where |Xi| is the magnitude of an I/Q pair, and n is the number of I/Q pairs in the specified region(s).

DMEan

Returns a single value that is the mean power (in dB/ dBm) of the data point values for the specified region(s) of trace data. See the following equation:

Equation 3: DMEan Value of Data Points for Specified Region(s)

$$\mathrm{DME} = 10 \times \log_{10}\left(\frac{1}{n} \sum_{\mathrm{Xi}\ \in\ \mathrm{region(s)}} 10^{\frac{\mathrm{Xi}}{10}} \right)$$

RMS

Returns a single value that is the average power on a root-mean-squared voltage scale (arithmetic rms) of the data point values for the specified region(s) of trace data. See the following equation.

Equation 4: RMS Value of Data Points for Specified Region(s)

$$\mathrm{RMS} = \sqrt{\frac{1}{n} \sum_{\mathrm{Xi}\, \in\, \mathrm{region(s)}} \mathrm{Xi}^2}$$

where Xi is a data point value, and n is the number of data points in the specified region(s).

For I/Q trace data, the rms of the magnitudes of the I/Q pairs is returned. See the following equation.

NOTE **This function is very useful for I/Q trace data. However, if the original trace data is in dB, this function returns the rms of the log values which is not usually needed.**

Equation 5: RMS Value of I/Q Data Pairs for Specified Region(s)

$$\mathrm{RMS} = \sqrt{\frac{1}{n} \sum_{\mathrm{Xi}\, \in\, \mathrm{region(s)}} \mathrm{Xi}\ \mathrm{Xi}^*}$$

where Xi is the complex value representation of an I/Q pair, Xi* its conjugate complex number, and n is the number of I/Q pairs in the specified region(s).

Once you have the rms value for a region of trace data (linear or I/Q), you may want to calculate the mean power. You must convert this rms value (peak volts) to power in dBm:

*10 x log[10 * (rms value)2]*

SAMPle

Returns the first data value (x,y pair) for the specified region(s) of trace data. For I/Q trace data, the first I/Q pair is returned.

SDEViation

Returns a single value that is the arithmetic standard deviation for the data point values for the specified region(s) of trace data. See the following equation.

Equation 6: Standard Deviation of Data Point Values for Specified Region(s)

$$\mathrm{SDEV} = \sqrt{\frac{1}{n} \sum_{Xi \in \mathrm{region(s)}} (Xi - \overline{X})^2}$$

where Xi is a data point value, X is the arithmetic mean of the data point values for the specified region(s), and n is the number of data points in the specified region(s).

For I/Q trace data, the standard deviation of the magnitudes of the I/Q pairs is returned. See the following equation.

Equation 7: Standard Deviation of I/Q Data Pair Values for Specified Region(s)

$$\mathrm{SDEV} = \sqrt{\frac{1}{n} \sum_{Xi \in \mathrm{region(s)}} (|Xi| - \overline{X})^2}$$

where |Xi| is the magnitude of an I/Q pair, X is the mean of the magnitudes for the specified region(s), and n is the number of data points in the specified region(s).

PPHase

Returns the x,y pairs of both rms power (dBm) and arithmetic mean phase (radian) for every specified region and frequency offset (Hz). The number of pairs is defined by the specified number of regions. This parameter can be used for I/Q vector (n=0) in Waveform (time domain) measurement and all parameters are specified by data point in `PPHase`.

The rms power of the specified region may be expressed as:

Power = 10 x log [10 x (RMS I/Q value)] + 10.

The RMS I/Q value (peak volts) is:

$$\sqrt{\frac{1}{n} \sum_{Xi \in \mathrm{region}} Xi\, Xi^*}$$

where Xi is the complex value representation of an I/Q pair, Xi* its conjugate complex number, and n is the number of I/Q pairs in the specified region.

The arithmetic mean phase of the specified region may be expressed as:

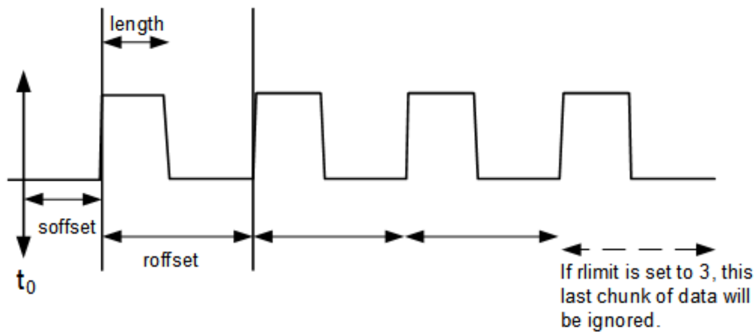
$$\frac{1}{n} \sum_{Yi \in \mathrm{region}} Yi$$

where Yi is the unwrapped phase of I/Q pair with applying frequency correction and n is the number of I/Q pairs in the specified region.

The frequency correction is made by the frequency offset calculated by the arithmetic mean of every specified region's frequency offset. Each frequency offset is calculated by the least square method against the unwrapped phase of I/Q pair.

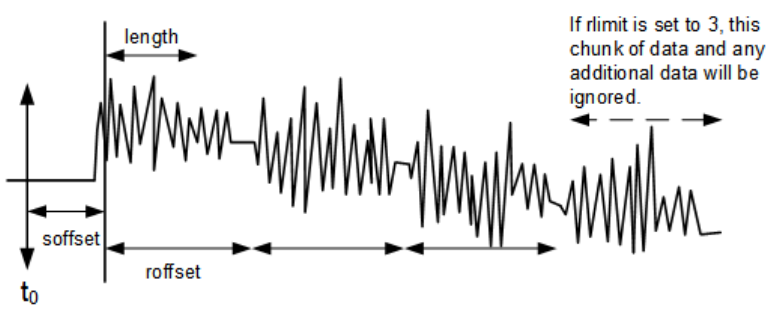
Sample Trace Data - Constant Envelope

(See below for explanation of variables.)



Sample Trace Data - Not Constant Envelope

(See below for explanation of variables.)



`<soffset>`	Optional real number, in seconds for time-domain traces, and is a dimensionless index 0 to Npoints – 1, for frequency-domain traces Specifies the amount of data at the beginning of the trace that will be ignored before the decimation process starts. It is the time or frequency change from the start of the trace to the point where you want to start using the data. The default value is zero
`<length>`	Optional real number, in seconds for time-domain traces, and is a dimensionless index 0 to Npoints – 1, for frequency-domain traces Defines how much data will be compressed into one value. This parameter has a default value equal to the current trace length
`<roffset>`	Optional real number, in seconds for time-domain traces, and is a dimensionless index 0 to Npoints – 1, for frequency-domain traces

	Defines the beginning of the next field of trace elements to be compressed. This is relative to the beginning of the previous field. This parameter has a default value equal to the `<length>` variable. Note that this parameter is used for a completely different purpose when curve fitting (see "CFIT or curve fit" on page 2741 above)
`<rlimit>`	Optional integer Specifies the number of data items that you want returned. Ignores any additional items beyond that number. You can use the Start offset and the Repeat limit to pick out exactly what part of the data you want to use. The default value is all the data

9.3.3.6 Calculate Peaks of Trace Data (Remote Command Only)

Returns a list of all the peaks for the currently selected measurement and sub-opcode `[n]`. The peaks must meet the requirements of the peak threshold and excursion values.

`n` = any valid sub-opcode for the current measurement. See the `:MEASure:<measurement>` command description of your specific measurement for information on the data that can be returned.

The command can only be used with specific sub-opcodes with measurement results that are trace data. Both real and complex traces can be searched, but complex traces are converted to magnitude in dBm. In many measurements the sub-opcode `n` = 0, is the raw trace data, which cannot be searched for peaks, and sub-opcode `n` = 1, is often calculated results values which also cannot be searched for peaks.

This command uses the data setting specified by "Format Data: Byte Order (Remote Command Only)" on page 2740 and "Format Data: Numeric Data (Remote Command Only)" on page 2739, and can return real or ASCII data. If the format is set to `INT,32`, it returns `REAL,32` data.

The command has four types of parameters:

1. Threshold (in dBm)
2. Excursion (in dB)
3. Sorting order (amplitude, frequency, time)
4. Optional in some measurements: Display line use (all, > display line, < display line)

Remote Command	For Swept SA measurement: `:CALCulate:DATA[1]|2|…|6:PEAKs? <threshold>,<excursion>[,AMPLitude | FREQuency | TIME[,ALL | GTDLine | LTDLine]]`

	For most other measurements: `:CALCulate:DATA[1]|2|…|6:PEAKs? <threshold>,<excursion>[,AMPLitude	FREQuency	TIME]`
Notes	Parameters:

`<n>`	The trace that will be used: `[1]|2|…|6`
`<threshold>`	The level below which trace data peaks are ignored Note that the threshold value is required and is always used as a peak criterion. To effectively disable the threshold criterion for this command, provide a substantially low threshold value such as –200 dBm Note also that the threshold value used in this command is independent of and has no effect on the threshold value stored under the Peak Criteria menu
`<excursion>`	The minimum amplitude variation (rise and fall) required for a signal to be identified as peak Note that the excursion value is required and is always used as a peak criterion. To effectively disable the excursion criterion for this command, provide the minimum value of 0.0 dB Note also that the excursion value used in this command is independent of and has no effect on the excursion value stored under the Peak Criteria menu

Values must be provided for threshold and excursion. The sorting and display line parameters are optional (defaults are `AMPLitude` and `ALL`)

Note that there is always a Y-axis value for the display line, regardless of whether the display line state is on or off. It is the current Y-axis value of the display line which is used by this command to determine whether a peak should be reported

Sorting order:

`AMPLitude`	Lists the peaks in order of descending amplitude, with the highest peak first If this optional parameter not sent, this is the default
`FREQuency`	Lists the peaks in order of occurrence, left to right across the x-axis
`TIME`	Lists the peaks in order of occurrence, left to right across the x-axis

Peaks vs. Display Line:

`ALL`	Lists all of the peaks found (default if optional parameter not sent)
`GTDLine` Greater than display line	Lists all of the peaks found above the display line
`LTDLine` Less than display line	Lists all of the peaks found below the display line

For example, for Swept SA measurement in Spectrum Analyzer Mode:

`:CALC:DATA4:PEAK? –40,10,FREQ,GTDL`

Identifies the peaks of trace 4 that are above –40 dBm, with excursions of at least 10 dB. The peaks are returned in order of increasing frequency, starting with the lowest frequency. Only the peaks that are above the display line are returned

Query Results:

If `:FORMat:DATA REAL,32` is selected, returns a list of floating-point numbers. The first value in the list is the number of peak points that are in the following list. A peak point consists of two values: a peak amplitude followed by its corresponding frequency (or time)

If no peaks are found, the peak list consists of only the number of peaks, (0)

9.3.3.7 Smooth Trace Data (Remote Command Only)

Included for ESA compatibility. Not recommended for new designs. Use `:CALCulate:DATA:COMPress` instead.

Smoothes the trace according to the number of points specified in `:TRACe:MATH:SMOoth:POINts`. There is no equivalent front panel function.

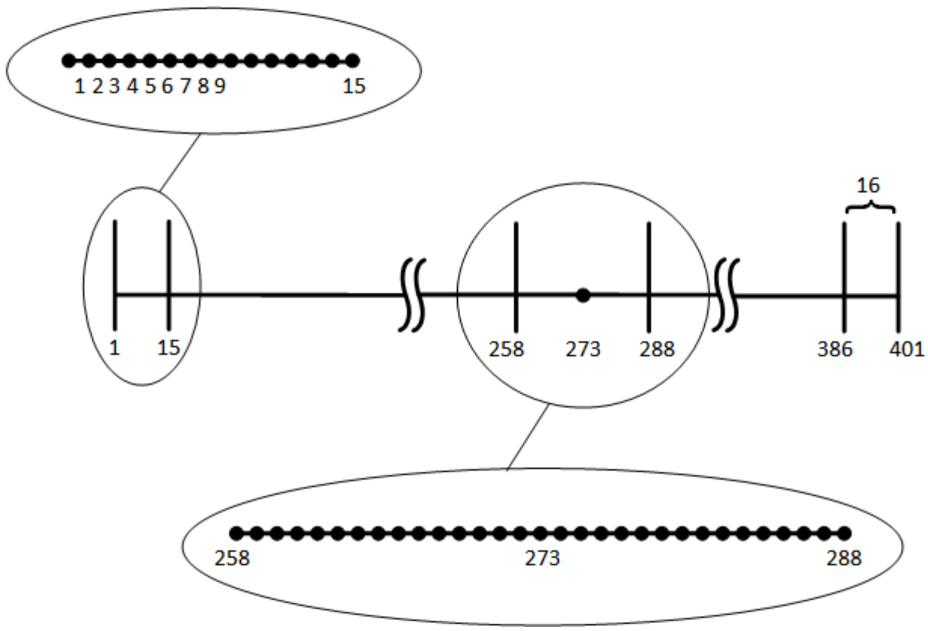
The purpose of this function is to perform a spatial video averaging, as compared to the temporal version supplied by the video-average command `[:SENSe]:AVERage:TYPE VIDeo`. The functions of `:TRACe:MATH:SMOoth <trace>` and `[:SENSe]:AVERage:TYPE VIDeo|POWer` are not interchangeable.

Backwards Compatibility SCPI	`:TRACe:MATH:SMOoth TRACE1 | … | TRACE6`

Each point value is replaced with the average of the values of the selected number of points, with half of those points located on each side of any particular point (when possible). Refer to the illustration below, which shows a 401 point trace with a smoothing number of 31. Think of the trace points as “buckets” of data. To smooth (arbitrary) point 273, the instrument averages buckets 258 through 288 and applies that value to point 273.

Increasing the number of points increases smoothing at the cost of decreasing resolution.

The amount of smoothing decreases at the end points. Because `:TRACe:MATH:SMOoth <trace>` averages values that occur before and after the data point in time, display irregularities can be caused at the start and stop frequencies. To avoid possible irregularities (signal distortion) at the ends of the trace, use small values for the smooth parameter.



Smoothing With 401 Trace Points and 31 Smoothing Points

Refer to the illustration above for a discussion of this end-point smoothing phenomena. With 31 smoothing points and a 401 point trace, point 16 will be the first point to have full 31-bucket smoothing. Likewise, point 386 will be the last point with full 31-bucket smoothing. Under the conditions stated, points 2 through 15 will be smoothed as follows: Point 2 is derived from averaging buckets 1 through 3. Point 3 is derived from averaging buckets 1 through 5, Point 4 is derived from averaging buckets 1 through 7, and so forth until point 16 is reached. The quantity of buckets used for the smoothing running average increases at the rate of 2 buckets per point, from point 1 to point ([smoothing number+1]/2), at which time the full number of smoothing points is utilized. The same characteristic occurs at the completion of the trace, beginning at point 386, beyond which the number of averaging buckets begins to decrease until point 401 is reached.

By replacing the value of each point in a trace with the average of the values of a number of points centered about that point, any rapid variations in noise or signals are smoothed into more gradual variations. It thereby performs a function similar to reducing the video bandwidth without the corresponding changes in sweep time; as such, frequency resolution is decreased. Also, signal peaks are reduced with large smoothing values. This can cause the amplitude to appear to be less than its actual value.

9.3.3.8 Number of Points for Smoothing (Remote Command Only)

Included for ESA compatibility. Not recommended for new designs. Use `:CALCulate:DATA:COMPress` instead.

Specifies the number of points that will be smoothed. Increasing the number of points increases smoothing at the cost of decreasing resolution. If the number of points is an even number, then the number of points is increased by one. If the number of points is larger than the number of sweep points, then the number of sweep points is used, unless the number of sweep points is even, in which case the number of points will be the sweep points minus one. The number of points smoothed is always an odd number.

Example	`:TRAC:MATH:SMO:POIN 501`
Notes	Only odd values are allowed If an even value of `<integer>` is specified, adds 1 unless `<integer>` = number of sweep points, in which case subtract 1 Used with `TRACe:MATH:SMOoth`
Preset	11
Min	3
Max	Number of sweep points
Backwards Compatibility SCPI	`:TRACe:MATH:SMOoth:POINts <integer>` `:TRACe:MATH:SMOoth:POINts?`

9.3.3.9 Mean Trace Data (Remote Command Only)

Included for ESA compatibility. Not recommended for new designs. Use `:CALCulate:DATA:COMPress` instead.

Returns the mean of the amplitudes of the trace amplitude elements in measurement units.

Example	`:TRAC:MATH:MEAN? TRACE2`
Backwards Compatibility SCPI	`:TRACe:MATH:MEAN? TRACE1 | … | TRACE6`

9.4 Status Register System & STATus Subsystem

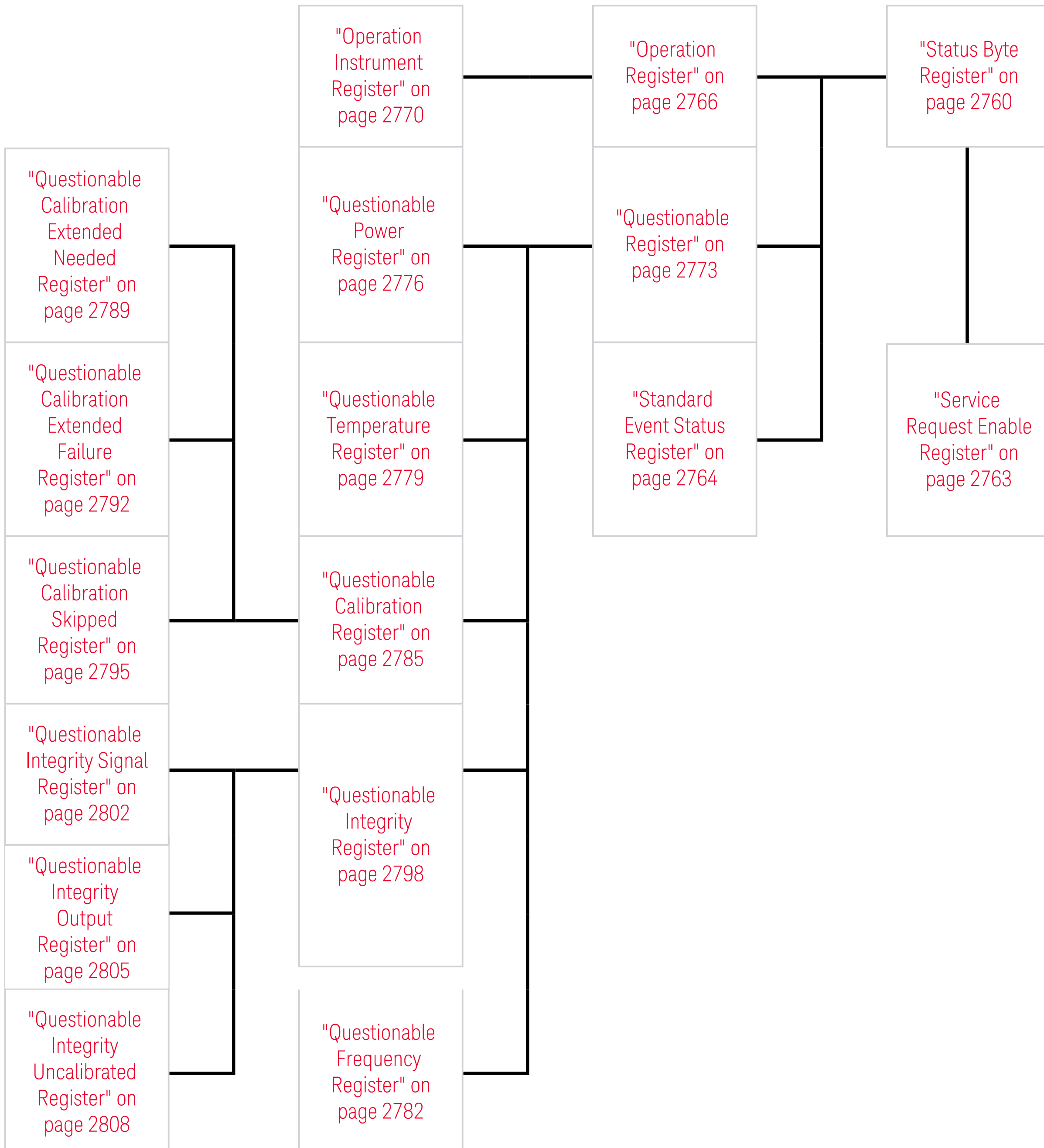
This section provides an overview of the X-Series SCPI status register system, and how to manage the registers. For detailed programming information on each status register, see "Status Subsystem Registers and Commands" on page 2760.

