Keysight X-Series Signal Analyzer

This documentation is for the following X-Series Instruments:

- Multi-Touch Signal Analyzers (UXA, PXA, MXA)

RTSA Mode User's & Programmer's Reference

KEYSIGHT TECHNOLOGIES

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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 41

– "Additional Documentation" on page 42

KEYSIGHT TECHNOLOGIES

1.1 Products Covered by this Document

Product Family	Full Product Name	Model Numbers
Multi-Touch Signal Analyzers	UXA Signal Analyzer	N9041B
		N9040B
	PXA Signal Analyzer	N9030B
	MXA Signal Analyzer	N9020B
	EXA Signal Analyzer	N9010B
	CXA Signal Analyzer	N9000B
Multi-Touch PXIe Vector Transceivers	VXT PXIe Vector Transceiver	

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/RTSAMode/FlexUI.htm
- **Users & Programmers Reference**, in downloadable PDF format

  For information on this Mode, download from:

  http://literature.cdn.keysight.com/litweb/pdf/N9030-90114.pdf

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 Signal Analyzers Instrument Messages
- 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

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 126

"Onscreen Keyboard key" on page 127

"Touch On/Off Key" on page 128

"Tab key" on page 129

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 111 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 46. In addition, if you have a PC keyboard plugged in, the sequence CTL-SHIFT-M will open up this dialog.

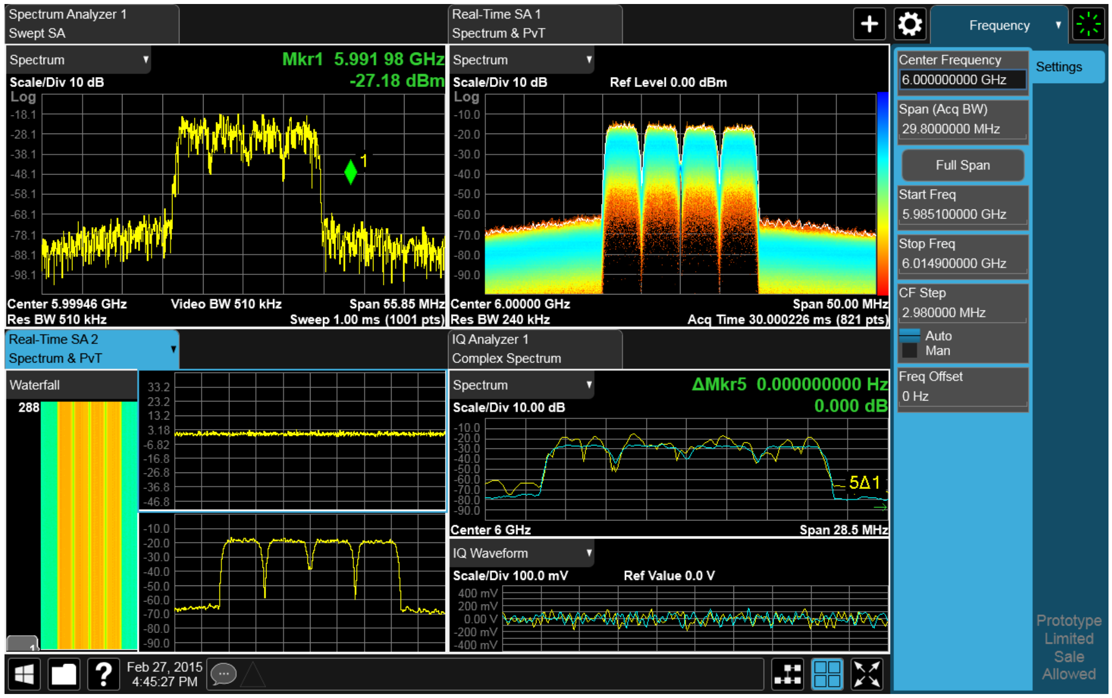
The + tab at the right of the Screen Tabs bar adds a new Screen by cloning the current screen. The new Screen has the identical setup and settings as the current Screen. You can then change the Mode, Measurement and/or settings of the new Screen.

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 46

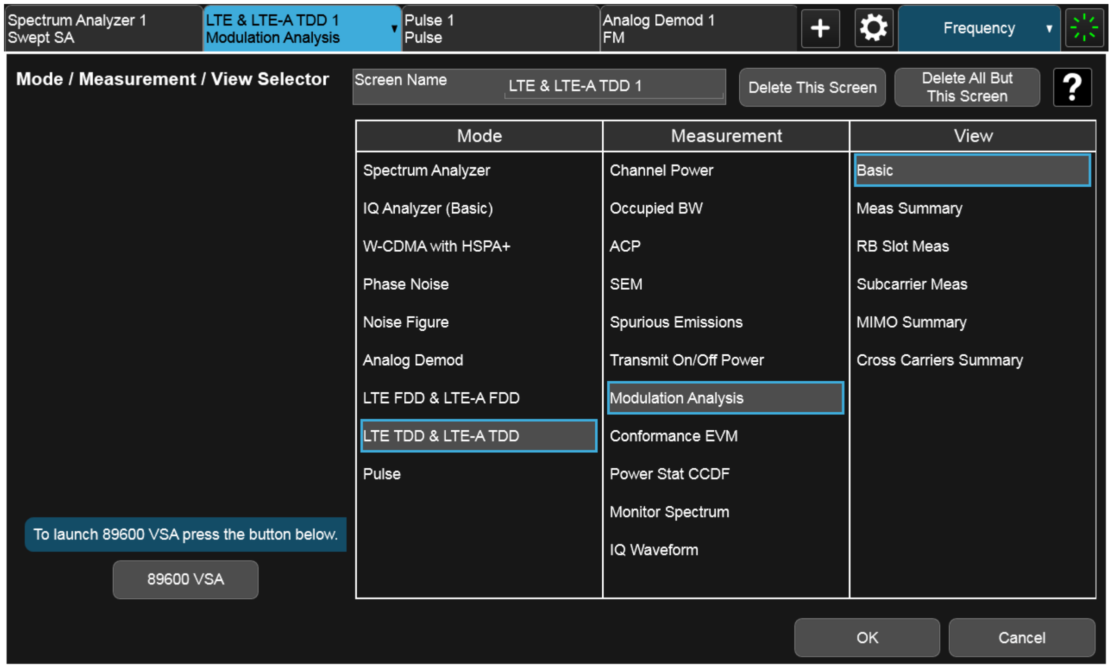
– "Add Screen" on page 62

– "Multiscreen" on page 111

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 45) or the **Mode/Meas** front panel key.

This dialog displays lists of available Modes, Measurements and Views, as well as the "Sequencer" on page 56 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 49

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 49.

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 48. The Mode Numbers may be found in the table under "Index to Modes" on page 49.

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 48.

Remote Command	`:INSTrument[:SELect] <mode_id>`
	where <mode_id> is one of the values listed in Index to Modes 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 a “Restore System Defaults->All”, unless noted below: For N8973B, N8974B, N8975B, or N8976B: NFIG For E7760: BASIC
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 49 SA mode is number 1 The command is sequential: i.e. 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` on a “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>:<meas>` where <mode> 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> are dependent upon installed and licensed applications resident in the instrument. The available parameters for <meas> are dependent on the <mode> 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
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 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. It is also possible, using the same utility, 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 (by either pressing that applications Mode key or sending that application's :INST:SEL command over SCPI), 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 the :INSTrument[:SELect] command.

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`

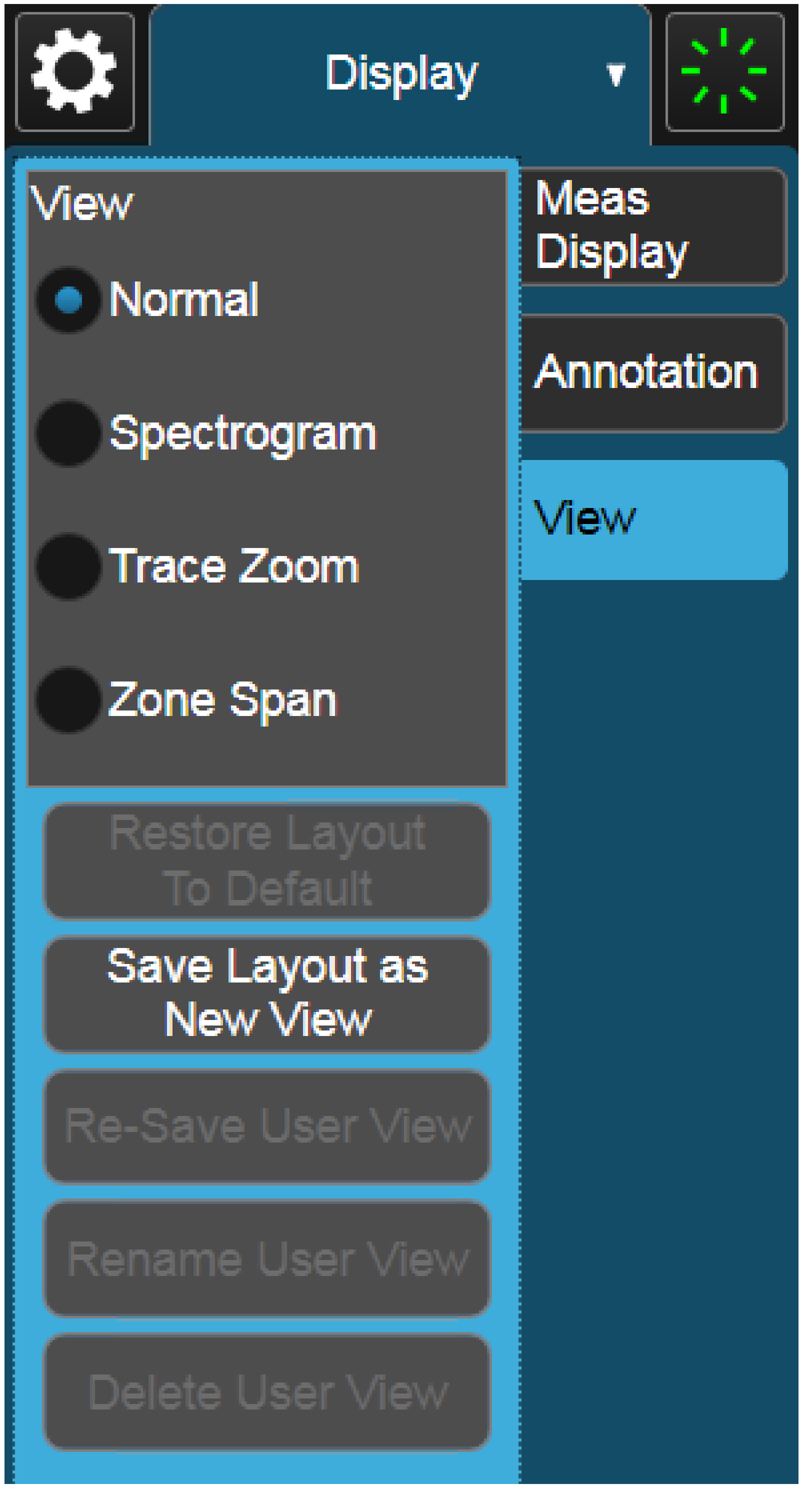
2.1.1.3 Measurement

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 46 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 46.



2.1.1.5 Sequencer

The Screen Sequencer allows multiple Screens to update sequentially while in "Multiscreen" on page 111 display mode. Each Screen will update 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 45

).

If you want each Screen to use a different input, you must turn off **All Screens Use Same Input** under **Input/Output**, **Input**. Be aware that this could cause mechanical switches to cycle as you go from Screen to Screen, potentially reducing the life of these switches.

NOTE 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 any SCPI commands that are sent is unpredictable, so you should stop the Sequencer before sending any measurement related SCPI commands. Once the Sequencer is stopped, select a specific Screen by using the `:INSTrument:SCReen:SELect` command before sending any further commands. See "Select Screen" on page 113

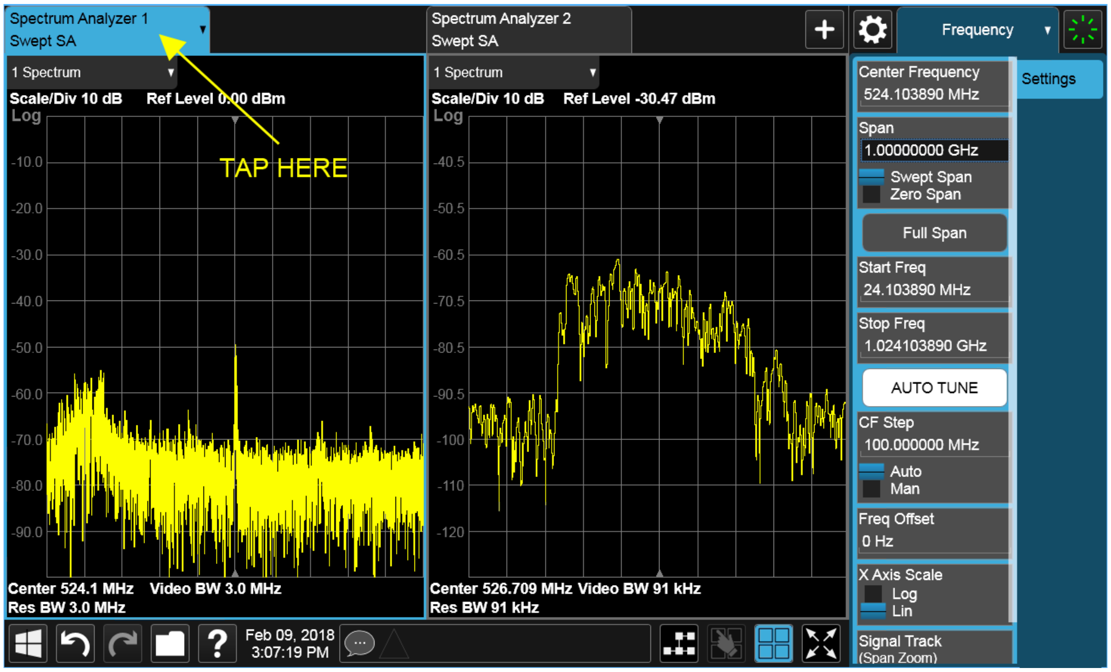
NOTE When the Sequencer is running, Auto alignment is temporarily disabled. A pending auto alignment might be executed when the sequencer is stopped.

See "More Information" on page 57

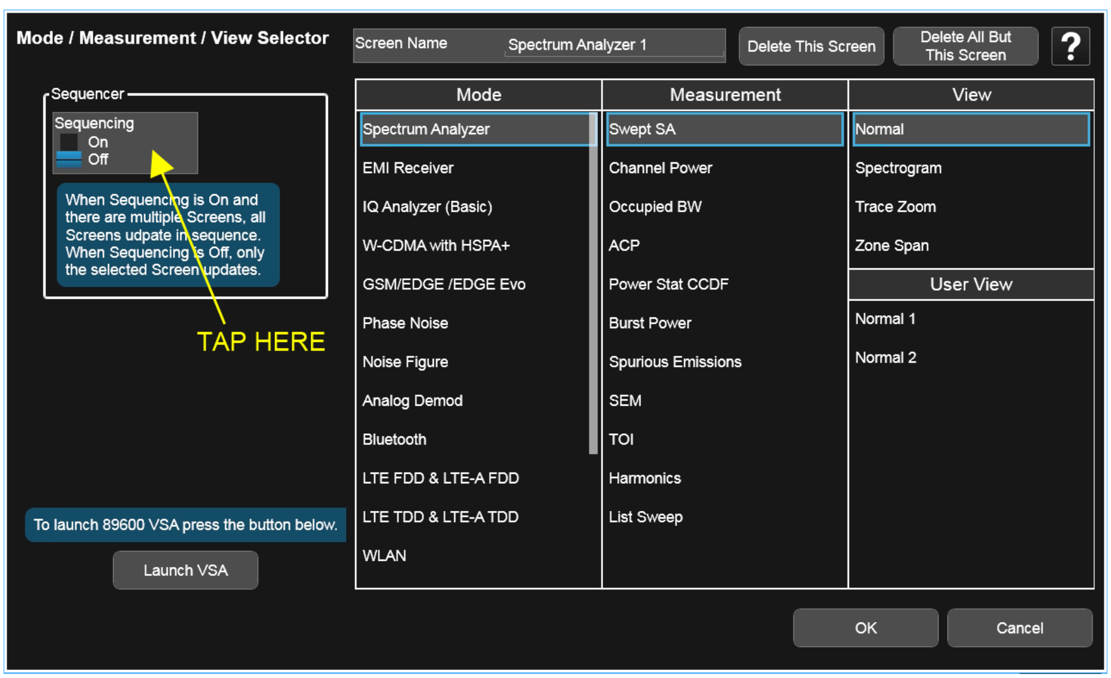
Remote Command	`:SYSTem:SEQuencer ON | OFF | 1 | 0` `:SYSTem:SEQuencer?`
Example	`:SYST:SEQ ON`
Notes	If the display is disabled (via `:DISP:ENAB OFF`) then the error message “-221, Settings conflict; Screen SCPI cannot be used when Display is disabled” is generated
Dependencies	To start the Sequencer, 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:

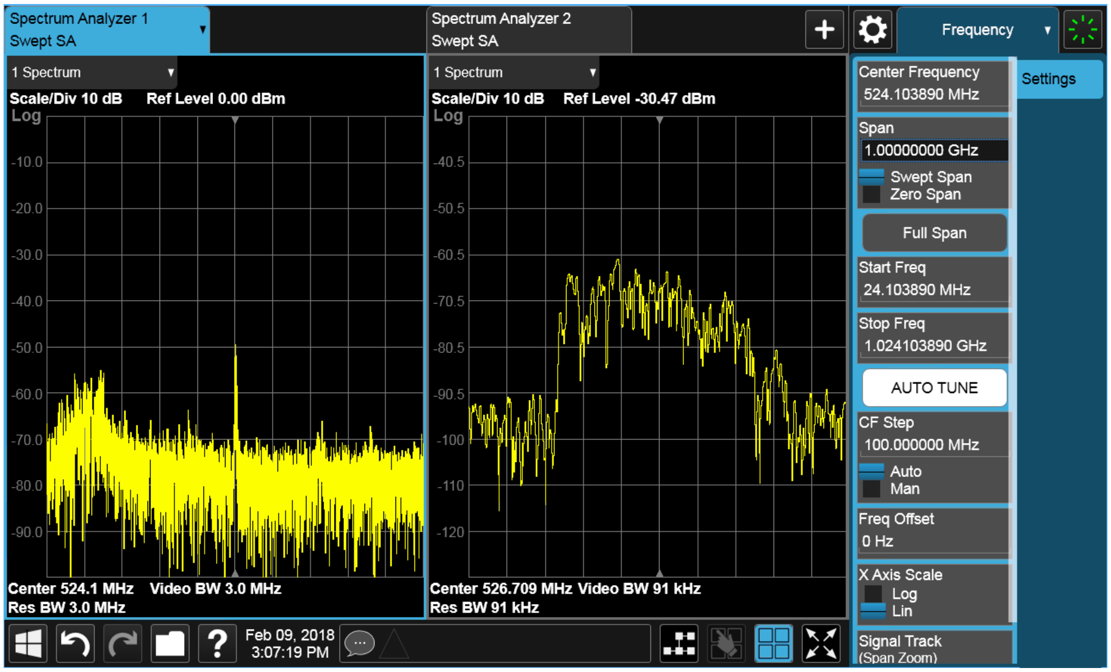


In the Sequencer block in the upper left hand corner, tap the Sequencing switch to turn it On:

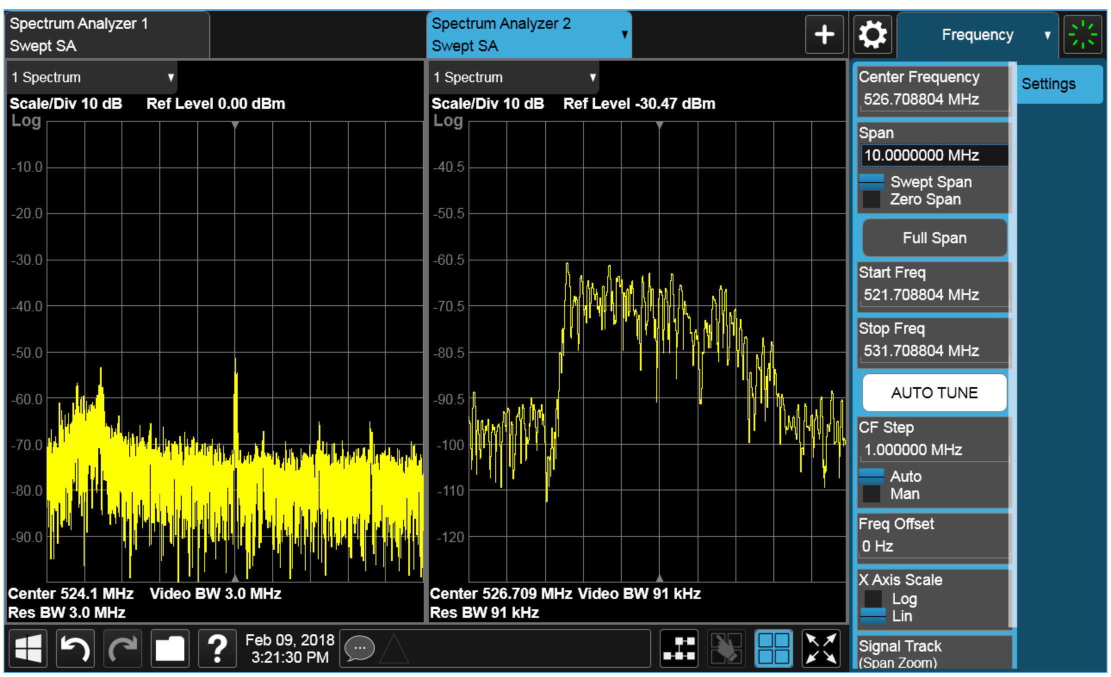


The instrument will immediately exit the Mode/Meas/View Dialog and begin making measurements in each of the screens, one after the other. When a measurement is being made in a particular Screen, that Screen's tab will be blue.

Measurement being made in Screen 1:



Measurement being made in Screen 2:



Touching any hardkey 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.

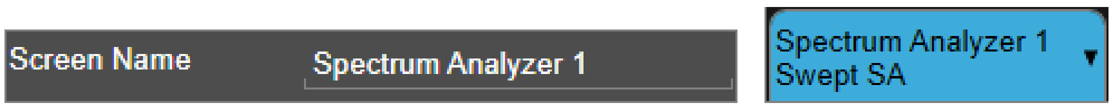
When the Sequencer is running, the screens update in the order in which they were created.

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 turned 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 46:



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".