The SCPI `STATus` Subsystem allows you to monitor a number of status conditions within the instrument through the use of a hierarchy of status registers containing bits which go true or false depending on various conditions.

9.4.1 Status Register System Diagram

The diagram below provides a top-level overview of all the Status Registers and their interconnections.

To navigate to detailed information about each Register, click on a register name:


"Operation Instrument Register" on page 2770
"Operation Register" on page 2766
"Status Byte Register" on page 2760
"Questionable Calibration Extended Needed Register" on page 2789
"Questionable Power Register" on page 2776
"Questionable Register" on page 2773
"Questionable Calibration Extended Failure Register" on page 2792
"Questionable Temperature Register" on page 2779
"Standard Event Status Register" on page 2764
"Service Request Enable Register" on page 2763
"Questionable Calibration Skipped Register" on page 2795
"Questionable Calibration Register" on page 2785
"Questionable Integrity Signal Register" on page 2802
"Questionable Integrity Register" on page 2798
"Questionable Integrity Output Register" on page 2805
"Questionable Integrity Uncalibrated Register" on page 2808
"Questionable Frequency Register" on page 2782

Detailed System Diagram

As from the **X-Apps 2023** update, the fully-detailed system diagram that previously appeared here is still available, but, for improved readability, it is now published as a separate high-resolution PDF. You can download the document from Keysight's web site at:

http://literature.cdn.keysight.com/litweb/pdf/N9040-90056.pdf

9.4.2 Status Register Hierarchy

The Status Register system contains multiple registers, arranged in a hierarchy. The lower-level registers propagate their data to the higher-level registers in the data structures by means of summary bits.

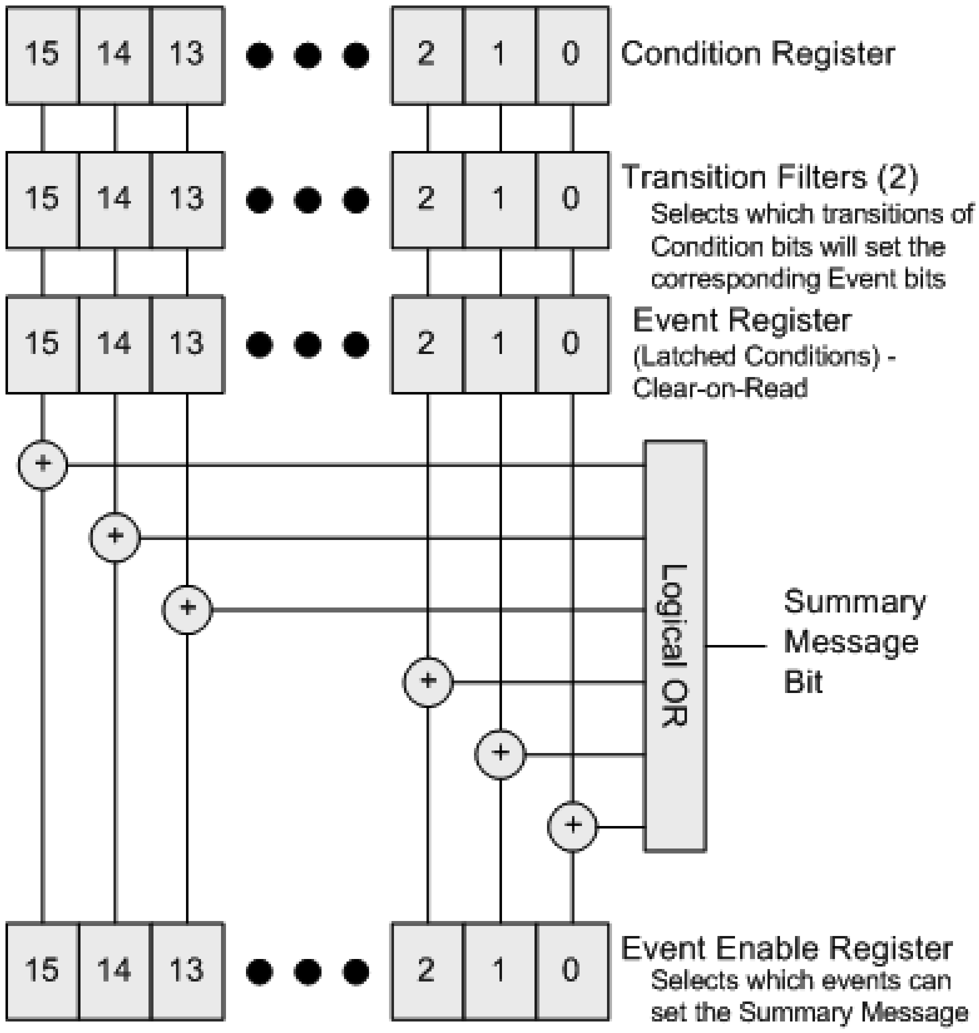
The "Status Byte Register" on page 2760 is at the top of the hierarchy and contains general status information for the instrument's events and conditions. All other individual registers are used to determine the specific events or conditions.

The "Operation Register" on page 2766 and "Questionable Register" on page 2773 are sets of registers that monitor the overall instrument condition. They are accessed using `:STATus:OPERation` and `:STATus:QUEStionable` commands in the `STATus` subsystem. Each composite status register set consists of five sub-registers:

1	Condition Register	Reports the real-time state of the signals monitored by this register set. There is no latching or buffering for a condition register
2	Positive Transition Register	Transition Filter Register Controls which signals will set a bit in the event register when the signal makes a low to high transition (when the condition bit changes from 0 to 1)
3	Negative Transition Register	Transition Filter Register Controls which signals will set a bit in the event register when the signal makes a high to low transition (when the condition bit changes from 1 to 0)
4	Event Register	Latches any signal state changes, in the way specified by the filter registers. Bits in the event register are never cleared by signal state changes. Event registers are cleared when read. They are also cleared by *CLS and by presetting the instrument
5	Event Enable Register	Controls which of the bits, being set in the event register, will be summarized as a single output for the register set. Summary bits are then used by the next higher register

Each status register produces a summary message bit.

The diagram below shows how the sub-registers relate to each other.



The settings of the Transition Filter registers determine whether or not a bit set in a Condition register ripples through to the Event register, as follows:

- If a bit is set in the Positive Transition register, then the corresponding bit in the Event register is set when the condition bit goes from low to high (false to true, off to on)
- Conversely, if a bit is set in the Negative Transition register then the Event register bit is set when the condition bit goes from high to low
- If *both* Transition Filter registers are set true, then the event bit for that condition is set whenever there is any change in the bit. If an event bit is set, the Event Enable register determines whether or not it will OR into the summary bit that is sent to the next level of register. If this bit is set, then the corresponding event bit will be included

Note that the Event register is "Clear-on-Read": when any bit is read, it is automatically cleared.

Questionable Registers

These registers report abnormal operating conditions. The status register hierarchy is:

- The summary outputs from the six `QUEStionable:<keyword>` detail registers are inputs to the "Questionable Register" on page 2773
- The summary output from the "Questionable Register" on page 2773 is an input to the Status Byte Register
- The summary output from the is an input to the "Operation Register" on page 2766. The inputs to the "Operation Condition Query" on page 2767 Register indicate the real time state of the instrument. The "Operation Event Query" on page 2768 Register summary output is an input to the Status Byte Register

Note that, in E4406A only, the "Operation Enable" on page 2768 Register has an additional function. It is `ANDed` with the "Operation Condition Query" on page 2767 Register to determine the instrument busy state, which is checked by "*OPC? - Operation Complete" on page 2726 and "*WAI - Wait-to-Continue" on page 2730 . If the `ANDed` result is non-zero, the instrument is considered busy.

9.4.3 Status Register SCPI Commands

Monitoring of instrument conditions is done at the highest level using the following IEEE 488.2 common commands.

For complete command descriptions, see "IEEE 488.2 Common Commands" on page 2723. Individual status registers can be set and queried using the commands described in "Status Subsystem Registers and Commands" on page 2760.

`*CLS`	Clear Status	Clears the status byte by emptying the error queue and clearing all the event registers
`*ESE` `*ESE?`	Event Status Enable	Sets and queries the bits in the enable register part of the standard event status register
`*ESR?`	Event Status Register	Queries and clears the event register part of the standard event status register
`*OPC` `*OPC?`	Operation Complete	Sets the standard event status register to monitor the completion of all commands. The query stops any new commands from being processed until the current processing is complete, then returns a ‘1’
`*PSC` `*PSC?`	Power-on State Clear	Sets the power-on state so that it clears the service request enable register and the event status enable register at power on

*SRE *SRE?	Service Request Enable	Sets and queries the value of the service request enable register
*STB?	Status Byte	Queries the value of the status byte register without erasing its contents

9.4.4 How to Use Status Registers

A program often needs to be able to detect and manage error conditions or changes in instrument status.

There are two methods you can use to programmatically access the information in status registers:

- The "Polling Method" on page 2756
- The "Service Request (SRQ) Method" on page 2757

The Polling Method works well if you do not need to know about changes the moment they occur. To detect a change using this method, the program must repeatedly read the registers.

The SRQ Method should be used if you must know immediately when a condition changes.

Either method allows you to monitor one or more conditions.

9.4.4.1 Polling Method

In this method, the instrument has a passive role. It only tells the controller that conditions have changed when the controller asks the right question.

Use this method when:

- your programming language/development environment does not support SRQ interrupts
- you want to write a simple, single-purpose program and don’t want the added complexity of setting up an SRQ handler

To monitor a condition:

- Determine which register contains the bit that reports the condition
- Send the unique SCPI query to read that register
- Examine the bit to see if the condition has changed

Monitoring Options

You can monitor conditions in various ways:

1	Check the current instrument hardware and firmware status	Do this by querying the condition registers, which continuously monitor status. These registers represent the current state of the instrument. Bits in a condition register are updated in real time When the condition monitored by a particular bit becomes true, the bit is set to 1. When the condition becomes false, the bit is reset to 0
2	Monitor a particular condition (bit)	You can enable a particular bit(s), using the "Standard Event Status Enable Register" on page 2765. The instrument will then monitor that particular condition. If the bit becomes true (0 to 1 transition) in the Event Register, it will stay set until the Event Register is cleared. Querying the Event Register allows you to detect that this condition occurred, even if the condition no longer exists. The Event Register can only be cleared by querying it, or by sending `*CLS`
3	Monitor a particular type of change in a condition (bit)	By default, the Transition Registers are set if the condition goes from 0 to 1 (false to true, or a positive transition), but you can change this behavior so the selected condition is detected if the bit goes from 1 to 0 (true to false, or a negative transition) You can also detect *both* types of transitions, or neither If both Transition Registers are set to 0 for a particular bit position, that bit is *not* set in the "Standard Event Status Enable Register" on page 2765 for either type of change

9.4.4.2 Service Request (SRQ) Method

In this method, the instrument takes a more active role, by informing the controller when there has been a condition change, without the controller asking.

Use this method when:

- you need time-critical notification of changes
- you are monitoring more than one device which supports SRQs
- you need to have the controller do something else while waiting
- you can't afford the performance penalty inherent to polling

Using the Service Request (SRQ) Method

Your language, bus, and programming environment must be able to support SRQ interrupts, for example, BASIC used with VXI-11.3 (GPIB over LAN). When you monitor a condition with the SRQ method, you must:

- Determine which bit monitors the condition
- Determine how that bit reports to the request service (RQS) bit of the status byte
- Send SCPI commands to enable the bit that monitors the condition and to enable the summary bits that report the condition to the RQS bit
- Enable the controller to respond to service requests

When the condition changes, the instrument sets its RQS bit. The controller is informed of the change as soon as it occurs. As a result, the time the controller would otherwise have used to monitor the condition can be used to perform other tasks. Your program determines how the controller responds to the SRQ.

Bit 6 of the "Status Byte Register" on page 2760 is the request service (RQS) bit. Use *SRE to configure the RQS bit to report changes in instrument status. When such a change occurs, the RQS bit is set. It is cleared when the Status Byte Register is queried using *SRE? (with a serial poll.) It can be queried *without* erasing the contents by using *STB?.

When a register being set causes a summary bit in the status byte to change from 0 to 1, the instrument can initiate the service request (SRQ) process. However, the process is only initiated if *both* the following conditions are true:

The corresponding bit of the service request enable register is also set to 1

The instrument does not have a service request pending. (A service request is considered to be pending between the time the instrument's SRQ process is initiated and the time the controller reads the status byte register)

The SRQ process sets the SRQ true. It also sets the status byte's request service (RQS) bit to 1. Both actions are necessary to inform the controller that the instrument requires service. Setting the SRQ line *only* informs the controller that some device on the bus requires service. Setting the RQS bit allows the controller to determine which instrument requires service.

If your program enables the controller to detect and respond to service requests, it should instruct the controller to perform a serial poll when the SRQ is set true. Each device on the bus returns the contents of its Status Byte Register in response to this poll. The device whose RQS bit is set to 1 is the device that requested service.

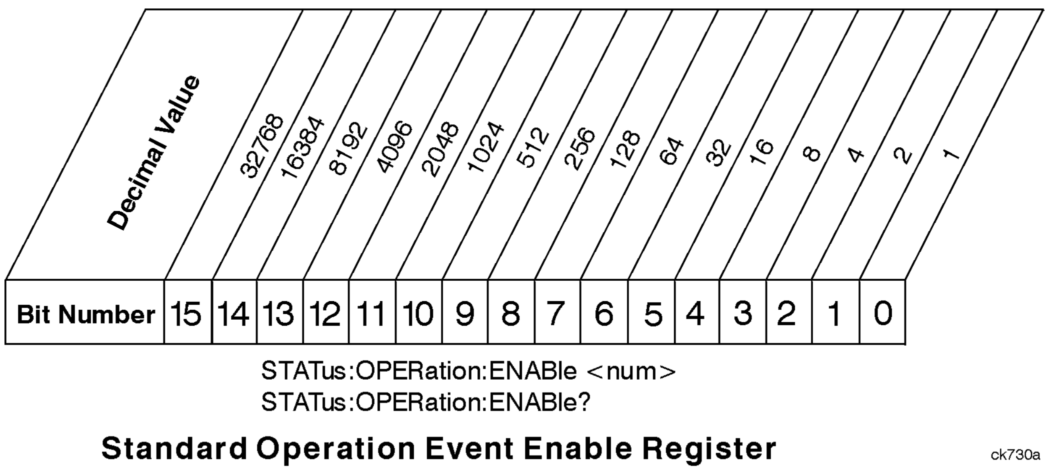
NOTE **When you read the instrument's Status Byte Register using a serial poll, the RQS bit is reset to 0. Other bits in the register are not affected.**

If the status register is configured to SRQ on end-of-measurement, and the measurement is in **Continuous** mode, then restarting a measurement (via :INIT) can cause the measuring bit to pulse low. This causes an SRQ even though you have not actually reached the "end-of-measurement" condition. To avoid this:

- Set `:INITiate:CONTinuous OFF`
- Set/enable the status registers
- Restart the measurement (send `:INIT`)

9.4.5 Status Register Bit Parameters

The diagram below shows a typical status register, in this case the "Operation Enable" on page 2768 Register. Each bit in a register is represented by a numerical value based on its location. When a command requires a bit pattern to be sent as its parameter, that can be entered as a numeric value using decimal or hexadecimal representations. (where 0 to 32767 is equivalent to `#H0` to `#H7FFF`). If you want to enable more than one bit, you send the sum of all the bits that you want to monitor.



Standard Operation Event Enable Register

NOTE: Bit 15 is not used to report status.

Example 1

To enable bit 0 and bit 6 of standard event status register, you would send the command `*ESE 65` because 1 + 64 = 65

The results of a query are evaluated in a similar way. If the `*STB?` command returns a decimal value of 140, (140 = 128 + 8 + 4) then bit 7 is true, bit 3 is true and bit 2 is true

Example 2

Suppose you want to know if an Auto-trigger Timeout occurs, but you only cared about that specific condition. So you would want to know what was happening with bit 10 in the Status Questionable Integrity register, and not about any other bits

It is usually a good idea to start by clearing all the status registers, using `*CLS`

Sending `:STAT:QUES:INT:ENAB 1024` lets you monitor only bit 10 events, instead of the default monitoring all the bits in the register. The register default is for positive transition events (0 to 1 transition), that is, when an auto-trigger timeout occurs. If instead, you want to know when the Auto-trigger timeout condition is cleared, then you set `:STAT:QUES:INT:PTR 0` and `:STAT:QUES:INT:NTR 32767`

Now, the only output from the "Questionable Integrity Register" on page 2798 will come from a bit 10 positive transition, and goes to the Integrity Sum bit 9 of the "Questionable Register" on page 2773

If you want only to monitor bit 9 of the same register, send `:STAT:QUES:ENAB 512`

The "Questionable Register" on page 2773 output goes to the “Status Questionable Summary” bit 3 of the "Status Byte Register" on page 2760. The output from this register can be enabled using `*SRE 8`.

Finally, you can use the serial polling functionality available for the particular bus/software that you are using to monitor the Status Byte Register, or you could use `*STB?` to poll the Status Byte Register.

9.4.6 Status Subsystem Registers and Commands

The Status Subsystem registers monitor various events and conditions in the instrument. Software written to control the instrument may need to monitor some of these events and conditions.

To set and query status registers, you can use the `STATus` subsystem SCPI commands and queries.

NOTE

All status register commands are sequential. You can send them in the middle of an ongoing overlapped command to get the current status. You can also send them following a sequential command. In this case, the status register command waits for the completion of the previously-sent sequential command before performing the action.

***Most commands are sequential commands*; only a few are overlapped.**

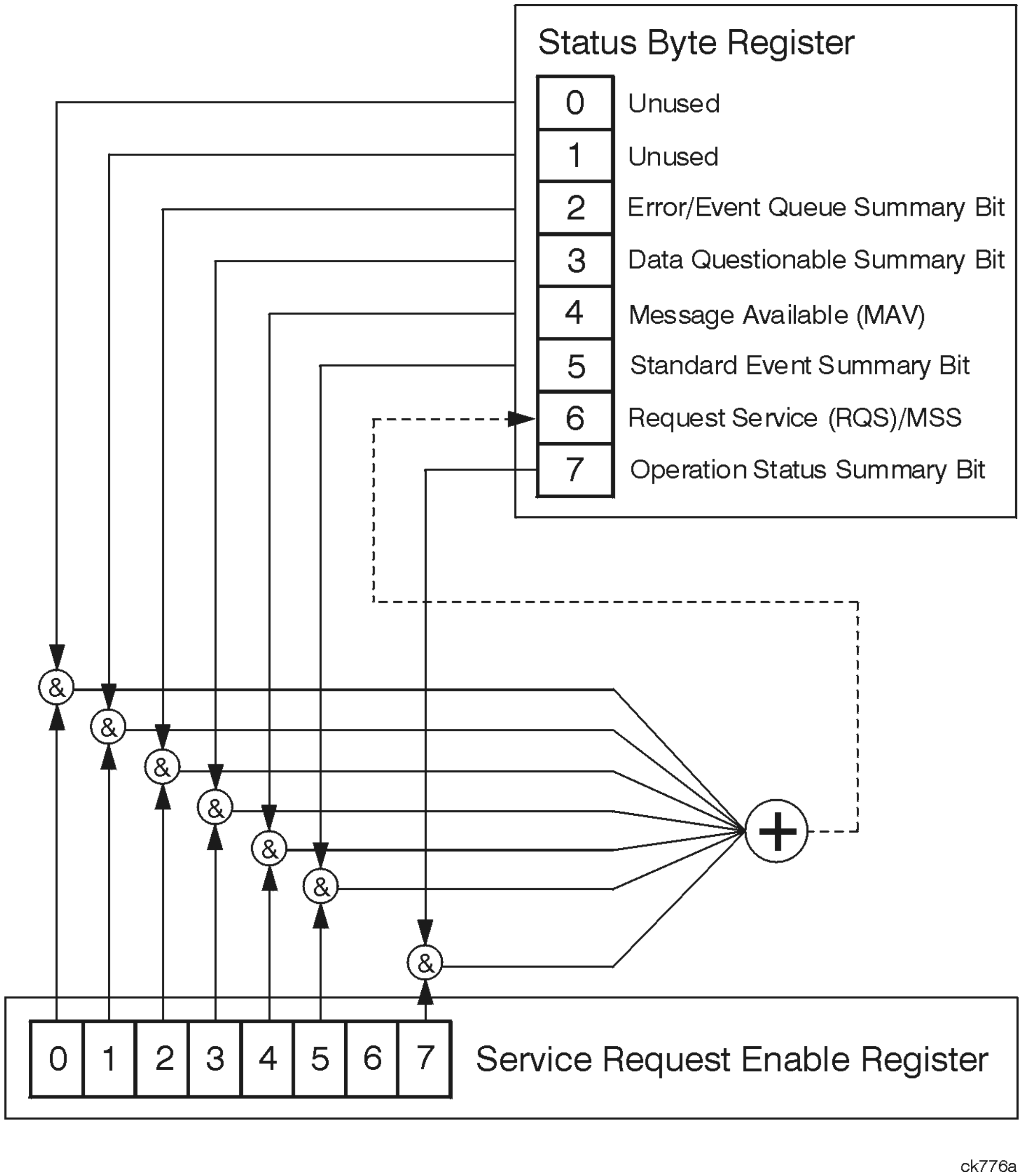
If a command *is* overlapped, then that is explicitly stated in the command description.

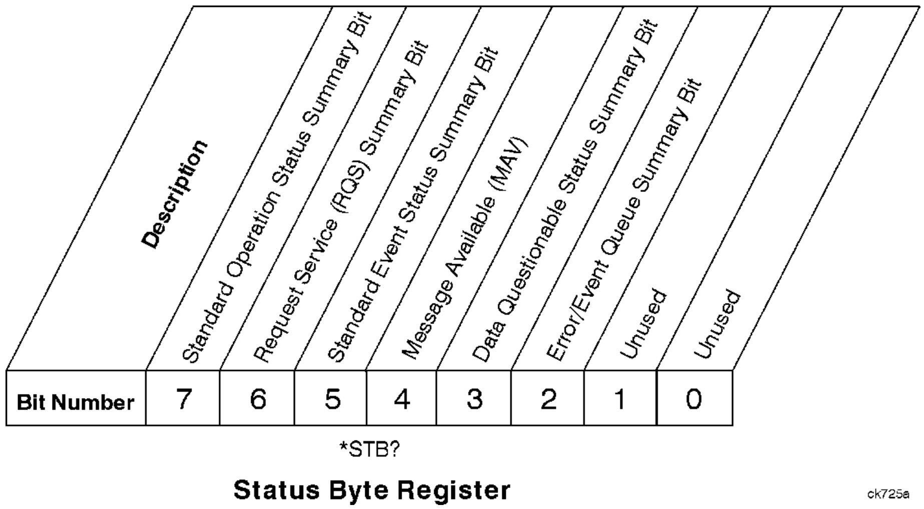
See also the Keysight X-Series Signal Analyzers Instrument Messages manual for more detail on the instrument conditions that can cause these bits to be set.

9.4.6.1 Status Byte Register

Provides a one-byte overview of the entire `STATus` subsystem. All the other registers funnel into this register via summary bits, as shown in the "Status Register System

Diagram" on page 2751.





Bit	Description
0, 1	These bits are always set to 0
2	A 1 in this bit position indicates that the SCPI error queue is not empty which means that it contains at least one error message
3	A 1 in this bit position indicates that the data questionable summary bit has been set. The data questionable event register can then be read to determine the specific condition that caused this bit to be set
4	A 1 in this bit position indicates that the instrument has data ready in the output queue. There are no lower status groups that provide input to this bit
5	A 1 in this bit position indicates that the standard event summary bit has been set. The standard event status register can then be read to determine the specific event that caused this bit to be set
6	A 1 in this bit position indicates that the instrument has at least one reason to report a status change. This bit is also called the master summary status bit (MSS)
7	A 1 in this bit position indicates that the standard operation summary bit has been set. The standard operation event register can then be read to determine the specific condition that caused this bit to be set

To query the Status Byte Register, send "*STB? - Status Byte Query" on page 2729. The response will be the decimal sum of the bits that are set to 1. For example, if bit number 7 and bit number 3 are set to 1, the decimal sum of the 2 bits is 128 plus 8, so the decimal value 136 is returned.

`*STB` does *not* clear the status register.

The `RQS` bit is read and reset by a serial poll. The same bit position (`MSS`) is read non-destructively by `*STB?`. If you serial-poll bit 6, it is read as `RQS`, but if you send `*STB`, it reads bit 6 as `MSS`. For more information refer to Section 11 of: IEEE Standard 488.2-1992

In addition to the Status Byte Register, the status byte group also contains the "Service Request Enable Register" on page 2763, which lets you select which bits in the Status Byte Register will trigger a service request.

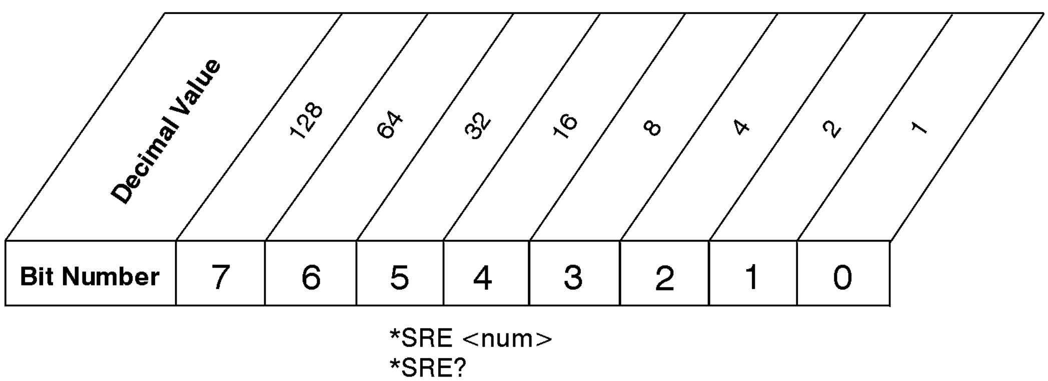
Service Request Enable Register

Enables the desired bits of the Service Request (`SRQ`) subsystem.

Send `*SRE <integer>`, where `<integer>` is the sum of the decimal values of the bits you want to enable plus the decimal value of bit 6. For example, assume that you want to enable bit 7 so that whenever the standard operation status register summary bit is set to 1 it will trigger a service request. Send the command `*SRE 192` (because 192 = 128 + 64). You must always add 64 (the numeric value of `RQS` bit 6) to your numeric sum when you enable any bits for a service request.

`*SRE?` returns the decimal value of the sum of the bits previously enabled with `*SRE <integer>`.

This register presets to zeros (0).



Service Request Enable Register

See also "*SRE - Service Request Enable" on page 2728

Preset the Status Byte

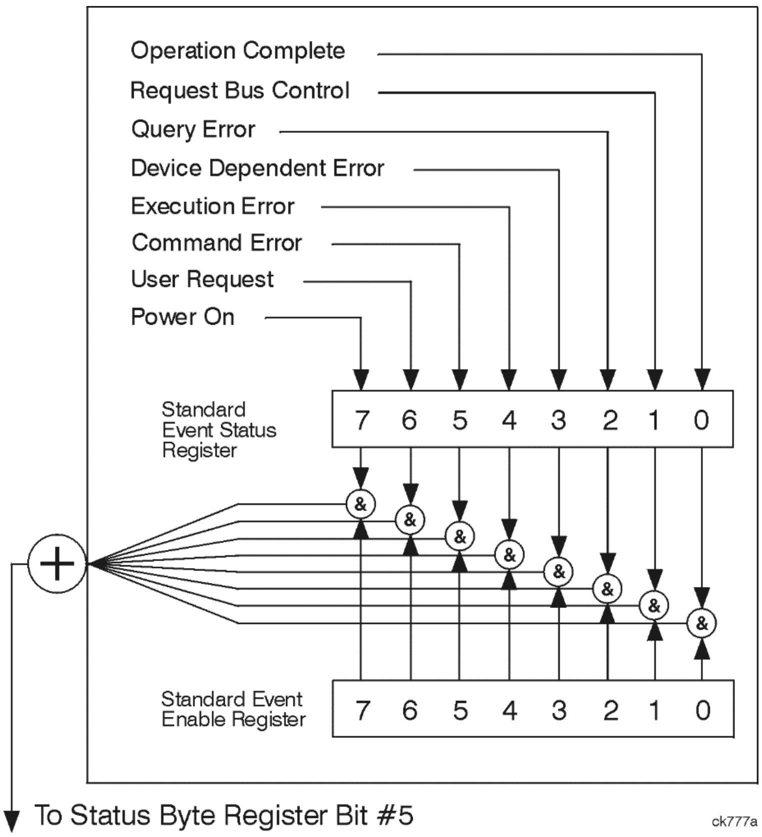
Sets bits in most of the enable and transition registers to their default state.

- Presets:
- All Transition Filters
- All Enable Registers
- Error/Event Queue Enable

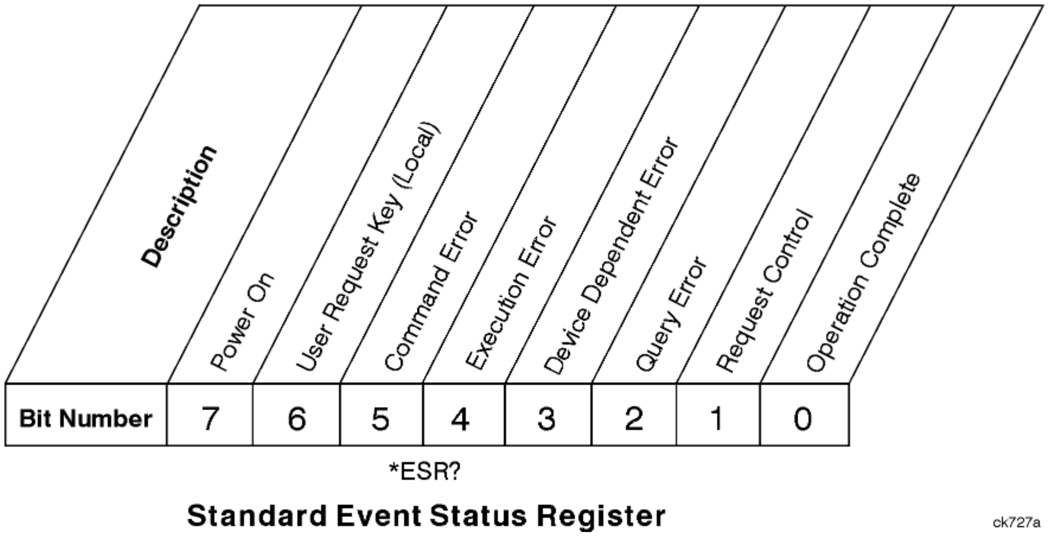
Has no effect on Event Registers, Error/Event QUEue, IEEE 488.2 ESE, and SRE Registers, as described in: IEEE Standard 488.2–1992

Remote Command	`:STATus:PRESet`
Example	`:STAT:PRES`

9.4.6.2 Standard Event Status Register



The standard event status register contains the following bits:



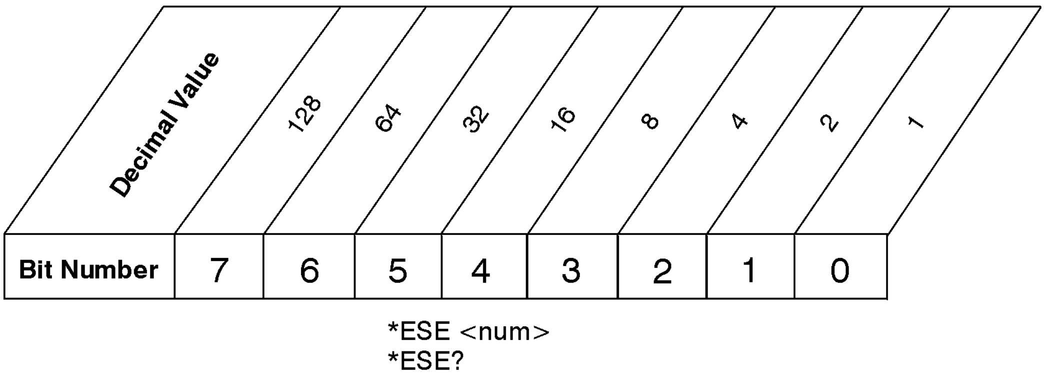
Bit	Description
0	A 1 in this bit position indicates that all pending operations were completed following execution of the *OPC command
1	For GPIB handshaking to request control. Currently it is set to 0, because there are no implementations where the spectrum analyzer controls another instrument
2	A 1 in this bit position indicates that a query error has occurred. Query errors have SCPI error numbers from -499 to -400
3	A 1 in this bit position indicates that a device dependent error has occurred. Device dependent errors have SCPI error numbers from -399 to -300 and 1 to 32767
4	A 1 in this bit position indicates that an execution error has occurred. Execution errors have SCPI error numbers from -299 to -200
5	A 1 in this bit position indicates that a command error has occurred. Command errors have SCPI error numbers from -199 to -100
6	A 1 in this bit position indicates that the **LOCAL** key has been pressed. This is true even if the instrument is in local lockout mode
7	A 1 in this bit position indicates that the instrument has been turned off and then on

The Standard Event Status Register is used to determine the specific events that set bit 5 in the "Status Byte Register" on page 2760. To query this register, send `*ESR?`. The response will be the decimal sum of the bits that are enabled (set to 1). For example, if bit number 7 and bit number 3 are enabled, the decimal sum of the 2 bits is 128 plus 8, so the decimal value 136 is returned. See also "*ESR? - Standard Event Status Register Query" on page 2725

Standard Event Status Enable Register

In addition to the "Standard Event Status Register" on page 2764, the Standard Event status group also contains a Standard Event Status Enable Register. This register lets you choose which bits in the standard event status register will set the summary bit (bit 5 of the status byte register) to 1. Send `*ESE <integer>`, where `<integer>` is the sum of the decimal values of the bits you want to enable. For example, to enable bit 7 and bit 6 so that whenever either of those bits is set to 1, the standard event status summary bit of the status byte register will be set to 1, send `*ESE 192` (128 + 64). `*ESE?` returns the decimal value of the sum of the bits previously enabled with `*ESE <integer>`.

The standard event status enable register presets to zeros (0).



Standard Event Status Enable Register

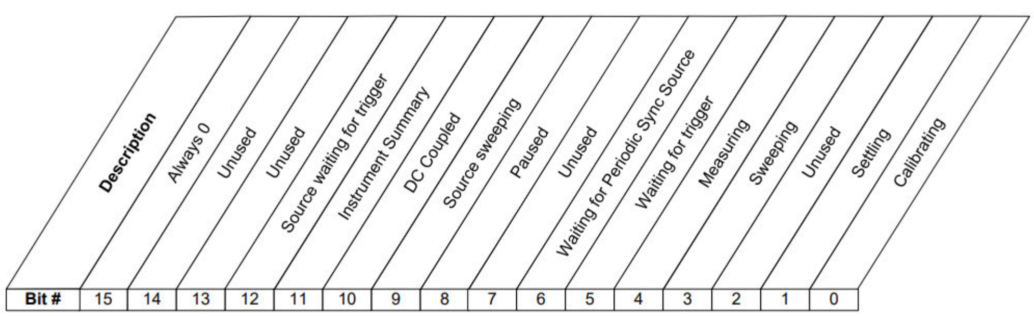
ck728a

See also "*ESE - Standard Event Status Enable" on page 2724

9.4.6.3 Operation Register

This register and the "Questionable Register" on page 2773 are sets of registers that monitor the overall instrument condition. They are accessed using `:STATus:OPERation` and `:STATus:QUEStionable`.