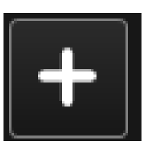
Example

```
: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 45 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 46 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 111.

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

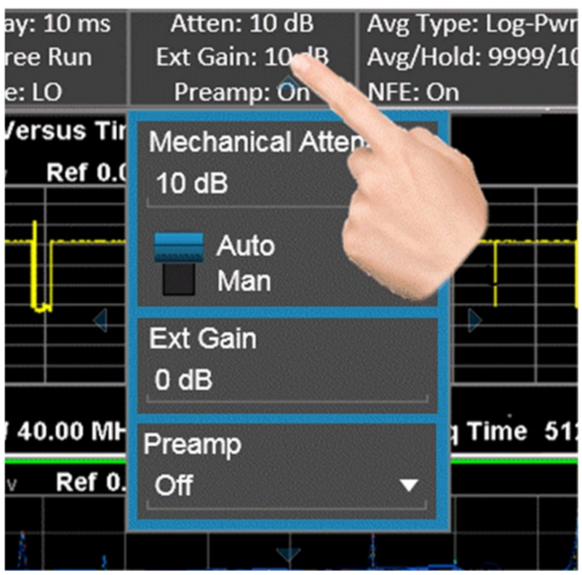
2.2 Meas Bar

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.

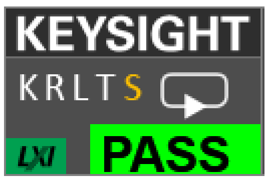
In a hotspot panel, the control in black with the blue border is the active function. Each panel may have its own default active function.

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:

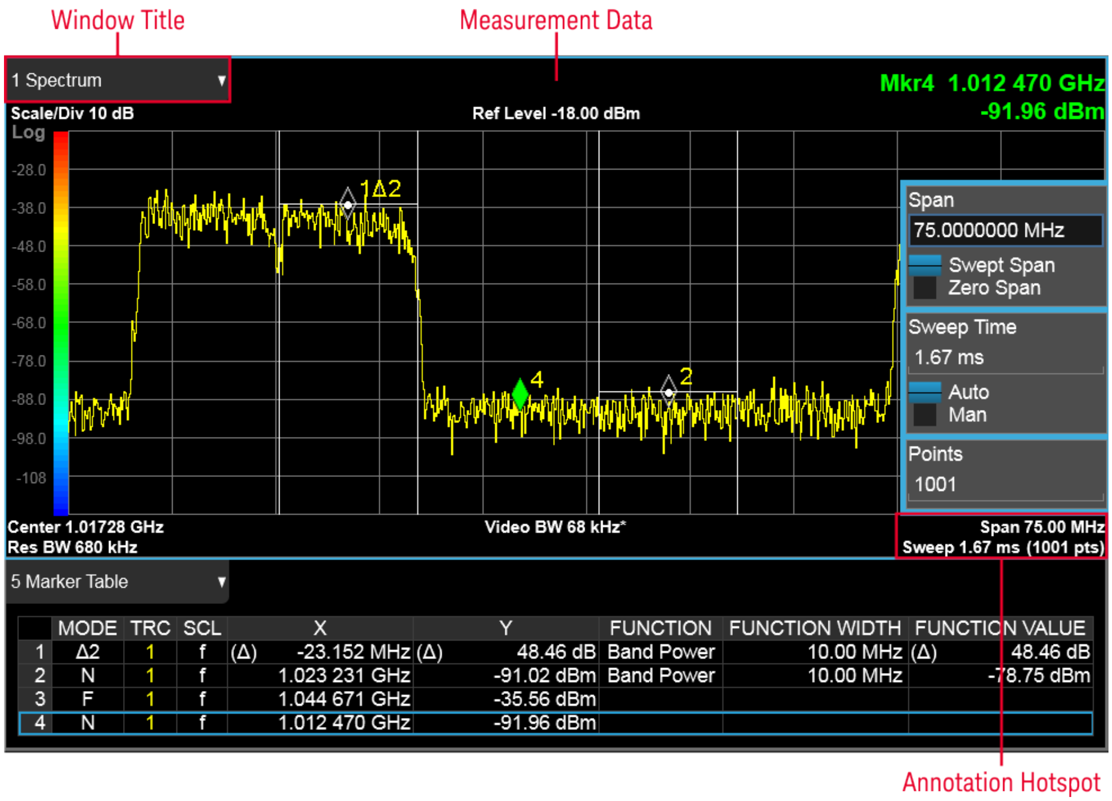
- The top row shows the Trace Number, in the trace color.
- The second row shows the Trace Type for each trace (W=Clear/Write, A=Trace Average, M=Max Hold, m=Min Hold); this letter is in white if the trace is Active, in gray if the trace is inactive; there is a bar through the letter if the trace is 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 67, "Measurement Data" on page 71, and graphical windows also may contain "Annotation Hotspot" on page 74s.

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”).

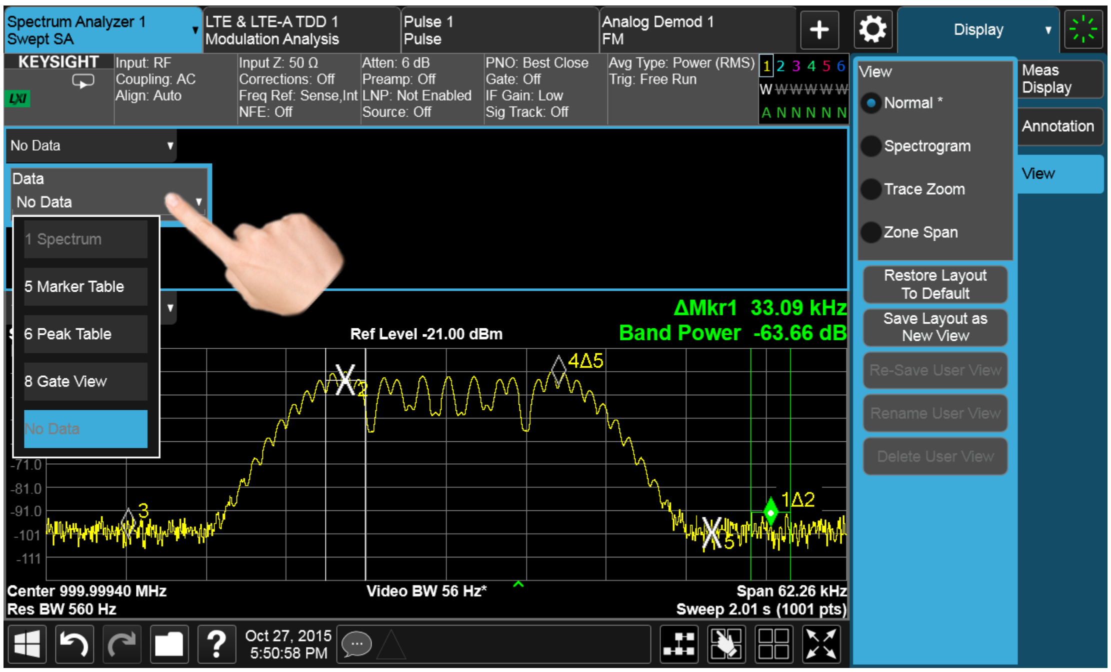
Measurements that support User Views (see "View Editor" on page 89) also display the Window Number in the Window Title, to enable window addressing from SCPI. The number is the number that will be used in the SCPI command to address that window, for example, in the WCDMA Mod Accuracy measurement, Code Domain

Power is assigned window number 6, so you address it with the following SCPI command:

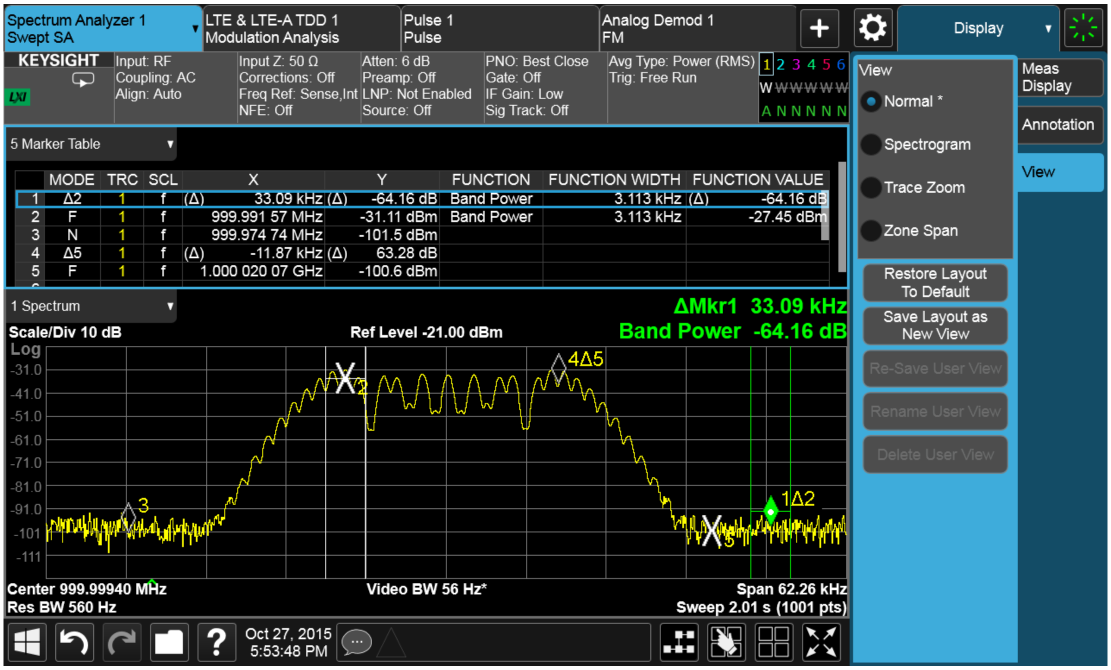
```
:DISP:RHO:WIND6:TRAC:Y:RLEV 0.0
```

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.

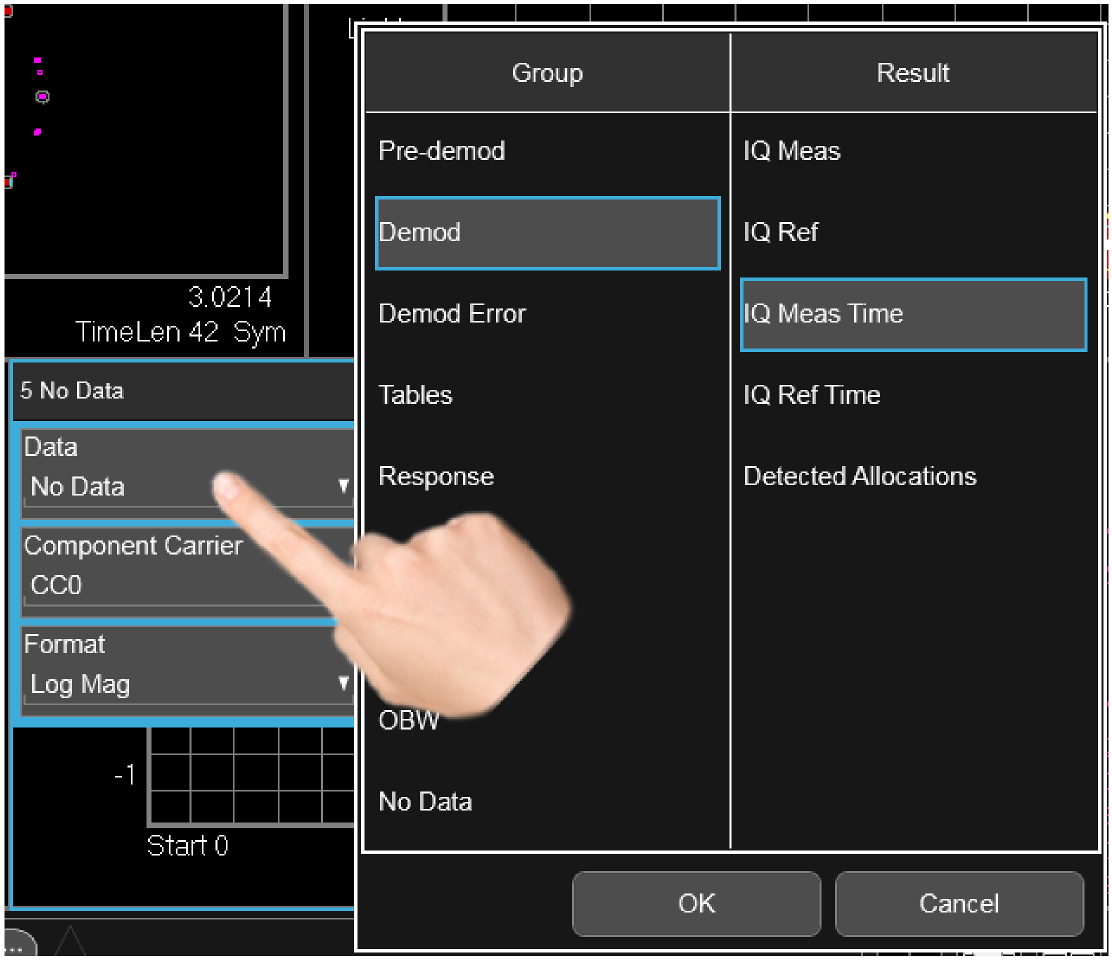
For example, if we wish to assign the results of the upper window in the display below to the Marker Table, we would touch the window title and then the "Data" control that is revealed, as shown:



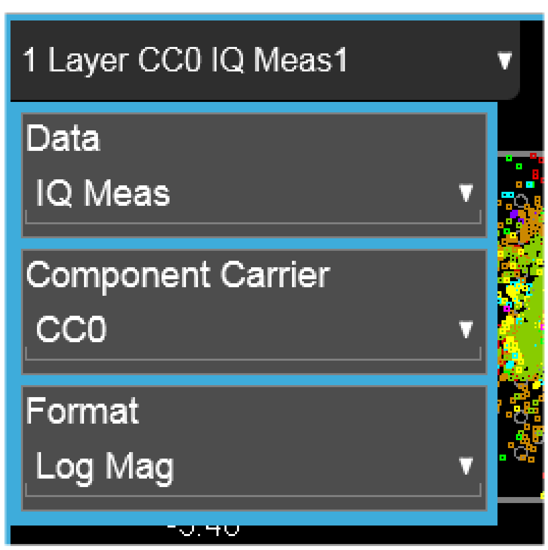
And then select Marker Table, yielding the result below:



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
Toggle control	Toggle in that direction

Pinch

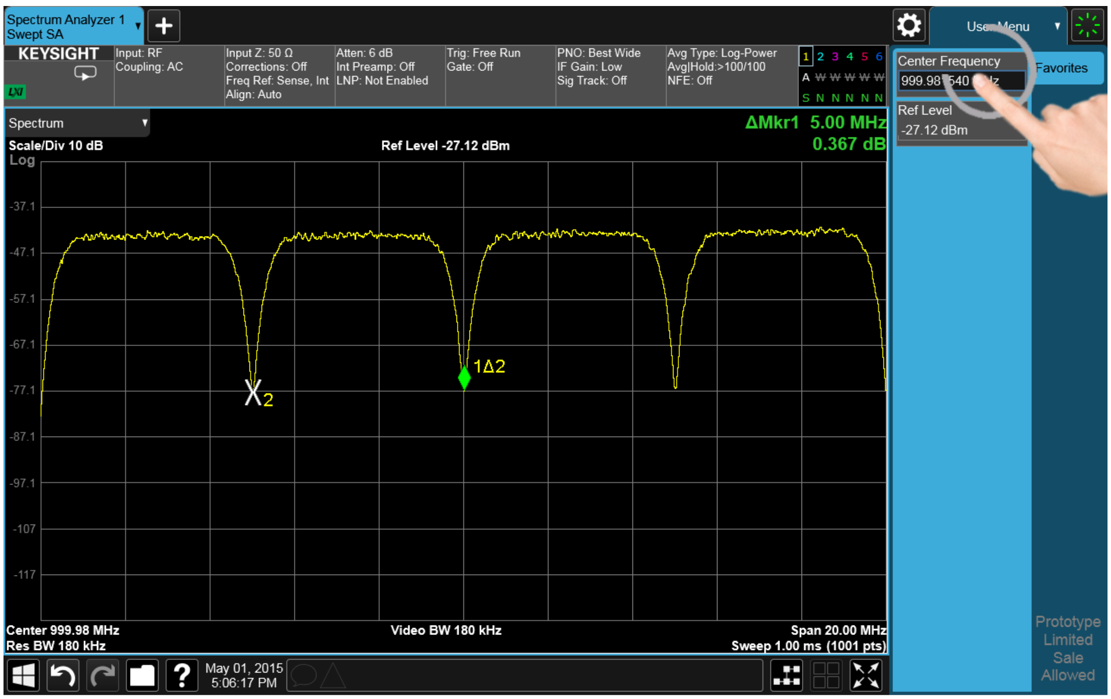
You can also pinch in or out either horizontally or vertically to zoom in the x-axis or y-axis dimension. For example, a pinch horizontally lets you adjust the Span of the

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

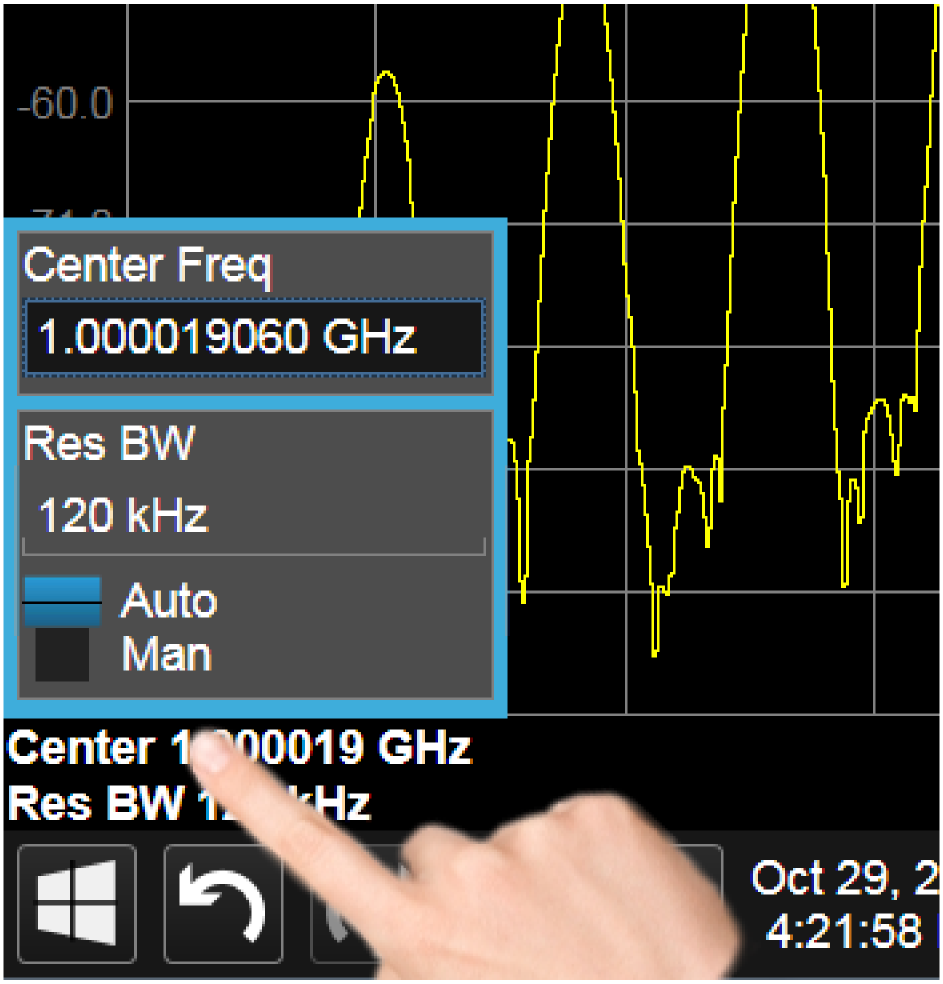
Double Tap

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.



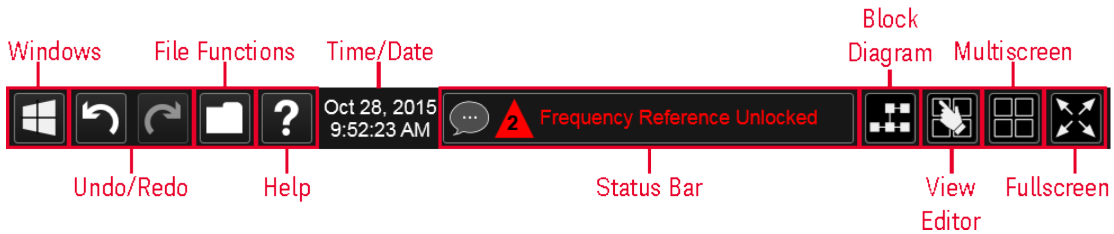
Touching anywhere off the hotspot panel or pressing any hardkey except **Save** or **Quick Save** closes the hotspot panel.

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 Control Bar

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



2.4.1 Windows

Pressing the Windows icon on the "Control Bar" on page 76 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.

2.4.2 Undo/Redo

The Undo button in the "Control Bar" on page 76,

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 76 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:

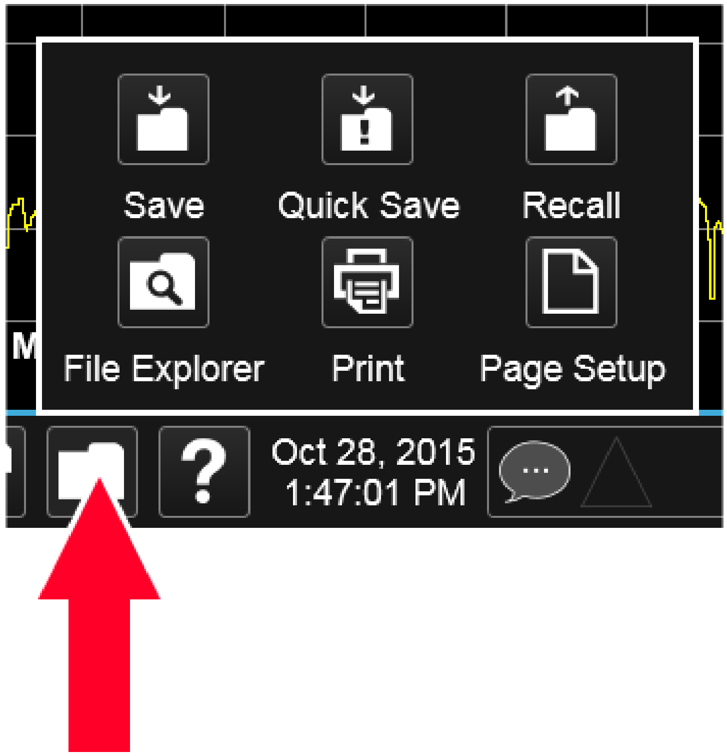
```
REDO: Center Freq 300 MHz -> 1 GHz
```

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

2.4.3 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 76.

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



Tapping this folder icon displays the File Functions popup

2.4.3.1 File Explorer

Pressing the File Explorer button in the "File Functions" on page 79 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.

2.4.4 Help

Pressing the Help button in the "Control Bar" on page 76, the **Help** front panel key, or **F1** if you have a PC keyboard connected, opens the context-sensitive Help system and allows you to get Help on the current menu panel. The Help button appears in the "Control Bar" on page 76 and also 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.

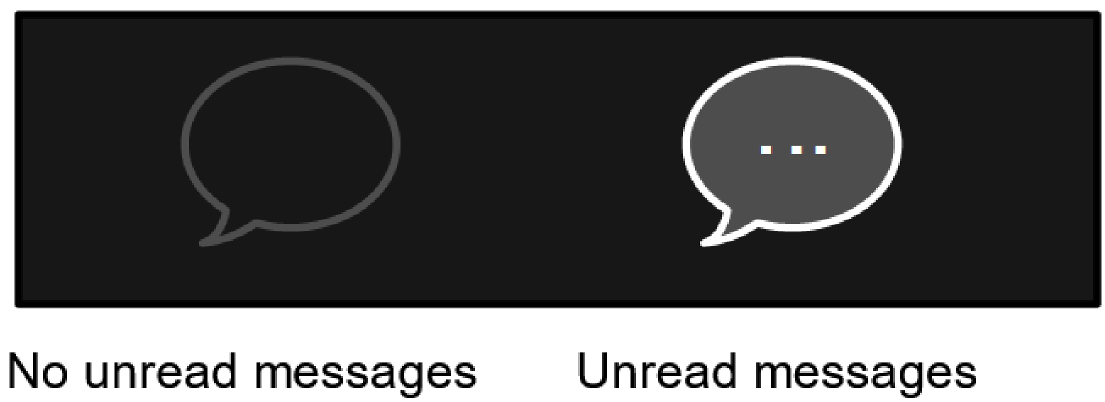
In addition, if you touch and hold a specific control, one of the choices is **Help on this setting**.

The Help window appears in full screen mode, with the Contents pane on the left and the User Documentation pane on the right. The small pullout tab between the Contents pane and the User Documentation pane enables you to hide or view the Contents pane.