This register monitors the current instrument measurement state and various instrument operations for a quick summary of what is happening within the instrument. It checks to see if the instrument is calibrating, sweeping, or waiting for a trigger (see also "*OPC? - Operation Complete" on page 2726).



STATus:OPERation Register

Bit	Condition	Operation
0	Calibrating	The instrument is busy executing its Align Now process
1	Settling	The instrument circuitry is settling
3	Sweeping	The instrument is busy taking a sweep
4	Measuring	The instrument is busy making a measurement. Measurements often require multiple sweeps. They are initiated by user-interface keys or with the MEASure group of commands The bit is valid for most X-Series Modes
5	Waiting for trigger	The instrument is waiting for the trigger conditions to be met, then it will trigger a sweep or measurement
6	Waiting for Periodic Sync Source	The instrument is waiting for the Periodic trigger Sync Source conditions to be met, then the sweep or measurement period will be synchronized
8	Paused	The measurement is paused
9	Source Sweeping	The List Sequencer is running or Freq Scan results are available
10	DC Coupled	The instrument is DC coupled
11	Instrument Summary	The summary bit for the "Operation Instrument Register" on page 2770
12	Source Waiting for Trigger	The built in source is waiting for a trigger

Filter Registers

– "Operation Condition Query" on page 2767
– "Operation Enable" on page 2768
– "Operation Event Query" on page 2768
– "Operation Negative Transition" on page 2769
– "Operation Positive Transition" on page 2769

Operation Condition Query

Returns the decimal value of the sum of the bits in the Status Operation Condition register.

NOTE: **The data in this register is continuously updated and reflects the current conditions.**

Remote Command	`:STATus:OPERation:CONDition?`

Example	:STAT:OPER:COND?
Preset	0
Status Bits/OPC dependencies	Sequential command

Operation Enable

Determines which bits in the "Operation Event Query" on page 2768 register will set the Operation Status Summary bit (bit 7) in the "Status Byte Register" on page 2760.

The variable <integer> is the sum of the decimal values of the bits you want to enable.

NOTE **The preset condition is to have all bits in this enable register set to 0. To have any Operation Events reported to the Status Byte Register, one or more bits need to be set to 1.**

Remote Command	:STATus:OPERation:ENABle <integer> :STATus:OPERation:ENABle?
Example	:STAT:OPER:ENAB 1 Sets the register so that Align Now events will be reported to the Status Byte Register
Preset	0
Min	0
Max	32767
Status Bits/OPC dependencies	Sequential command

Operation Event Query

Returns the decimal value of the sum of the bits in the Operation Event register.

NOTE **The register requires that the associated PTRansition or NTRansition filters be set before a condition register bit can set a bit in the event register. The data in this register is latched until it is queried. Once queried, the register is cleared.**

Remote Command	:STATus:OPERation[:EVENt]?
Example	:STAT:OPER?
Preset	0
Status Bits/OPC dependencies	Sequential command

Operation Negative Transition

Determines which bits in the "Operation Condition Query" on page 2767 register will set the corresponding bit in the "Operation Event Query" on page 2768 register when the condition register bit has a negative transition (1 to 0).

The variable `<integer>` is the sum of the decimal values of the bits that you want to enable.

Remote Command	`:STATus:OPERation:NTRansition <integer>` `:STATus:OPERation:NTRansition?`
Example	`:STAT:OPER:NTR 1` Align Now operation complete will be reported to the Status Byte Register
Preset	0
Min	0
Max	32767
Status Bits/OPC dependencies	Sequential command

Operation Positive Transition

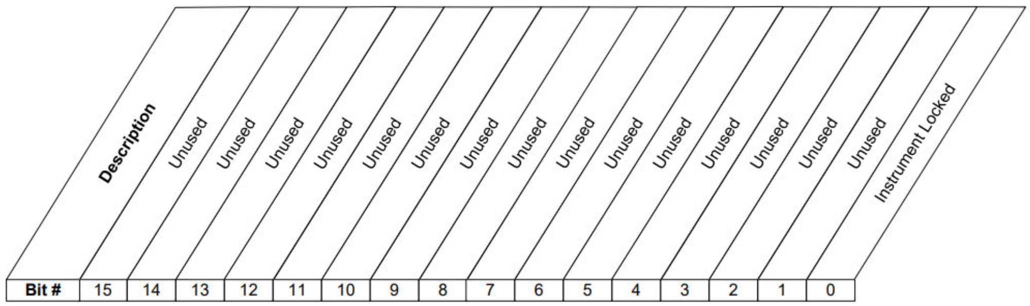
Determines which bits in the "Operation Condition Query" on page 2767 register will set the corresponding bit in the "Operation Event Query" on page 2768 register when the condition register bit has a positive transition (0 to 1).

The variable `<integer>` is the sum of the decimal values of the bits that you want to enable.

Remote Command	`:STATus:OPERation:PTRansition <integer>` `:STATus:OPERation:PTRansition?`
Example	`:STAT:OPER:PTR 1` Align Now operation beginning will be reported to the Status Byte Register
Preset	32767
Min	0
Max	32767
Status Bits/OPC dependencies	Sequential command

9.4.6.4 Operation Instrument Register

Monitors instrument-related operations and summarizes them in bit 11 of the "Operation Register" on page 2766.



STATus:OPERation:INSTrument Register

Bit	Condition	Operation
0	Instrument Locked	The instrument is locked

Filter Registers

- "Operation Instrument Condition" on page 2770
- "Operation Instrument Enable" on page 2771
- "Operation Instrument Event Query" on page 2771
- "Operation Instrument Negative Transition" on page 2772
- "Operation Instrument Positive Transition" on page 2772

Operation Instrument Condition

Returns the decimal value of the sum of the bits in the Status Operation Instrument Condition register.

NOTE **The data in this register is continuously updated and reflects the current conditions.**

Remote Command	:STATus:OPERation:INSTrument:CONDition?
Example	:STAT:OPER:INST:COND?
Preset	0
Status Bits/OPC dependencies	Sequential command

Operation Instrument Enable

Determines which bits in the "Operation Instrument Condition" on page 2770 Register will set bits in the "Operation Instrument Event Query" on page 2771 register, which also sets the Instrument Summary bit (bit 11) in the "Operation Instrument Register" on page 2770.

The variable `<integer>` is the sum of the decimal values of the bits you want to enable.

NOTE The preset condition is to have all bits in this enable register set to 0. To have any Instrument Events reported to the Status Byte Register, one or more bits need to be set to 1.

Remote Command	`:STATus:OPERation:INSTrument:ENABle <integer>` `:STATus:OPERation:INSTrument:ENABle?`
Example	`:STAT:OPER:INST:ENAB 1` Sets the register so that Instrument Locked will be reported to the Status Byte Register
Preset	32767
Min	0
Max	32767
Status Bits/OPC dependencies	Sequential command

Operation Instrument Event Query

Returns the decimal value of the sum of the bits in the Operation Instrument Event register.

NOTE The register requires that the associated PTRansition or NTRansition filters be set before a condition register bit can set a bit in the event register. The data in this register is latched until it is queried. Once queried, the register is cleared.

Remote Command	`:STATus:OPERation:INSTrument[:EVENt]?`
Example	`:STAT:OPER:INST?`
Preset	0
Status Bits/OPC dependencies	Sequential command

Operation Instrument Negative Transition

Determines which bits in the "Operation Condition Query" on page 2767 Register will set the corresponding bit in the "Operation Event Query" on page 2768 register when the condition register bit has a negative transition (1 to 0).

The variable `<integer>` is the sum of the decimal values of the bits that you want to enable.

Remote Command	`:STATus:OPERation:INSTrument:NTRansition <integer>` `:STATus:OPERation:INSTrument:NTRansition?`
Example	`:STAT:OPER:INST:NTR 1` Instrument Locked being cleared will be reported to the Instrument Summary of the Status Operation register
Preset	0
Min	0
Max	32767
Status Bits/OPC dependencies	Sequential command

Operation Instrument Positive Transition

Determines which bits in the "Operation Condition Query" on page 2767 Register will set the corresponding bit in the "Operation Event Query" on page 2768 register when the condition register bit has a positive transition (0 to 1).

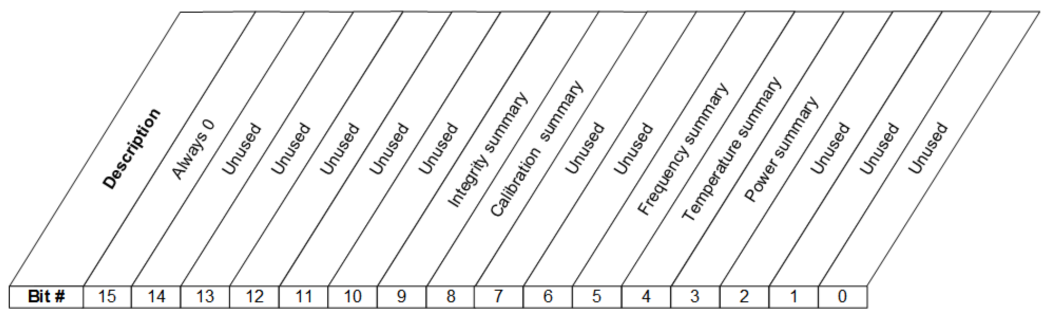
The variable `<integer>` is the sum of the decimal values of the bits that you want to enable.

Remote Command	`:STATus:OPERation:INSTrument:PTRansition <integer>` `:STATus:OPERation:INSTrument:PTRansition?`
Example	`:STAT:OPER:INST:PTR 1` Instrument Locked being set will be reported to the Instrument Summary of the Status Operation register
Preset	32767
Min	0
Max	32767
Status Bits/OPC dependencies	Sequential command

9.4.6.5 Questionable Register

This register and the "Operation Register" on page 2766 monitor the overall instrument condition. They are accessed using `:STATus:OPERation` and `:STATus:QUEStionable`.

This register monitors the instrument's condition to see if anything questionable has happened. It detects anything that might cause an error or a bad measurement, such as a hardware problem, an out-of-calibration situation, or a unusual signal. All the bits are summary bits from lower-level event registers.



STATus:QUEStionable Register

Bit	Condition	Operation
3	Power summary	Summary bit for "Questionable Power Register" on page 2776
4	Temperature summary	Summary bit for "Questionable Temperature Register" on page 2779
5	Frequency summary	Summary bit for "Questionable Frequency Register" on page 2782
8	Calibration summary	Summary bit for "Questionable Calibration Register" on page 2785
9	Integrity summary	Summary bit for "Questionable Integrity Register" on page 2798

Filter Registers

– "Questionable Condition" on page 2774

– "Questionable Enable" on page 2774

– "Questionable Event Query" on page 2775

– "Questionable Negative Transition" on page 2775

– "Questionable Positive Transition" on page 2775

Questionable Condition

Returns the decimal value of the sum of the bits in the Questionable Condition register.

NOTE The data in this register is continuously updated and reflects current conditions.

Remote Command	`:STATus:QUEStionable:CONDition?`
Example	`:STAT:QUES:COND?`
Preset	0
Status Bits/OPC dependencies	Sequential command

Questionable Enable

Determines which bits in the "Questionable Event Query" on page 2775 Register will set the Questionable Status Summary bit (bit3) in the "Status Byte Register" on page 2760.

The variable `<integer>` is the sum of the decimal values of the bits you want to enable.

NOTE The preset condition is all bits in this enable register set to 0. To report any Questionable Events to the Status Byte Register, one or more bits need to be set to 1. The "Standard Event Status Register" on page 2764 should be queried after each measurement to check the Questionable Status Summary (bit 3). If it is equal to 1, a condition during the test may have made the test results invalid. If it is equal to 0, this indicates that no hardware problem or measurement problem was detected by the analyzer.

Remote Command	`:STATus:QUEStionable:ENABle <integer>`
	`:STATus:QUEStionable:ENABle?`
	`:STATus:OPERation:ENABle <integer>`
	`:STATus:OPERation:ENABle?`

Example	`:STAT:QUES:ENAB 16` Sets the register so that questionable temperature events will be reported to the Status Byte Register
Preset	0
Min	0
Max	32767

Status Bits/OPC dependencies	Sequential command

Questionable Event Query

Returns the decimal value of the sum of the bits in the Questionable Event register.

NOTE **The register requires that the associated PTRansition or NTRansition filters be set before a condition register bit can set a bit in the event register. The data in this register is latched until it is queried. Once queried, the register is cleared.**

Remote Command	`:STATus:QUEStionable[:EVENt]?`
Example	`:STAT:QUES?`
Preset	0
Status Bits/OPC dependencies	Sequential command

Questionable Negative Transition

Determines which bits in the "Questionable Condition" on page 2774 Register will set the corresponding bit in the "Questionable Event Query" on page 2775 Register when the condition register bit has a negative transition (1 to 0).

The variable `<integer>` is the sum of the decimal values of the bits that you want to enable.

Remote Command	`:STATus:QUEStionable:NTRansition <integer>` `:STATus:QUEStionable:NTRansition?`
Example	`:STAT:QUES:NTR 16` Temperature summary ‘questionable cleared’ will be reported to the Status Byte Register
Preset	0
Min	0
Max	32767
Status Bits/OPC dependencies	Sequential command

Questionable Positive Transition

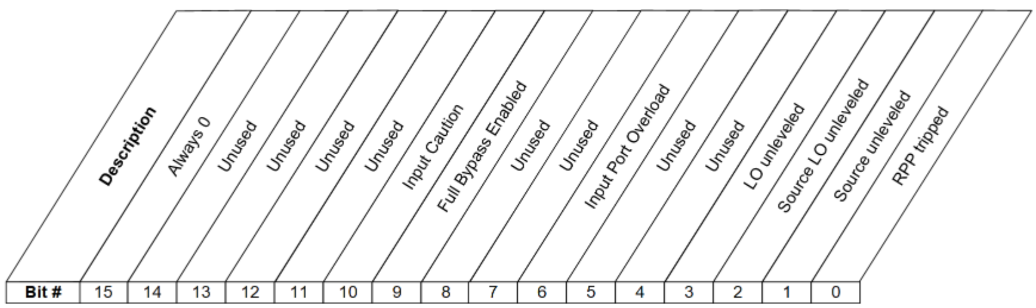
Determines which bits in the "Questionable Condition" on page 2774 Register will set the corresponding bit in the "Questionable Event Query" on page 2775 Register when the condition register bit has a positive transition (0 to 1).

The variable `<integer>` is the sum of the decimal values of the bits that you want to enable.

Remote Command	`:STATus:QUEStionable:PTRansition <integer>` `:STATus:QUEStionable:PTRansition?`
Example	`:STAT:QUES:PTR 16` Temperature summary ‘questionable asserted’ will be reported to the Status Byte Register
Preset	32767
Min	0
Max	32767
Status Bits/OPC dependencies	Sequential command

9.4.6.6 Questionable Power Register

Monitors power-related conditions within the instrument and summarizes them in bit 3 of the "Questionable Register" on page 2773.



STATus:QUEStionable:POWer Register

Bit	Condition	Operation
0	RPP tripped	(not currently in use)
1	Source Unleveled	The built-in source is not properly leveled
2	Source LO Unleveled	(not currently in use)
3	LO Unleveled	(not currently in use)
6	Input Port Overload	A power overload condition exists at an input port
9	Full Bypass Enabled	Frontend circuitry is bypassed, use caution to protect the mixer
10	Input Caution	Input circuitry is configured such that care is required to prevent damage

Filter Registers

– "Questionable Power Condition" on page 2777
– "Questionable Power Enable" on page 2777
– "Questionable Power Event Query" on page 2778
– "Questionable Power Negative Transition" on page 2778
– "Questionable Power Positive Transition" on page 2778

Questionable Power Condition

Returns the decimal value of the sum of the bits in the Questionable Power Condition register.

NOTE The data in this register is continuously updated and reflects the current conditions.

Remote Command	`:STATus:QUEStionable:POWer:CONDition?`
Example	`:STAT:QUES:POW:COND?`
Preset	0
Status Bits/OPC dependencies	Sequential command

Questionable Power Enable

Determines which bits in the "Questionable Power Condition" on page 2777 Register will set bits in the Questionable Power Event register, which also sets the Power Summary bit (bit 3) in the "Questionable Register" on page 2773.

The variable `<integer>` is the sum of the decimal values of the bits you want to enable.

Remote Command	`:STATus:QUEStionable:POWer:ENABle <integer>` `:STATus:QUEStionable:POWer:ENABle?`
Example	`:STAT:QUES:POW:ENAB 2` Source Unlevelled will be reported to the Power Summary of the Status Questionable register
Preset	32767
Min	0
Max	32767
Status Bits/OPC dependencies	Sequential command

Questionable Power Event Query

Returns the decimal value of the sum of the bits in the Questionable Power Event Query register.

NOTE **The register requires that the associated PTRansition or NTRansition filters be set before a condition register bit can set a bit in the event register. The data in this register is latched until it is queried. Once queried, the register is cleared.**

Remote Command	`:STATus:QUEStionable:POWer[:EVENt]?`
Example	`:STAT:QUES:POW?`
Preset	0
Status Bits/OPC dependencies	Sequential command

Questionable Power Negative Transition

Determines which bits in the "Questionable Power Condition" on page 2777 register will set the corresponding bit in the "Questionable Power Event Query" on page 2778 register when the condition register bit has a negative transition (1 to 0).

The variable `<integer>` is the sum of the decimal values of the bits that you want to enable.

Remote Command	`:STATus:QUEStionable:POWer:NTRansition <integer>` `:STATus:QUEStionable:POWer:NTRansition?`
Example	`:STAT:QUES:POW:NTR 2` Source Unlevelled being cleared will be reported to the Power Summary of the Status Questionable register
Preset	0
Min	0
Max	32767
Status Bits/OPC dependencies	Sequential command

Questionable Power Positive Transition

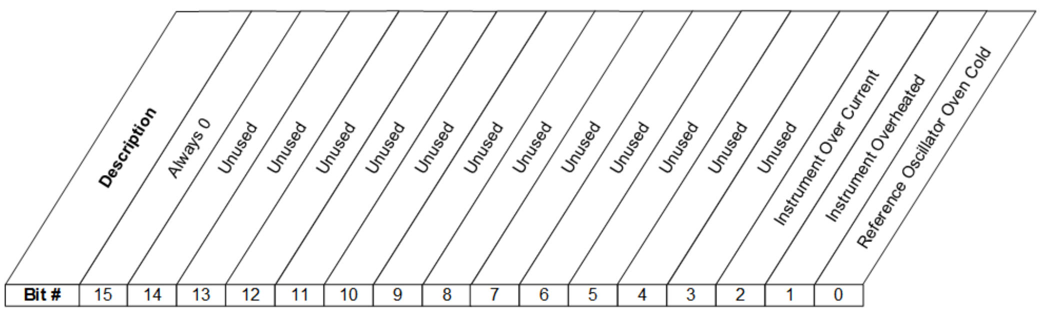
Determines which bits in the "Questionable Power Condition" on page 2777 register will set the corresponding bit in the "Questionable Power Event Query" on page 2778 register when the condition register bit has a positive transition (0 to 1).