2.4.5 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.

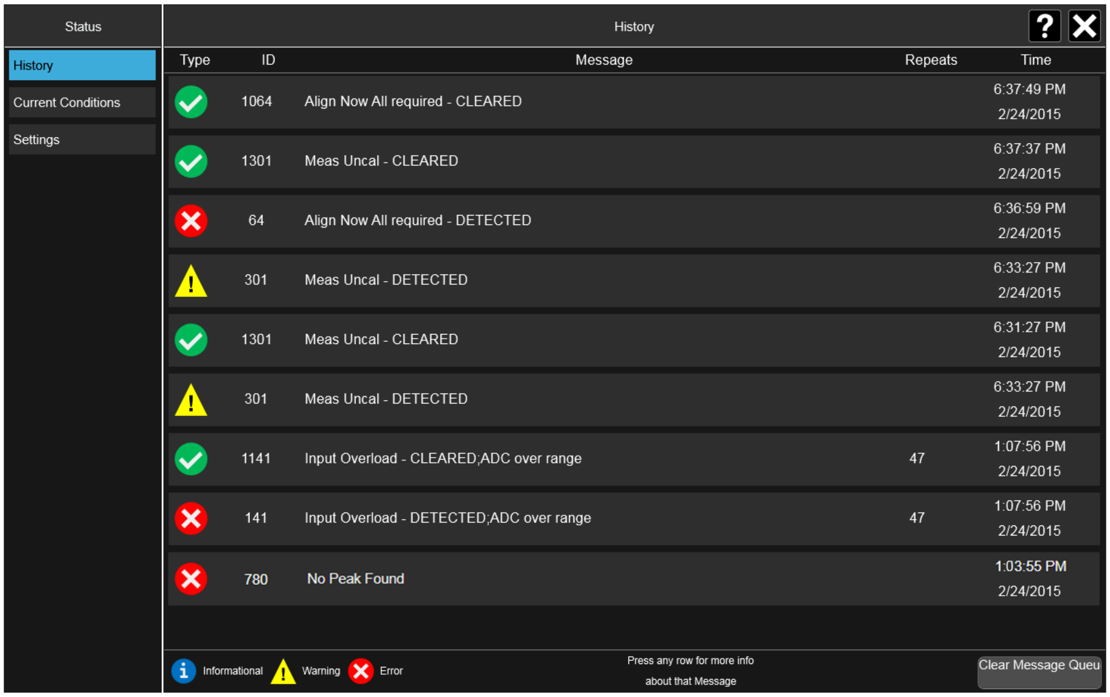
The Condition Message appears to the right of the Condition Indicator. In the example below, the cCondition Message is “Align All, Now required”:

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 84

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

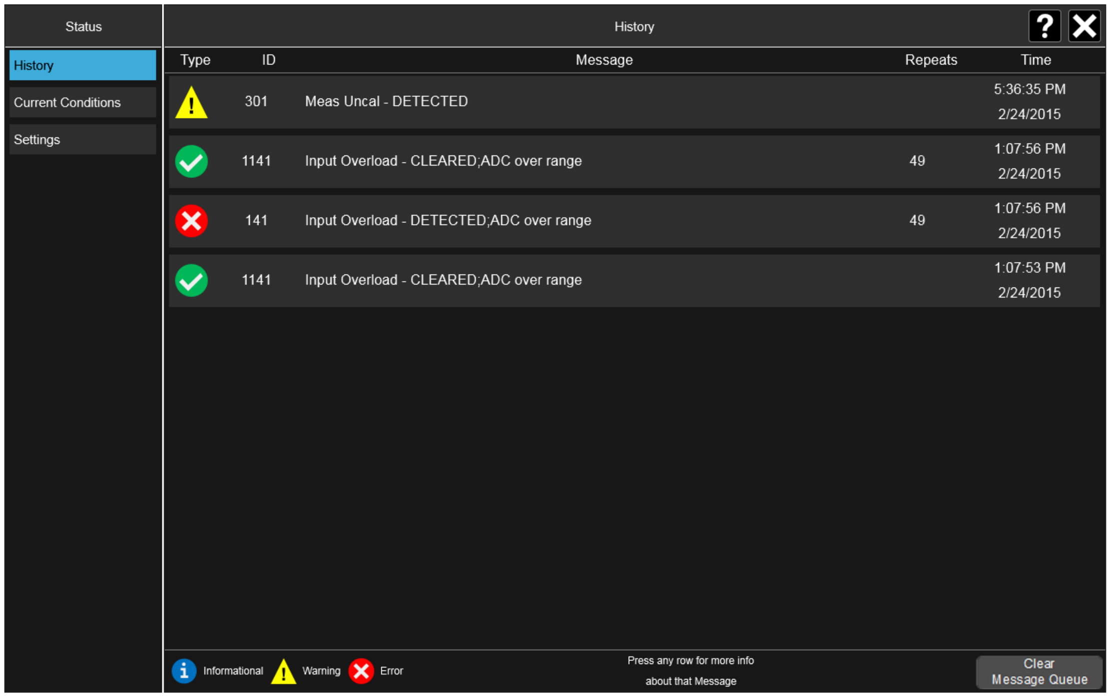
Backwards Compatibility Notes	In some legacy analyzers, the Repeat field shows the number of times the message has repeated since the last time the error queue was cleared. In the X-Series, the Repeat field shows the number of times the error has repeated since the last intervening error. So the count 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

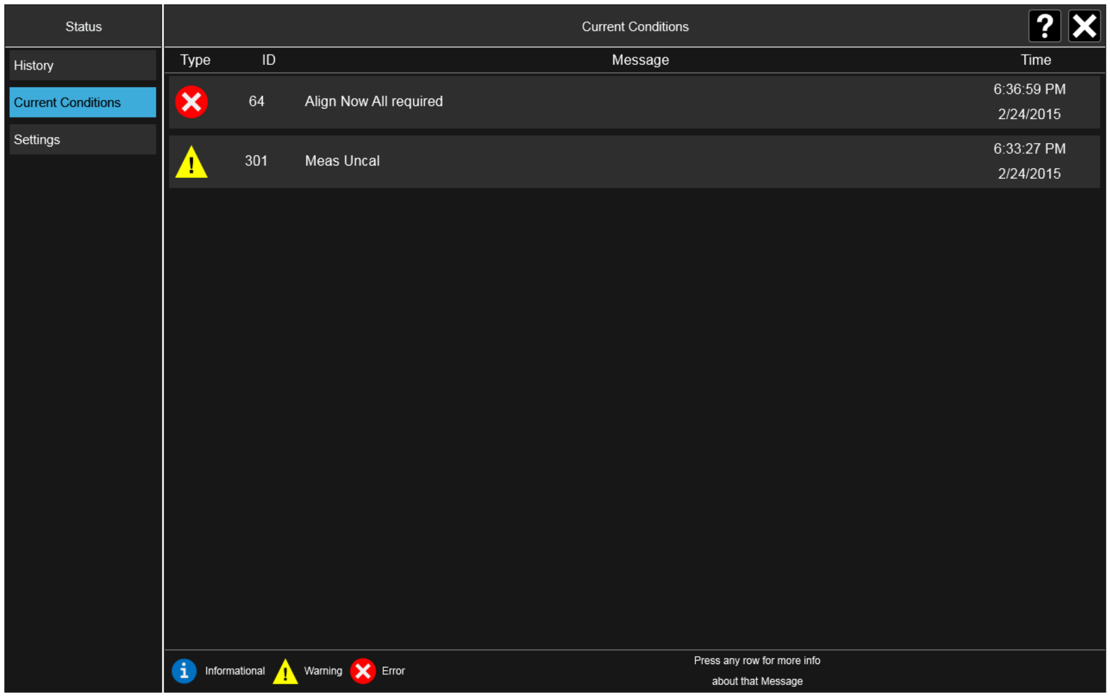
1301, Meas Uncal – CLEARED

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:

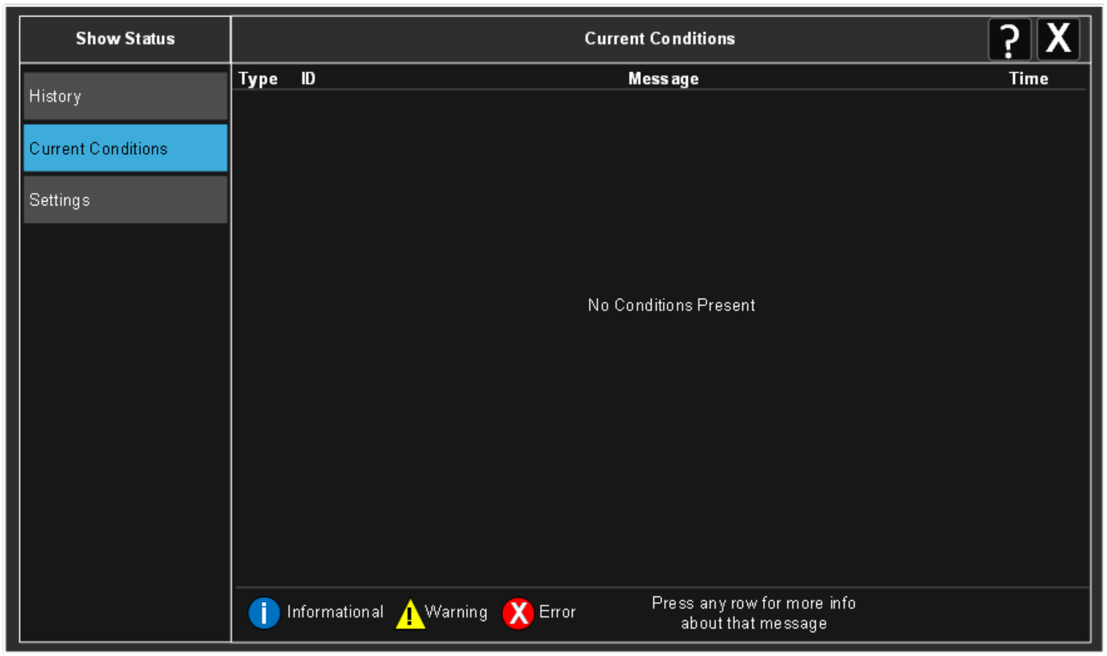


The fields on the Current Conditions display are:

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

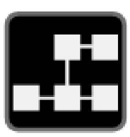
Touching a condition message expands the display of that message. Touching again collapses it. The description is the same as the one that appears on the message dialog. An example of this is shown in the History section, below.

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



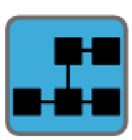
2.4.6 Block Diagram

When you press the Block Diagram button in the "Control Bar" on page 76, 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.



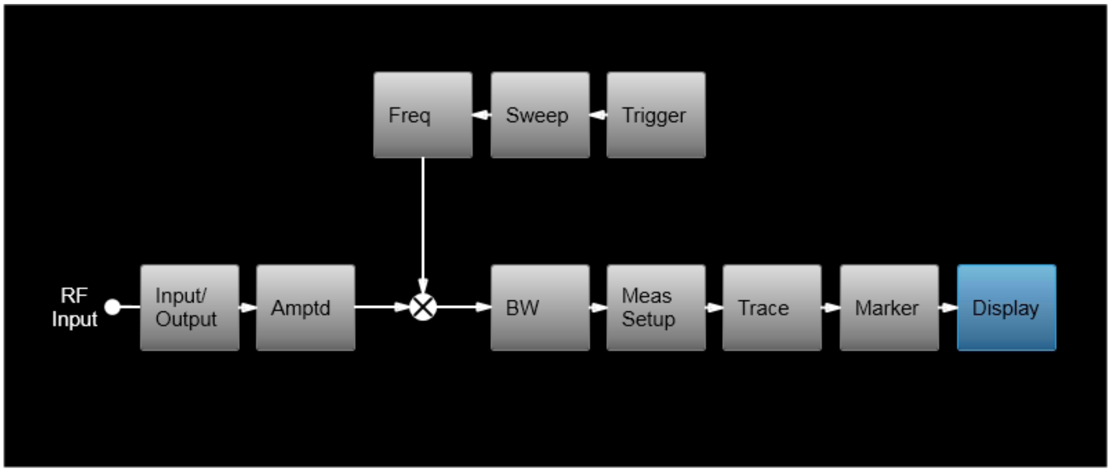
When you press the Block Diagram button, the display changes to a stylized pictorial representation of the current internal hardware setup and signal processing path. When you touch one of the blocks on the Block Diagram, the corresponding menu panel opens.

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

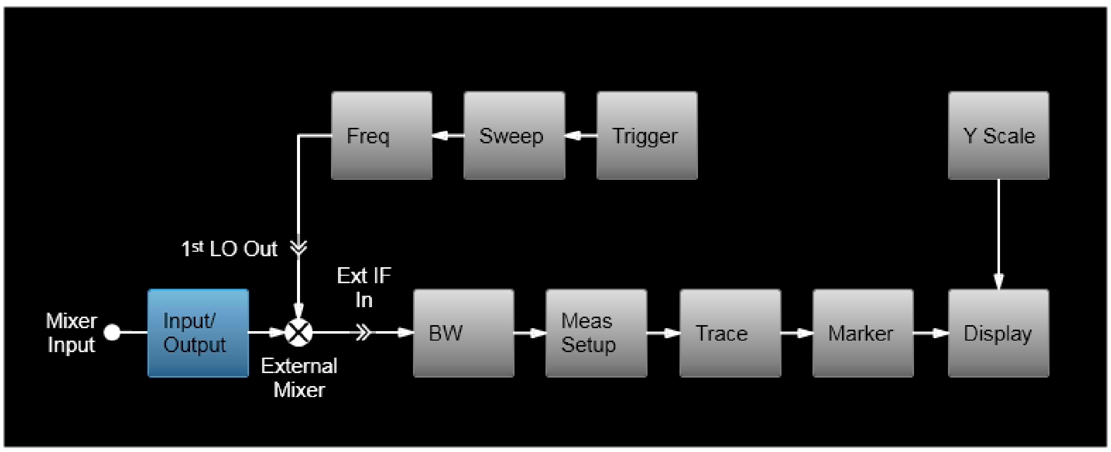


To exit the Block Diagram display, tap the button again.

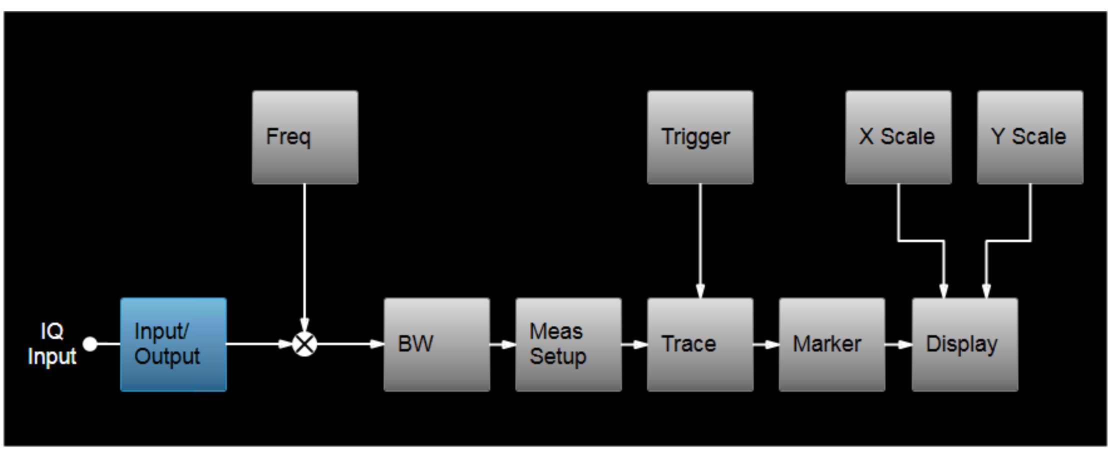
The Block Diagram display is not meant to be a completely accurate representation, but one which can show differences as you change the hardware setup. For example, here is the basic RF Block Diagram:



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



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

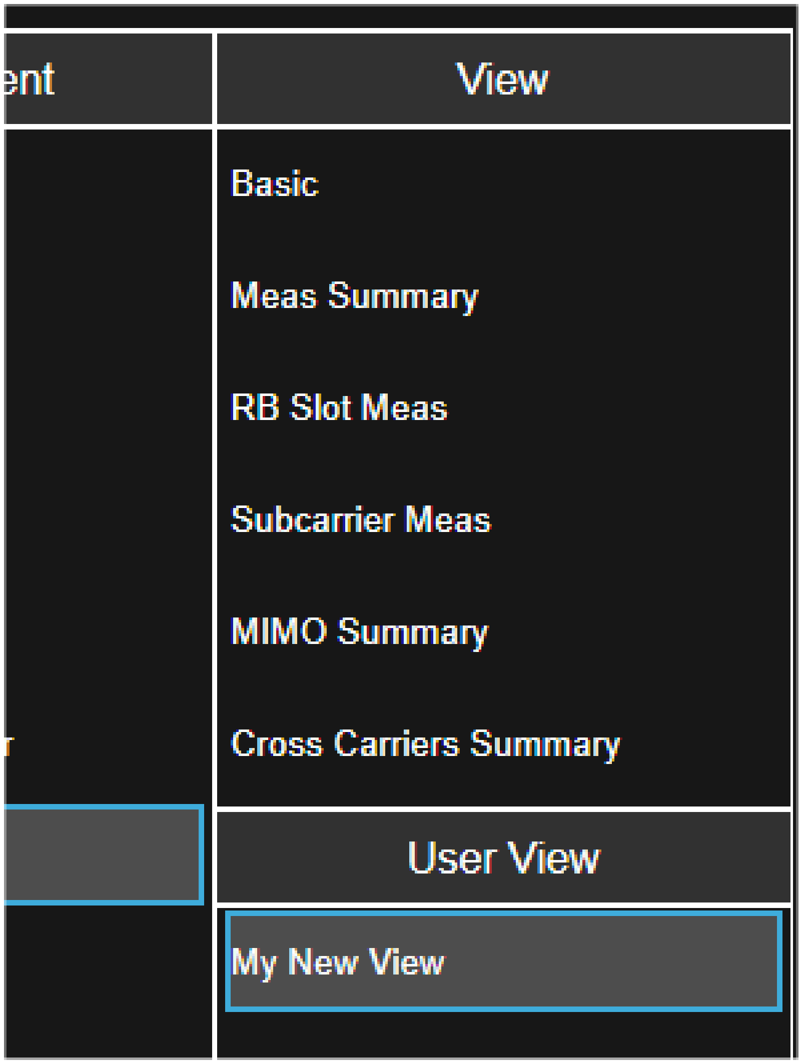


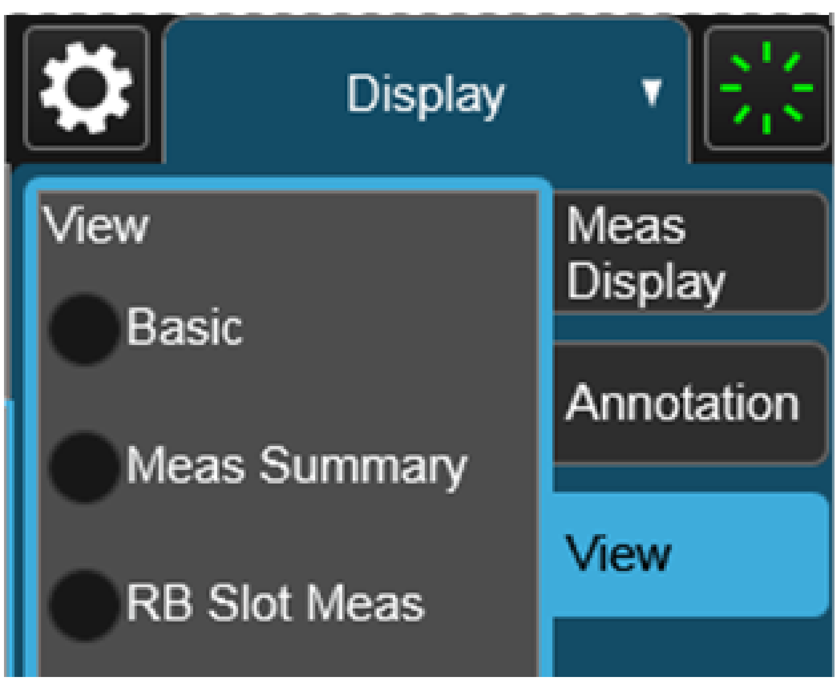
2.4.7 View Editor

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:


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

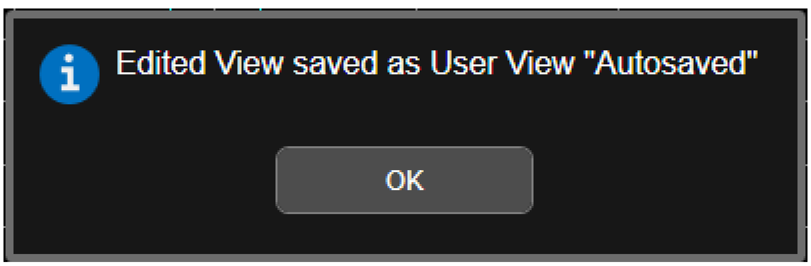

Display
View
Basic
Meas Summary
RB Slot Meas
Meas Display
Annotation
View

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 105).

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 76, 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 46) 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

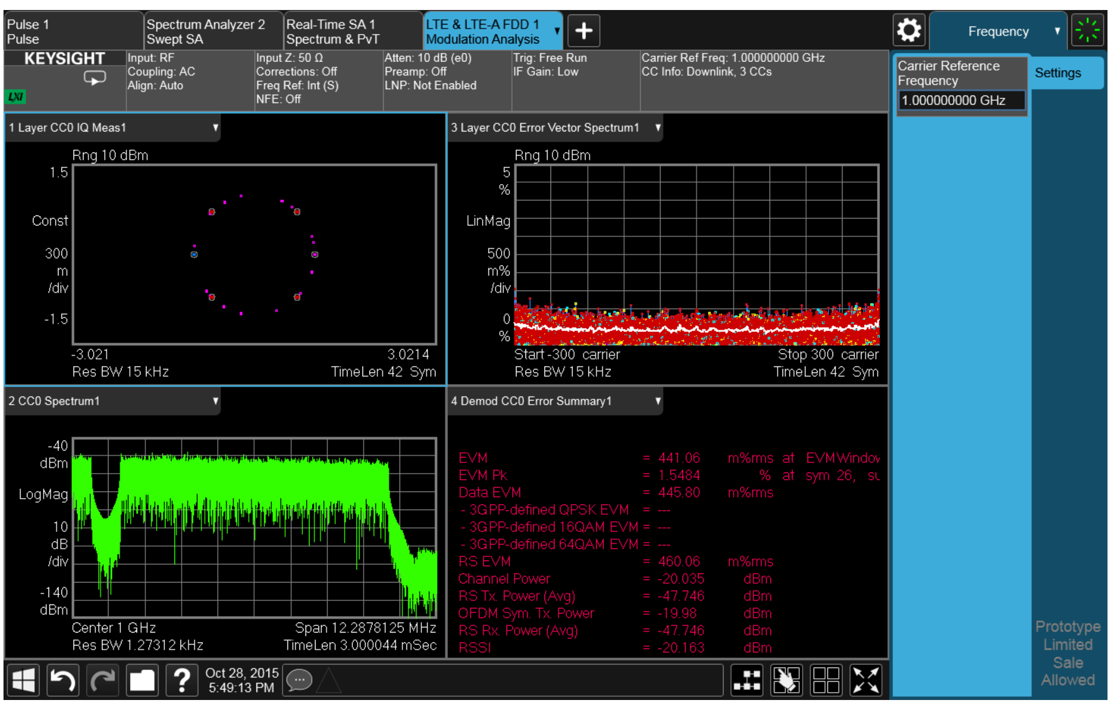
A User View is any View that is not in the list of predefined Views for the current measurement. For example, the Swept SA measurement has four predefined Views: Normal, Spectrogram, Zone Span, and Trace Zoom.

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

2.4.7.1 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.

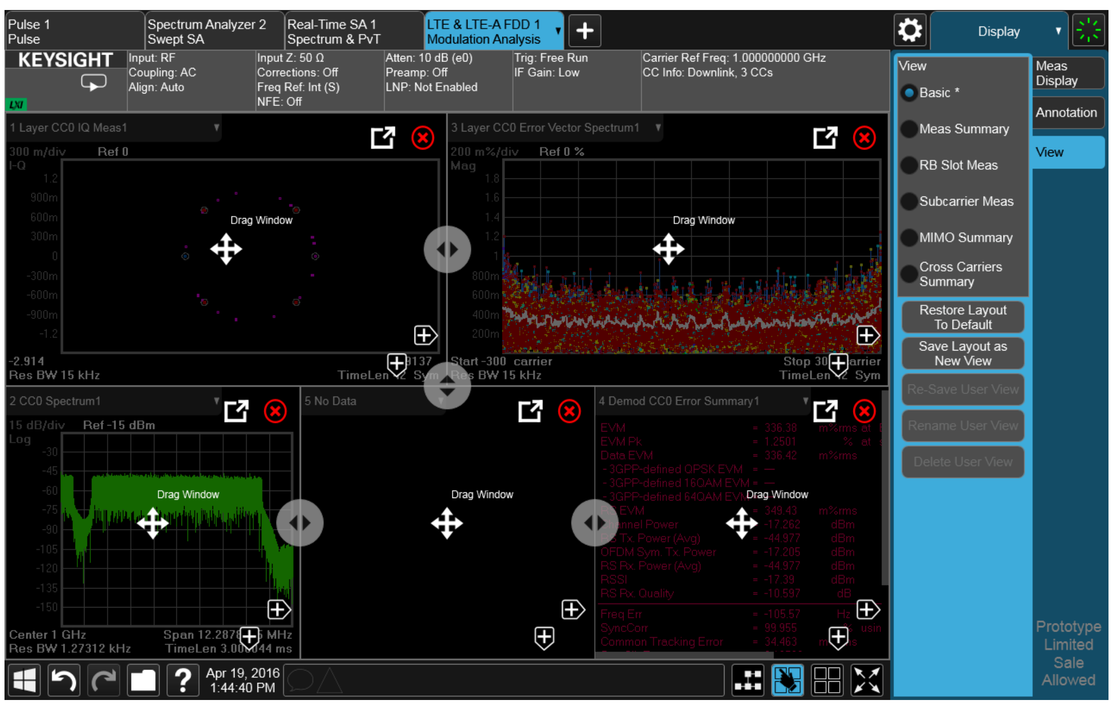
For example, to edit the View shown below, you press the Edit View icon.



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).

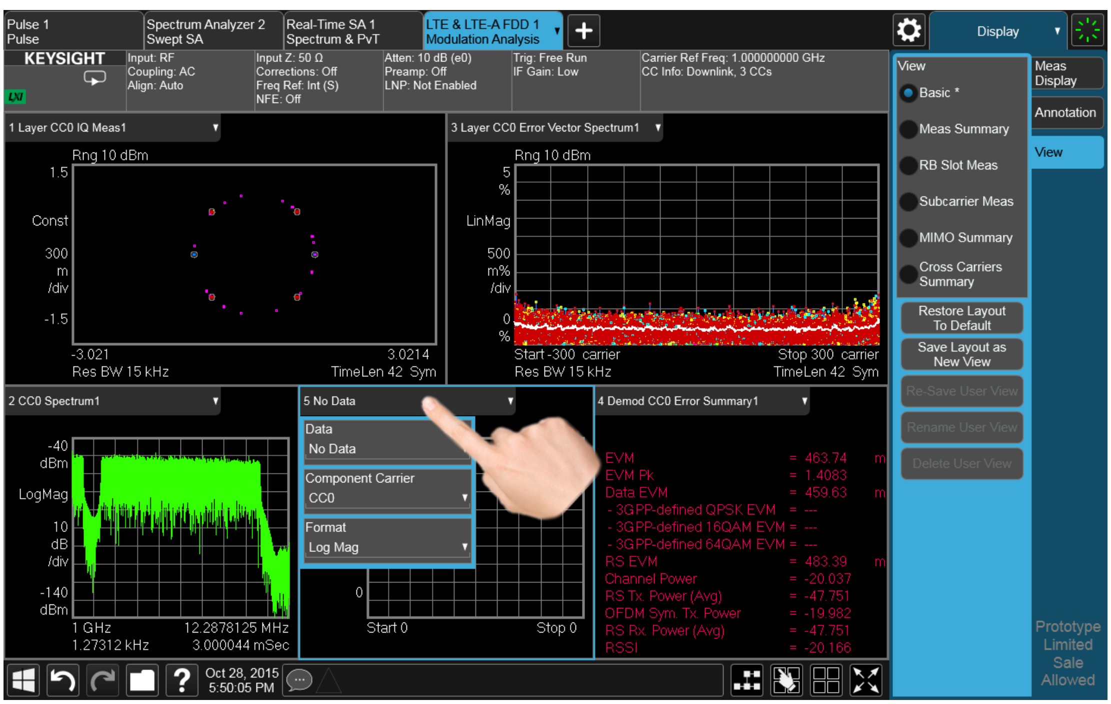
Note the * that now appears next to Basic in the View menu, indicating that you are now in the **modified** Basic View. You see the * if you add, delete or rearrange windows, but simply resizing windows does not display the *. The * means you are in a modified View, which must be saved as a User View 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.

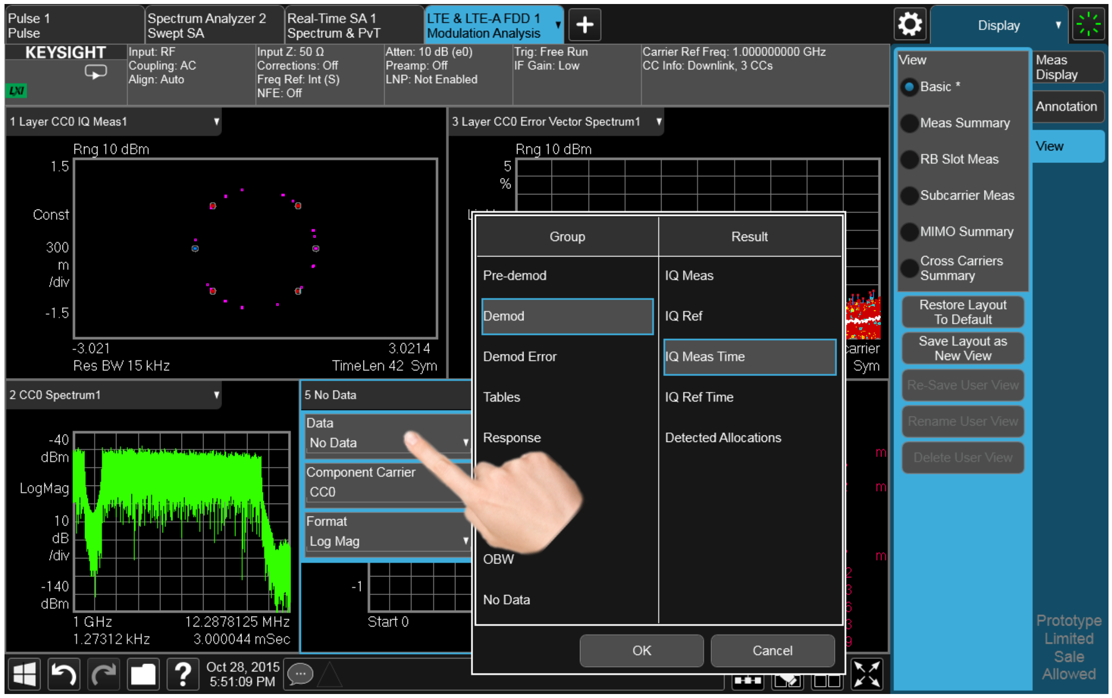
You can add more windows with the "+" arrow symbols. Note that the "+" arrow symbols only appear if the current measurement has more windows available to display. If you are already displaying all the measurement's windows, the "+" symbols disappear.

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

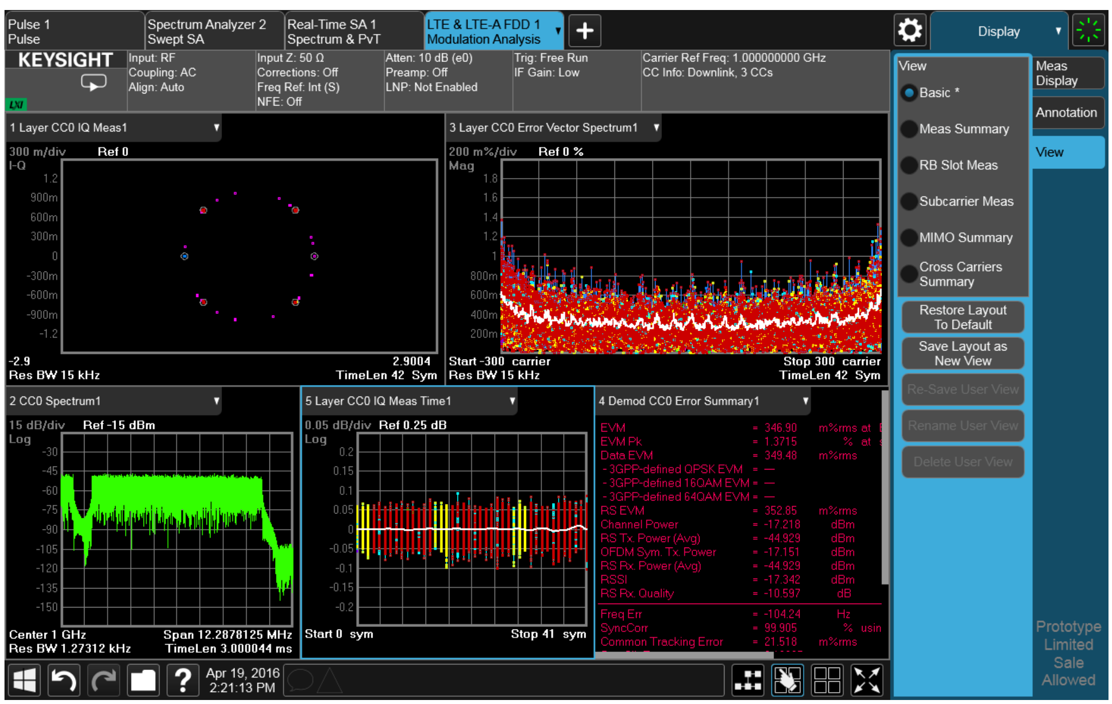