The variable `<integer>` is the sum of the decimal values of the bits that you want to enable.

Remote Command	`:STATus:QUEStionable:POWer:PTRansition <integer>` `:STATus:QUEStionable:POWer:PTRansition?>`
Example	`:STAT:QUES:POW:PTR 32` Source Unlevelled being set will be reported to the Power Summary of the Status Questionable register
Preset	32767
Min	0
Max	32767
Status Bits/OPC dependencies	Sequential command

9.4.6.7 Questionable Temperature Register

Monitors temperature-related conditions within the instrument and summarizes them in bit 4 of the "Questionable Register" on page 2773.



STATus:QUEStionable:TEMPerature Register

Bit	Condition	Operation
0	Reference Oscillator Oven Cold	(not currently in use)
1	Instrument overheated (over temperature)	Excessive heat has been detected in some part of the instrument
2	Instrument over current	Excessive heat has been detected in some part of the instrument, the instrument should be restarted

Filter Registers

– "Questionable Temperature Condition" on page 2780
– "Questionable Temperature Enable" on page 2780

- "Questionable Temperature Event Query" on page 2781
- "Questionable Temperature Negative Transition" on page 2781
- "Questionable Temperature Positive Transition" on page 2781

Questionable Temperature Condition

Returns the decimal value of the sum of the bits in the Questionable Temperature Condition register.

NOTE **The data in this register is continuously updated and reflects the current conditions.**

Remote Command	`:STATus:QUEStionable:TEMPerature:CONDition?`
Example	`:STAT:QUES:TEMP:COND?`
Preset	0
Status Bits/OPC dependencies	Sequential command

Questionable Temperature Enable

Determines which bits in the "Questionable Temperature Condition" on page 2780 Register will set bits in the "Questionable Temperature Event Query" on page 2781 register, which also sets the Temperature Summary bit (bit 4) in the "Questionable Register" on page 2773.

The variable `<integer>` is the sum of the decimal values of the bits you want to enable.

Remote Command	`:STATus:QUEStionable:TEMPerature:ENABle <integer>` `:STATus:QUEStionable:TEMPerature:ENABle?`
Example	`:STAT:QUES:TEMP:ENAB 2` Instrument Overheated will be reported to the Temperature Summary of the Questionable Register
Preset	32767
Min	0
Max	32767
Status Bits/OPC dependencies	Sequential command

Questionable Temperature Event Query

Returns the decimal value of the sum of the bits in the Questionable Temperature Event register.

NOTE The register requires that the associated PTRansition or NTRansition filters be set before a condition register bit can set a bit in the event register. The data in this register is latched until it is queried. Once queried, the register is cleared.

Remote Command	`:STATus:QUEStionable:TEMPerature[:EVENt]?`
Example	`:STAT:QUES:TEMP?`
Preset	0
Status Bits/OPC dependencies	Sequential command

Questionable Temperature Negative Transition

Determines which bits in the "Questionable Temperature Condition" on page 2780 Register will set bits in the "Questionable Temperature Event Query" on page 2781 register, when the condition register bit has a negative transition (1 to 0).

The variable `<integer>` is the sum of the decimal values of the bits that you want to enable.

Remote Command	`:STATus:QUEStionable:TEMPerature:NTRansition <integer>` `:STATus:QUEStionable:TEMPerature:NTRansition?`
Example	`:STAT:QUES:TEMP:NTR 2` Instrument Overheated being cleared will be reported to the Temperature Summary of the Status Questionable register
Preset	0
Min	0
Max	32767
Status Bits/OPC dependencies	Sequential command

Questionable Temperature Positive Transition

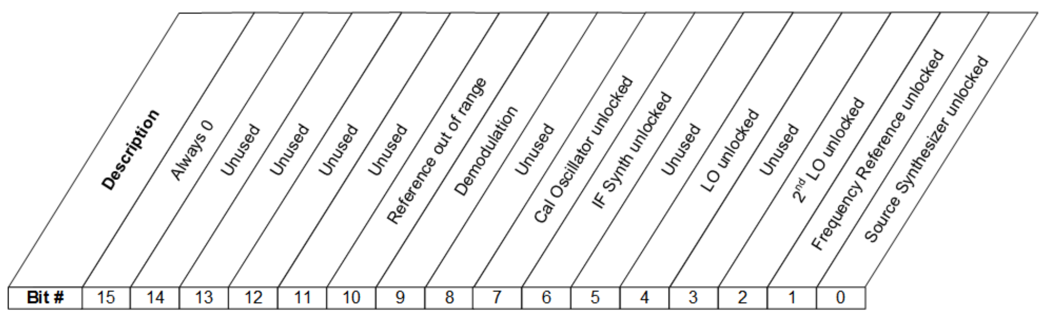
Determines which bits in the "Questionable Temperature Condition" on page 2780 Register will set bits in the "Questionable Temperature Event Query" on page 2781 register, when the condition register bit has a positive transition (0 to 1).

The variable `<integer>` is the sum of the decimal values of the bits that you want to enable.

Remote Command	`:STATus:QUEStionable:TEMPerature:PTRansition <integer>` `:STATus:QUEStionable:TEMPerature:PTRansition?`
Example	`:STAT:QUES:TEMP:PTR 2` Instrument Overheated being set will be reported to the Temperature Summary of the Questionable register
Preset	32767
Min	0
Max	32767
Status Bits/OPC dependencies	Sequential command

9.4.6.8 Questionable Frequency Register

Monitors frequency-related conditions within the instrument and summarizes them in bit 5 of the "Questionable Register" on page 2773.



STATus:QUEStionable:FREQuency Register

Bit	Condition	Operation
0	Source Synth Unlocked	The synthesizer in the built-in source is not locked
1	Frequency Reference Unlocked	The instrument's frequency reference is unlocked
2	2^{nd} LO Unlocked	The instrument's second LO (local oscillator) is unlocked
4	LO Unlocked	The instrument's main LO (local oscillator) is unlocked
6	IF Synth Unlocked	The synthesizer in the IF is not locked
7	Cal Osc Unlocked	The oscillator used for internal calibrations is not locked
9	Demodulation	Demodulation cannot be performed due to an out of range frequency

Bit	Condition	Operation
10	Reference missing or out of range	The signal being fed to a reference input is missing or too high or low in frequency for the reference to lock

Filter Registers

- "Questionable Frequency Condition" on page 2783
- "Questionable Frequency Enable" on page 2783
- "Questionable Frequency Event Query" on page 2784
- "Questionable Frequency Negative Transition" on page 2784
- "Questionable Frequency Positive Transition" on page 2785

Questionable Frequency Condition

Returns the decimal value of the sum of the bits in the Questionable Frequency Condition register.

NOTE The data in this register is continuously updated and reflects the current conditions.

Remote Command	`:STATus:QUEStionable:FREQuency:CONDition?`
Example	`:STAT:QUES:FREQ:COND?`
Preset	0
Status Bits/OPC dependencies	Sequential command

Questionable Frequency Enable

Determines which bits in the "Questionable Frequency Condition" on page 2783 Register will set bits in the "Questionable Temperature Event Query" on page 2781 register, which also sets the Frequency Summary bit (bit 5) in the "Questionable Register" on page 2773.

The variable `<integer>` is the sum of the decimal values of the bits you want to enable.

Remote Command	`:STATus:QUEStionable:FREQuency:ENABle <integer>` `:STATus:QUEStionable:FREQuency:ENABle?`
Example	`:STAT:QUES:FREQ:ENAB 2` Frequency Reference Unlocked will be reported to the Frequency Summary of the Status

	Questionable register
Preset	32767
Min	0
Max	32767
Status Bits/OPC dependencies	Sequential command

Questionable Frequency Event Query

Returns the decimal value of the sum of the bits in the Questionable Frequency Event register.

NOTE **The register requires that the associated PTRansition or NTRansition filters be set before a condition register bit can set a bit in the event register. The data in this register is latched until it is queried. Once queried, the register is cleared.**

Remote Command	`:STATus:QUEStionable:FREQuency[:EVENt]?`
Example	`:STAT:QUES:FREQ?`
Preset	0
Status Bits/OPC dependencies	Sequential command

Questionable Frequency Negative Transition

Determines which bits in the "Questionable Frequency Condition" on page 2783 register will set the corresponding bit in the "Questionable Frequency Event Query" on page 2784 register when the condition register bit has a negative transition (1 to 0).

The variable `<integer>` is the sum of the decimal values of the bits that you want to enable.

Remote Command	`:STATus:QUEStionable:FREQuency:NTRansition <integer>` `:STATus:QUEStionable:FREQuency:NTRansition?`
Example	`:STAT:QUES:FREQ:NTR 2` Frequency Reference ‘regained lock’ will be reported to the Frequency Summary of the Status Questionable register
Preset	0
Min	0
Max	32767

Status Bits/OPC dependencies	Sequential command

Questionable Frequency Positive Transition

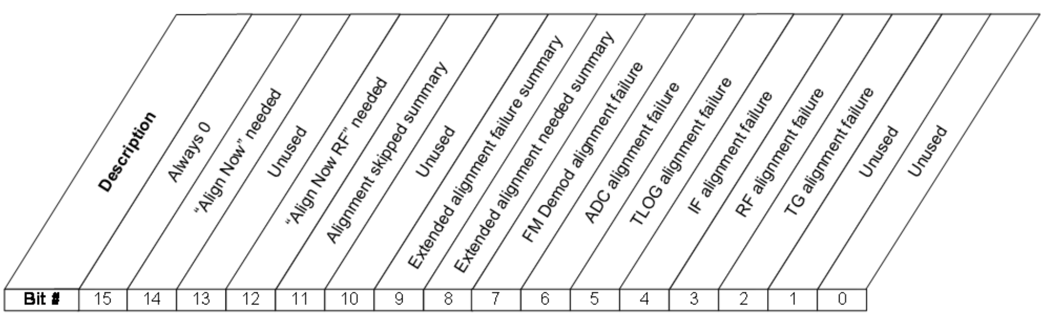
Determines which bits in the "Questionable Frequency Condition" on page 2783 register will set the corresponding bit in the "Questionable Frequency Event Query" on page 2784 register when the condition register bit has a positive transition (0 to 1).

The variable `<integer>` is the sum of the decimal values of the bits that you want to enable.

Remote Command	`:STATus:QUEStionable:FREQuency:PTRansition <integer>` `:STATus:QUEStionable:FREQuency:PTRansition?`
Example	`:STAT:QUES:FREQ:PTR 2` Frequency Reference 'became unlocked' will be reported to the Frequency Summary of the Status Questionable register
Preset	32767
Min	0
Max	32767
Status Bits/OPC dependencies	Sequential command

9.4.6.9 Questionable Calibration Register

Monitors calibration-related conditions within the instrument and summarizes them in bit 8 of the "Questionable Register" on page 2773. Three of the bits are summary bits from lower-level event registers.



STATus:QUEStionable:CALibration Register

Bit	Condition	Operation
2	TG Alignment Failure	The Tracking Generator failed to align properly
3	RF Alignment Failure	The RF section (frontend) failed to align properly
4	IF Alignment Failure	The IF section failed to align properly
5	LO Alignment Failure	The LO (local oscillator) failed to align properly
6	ADC Alignment Failure	The ADC section failed to align properly
7	FM Demod Alignment Failure	The FM Demod section failed to align properly
8	Extended Align Needed Summary	Summary bit for "Questionable Calibration Extended Needed Register" on page 2789
9	Extended Align Failure Summary	Summary bit for "Questionable Calibration Extended Failure Register" on page 2792
11	Align Skipped Sum Summary	Summary bit for "Questionable Calibration Skipped Register" on page 2795
12	"Align Now RF" required	Go to the System, Alignments, Align Now menu and perform an "Align Now RF"
14	"Align Now" required	Go to the System, Alignments, Align Now menu and perform an "Align Now All" or an "Align Now Expired"

Filter Registers

– "Questionable Calibration Condition" on page 2786
– "Questionable Calibration Enable" on page 2787
– "Questionable Calibration Event Query" on page 2787
– "Questionable Calibration Negative Transition" on page 2788
– "Questionable Calibration Positive Transition" on page 2788

Questionable Calibration Condition

Returns the decimal value of the sum of the bits in the Questionable Calibration Condition register.

NOTE The data in this register is continuously updated and reflects the current conditions.

Remote Command	`:STATus:QUEStionable:CALibration:CONDition?`
Example	`:STAT:QUES:CAL:COND?`
Preset	0
Status Bits/OPC dependencies	Sequential command

Questionable Calibration Enable

Determines which bits in the "Questionable Calibration Condition" on page 2786 Register will set bits in the "Questionable Calibration Event Query" on page 2787 register, which also sets the Calibration Summary bit (bit 8) in the "Questionable Register" on page 2773.

The variable `<integer>` is the sum of the decimal values of the bits you want to enable.

Remote Command	`:STATus:QUEStionable:CALibration:ENABle <integer>` `:STATus:QUEStionable:CALibration:ENABle?`
Example	`:STAT:QUES:CAL:ENAB 16384` Can be used to query if an alignment is needed, if you have turned off the automatic alignment process
Min	0
Max	32767
Status Bits/OPC dependencies	Sequential command

Questionable Calibration Event Query

Returns the decimal value of the sum of the bits in the Questionable Calibration Event register.

NOTE **The register requires that the associated PTRansition or NTRansition filters be set before a condition register bit can set a bit in the event register. The data in this register is latched until it is queried. Once queried, the register is cleared.**

Remote Command	`:STATus:QUEStionable:CALibration[:EVENt]?`
Example	`:STAT:QUES:CAL?`
Preset	0
Status Bits/OPC dependencies	Sequential command

Questionable Calibration Negative Transition

Determines which bits in the "Questionable Calibration Condition" on page 2786 register will set the corresponding bit in the "Questionable Calibration Event Query" on page 2787 register when the condition register bit has a negative transition (1 to 0).

The variable `<integer>` is the sum of the decimal values of the bits that you want to enable.

Remote Command	`:STATus:QUEStionable:CALibration:NTRansition <integer>` `:STATus:QUEStionable:CALibration:NTRansition?`
Example	`:STAT:QUES:CAL:NTR 16384` “Align All Now Needed” being cleared will be reported to the Calibration Summary of the Status Questionable register
Preset	0
Min	0
Max	32767
Status Bits/OPC dependencies	Sequential command

Questionable Calibration Positive Transition

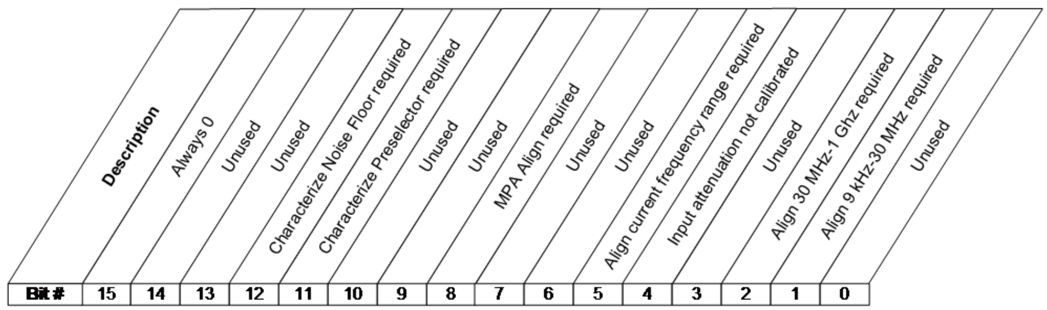
Determines which bits in the "Questionable Calibration Condition" on page 2786 register will set the corresponding bit in the "Questionable Calibration Event Query" on page 2787 register when the condition register bit has a positive transition (0 to 1).

The variable `<integer>` is the sum of the decimal values of the bits that you want to enable.

Remote Command	`:STATus:QUEStionable:CALibration:PTRansition <integer>` `:STATus:QUEStionable:CALibration:PTRansition?`
Example	`:STAT:QUES:CAL:PTR 16384` “Align All Now Needed” being set will be reported to the Calibration Summary of the Status Questionable register
Preset	32767
Min	0
Max	32767
Status Bits/OPC dependencies	Sequential command

9.4.6.10 Questionable Calibration Extended Needed Register

Monitors conditions that occur because a calibration or alignment is required to guarantee accurate measurements. It summarizes them in bit 8 of the "Questionable Calibration Register" on page 2785.



STATus:QUEStionable:CALibration:EXTended:NEEDed Register

Bit	Condition	Operation
1	Align 9kHz-30MHz required	EMI receiver alignment required, 9kHz-30 MHz (conducted band)
2	Align 30MHz-1GHz required	EMI receiver alignment required, 30 MHz-1 GHz (radiated band)
4	Input Attenuation not calibrated	The input attenuator is uncalibrated
5	Align current frequency range required	Alignment for current set frequency range is needed. It is suggested to process Align Selected Freq Range for the frequency range in use
8	MPA Align required	The Multiport Adaptor must be calibrated (EXT only)
11	Characterize Preselector required	Go to the System, Alignments, Advanced menu and perform a “Characterize Preselector”
12	Characterize Noise Floor required	Go to the System, Alignments, Advanced menu and perform a “Characterize Noise Floor”

Filter Registers

– "Questionable Calibration Extended Needed Condition" on page 2790

– "Questionable Calibration Extended Needed Enable" on page 2790

– "Questionable Calibration Extended Needed Event Query" on page 2791

– "Questionable Calibration Extended Needed Negative Transition" on page 2791

– "Questionable Calibration Extended Needed Positive Transition" on page 2791

Questionable Calibration Extended Needed Condition

Returns the decimal value of the sum of the bits in the Questionable Calibration Extended Needed Condition register.

NOTE **The data in this register is continuously updated and reflects the current conditions.**

Remote Command	`:STATus:QUEStionable:CALibration:EXTended:NEEDed:CONDition?`
Example	`:STAT:QUES:CAL:EXT:NEED:COND?`
Preset	0
Status Bits/OPC dependencies	Sequential command

Questionable Calibration Extended Needed Enable

Determines which bits in the "Questionable Calibration Extended Needed Condition" on page 2790 will set bits in the "Questionable Calibration Extended Needed Event Query" on page 2791 register, which also sets bit 14 of the "Questionable Calibration Register" on page 2785.

The variable `<integer>` is the sum of the decimal values of the bits that you want to enable.