You can specify which result you want to see in the new window by tapping its title region.



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:



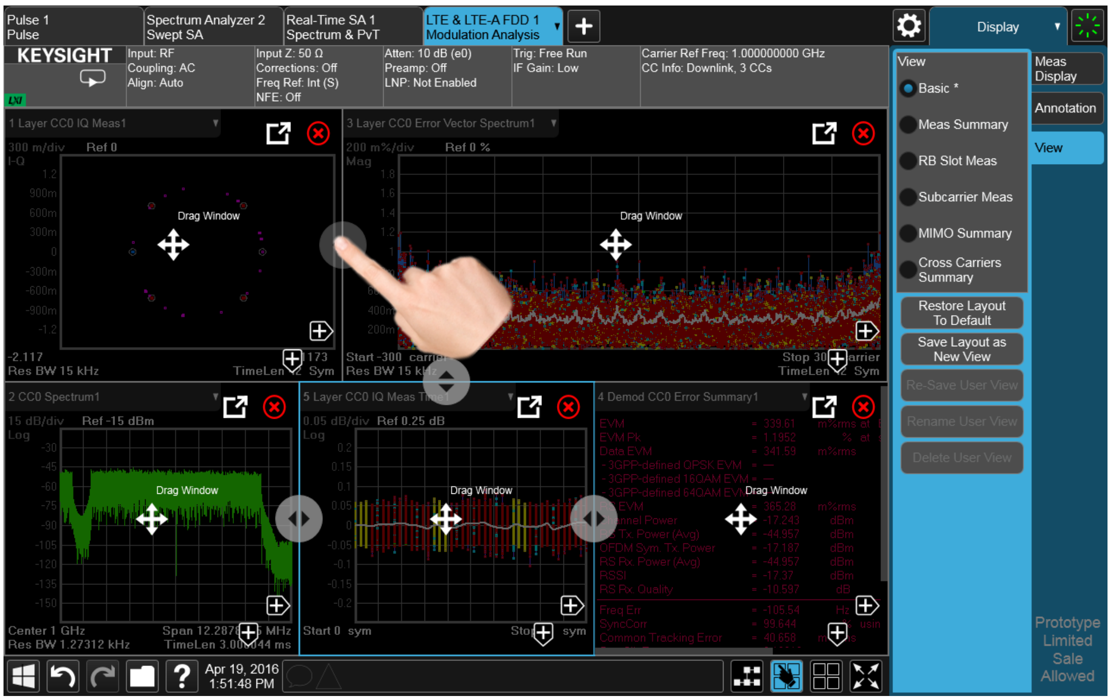
Choose the result you want and tap OK. Here we have chosen IQ Meas Time from the Demod group:



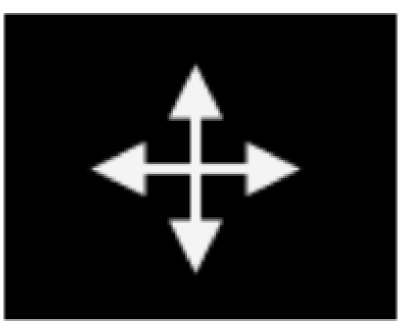
Your new, edited User View is now ready to use.

2.4.7.2 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.

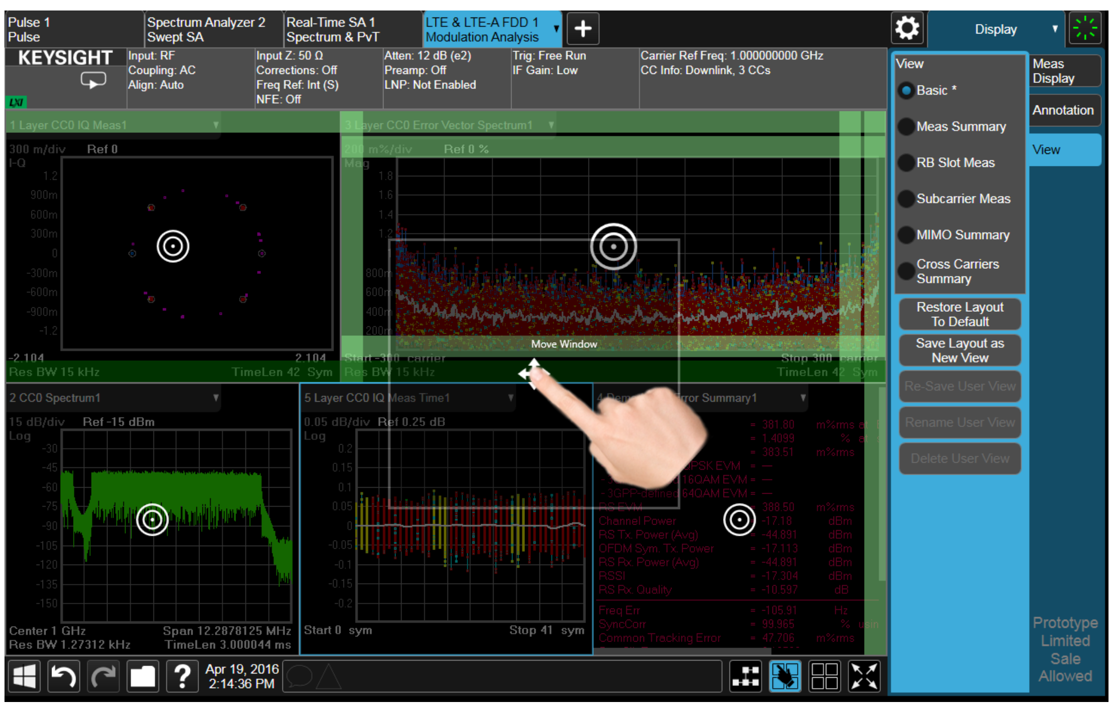


Another feature that comes with the View Editor is the ability to move windows around. You do this by dragging the four-arrow objects in the center of the window; the whole window goes along. Actually you can touch and drag anywhere in the window (except on one of the arrows or the delete circle) and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

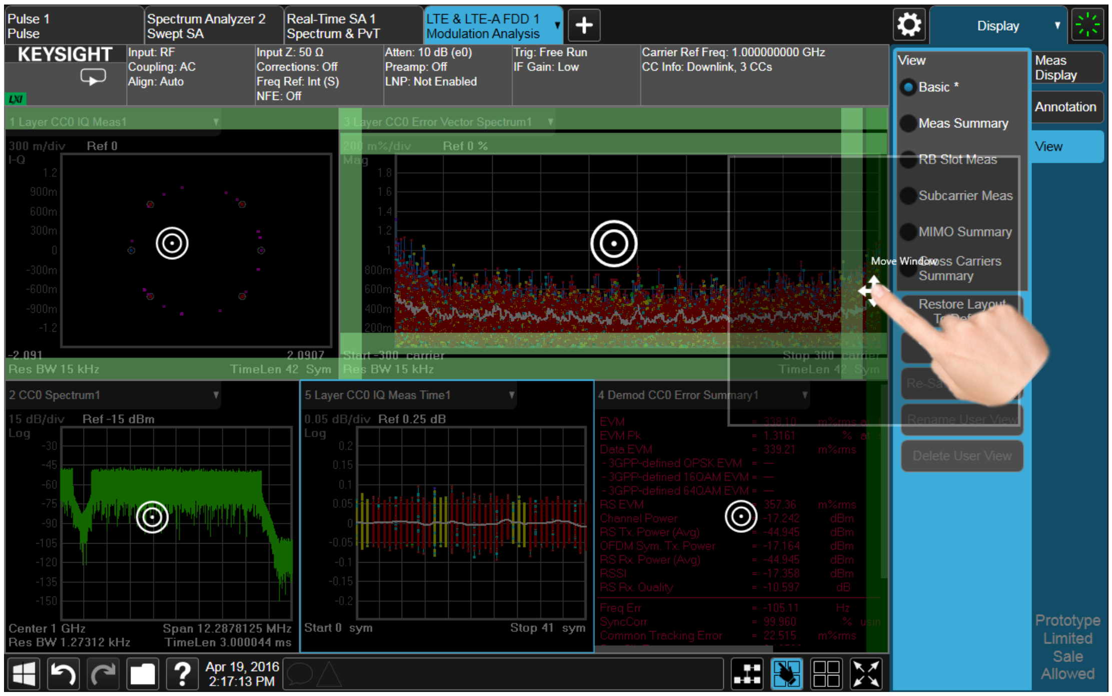


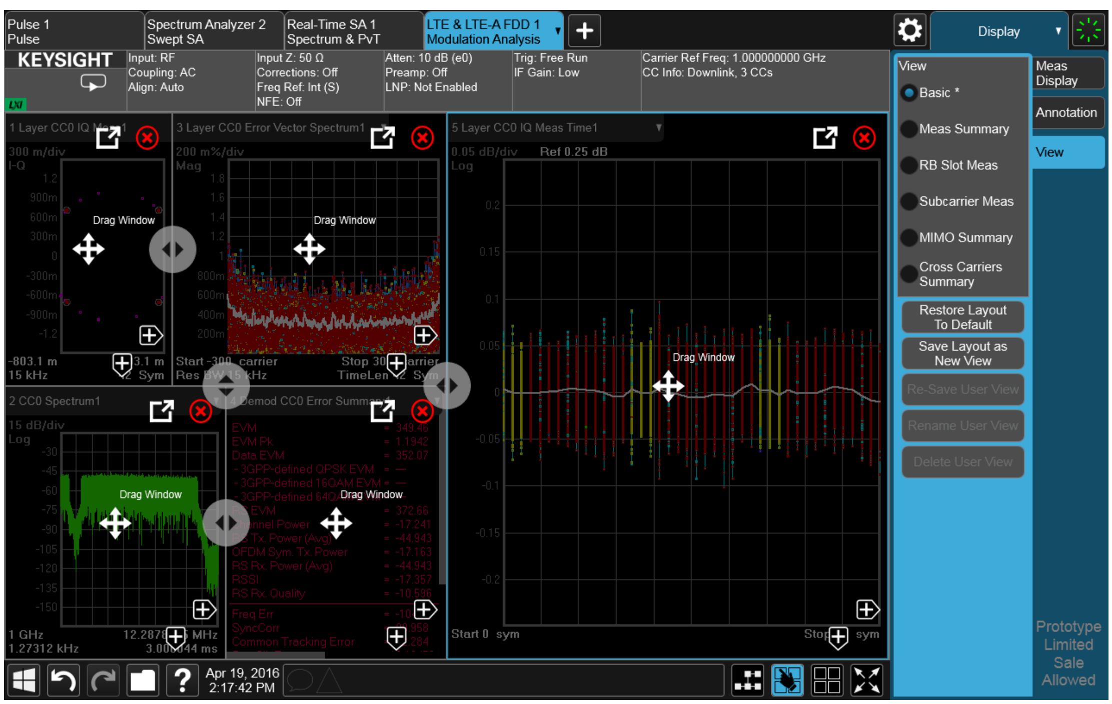
The outline of the window appears as it is being dragged. When you start to drag a window, target symbols appear in the other windows:

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.

2.4.7.3 To Undock and Redock Windows

You can undock a window from the analyzer's display frame so that it becomes a separate, floating window with its own Windows banner and title. There are two different ways to do this:

1. Drag the window to a spot on the display where its center is not on top of any targets or green stripes. When you do this the note on the window will change to "Undock Window":

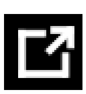
Now release the window and it will undock in place without changing size:

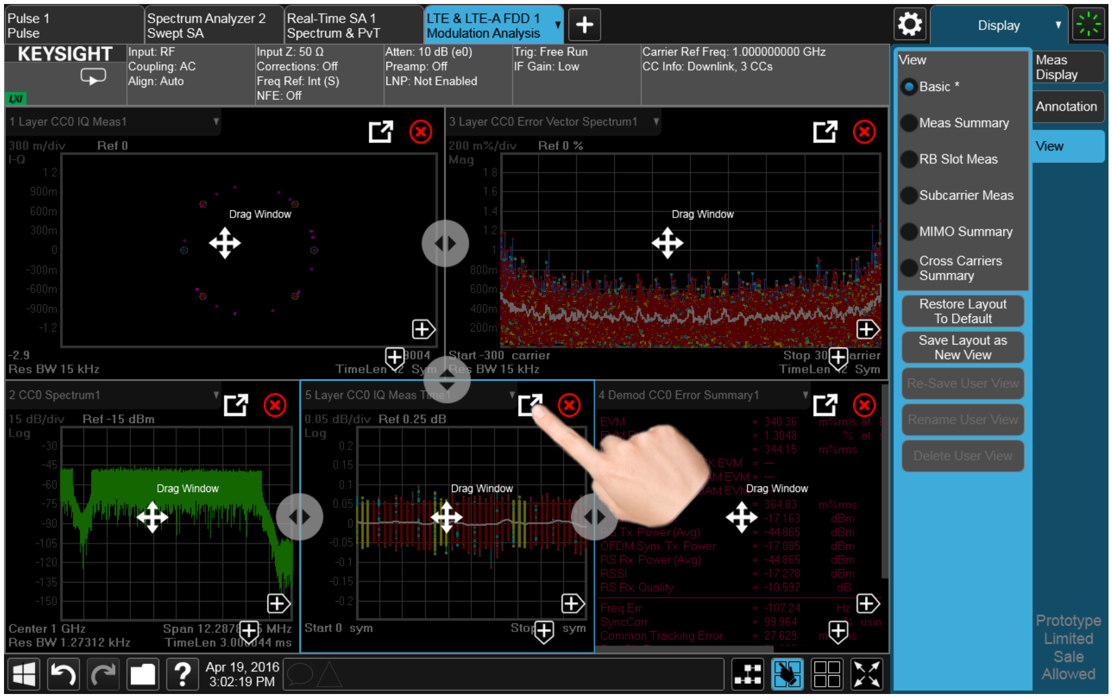
Notice that it now has a banner and a title of its own. The first line of the banner is the Mode name and the second is the Measurement name. If the window is too small, these will be shortened with an ellipsis. The window name and number themselves appear in the upper left corner of the window, as usual.

Note that we are still in Edit View mode so the main window stills display the shaded overlay and, if there is more than one window left on the main display, the “move” arrows and delete and undock controls.

There are no “add” arrows or “drag cross” or “delete X” on the undocked window, because now it is a normal Windows window; so you can minimize it, maximize it, delete it, and resize it in the normal Windows way, whether the main window is in Edit View or not. You can also drag it around or to any monitor, and it will snap to full screen when dragged to an edge like any other Windows window.

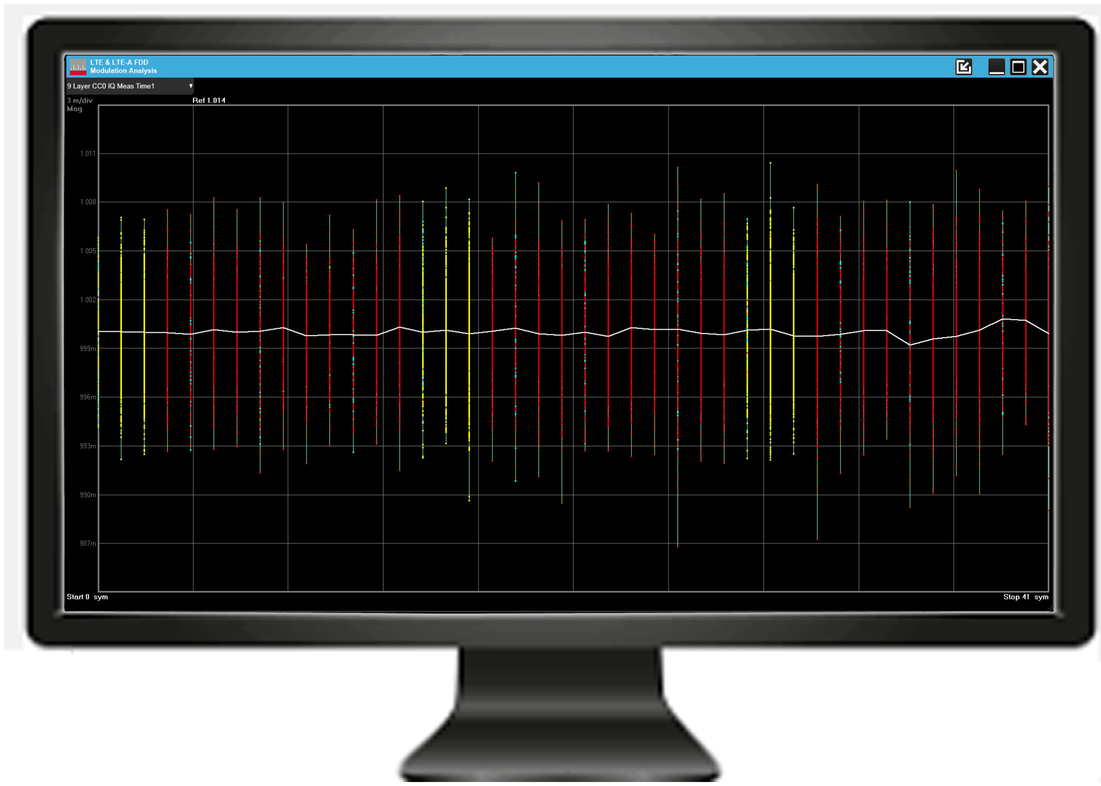
2. Tap the “undock” icon in the corner of the window:





A prompt will appear with a picture which allows you to specify which monitor to which you wish to undock the window:

Tap one of the monitors and you will see the window undock to that monitor, which may be a different monitor than the analyzer:



You can now treat this window like any other in Windows; you can resize it, drag it around and/or to a different monitor, etc.

The undocked windows represent a modified (starred) View and can be saved to a User View. They disappear if you change measurements or Views and return if you change back. If the external monitor is unplugged, the undocked windows land back on the main analyzer window and remain there, undocked, even if the monitor is plugged back in. The same is true if a User View is selected which had windows on a monitor that is not connected.

Note that even with a window undocked, there is still only one selected window in xSA, indicated by a blue window border (for a docked window) or a blue window banner (for an undocked window). Also, all popup messages still appear only on the main analyzer screen.

In multiscreen display mode, all windows for each Screen's current View (docked and undocked) are displayed. In single screen display mode, only the windows associated with the current Screen's current View (docked and undocked) are displayed.

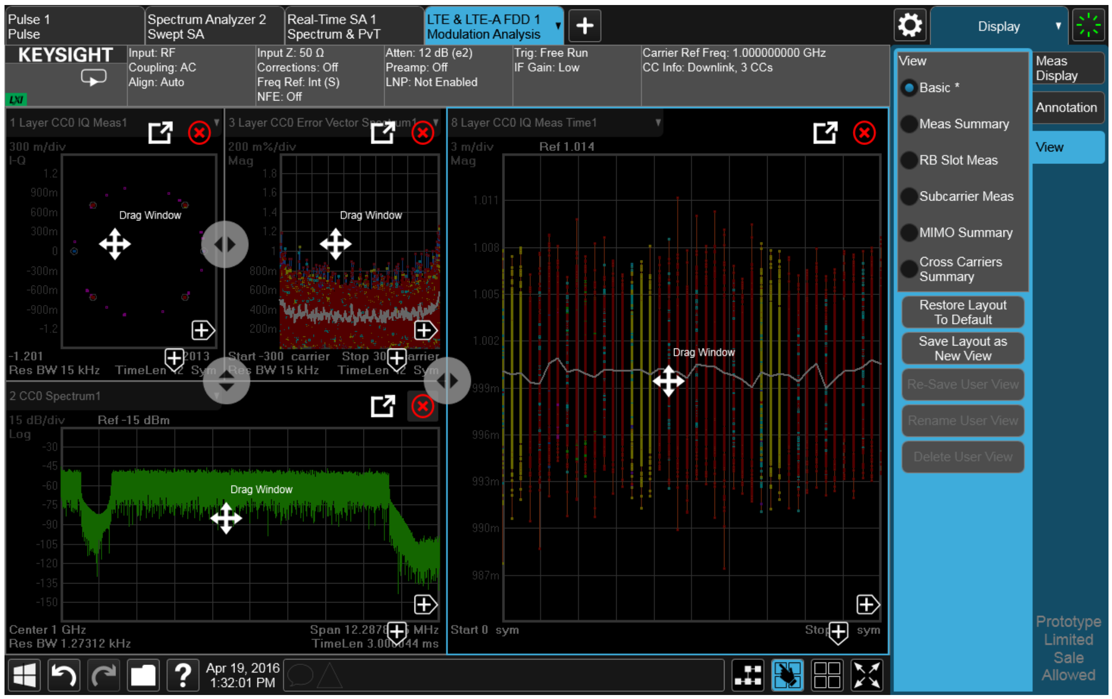
With undocked windows, when you save a Screen Image, the undocked windows are not included in the png.

To redock an undocked window to its original location, tap the "redock" icon in the window's banner:  The window will return to its original location.

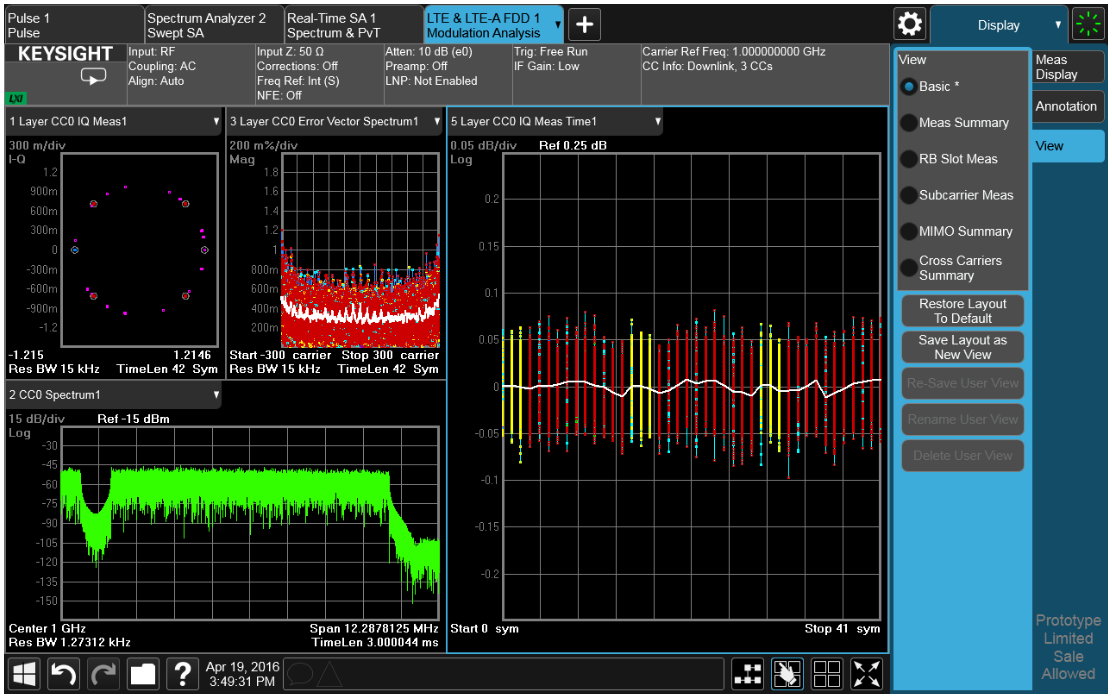
2.4.7.4 To Delete a Window from a View

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:



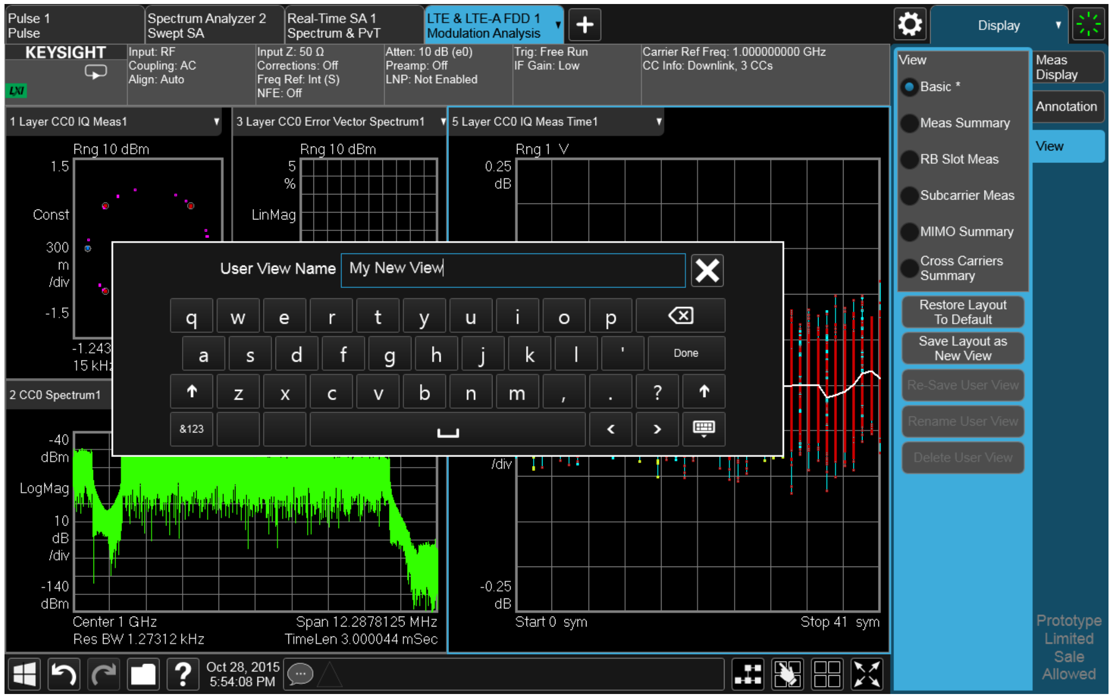
When you are finished with it, you can restore the Layout to the default for Basic by pressing “Restore Layout to Default”. Or you can save your edited View as a “User View” (if you exit the measurement without saving the edited View, the instrument will save it for you as a User View called “Autosaved”).

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.

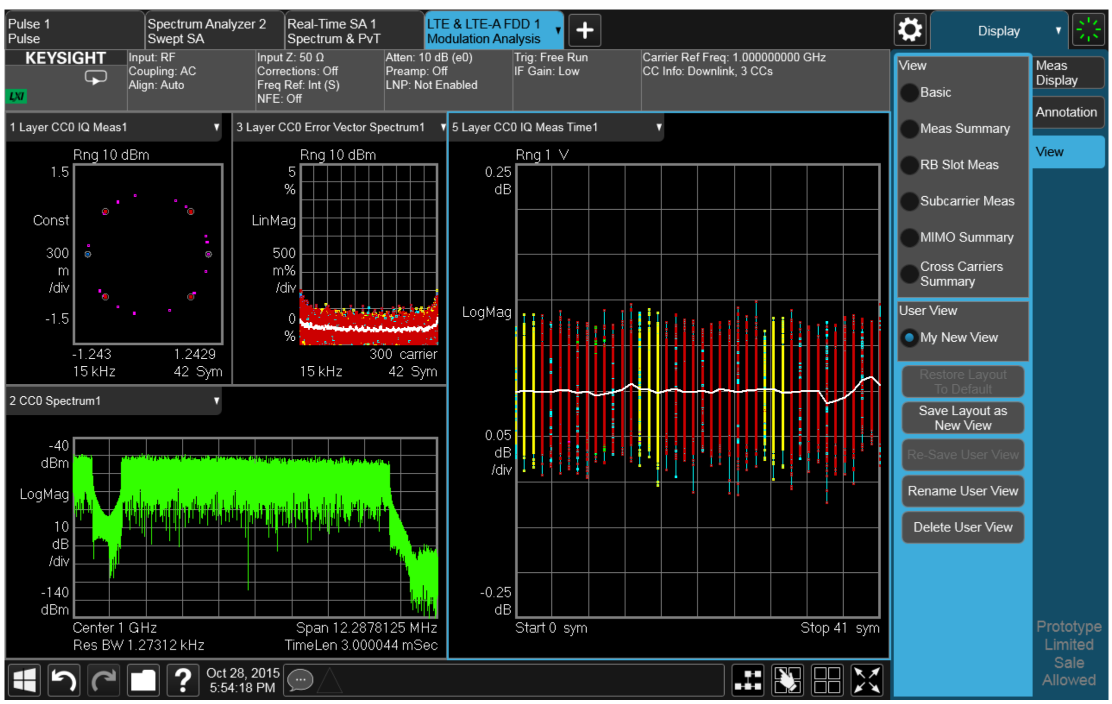
2.4.7.5 To Save a User View

See also "Transferring User Views Between Instruments" on page 107

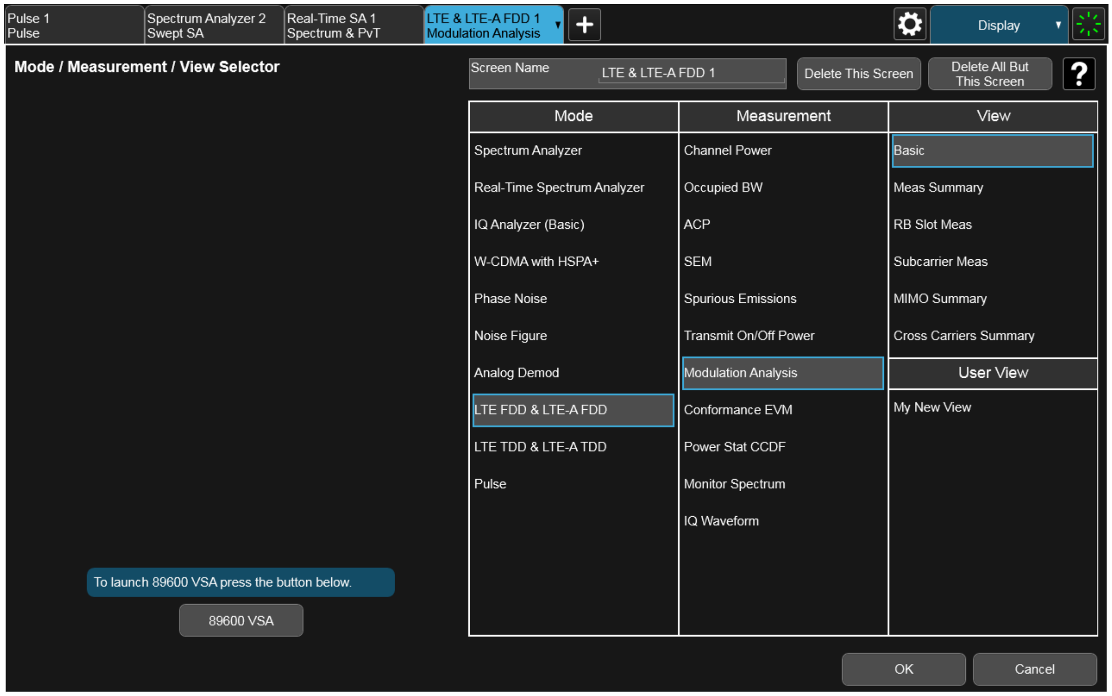
To save your new View as a User View, tap the “Save Layout as New View” control. You will get an alpha keyboard that lets you name your new View; the default is the old View name with a number. Below, we have typed in “My New View”:



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 47.

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

Measurement Name	SCPI ID
ACP, Adjacent Channel Power	`ACPower`

Measurement Name	SCPI ID
AM	AM
APD	APD
Burst Power	BPOWer
Channel Power	CHPower
Code Domain	CDPower
Combined GSM	CGSM
Combined WCDMA	CWCDma
Complex Spectrum	SPECtrum
Conformance EVM	CEVM
Digital Demod	DDEMod
Disturbance Analyzer	DANalyzer
EDR In-band Spurious Emissions	IBSPurious
EVM	EEVM
FM	FM
FM Stereo	FMStereo
Frequency Scan	FSCan
GMSK Phase & Freq Error	PFERror
Harmonics	HARMonics
IQ Waveform	WAVeform
LE In-band Emissions	IBEMissions
List Power Step	LPSTep
List Sweep	LIST
Log Plot	LPLot
Mod Accuracy	RHO
Modulation Analysis	EVM
Monitor Spectrum	MONitor
Noise Figure	NFIGure
Occupied BW	OBWidth
Output RF Spectrum	EORFspectr
Output Spectrum BW	OBWidth
PM	PM
Power Amplifier	PAMPlifier
Power Control	PCONtrol
Power Stat CCDF	PSTatistic
Power vs Time	EPVTime
Pulse	PULSe
QPSK EVM	EVMQpsk

Measurement Name	SCPI ID
SEM	SEMask
Spectral Flatness	FLATness
Spectrum & PvT	RTSA
Spot Frequency	SFRequency
Spurious Emission	SPURious
Strip Chart	SCHart
Swept SA	SANalyzer
TOI	TOI
Transmit Analysis	TX
Transmit On/Off Power	PVTime
Transmit Power	TXPower
Tx Band Spur	ETSPur

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: 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: When you delete the last User View for a measurement, the file is removed.

2.4.7.6 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.

2.4.7.7 To Delete a User View

You can delete a User View by doing the following:

1. From the "Mode/Meas/View Dialog" on page 46, *or* from the **View** menu, select the User View that you want to delete

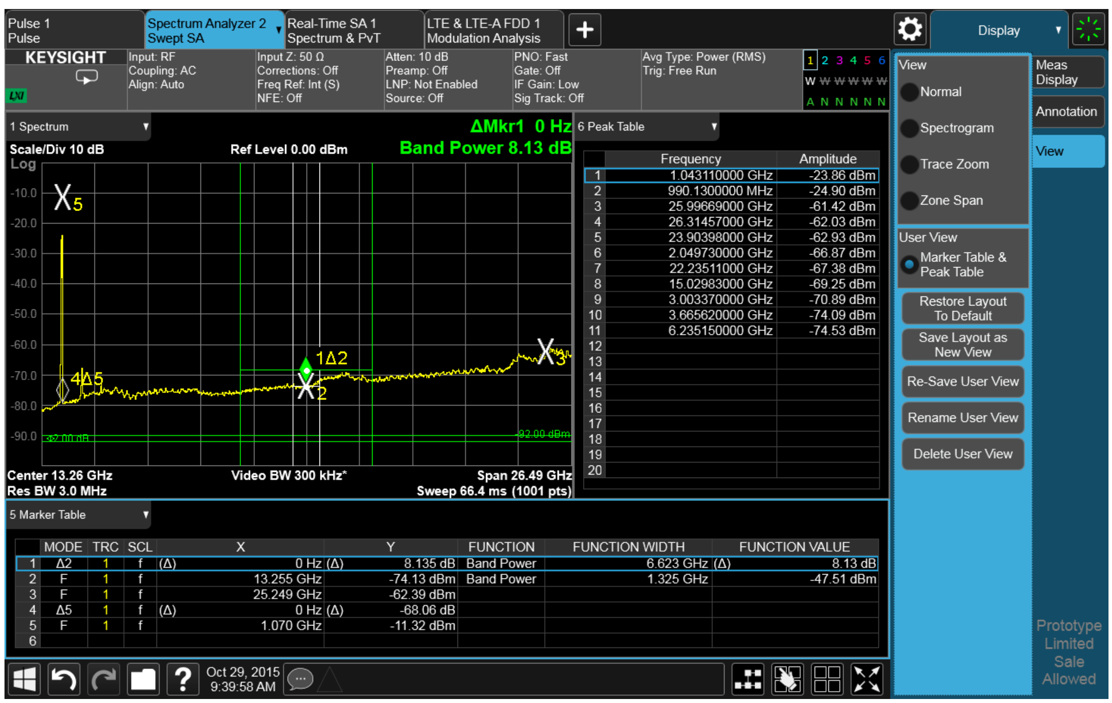
2. Switch to the **Display** menu
3. Select the **View** tab
4. Tap **Delete User View**

2.4.7.8 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.

2.4.7.9 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.

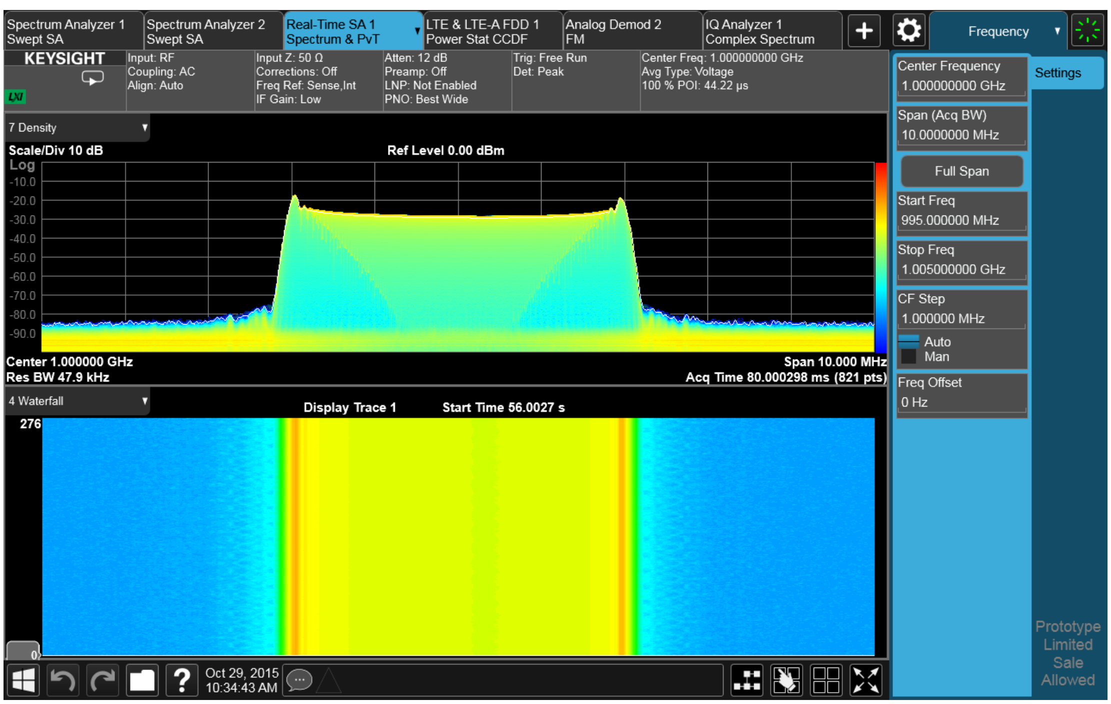
2.4.7.10 View Editor Remote Commands

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

See "View" on page 213.

2.4.8 Multiscreen

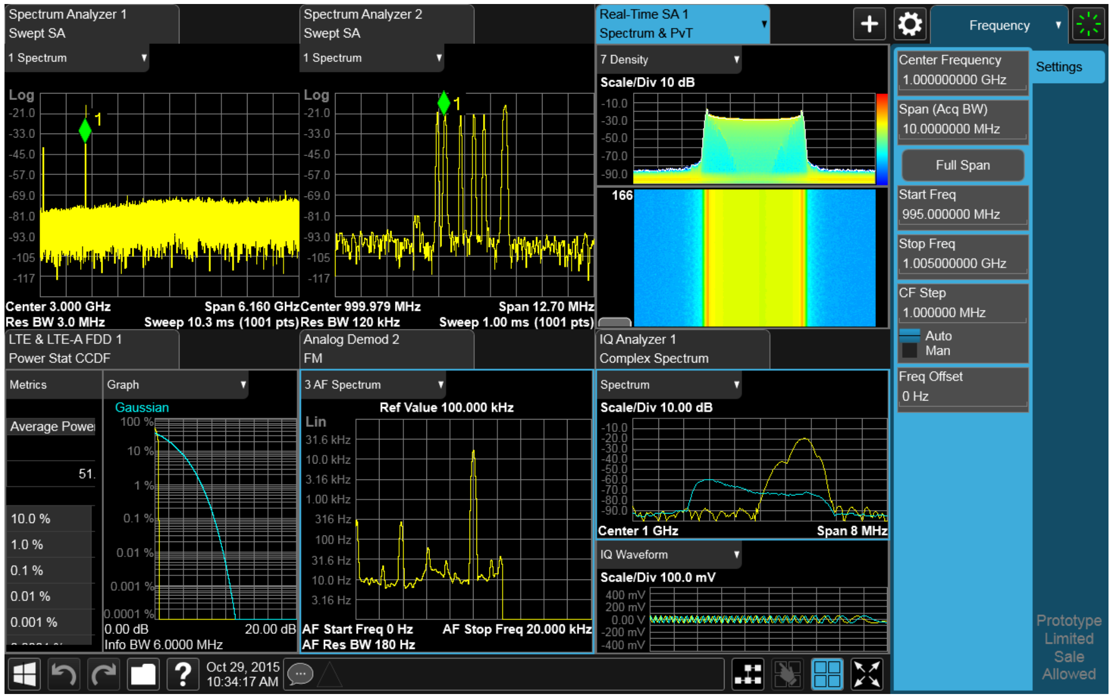
You can configure up to 16 different Screens at a time. Normally, you only see one Screen, and the set of configured screens is shown across the top of the display in a series of "Screen Tabs" on page 45. Touching any screen’s tab brings it to the foreground, makes it the current Screen and starts it 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 76 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 46 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 113
- "Screen List (Remote only command)" on page 114

2.4.8.1 Select Screen

You can select a screen by touching its tab or, in "Multiscreen" on page 111 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

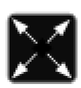
2.4.8.2 Screen List (Remote only command)

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

2.4.9 Fullscreen

The Fullscreen button is in the "Control Bar" on page 76, 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)

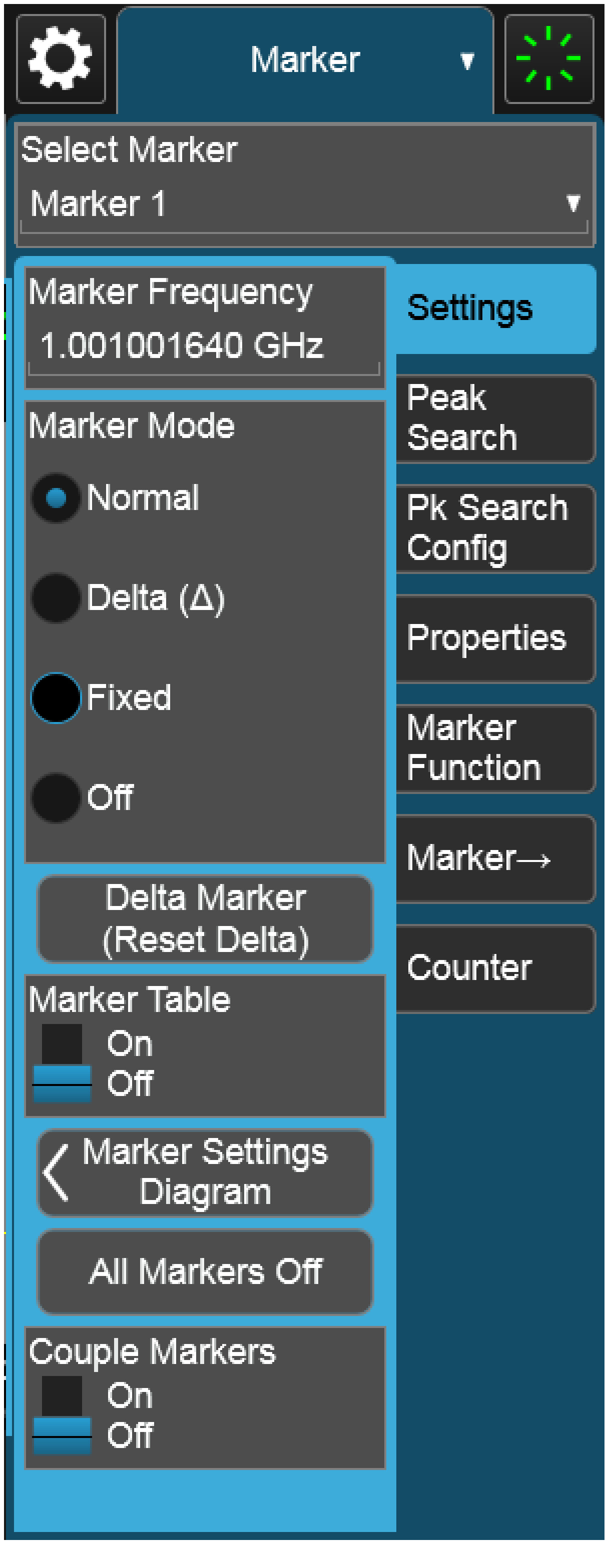
Full Screen is canceled by the **Preset** key.

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

2.5 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.

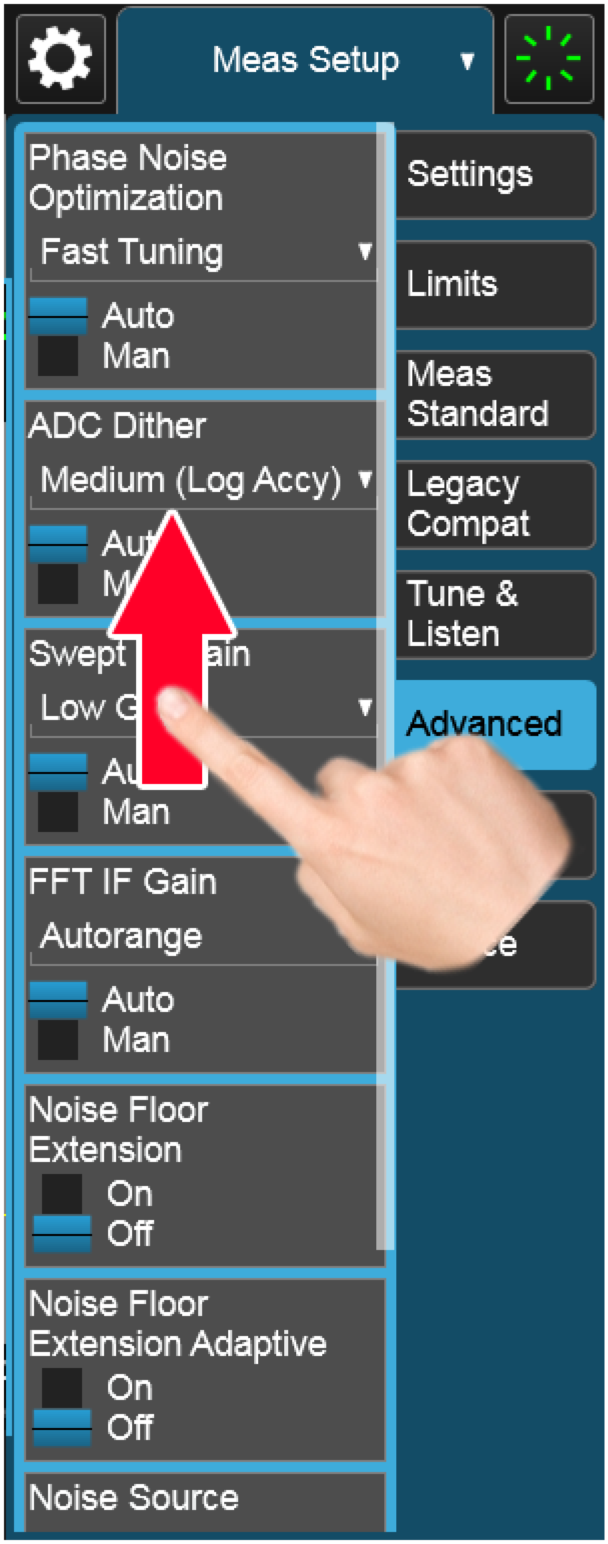