Remote Command	`:STATus:QUEStionable:CALibration:EXTended:NEEDed:ENABle <integer>` `:STATus:QUEStionable:CALibration:EXTended:NEEDed:ENABle?`
Example	`:STAT:QUES:CAL:EXT:NEED:ENAB 2` Can be used to query if an EMI conducted alignment is needed
Preset	32767
Min	0
Max	32767
Status Bits/OPC dependencies	Sequential command

Questionable Calibration Extended Needed Event Query

Returns the decimal value of the sum of the bits in the Questionable Calibration Extended Needed Event register.

NOTE The register requires that the associated PTRansition or NTRansition filters be set before a condition register bit can set a bit in the event register. The data in this register is latched until it is queried. Once queried, the register is cleared.

Remote Command	`:STATus:QUEStionable:CALibration:EXTended:NEEDed[:EVENt]?`
Example	`:STAT:QUES:CAL:EXT:NEED?`
Preset	0
Status Bits/OPC dependencies	Sequential command

Questionable Calibration Extended Needed Negative Transition

Determines which bits in the "Questionable Calibration Extended Needed Condition" on page 2790 register will set the corresponding bit in the "Questionable Calibration Extended Needed Event Query" on page 2791 register when the condition register bit has a negative transition (1 to 0).

The variable `<integer>` is the sum of the decimal values of the bits that you want to enable.

Remote Command	`:STATus:QUEStionable:CALibration:EXTended:NEEDed:NTRansition <integer>` `:STATus:QUEStionable:CALibration:EXTended:NEEDed:NTRansition?`
Example	`:STAT:QUES:CAL:EXT:NEED:NTR 2` Conducted alignment required bit being cleared will be reported
Preset	0
Min	0
Max	32767
Status Bits/OPC dependencies	Sequential command

Questionable Calibration Extended Needed Positive Transition

Determines which bits in the "Questionable Calibration Extended Needed Condition" on page 2790 register will set the corresponding bit in the "Questionable Calibration

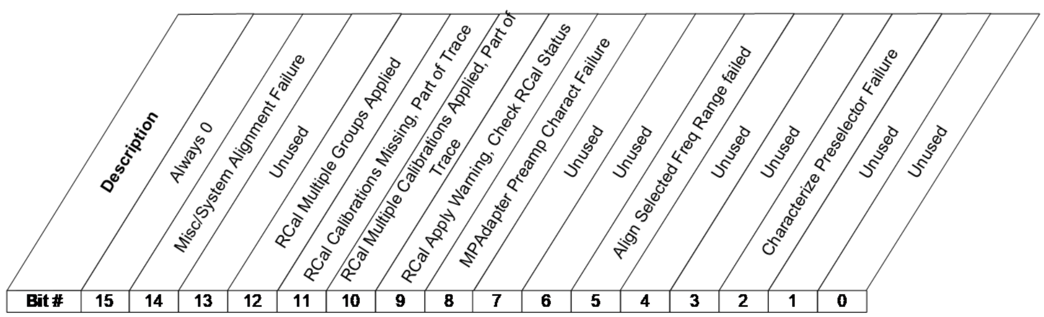
Extended Needed Event Query" on page 2791 register when the condition register bit has a positive transition (0 to 1).

The variable <integer> is the sum of the decimal values of the bits that you want to enable.

Remote Command	`:STATus:QUEStionable:CALibration:EXTended:NEEDed:PTRansition <integer>` `:STATus:QUEStionable:CALibration:EXTended:NEEDed:PTRansition?`
Example	`:STAT:QUES:CAL:EXT:NEED:PTR 2` Conducted alignment required bit being set will be reported
Preset	32767
Min	0
Max	32767
Status Bits/OPC dependencies	Sequential command

9.4.6.11 Questionable Calibration Extended Failure Register

Monitors conditions that occur because a calibration or alignment has failed to complete properly. It summarizes them in bit 9 of the "Questionable Calibration Register" on page 2785.



STATus:QUEStionable:CALibration:EXTended:FAILure Register

Bit	Condition	Operation
2	Characterize Preselector Failure	The preselector characterization failed
5	Align Selected Freq Range failed	The alignment for selected frequency range failed
8	MPAdapter Preamp Charact Failure	The Multiport Adaptor must be calibrated (EXT only)
9	RCal Apply Warning, Check RCal Status	The calibration request sent to the RCal module failed

Bit	Condition	Operation
10	RCal Multiple Calibrations Applied, Part of Trace	More than one calibration is being applied to part of the trace for current measurement
11	RCal Calibrations Missing, Part of Trace	The calibration being applied is not being applied to all of the trace for the current measurement
12	RCal Multiple Groups Applied	More than one calibrated rows are being applied to the current measurement
14	Misc/System Alignment Failure	Miscellaneous/System alignments have failed

Filter Registers

– "Questionable Calibration Extended Failure Condition" on page 2793
– "Questionable Calibration Extended Failure Enable" on page 2793
– "Questionable Calibration Extended Failure Event Query" on page 2794
– "Questionable Calibration Extended Failure Negative Transition" on page 2794
– "Questionable Calibration Extended Failure Positive Transition" on page 2795

Questionable Calibration Extended Failure Condition

Returns the decimal value of the sum of the bits in the Questionable Calibration Extended Failure Condition register.

NOTE The data in this register is continuously updated and reflects the current conditions.

Remote Command	`:STATus:QUEStionable:CALibration:EXTended:FAILure:CONDition?`
Example	`:STAT:QUES:CAL:EXT:FAIL:COND?`
Preset	0
Status Bits/OPC dependencies	Sequential command

Questionable Calibration Extended Failure Enable

Determines which bits in the "Questionable Calibration Extended Failure Condition" on page 2793 Register will set bits in the "Questionable Calibration Extended Failure Event Query" on page 2794 register, which also sets bit 9 of the "Questionable Calibration Register" on page 2785.

The variable `<integer>` is the sum of the decimal values of the bits that you want to enable.

Remote Command	`:STATus:QUEStionable:CALibration:EXTended:FAILure:ENABle <integer>` `:STATus:QUEStionable:CALibration:EXTended:FAILure:ENABle?`
Example	`:STAT:QUES:CAL:EXT:FAIL:ENAB 1` Can be used to query if an EMI conducted alignment failed
Preset	32767
Min	0
Max	32767
Status Bits/OPC dependencies	Sequential command

Questionable Calibration Extended Failure Event Query

Returns the decimal value of the sum of the bits in the Questionable Calibration Extended Failure Event register.

NOTE **The register requires that the associated PTRansition or NTRansition filters be set before a condition register bit can set a bit in the event register. The data in this register is latched until it is queried. Once queried, the register is cleared.**

Remote Command	`:STATus:QUEStionable:CALibration:EXTended:FAILure[:EVENt]?`
Example	`:STAT:QUES:CAL:EXT:FAIL?`
Preset	0
Status Bits/OPC dependencies	Sequential command

Questionable Calibration Extended Failure Negative Transition

Determines which bits in the "Questionable Calibration Extended Failure Condition" on page 2793 register will set the corresponding bit in the "Questionable Calibration Extended Failure Event Query" on page 2794 register when the condition register bit has a negative transition (1 to 0).

The variable `<integer>` is the sum of the decimal values of the bits that you want to enable.

Remote Command	`:STATus:QUEStionable:CALibration:EXTended:FAILure:NTRansition <integer>` `:STATus:QUEStionable:CALibration:EXTended:FAILure:NTRansition?`
Example	`:STAT:QUES:CAL:EXT:FAIL:NTR 1`

	Conducted alignment failed bit being cleared will be reported
Preset	0
Min	0
Max	32767
Status Bits/OPC dependencies	Sequential command

Questionable Calibration Extended Failure Positive Transition

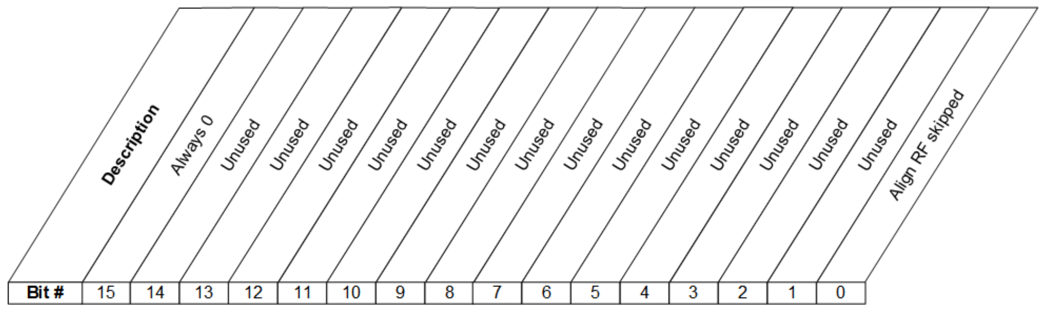
Determines which bits in the "Questionable Calibration Extended Failure Condition" on page 2793 register will set the corresponding bit in the "Questionable Calibration Extended Failure Event Query" on page 2794 register when the condition register bit has a positive transition (0 to 1).

The variable `<integer>` is the sum of the decimal values of the bits that you want to enable.

Remote Command	`:STATus:QUEStionable:CALibration:EXTended:FAILure:PTRansition <integer>` `:STATus:QUEStionable:CALibration:EXTended:FAILure:PTRansition?`
Example	`:STAT:QUES:CAL:EXT:FAIL:PTR 1` Conducted alignment failed bit being set will be reported
Preset	32767
Min	0
Max	32767
Status Bits/OPC dependencies	Sequential command

9.4.6.12 Questionable Calibration Skipped Register

Monitors conditions that occur because a calibration or alignment has been skipped due to various settings or conditions. It summarizes them in bit 11 of the "Questionable Calibration Register" on page 2785.



STATus:QUEStionable:CALibration:SKIPped Register

Bit	Condition	Operation
0	Align RF skipped	During an alignment, the calibration of the RF section (frontend) of the instrument was not performed. This can be caused by an interfering user signal present at the RF Input See "Align Now" on page 2087, "Align Now All" on page 2089

Filter Registers

– "Questionable Calibration Skipped Condition" on page 2796

– "Questionable Calibration Skipped Enable" on page 2797

– "Questionable Calibration Skipped Event Query" on page 2797

– "Questionable Calibration Skipped Negative Transition" on page 2797

– "Questionable Calibration Skipped Positive Transition" on page 2798

Questionable Calibration Skipped Condition

Returns the decimal value of the sum of the bits in the Questionable Calibration Skipped Condition register.

NOTE The data in this register is continuously updated and reflects the current conditions.

Remote Command	`:STATus:QUEStionable:CALibration:SKIPped:CONDition?`
Example	`:STAT:QUES:CAL:SKIP:COND?`
Preset	0
Status Bits/OPC dependencies	Sequential command

Questionable Calibration Skipped Enable

Determines which bits in the "Questionable Calibration Skipped Condition" on page 2796 Register will set bits in the "Questionable Calibration Skipped Event Query" on page 2797 register, which also sets bit 11 of the "Questionable Calibration Register" on page 2785.

The variable `<integer>` is the sum of the decimal values of the bits that you want to enable.

Remote Command	`:STATus:QUEStionable:CALibration:SKIPped:ENABle <integer>` `:STATus:QUEStionable:CALibration:SKIPped:ENABle?`
Example	`:STAT:QUES:CAL:SKIP:ENAB 1` Can be used to query if an RF alignment skipped condition is detected
Preset	32767
Min	0
Max	32767
Status Bits/OPC dependencies	Sequential command

Questionable Calibration Skipped Event Query

Returns the decimal value of the sum of the bits in the Questionable Calibration Event register.

NOTE The register requires that the associated PTRansition or NTRansition filters be set before a condition register bit can set a bit in the event register. The data in this register is latched until it is queried. Once queried, the register is cleared.

Remote Command	`:STATus:QUEStionable:CALibration:SKIPped[:EVENt]?`
Example	`:STAT:QUES:CAL:SKIP?`
Preset	0
Status Bits/OPC dependencies	Sequential command

Questionable Calibration Skipped Negative Transition

Determines which bits in the "Questionable Calibration Skipped Condition" on page 2796 register will set the corresponding bit in the "Questionable Calibration Skipped

Event Query" on page 2797 register when the condition register bit has a negative transition (1 to 0).

The variable `<integer>` is the sum of the decimal values of the bits that you want to enable.

Remote Command	`:STATus:QUEStionable:CALibration:SKIPped:NTRansition <integer>` `:STATus:QUEStionable:CALibration:SKIPped:NTRansition?`
Example	`:STAT:QUES:CAL:SKIP:NTR 1` RF Align Skipped bit being cleared will be reported
Preset	0
Min	0
Max	32767
Status Bits/OPC dependencies	Sequential command

Questionable Calibration Skipped Positive Transition

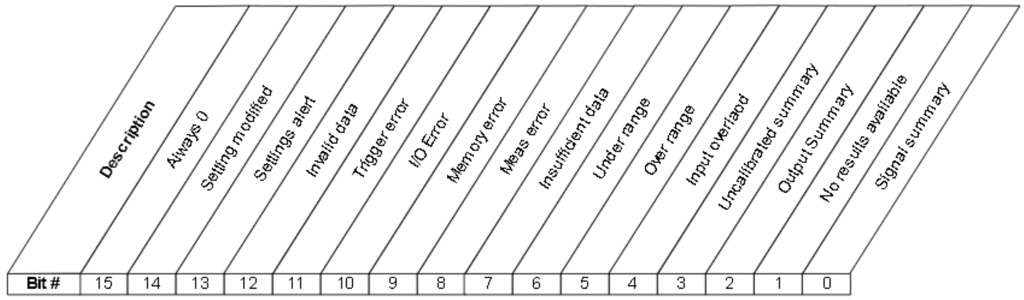
Determines which bits in the "Questionable Calibration Skipped Condition" on page 2796 register will set the corresponding bit in the "Questionable Calibration Skipped Event Query" on page 2797 register when the condition register bit has a positive transition (0 to 1).

The variable `<integer>` is the sum of the decimal values of the bits that you want to enable.

Remote Command	`:STATus:QUEStionable:CALibration:SKIPped:PTRansition <integer>` `:STATus:QUEStionable:CALibration:SKIPped:PTRansition?`
Example	`:STAT:QUES:CAL:SKIP:PTR 1` RF Align Skipped bit being set will be reported
Preset	32767
Min	0
Max	32767
Status Bits/OPC dependencies	Sequential command

9.4.6.13 Questionable Integrity Register

Monitors measurement integrity-related conditions within the instrument and summarizes them in bit 9 of the "Questionable Register" on page 2773. Two of the bits are summary bits from lower-level event registers.



STATus:QUEStionable:INTegrity Register

Bit	Condition	Operation
0	Signal Summary	The summary bit for the "Questionable Integrity Signal Register" on page 2802
1	No Result	The current measurement is incompatible with a setting or combination of settings, such as the selected Input, Radio Standard, etc.
2	Output Summary	The summary bit for the "Questionable Integrity Output Register" on page 2805
3	Uncalibrated Summary	The summary bit for the "Questionable Integrity Uncalibrated Register" on page 2808
4	Input Overload	A signal overload condition exists
5	Over Range	The signal at the input for this measurement is too high. You should increase the attenuation or decrease the signal level
6	Under Range	The signal at the input for this measurement is too low. You should decrease the attenuation or increase the signal level
7	Insufficient Data	Signal or settings conditions did not allow enough data to be taken during an acquisition for a valid measurement
8	Meas Error	(not currently in use)
9	Memory Error	There is not enough memory to perform the desired operation
10	I/O Error	I/O settings are preventing communication with an instrument or peripheral
11	Trigger Error	Signal or settings conditions did not allow enough data to be taken during an acquisition for a valid measurement
12	Invalid data	The Invalid Data indicator (* in upper right of display) is on, indicating that onscreen data may be stale and not match the current settings
13	Settings Alert	Settings are not right for a valid measurement, but the instrument is nonetheless allowing a measurement to be taken
14	Setting Modified	Settings are not right for a valid measurement, and the instrument is using different settings than the ones you entered in order to take a measurement

Filter Registers

– "Questionable Integrity Condition" on page 2800
– "Questionable Integrity Enable" on page 2800
– "Questionable Integrity Event Query" on page 2801
– "Questionable Integrity Negative Transition" on page 2801
– "Questionable Integrity Positive Transition" on page 2801

Questionable Integrity Condition

Returns the decimal value of the sum of the bits in the Questionable Integrity Condition register.

NOTE: The data in this register is continuously updated and reflects the current conditions.

Remote Command	`:STATus:QUEStionable:INTegrity:CONDition?`
Example	`:STAT:QUES:INT:COND?`
Preset	0
Status Bits/OPC dependencies	Sequential command

Questionable Integrity Enable

Determines which bits in the "Questionable Integrity Condition" on page 2800 Register will set bits in the "Questionable Integrity Event Query" on page 2801 register, which also sets the Integrity Summary bit (bit 9) in the "Questionable Register" on page 2773.

The variable `<integer>` is the sum of the decimal values of the bits that you want to enable.

Remote Command	`:STATus:QUEStionable:INTegrity:ENABle <integer>` `:STATus:QUEStionable:INTegrity:ENABle?`
Example	`:STAT:QUES:INT:ENAB 8` Uncalibrated Summary will be reported to the Integrity Summary of the Status Questionable register
Preset	32767
Min	0
Max	32767
Status Bits/OPC dependencies	Sequential command

Questionable Integrity Event Query

Returns the decimal value of the sum of the bits in the Questionable Integrity Event register.

NOTE The register requires that the associated PTRansition or NTRansition filters be set before a condition register bit can set a bit in the event register. The data in this register is latched until it is queried. Once queried, the register is cleared.

Remote Command	`:STATus:QUEStionable:INTegrity[:EVENt]?`
Example	`:STAT:QUES:INT?`
Preset	0
Status Bits/OPC dependencies	Sequential command

Questionable Integrity Negative Transition

Determines which bits in the "Questionable Integrity Condition" on page 2800 register will set the corresponding bit in the "Questionable Integrity Event Query" on page 2801 register when the condition register bit has a negative transition (1 to 0).

The variable `<integer>` is the sum of the decimal values of the bits that you want to enable.