The menu panel normally appears on the right side of the display and consists of a rectangular panel with multiple "sub-panels" lying on top of each other, each sub-panel being accessed by a tab on the right.

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.

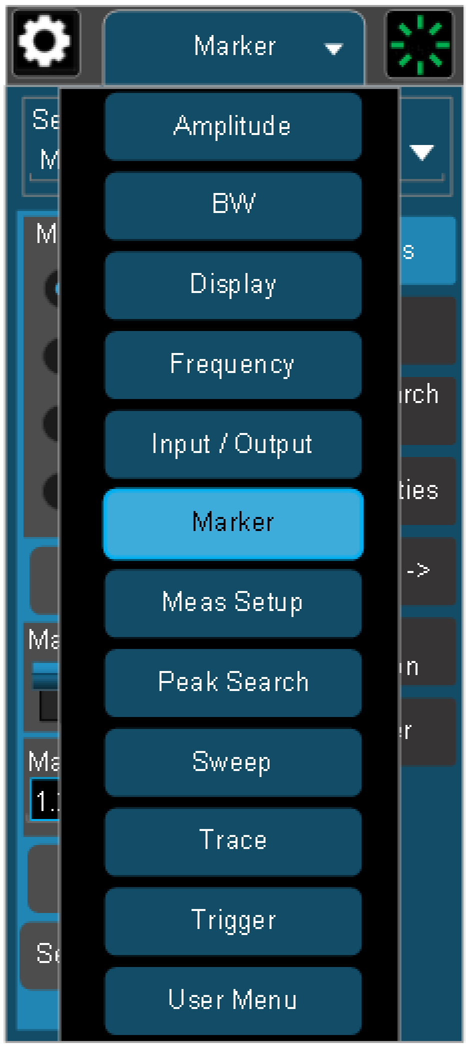
If the number of controls on a panel exceeds the height of the panel, scrolling is enabled, which is indicated by a white bar on the left that fades away after a few seconds. You swipe up or down with your finger to scroll the panel, or you can grab the white bar with a mouse.



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

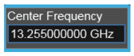
You can access the menu panels without using the front panel keys, as you would need to do if you were operating the instrument using Remote Desktop. Touch or click on the menu title, as shown below. A dropdown containing the twelve measurement hardkeys appears. Selecting a hardkey from the dropdown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

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.

2.6 Cancel key

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.

2.7 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

2.8 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.

2.9 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

2.10 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 126.

3 Real Time Spectrum Analyzer Mode (RTSA)

Real Time Spectrum Analyzer (RTSA) mode provides real-time signal analysis, with very high probability-of-intercept for intermittent signals with appropriate triggers.

Many features of RTSA are drawn directly from the Swept SA measurement in the Spectrum Analyzer Mode. Where possible the functionality and user interfaces (front panel and remote) have been kept the same as Spectrum Analyzer Mode so that the user familiar with Spectrum Analyzer Mode can make Real Time SA measurements using the same techniques.

Real Time Spectrum Analyzer (RTSA) mode has one measurement: Spectrum & PvT (Power vs. Time).

The `:INST:SEL` command is used to select the Mode.

Example	`:INST:SEL RTSA` `:INST:NSEL 2`
Dependencies	The mode must be installed and licensed in your instrument before it is available for use
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

Defining Real-Time Analysis

In a typical signal analyzer measurement, signals are not captured continuously but instead are captured for periods which are interrupted for signal processing and measurement hardware management. In a real-time analyzer, however, signals are captured continuously, with no gaps, in order to provide 100 percent probability-of-intercept (POI). This gap-free capture applies not only to spectrum analysis but also to trigger operation.

In addition to gap-free analysis, desirable features of an effective real-time RF analyzer include:

- wide measurement bandwidth
- high update-rate measurement capability
- FFT processing overlap
- advanced triggering capabilities (for example, frequency domain triggering)
- advanced multi-domain composite displays

All of these capabilities are present in the RTSA option. Its advanced displays can show you hard-to-see events and its conditional triggering capabilities can watch for transient or intermittent events in either time or frequency domains and initiate signal capture, measurement and display.

3.1 Spectrum & PvT Measurement

The Spectrum & PvT measurement lets you perform "traditional" Spectrum Analysis (Amplitude vs Frequency) measurements, as well as "Time Domain" (PvT) analysis, using Real-Time (gap-free) measurement methodologies.

The Spectrum views for this measurement ("Normal" on page 134, "Density" on page 134, "Spectrogram" on page 136, "Density Spectrogram" on page 137, "Trace Zoom" on page 137, "Zone Span " on page 138 and "Powergram Spectrogram" on page 140) provide real-time frequency-domain results to analyze the signal content of a range of frequencies. The x-axis of the display is frequency, the y-axis is amplitude.

There are cases when it is useful to analyze the data in the time domain. The PvT views for this measurement ("PvT" on page 138, "PvT Spectrum" on page 139, "PvT Spectrogram" on page 139, "Powergram" on page 140 and "Powergram Spectrogram" on page 140) take time data from the detector and present it 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. (The PvT Spectrum, PvT Spectrogram and Powergram Spectrogram views combine spectrum windows with the time domain view.)