Remote Command	`:STATus:QUEStionable:INTegrity:NTRansition <integer>` `:STATus:QUEStionable:INTegrity:NTRansition?`
Example	`:STAT:QUES:INT:NTR 8` Uncalibrated Summary being cleared will be reported to the Integrity Summary of the Status Questionable register
Preset	0
Min	0
Max	32767
Status Bits/OPC dependencies	Sequential command

Questionable Integrity Positive Transition

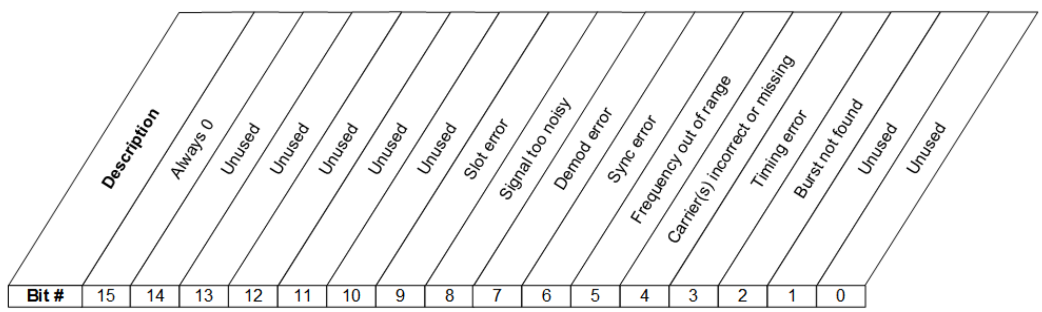
Determines which bits in the "Questionable Integrity Condition" on page 2800 register will set the corresponding bit in the "Questionable Integrity Event Query" on page 2801 register when the condition register bit has a positive transition (0 to 1).

The variable `<integer>` is the sum of the decimal values of the bits that you want to enable.

Remote Command	`:STATus:QUEStionable:INTegrity:PTRansition <integer>` `:STATus:QUEStionable:INTegrity:PTRansition?`
Example	`:STAT:QUES:INT:PTR 8` Uncalibrated Summary being set will be reported to the Integrity Summary of the Status Questionable register
Preset	32767
Min	0
Max	32767
Status Bits/OPC dependencies	Sequential command

9.4.6.14 Questionable Integrity Signal Register

Monitors conditions that occur because a measurement may not be able to return an accurate or valid result due to signal conditions. It summarizes them in bit 0 of the "Questionable Integrity Register" on page 2798.



STATus:QUEStionable:INTegrity:SIGNal Register

Bit	Condition	Operation
2	Burst not found	The instrument is expecting a bursted signal but such a signal cannot be detected because of inappropriate parameter settings or incorrect signal content
3	Timing Error	The instrument cannot establish appropriate timing from the signal
4	Carrier(s) incorrect or missing	The instrument cannot find the expected carrier(s) within the frequency ranges in which it is looking
5	Frequency out of range	One or more system or signal input frequencies are out of range
6	Sync error	The instrument cannot establish sync with the measured signal
7	Demod error	The instrument cannot demodulate the signal due to inappropriate

Bit	Condition	Operation
		signal or settings conditions
8	Signal Too Noisy	The instrument cannot measure the desired signal because it is too noisy
9	Slot Error	No valid signal slot found in captured data

Filter Registers

– "Questionable Integrity Signal Condition" on page 2803

– "Questionable Integrity Signal Enable" on page 2803

– "Questionable Integrity Signal Event Query" on page 2804

– "Questionable Integrity Signal Negative Transition" on page 2804

– "Questionable Integrity Signal Positive Transition" on page 2805

Questionable Integrity Signal Condition

Returns the decimal value of the sum of the bits in the Questionable Integrity Signal Condition register.

NOTE The data in this register is continuously updated and reflects the current conditions.

Remote Command	`:STATus:QUEStionable:INTegrity:SIGNal:CONDition?`
Example	`:STAT:QUES:INT:SIGN:COND?`
Preset	0
Status Bits/OPC dependencies	Sequential command

Questionable Integrity Signal Enable

Determines which bits in the "Questionable Integrity Signal Condition" on page 2803 Register will set bits in the "Questionable Integrity Signal Event Query" on page 2804 register, which also sets the Integrity Summary bit (bit 9) in the "Questionable Register" on page 2773.

The variable `<integer>` is the sum of the decimal values of the bits that you want to enable.

Remote	`:STATus:QUEStionable:INTegrity:SIGNal:ENABle <integer>`

Command	:STATus:QUEStionable:INTegrity:SIGNal:ENABle?
Example	:STAT:QUES:INT:SIGN:ENAB 4 Burst Not Found will be reported to the Integrity Summary of the Status Questionable register
Preset	32767
Min	0
Max	32767
Status Bits/OPC dependencies	Sequential command

Questionable Integrity Signal Event Query

Returns the decimal value of the sum of the bits in the Questionable Integrity Signal Event register.

NOTE **The register requires that the associated PTRansition or NTRansition filters be set before a condition register bit can set a bit in the event register. The data in this register is latched until it is queried. Once queried, the register is cleared.**

Remote Command	:STATus:QUEStionable:INTegrity:SIGNal[:EVENt]?
Example	:STAT:QUES:INT:SIGN?
Preset	0
Status Bits/OPC dependencies	Sequential command

Questionable Integrity Signal Negative Transition

Determines which bits in the "Questionable Integrity Signal Condition" on page 2803 register will set the corresponding bit in the "Questionable Integrity Signal Event Query" on page 2804 register when the condition register bit has a negative transition (1 to 0).

The variable `<integer>` is the sum of the decimal values of the bits that you want to enable.

Remote Command	:STATus:QUEStionable:INTegrity:SIGNal:NTRansition <integer> :STATus:QUEStionable:INTegrity:SIGNal:NTRansition?
Example	:STAT:QUES:INT:SIGN:NTR 4 Burst not found being cleared will be reported to the Integrity Summary of the Status Questionable register
Preset	0

Min	0
Max	32767
Status Bits/OPC dependencies	Sequential command

Questionable Integrity Signal Positive Transition

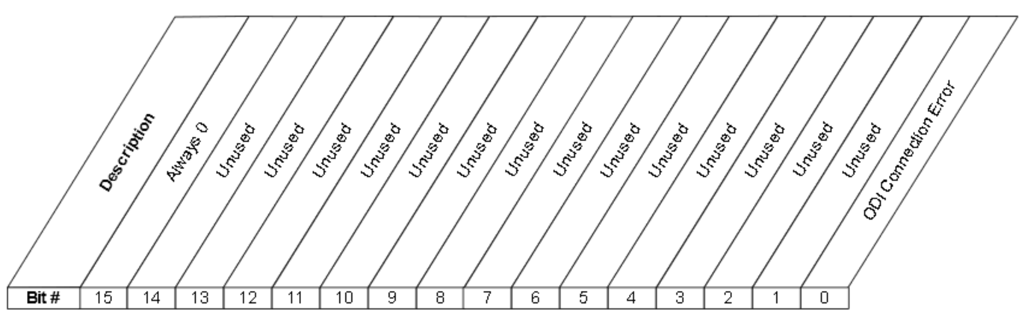
Determines which bits in the "Questionable Integrity Signal Condition" on page 2803 register will set the corresponding bit in the "Questionable Integrity Signal Event Query" on page 2804 register when the condition register bit has a positive transition (0 to 1).

The variable `<integer>` is the sum of the decimal values of the bits that you want to enable.

Remote Command	`:STATus:QUEStionable:INTegrity:SIGNal:PTRansition <integer>` `:STATus:QUEStionable:INTegrity:SIGNal:PTRansition?`
Example	`:STAT:QUES:INT:SIGN:PTR 4` Burst not found being set will be reported to the Integrity Summary of the Status Questionable register
Preset	32767
Min	0
Max	32767
Status Bits/OPC dependencies	Sequential command

9.4.6.15 Questionable Integrity Output Register

Monitors conditions that occur in connection status currently limited to ODI streaming . It summarizes them in bit 2 of the "Questionable Integrity Register" on page 2798.



STATus:QUEStionable:INTegrity:OUTPut Register

Bit	Condition	Operation
0	ODI Connection Error	ODI Connection Error This bit is never triggered, only its aliases are

Filter Registers

- "Questionable Integrity Output Condition" on page 2806
- "Questionable Integrity Output Enable" on page 2806
- "Questionable Integrity Output Event Query" on page 2807
- "Questionable Integrity Output Negative Transition" on page 2807
- "Questionable Integrity Output Positive Transition" on page 2808

Questionable Integrity Output Condition

Returns the decimal value of the sum of the bits in the Questionable Integrity Output Condition register.

NOTE The data in this register is continuously updated and reflects the current conditions.

Remote Command	`:STATus:QUEStionable:INTegrity:OUTPut:CONDition?`
Example	`:STAT:QUES:INT:OUTP:COND?`
Preset	0
Status Bits/OPC dependencies	Sequential command

Questionable Integrity Output Enable

Determines which bits in the "Questionable Integrity Output Condition" on page 2806 register will set the corresponding bit in the "Questionable Integrity Output Event Query" on page 2807 register, which also sets the Data Output Summary bit (bit 2) in the "Questionable Integrity Register" on page 2798.

The variable `<integer>` is the sum of the decimal values of the bits that you want to enable.

Remote Command	`:STATus:QUEStionable:INTegrity:OUTPut:ENABle` `:STATus:QUEStionable:INTegrity:OUTPut:ENABle?`
Example	`:STAT:QUES:INT:OUTP:ENAB 1`

	Oversweep (Meas Uncal) is reported to the Integrity Summary of the Status Questionable register
Preset	32767
Min	0
Max	32767
Status Bits/OPC dependencies	Sequential command

Questionable Integrity Output Event Query

Returns the decimal value of the sum of the bits in the "Questionable Integrity Output Condition" on page 2806 register.

NOTE

The register requires that the associated `PTRansition` or `NTRansition` filters be set before a condition register bit can set a bit in the event register. The data in this register is latched until it is queried. Once queried, the register is cleared.

Remote Command	`:STATus:QUEStionable:INTegrity:OUTPut[:EVENt]?`
Example	`:STAT:QUES:INT:OUTP?`
Preset	0
Status Bits/OPC dependencies	Sequential command

Questionable Integrity Output Negative Transition

Determines which bits in the "Questionable Integrity Output Condition" on page 2806 register will set the corresponding bit in the "Questionable Integrity Output Event Query" on page 2807 register when the condition register bit has a negative transition (1 to 0).

The variable `<integer>` is the sum of the decimal values of the bits that you want to enable.

Remote Command	`:STATus:QUEStionable:INTegrity:OUTPut:NTRansition <integer>` `:STATus:QUEStionable:INTegrity:OUTPut:NTRansition?`
Example	`:STAT:QUES:INT:OUTP:NTR 1` Oversweep cleared is reported to the Integrity Summary of the Status Questionable register
Preset	0
Min	0
Max	32767
Status Bits/OPC dependencies	Sequential command

Questionable Integrity Output Positive Transition

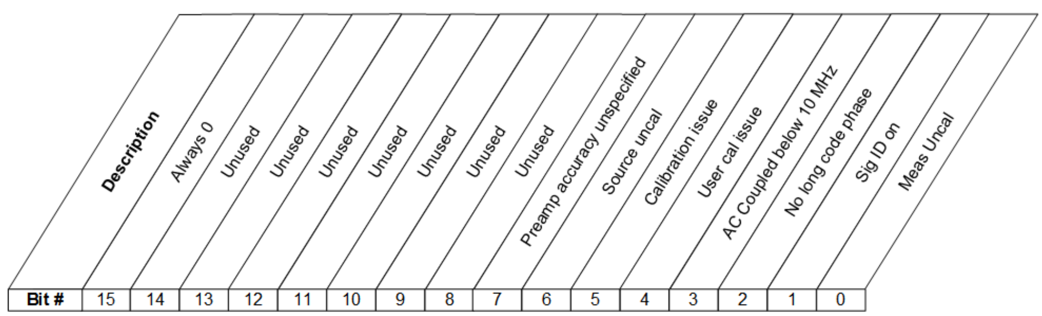
Determines which bits in the "Questionable Integrity Output Condition" on page 2806 register will set the corresponding bit in the "Questionable Integrity Output Event Query" on page 2807 register when the condition register bit has a positive transition (0 to 1).

The variable `<integer>` is the sum of the decimal values of the bits that you want to enable.

Remote Command	`:STATus:QUEStionable:INTegrity:OUTPut:PTRansition <integer>` `:STATus:QUEStionable:INTegrity:OUTPut:PTRansition?`
Example	`:STAT:QUES:INT:OUTP:PTR 1` Oversweep set is reported to the Integrity Summary of the Status Questionable register
Preset	32767
Min	0
Max	32767
Status Bits/OPC dependencies	Sequential command

9.4.6.16 Questionable Integrity Uncalibrated Register

Monitors conditions that occur because a measurement may not be able to return an accurate or valid result due to a mismatch between instrument settings and the signal, placing the instrument in an uncalibrated state for that signal. It summarizes them in bit 3 of the "Questionable Integrity Register" on page 2798.



STATus:QUEStionable:INTegrity:UNCalibrated Register

Bit	Condition	Operation
0	Meas Uncal	A Meas Uncal warning is being displayed; generally this means the sweep time must be reduced or the RBW increased
1	Signal ID on	In external mixing, the Sig ID function is on, which will impact the

Bit	Condition	Operation
		trace results
2	No Long Code Phase	The long code phase that identifies an access channel cannot be found (WCDMA)
3	AC coupled: Accy unspec'd <10 MHz	The instrument is AC coupled but is operating below 10 MHz, where the blocking capacitor will impact measurement accuracy
4	User cal issue	In noise figure measurements, the User Cal has not been performed or has been invalidated
5	Calibration issue	In noise figure measurements, one or more calibration or measurement frequency point exceeds the currently loaded Cal or Meas ENR Table frequency ranges
6	Source uncal	While using a Tracking Source, settings are putting it into an uncalibrated operational state
7	Preamp accuracy unspecified below XX MHz	The preamp is being used but is operating below frequencies for which its accuracy is specified

Filter Registers

– "Questionable Integrity Uncalibrated Condition" on page 2809

– "Questionable Integrity Uncalibrated Enable" on page 2810

– "Questionable Integrity Uncalibrated Event Query" on page 2810

– "Questionable Integrity Uncalibrated Negative Transition" on page 2810

– "Questionable Integrity Uncalibrated Positive Transition" on page 2811

Questionable Integrity Uncalibrated Condition

Returns the decimal value of the sum of the bits in the Questionable Integrity Uncalibrated Condition register.

NOTE **The data in this register is continuously updated and reflects the current conditions.**

Remote Command	`:STATus:QUEStionable:INTegrity:UNCalibrated:CONDition?`
Example	`:STAT:QUES:INT:UNC:COND?`
Preset	0
Status Bits/OPC dependencies	Sequential command

Questionable Integrity Uncalibrated Enable

Determines which bits in the "Questionable Integrity Uncalibrated Condition" on page 2809 Register will set bits in the "Questionable Integrity Uncalibrated Event Query" on page 2810 register, which also sets the Data Uncalibrated Summary bit (bit 3) in the "Questionable Integrity Register" on page 2798.

The variable `<integer>` is the sum of the decimal values of the bits that you want to enable.

Remote Command	`:STATus:QUEStionable:INTegrity:UNCalibrated:ENABle` `:STATus:QUEStionable:INTegrity:UNCalibrated:ENABle?`
Example	`:STAT:QUES:INT:UNC:ENAB 1` Oversweep (Meas Uncal) is reported to the Integrity Summary of the Status Questionable register
Preset	32767
Min	0
Max	32767
Status Bits/OPC dependencies	Sequential command

Questionable Integrity Uncalibrated Event Query

Returns the decimal value of the sum of the bits in the "Questionable Integrity Uncalibrated Condition" on page 2809 register.

NOTE **The register requires that the associated PTRansition or NTRansition filters be set before a condition register bit can set a bit in the event register. The data in this register is latched until it is queried. Once queried, the register is cleared.**

Remote Command	`:STATus:QUEStionable:INTegrity:UNCalibrated[:EVENt]?`
Example	`:STAT:QUES:INT:UNC?`
Preset	0
Status Bits/OPC dependencies	Sequential command

Questionable Integrity Uncalibrated Negative Transition

Determines which bits in the "Questionable Integrity Uncalibrated Condition" on page 2809 register will set the corresponding bit in the "Questionable Integrity

Uncalibrated Event Query" on page 2810 register when the condition register bit has a negative transition (1 to 0).

The variable `<integer>` is the sum of the decimal values of the bits that you want to enable.

Remote Command	`:STATus:QUEStionable:INTegrity:UNCalibrated:NTRansition <integer>` `:STATus:QUEStionable:INTegrity:UNCalibrated:NTRansition?`
Example	`:STAT:QUES:INT:UNC:NTR 1` Oversweep cleared is reported to the Integrity Summary of the Status Questionable register
Preset	0
Min	0
Max	32767
Status Bits/OPC dependencies	Sequential command

Questionable Integrity Uncalibrated Positive Transition

Determines which bits in the "Questionable Integrity Uncalibrated Condition" on page 2809 register will set the corresponding bit in the "Questionable Integrity Uncalibrated Event Query" on page 2810 register when the condition register bit has a positive transition (0 to 1).

The variable `<integer>` is the sum of the decimal values of the bits that you want to enable.

Remote Command	`:STATus:QUEStionable:INTegrity:UNCalibrated:PTRansition <integer>` `:STATus:QUEStionable:INTegrity:UNCalibrated:PTRansition?`
Example	`:STAT:QUES:INT:UNC:PTR 1` Oversweep set is reported to the Integrity Summary of the Status Questionable register
Preset	32767
Min	0
Max	32767
Status Bits/OPC dependencies	Sequential command

10 Hardware-Accelerated Fast Power Measurement (Remote Command Only)

The **Fast Power** option (FP2) enables very fast channel power measurements for instruments with the prerequisite hardware (DP2 and/or B40). It accomplishes this by performing real-time overlapped FFTs at the hardware layer, using software for basic post-processing before returning the result to the user. The upshot of this approach is improved throughput for user applications that require many sequential power measurements.

The analysis bandwidth of FP2 may be limited by the licenses in the instrument.

NOTE **FP2 is remote-only, which means the instrument does not switch to any particular mode or measurement. FP2 commands can be sent while another application is in use on the front panel.**

Each Fast Power measurement can be predefined using an array index, and up to 1,000 measurements can be stored. In the following documentation, instances of [1,2,...,999] can be substituted with a particular measurement index, for example, `:CALC:FPOW:POW1?`, `:CALC:FPOW:POW2?`, `:CALC:FPOW:POW134?`. In this way, power measurements can be defined one time in a batch, and then executed multiple times without having to redefine them, similar to “list mode” on other measurements.

In addition to basic channel power measurements, there are a number of other measurement “functions” for each channel, including peak power, peak frequency, and power spectral density.

10.1 Reset Fast Power Measurement (Remote Command Only)

Resets the measurement configuration to the defaults.

Remote Command	`:CALCulate:FPOWer:POWer[1,2,…,999]:RESet`
Example	`:CALC:FPOW:POW1:RES`
Notes	Option FP2 is required

10.2 Reset Fast Power Measurement (Remote Command Only)

Resets the measurement configuration to the defaults.

Remote Command	`:CALCulate:FPOWer:POWer[1,2,…,999]:RESet`
Example	`:CALC:FPOW:POW1:RES`
Notes	Option FP2 is required

10.2.1 Acquisition Time

Example	`:CALC:FPOW:POW1:DEF "AcquisitionTime=0.002"`
Notes	Sets the time in which the entire spectrum is measured. An increase in the acquisition time yields an improvement in measurement repeatability
Preset	0.001 s
Range	0 s to 1 s

10.2.2 Center Frequency

Example	`:CALC:FPOW:POW1:DEF "CenterFrequency=2e9"`
Notes	Sets the frequency in which the measurement is centered around. "Channel Offset Frequency Array" on page 2821 is calculated relative to the center frequency
Preset	1 GHz
Range	0 Hz to maximum instrument frequency

10.2.3 DC Coupled

Example	`:CALC:FPOW:POW1:DEF "DCCoupled=True"`
Notes	Allows you to specify whether the DC blocking capacitor is utilized. Set to `True` when measuring frequencies below 10 MHz
Preset	False
Range	True (DC Coupled) or False (AC Coupled)

10.2.4 Detector Type

Example	`:CALC:FPOW:POW1:DEF "DetectorType=Peak"`

Notes	Option FP2 is required Allows you to choose whether a RMS average or peak value is used during the measurement
Preset	RmsAverage
Range	RmsAverage, Peak

10.2.5 Do Noise Correction

Example	`:CALC:FPOW:POW1:DEF "DoNoiseCorrection=True"`
Notes	When noise correction is enabled, the linear noise power contributed by the instrument is subtracted from all measurements. This effectively lowers the noise floor of the instrument When noise correction is enabled, the first measurement for a given set of input parameters will take extra time. This is because the instrument takes an extra acquisition with the RF input disconnected from the instrument's front end to measure the noise of just the instrument. The measured noise floor is stored in a cache so the noise acquisition will occur only once for the same state settings. In other words, if noise correction was turned on and the instrument made an acquisition at frequency A, then frequency B, and back again to frequency A, the hidden initial noise floor acquisition would only occur for the first acquisition at frequency A and the cached noise floor would be used the second time frequency A was measured
Preset	False
Range	True (enable noise correction) or False (disable noise correction)

10.2.6 Do Spur Suppression

Example	`:CALC:FPOW:POW1:DEF "DoSpurSuppression=True"`
Notes	When measuring very low level signals, or when large out-of-band inputs are input into the instrument, sometimes unwanted spurs and residuals can appear in the measured spectrum. Spur suppression is a method to help minimize the levels of these internally generated spurs and residuals When spur suppression is enabled, the instrument will automatically take two acquisitions using two different internal analog LO frequencies. The FFT spectrums from both acquisitions are combined by taking the minimum power between both traces on a per FFT bin basis. External signals will have the same amplitude for both traces and therefore will return the expected amplitudes. However, low level spurs and residuals generated internally to the instrument tend to move to different FFT bins depending on the internal analog LO frequency used, and therefore tend to be suppressed using this spur suppression method Because two acquisitions, rather than a single acquisition, are made when spur suppression is enabled, the measurement time will always be slower when spur suppression is enabled
Preset	False
Range	True (enable spur suppression) or False (disable spur suppression)

10.2.7 Electronic Attenuator Bypass

Example	`:CALC:FPOW:POW1:DEF "ElecAttBypass =False"`
Notes	Allows you to either utilize or bypass the electronic attenuator. The electronic attenuator is only available for frequencies up to 3.6 GHz. Set parameter to true when using frequencies above 3.6 GHz and set the parameter to false when using the preamp
Preset	True
Range	True (bypass electronic attenuator) or False (use electronic attenuator)

10.2.8 Electronic Attenuation

Example	`:CALC:FPOW:POW1:DEF "ElecAttenuation=10"`
Notes	Option EA3 is required The electronic attenuation value parameter sets the amount of electrical attenuation from 0 to 24 dB (1 dB steps) Set "ElecAttBypass=False" to make sure the electronic attenuator path is enabled
Preset	0 dB
Range	0 – 24 dB (1 dB steps)

10.2.9 External Reference Frequency

Example	`:CALC:FPOW:POW1:DEF "ExternalReferenceFrequency=10"`
Notes	This is the user-specified frequency of the external reference: – Used when "Frequency Reference Source" on page 2816 is set to external or auto when the external source is present – Unused if `FrequencyReferenceSource` is set to internal
Preset	10 MHz

10.2.10 Frequency Reference Source

Example	`:CALC:FPOW:POW1:DEF "FrequencyReferenceSource= InternalFrequencyReference"`
Notes	Specifies which frequency reference source should be used for this request: – If `ExternalFrequencyReference` is selected and no external reference is present, the frequency reference unlocks but the data acquisition will continue – If `AutoExternalFrequencyReference` is selected, the hardware senses whether an

	external source is present before starting the data acquisition. If no external source is present then the internal source is selected and the data acquisition will continue
Preset	`InternalFrequencyReference`
Range	`InternalFrequencyReference, ExternalFrequencyReference, AutoExternalFrequencyReference`

10.2.11 IF Gain

Example	`:CALC:FPOW:POW1:DEF "IFGain=10"`
Notes	Allows you to specify the gain at the IF stage anywhere from -6 to 16 dB (1 dB steps). This is an advanced feature; for most cases this should remain at its default value of 0 dB
Preset	0 dB
Range	-6 – 16 dB (1 dB steps)

10.2.12 IF Type

Example	`:CALC:FPOW:POW1:DEF "IFType=B25M"`
Notes	Allows you to select between different IF paths. For example, if the signal is less than 25 MHz wide, then you can select the B25M path to take advantage of additional filtering on this analog IF path
Preset	B40M
Range	B10M, B25M, B40M

10.2.13 Include Power Spectrum

Example	`:CALC:FPOW:POW1:DEF "IncludePowerSpectrum=True"`
Notes	Allows you to read data on the entire spectrum for diagnostic purposes. It is not recommended for production use. See `:CALC:FPOW:POW[n]:READ2?` for details on the binary format of the response
Preset	False
Range	True (return both channel power and full power spectrum) False (returns only channel power)

10.2.14 Mechanical Attenuation

Example	`:CALC:FPOW:POW1:DEF "MechAttenuation=10"`
Notes	Sets the amount of mechanical attenuation anywhere from 0 to 70 dB (2 dB steps)
Preset	0 dB
Range	0 – 70 dB (2 dB steps)

10.2.15 Preamp Mode

Example	`:CALC:FPOW:POW1:DEF "PreAmpMode=Low"`
Notes	The license for the appropriate preamp is required Specifies whether the preamps are being utilized. Low allows any preamps up to 3.6 GHz, and Full allows all licensed preamps. Set "ElecAttBypass=True" in order to utilize any preamps
Preset	Off
Range	Off, Low, Full

10.2.16 Resolution Bandwidth Mode

Example	`:CALC:FPOW:POW1:DEF "PreAmpMode=Low"`
Notes	Allows you to choose whether the RBW filter is automatically or manually set. The BestSpeed value minimizes measurement time, while the Narrowest value minimizes RBW size (minimum of two FFT bins per RBW) To manually specify an RBW, set this parameter to Explicit, and set the ResolutionBW parameter to the desired value
Preset	BestSpeed
Range	BestSpeed, Narrowest, Explicit

10.2.17 Resolution Bandwidth

Example	`:CALC:FPOW:POW1:DEF "ResolutionBW=25e3"`
Notes	Sets the 3-dB bandwidth of the RBW filter. The ResolutionBWMode parameter must be set to Explicit in order to manually set the RBW
Preset	0 Hz

10.2.18 Trigger Delay

Example	`:CALC:FPOW:POW1:DEF "TriggerDelay=0.025"`
Notes	Sets the time after an external trigger is detected until the measurement is performed
Preset	0 s
Range	0 – 1 s

10.2.19 Trigger Level

Example	`:CALC:FPOW:POW1:DEF "TriggerLevel=2"`
Notes	Sets the voltage value at which an external trigger is detected
Preset	1.2 V
Range	-5 to 5 V

10.2.20 Trigger Slope

Example	`:CALC:FPOW:POW1:DEF "TriggerSlope=Negative"`
Notes	Specifies the direction of the edge trigger voltage for detection
Preset	Positive
Range	Positive, Negative

10.2.21 Trigger Source

Example	`:CALC:FPOW:POW1:DEF "TriggerSource=Ext1"`
Notes	Allows you to choose between measurement’s triggering freely or controlled by an external input. Ext1 and Ext2 correspond to Trigger 1 In and Trigger 2 In, respectively
Preset	Free
Range	Free, Ext1, Ext2

10.2.22 Trigger Timeout

Example	`:CALC:FPOW:POW1:DEF "TriggerTimeout=0.1"`
Notes	Sets the time in which the instrument will wait for a trigger before automatically performing the measurement
Preset	1 s
Range	0 – 1 s

10.2.23 Signal Input

Example	`:CALC:FPOW:POW1:DEF "SignalInput=Fp50MHzCW"`
Notes	Allows you to select between using the main RF input or the internal instrument reference CW signal of 50 MHz

Preset	FpMainRf
Range	FpMainRf, Fp50MHzCW

10.2.24 Use Preselector

Example	`:CALC:FPOW:POW1:DEF "UsePreSelector=True"`
Notes	Allows you to either utilize or bypass the front end tunable filter at frequencies above 3.6 GHz. For frequencies below 3.6 GHz, the preselector is automatically bypassed, so you do not need to set this parameter to False in those cases
Preset	False
Range	True (use preselector above 3.6 GHz) False (preselector bypassed)

10.2.25 Channel Bandwidth Array

Example	`:CALC:FPOW:POW1:DEF "Bandwidth=[3.84e6, 5e6, 3.84e6]"`
Notes	Defines the bandwidth of each channel that will be measured All array parameters should have the same number of elements. Alternatively, if all the elements are the same value, a single number with no square brackets can be used to define the parameter
Preset	[1e6]
Range	0 to 40 MHz

10.2.26 Channel Filter Type Array

Example	`:CALC:FPOW:POW1:DEF "FilterType=[RRC, IBW, RRC]"`
Notes	The filter type parameter allows you to choose between an integration bandwidth (IBW) filter or a root-raised-cosine (RRC) filter. The integration bandwidth filter weighs all frequencies within the bandwidth equally. The root-raised-cosine filter has an associated shape parameter, defined by the FilterAlpha parameter All array parameters should have the same number of elements. Alternatively, if all the elements are the same value, a single value with no square brackets can be used to define the parameter
Preset	[IBW]
Range	IBW, RRC

10.2.27 Channel Filter Alpha Array

Example	`:CALC:FPOW:POW1:DEF "FilterAlpha=[0.5, 0.0, 0.5]"`

Notes	The filter alpha parameter allows you to adjust the alpha value associated with the root-raised-cosine (RRC) filter type. Set FilterType to RRC in order to utilize this parameter All array parameters should have the same number of elements. Alternatively, if all the elements are the same value, a single number with no square brackets can be used to define the parameter
Preset	[0.22]
Range	0.0 – 1.0

10.2.28 Channel Measurement Function Array

Example	`:CALC:FPOW:POW1:DEF "Function=[BandPower, PeakPower, BandPower]"`
Notes	This parameter array defines what measurement is being made for each individually-specified channel:

BandPower	Total power within the specified bandwidth of the channel (dBm)
BandDensity	Total power density within the specified bandwidth of the channel (dBm/Hz)
PeakPower	The peak power value within the specified bandwidth of the channel (dBm)
PeakFrequency	The frequency which corresponds to the peak power value within the specified bandwidth of the channel. This frequency is relative to the center frequency (Hz)
XdBBandwidth	The half power (-3.01 dB) bandwidth of the highest amplitude signal that resides within the channel (Hz), dB is configurable using XdBBandwidth parameter
OccupiedBandwidth	The bandwidth at which 99% of the total power resides within the channel (Hz), percentage configurable using OccupiedBand-widthPercent parameter

	All array parameters should have the same number of elements Alternatively, if all the elements are the same value, a single value with no square brackets can be used to define the parameter
Preset	BandPower
Range	BandPower, BandDensity, PeakPower, PeakFrequency, XdBBandwidth, OccupiedBandwidth

10.2.29 Channel Offset Frequency Array

Example	`:CALC:FPOW:POW1:DEF "OffsetFrequency=[-5e6, 0, 5e6]"`
Notes	The offset frequency parameter array defines the difference between the center frequency to the center frequency of each channel All array parameters should have the same number of elements
Preset	[0]
Range	0 to 20 MHz

10.2.30 Channel Occupied Bandwidth Percent Array

Example	`:CALC:FPOW:POW1:DEF "OccupiedBandwidthPercent =[0.95, 0.95, 0.95]"`
Notes	This parameter only applies for channels whose Function is set to OccupiedBandwidth. The occupied bandwidth percent parameter specifies the percent of total power in these channels. The valid range for this parameter is 0.0 to 1.0, where 1.0 represents 100%. The default for this parameter is 0.99, which will return the bandwidth that contains 99% of the total channel power
Preset	[0.99]
Range	0 – 1.0

10.2.31 Channel x-dB Bandwidth Array

Example	`:CALC:FPOW:POW1:DEF " XdBBandwidth =[-6.02, -3.01, -1.0]"`
Notes	This parameter only applies for channels whose Function is set to `XdBBandwidth`. The X dB bandwidth parameter is used to specify the power relative to the peak channel power over which the bandwidth is calculated. The parameter value must be a negative number
Preset	[-3.01]
Range	-200 to 0 dB

10.3 Define Fast Power Measurement Query (Remote Command Only)

Retrieves a list of all defined parameters in an ASCII string format

The following is an example of returned results:

```
"DCCoupled=False,ElecAttBypass=True,ElecAttenuation=0,IFGain=0,MechAttenuation=
0,PreAmpMode=Off,PreSelectorOffset=0,UsePreSelector=False,ExternalReferenceFreq
uency=10000000,FrequencyReferenceSource=AutoExternalFrequencyReference,IFType=B
40M,LOMode=SLW,SignalInput=FpMainRf,AcquisitionTime=0.001,CenterFrequency=10000
00000,ResolutionBW=0,ResolutionBWMode=BestSpeed,DetectorType=RmsAverage,Bandwid
th=[1000000],OffsetFrequency=[0],Function=[BandPower],FilterType=
[IBW],FilterAlpha=[0.22],OccupiedBandwidthPercent=[0.99],XdBBandwidth=
[3.01],DoNoiseCorrection=False,DoSpurSuppression=False,MeasurementMethod=Hardwa
reFFT,IncludePowerSpectrum=False,TriggerDelay=0,TriggerLevel=1.2,TriggerSlope=P
ositive,TriggerSource=Free,TriggerTimeout=1"
```

Remote Command	`:CALCulate:FPOWer:POWer[1,2,…,999]:DEFine?`
Example	`:CALC:FPOW:POW1:DEF?`
Notes	Retrieves a list of all defined parameters in an ASCII format

10.4 Configure Fast Power Measurement (Remote Command Only)

Begins hardware setup and returns immediately, with no acquisition made. This can be used in parallel with other hardware operations to effectively hide the hardware setup time.

Remote Command	`:CALCulate:FPOWer:POWer[1,2,…,999]:CONFigure`
Example	`:CALC:FPOW:POW1:CONF`
Notes	Option FP2 is required

10.5 Initiate Fast Power Measurement (Remote Command Only)

Begins an acquisition and returns immediately. The results of the measurement can be retrieved using `:FETCh`.

Remote Command	`:CALCulate:FPOWer:POWer[1,2,…,999]:INITiate`
Example	`:CALC:FPOW:POW1:INIT`
Notes	Option FP2 is required

10.6 Fetch Fast Power Measurement (Remote Command Only)

Used to retrieve the results of an acquisition initiated by `:INIT`. The returned results are in *ASCII string* format. The string begins and ends with quotation marks.

Remote Command	`:CALCulate:FPOWer:POWer[1,2,…,999]:FETCh?`
Example	`:CALC:FPOW:POW1:FETC?`
Notes	Option FP2 is required Returns m comma-separated ASCII values, where m corresponds to the number of bandwidths defined 1. Declared function return in the 1st specified channel 2. Declared function return in the 2nd specified channel ... m. Declared function return in the last specified channel The INIT and FETC? command sequence performs the same functionality of a single CALC:FPOW:POW [n]? query. Units of the returned values are dependent on the Function parameter for each channel

10.7 Execute Fast Power Measurement (Remote Command Only)

This query is shorthand for `:INIT` immediately followed by `:FETC?`. The returned results are in *ASCII string* format. The string begins and ends with quotation marks.

Remote Command	`:CALCulate:FPOWer:POWer[1,2,…,999]?`
Example	`:CALC:FPOW:POW1?`
Notes	Option FP2 is required See notes for Fast Power Fetch for return format

10.8 Binary Read Fast Power Measurement (Remote Command Only)

This query is shorthand for `:INIT` immediately followed by `:FETC?`. The returned results are in *binary format*.

Remote Command	`:CALCulate:FPOWer:POWer[1,2,…,999]:READ?` `:CALCulate:FPOWer:POWer[1,2,…,999]:READ1?`
Example	`:CALC:FPOW:POW1:READ?` `:CALC:FPOW:POW1:READ1?`
Notes	Option FP2 is required Returns m 4 byte floating point binary values (Little-Endian), where m corresponds to the number of bandwidths defined

10.9 Diagnostic Binary Read Fast Power Measurement (Remote Command Only)

This query is shorthand for `:INIT` immediately followed by `:FETC?`. The returned results are in *binary format*. This command is used primarily for diagnostic purposes, to test for ADC overloads and to visibly inspect the spectrum.

Remote Command	`:CALCulate:FPOWer:POWer[1,2,…,999]:READ2?`
Example	`:CALC:FPOW:POW1:READ2?`
Notes	Option FP2 is required Note: Spectrum data is only returned if the IncludePowerSpectrum parameter is set to True. If IncludePowerSpectrum is False, the number of spectrum points will be zero (0) Units of the returned values are dependent on the Function parameter per channel (e.g. dBm for BandPower, Hz for PeakFrequency) Returns binary data (Little-Endian) that contains information on m amount of channels, along with ADC over range and full spectrum data The following is the binary format of the response Bandwidth Return Value 1. Number of channels specified, m [4 byte int] 2. Declared function result for the 1st specified channel [4 byte float] 3. Declared function result for the 2nd specified channel [4 byte float] ... (m + 1). Declared function result for the last (mth) specified channel [4 byte float] ADC Over Range 1. ADC over-range occurred (1: true, 0: false) [2 byte short] Spectrum Data 1. Number of points in the spectrum data, k [4 byte int] 2. Start frequency of spectrum data (Hz) [8 byte double] 3. Step frequency of spectrum data (Hz) [8 byte double] 4. FFT bin at 1st point (dBm) [4 byte float] 5. FFT bin at 2nd point (dBm) [4 byte float] ... (k + 3). FFT bin at last (kth) point (dBm) [4 byte float]

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