Spectrum & PvT Measurement Commands

The table below lists the measurement commands and their responses for the Spectrum & PvT measurement (note that the marker values are x, y pairs). Note that the following commands/queries are *not* part of RTSA: `:MEASure`, `:READ?`, `:FETCh?`

Command	Return Value
`:INITiate:RTSA`	None
`:CONFigure?`	`RTSA`
`:CONFigure:RTSA`	None (selects `SAN` measurement with Meas Setup settings in preset state – same as Meas Preset)

You can also query the results from the Density window using `:CALCulate:DATA:RTDensity?`. See "Fetch Density Results" on page 144.

3.2 Views

The Spectrum & PvT measurement has eleven views.

Some of 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.

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 | DENSity | DSGRam | PVTime | PSPectrum | PSGRam | POWergram | POSPectro`

Example	Set Normal view:
	`:DISP:VIEW NORM`
	Set Powergram Spectrogram view:
	`:DISP:VIEW POSP`

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 -221, "Option not available" is generated
Preset	`NORMal`
State Saved	Saved in instrument state

3.2.1 Normal

Windows: "Spectrum" on page 143

Single window view of the frequency domain. This is the classic SA view. This is also the View into which the analyzer 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`

3.2.2 Density

Windows: "Density" on page 144

The Density view uses a bitmap to represents the signal density at each frequency and amplitude point determined by the current analyzer settings. The density is defined as the number of times a frequency and amplitude point is hit during a capture interval, which is therefore the time a signal spends at each frequency and amplitude point in a given time period.

In this view, the X axis represents frequency, the Y axis represents amplitude, and the Z axis represents number of hits. This view therefore displays three dimensional data on a two dimensional display, using color to represent the third dimension.

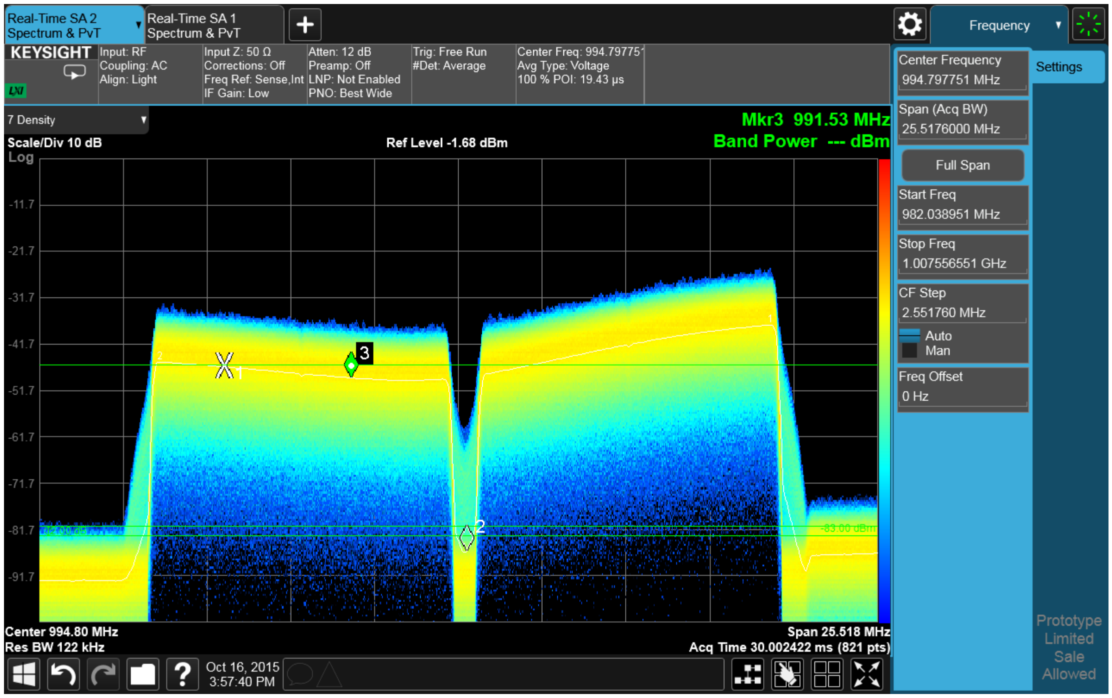
The view will also display a white trace over the bitmap. This trace shows the real time spectrum for the latest capture interval. The white trace is Trace 1 with detectors Peak, Negative Peak, and Average derived from the density values and Sample being the last FFT that was used by the density bitmap.

The format of the data will be a series of frequency/amplitude points with the value at each point representing the density percentage, in the range 0-1. Therefore a frequency/amplitude point that is hit 50% of the time during an acquisition will be represented by 0.5. The location of the frequency/amplitude point within the bitmap will correspond to the row/column point in the .csv file.

The format of the data will be a series of frequency/amplitude points with the value at each point representing the density percentage, in the range 0-1. Therefore a frequency/amplitude point that is hit 50% of the time during an acquisition will be represented by 0.5. The location of the frequency/amplitude point within the bitmap will correspond to the row/column point in the .csv file.

The key to these colors is displayed as a color bar on the right hand side of the graphical display, as opposed to the left hand side of the display where Spectrogram shows the color bar. This is to avoid confusion that the color bar represents amplitude, as it does in the other views.

In Density view, high density is represented by the color at the top of the color bar and low density by the color at the bottom of the color bar.



Example	`:DISP:VIEW DENS`
Dependencies	Marker2: Marker functionality will be limited to the white trace (Trace 1) only Trigger Delay: Only positive trigger delay is supported.

3.2.3 Spectrogram

Windows: "Spectrum" on page 143, "Waterfall" on page 145

The Spectrogram View allows a quick look at a history of 10000 traces. In the Spectrogram View, the display opens up a second window (the “waterfall window”), in which trace history is displayed, below the main Spectrum 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 comes back 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 analyzer.

See the Waterfall window description for detailed information about the Spectrogram View.

Example	`:DISP:VIEW SPEC`

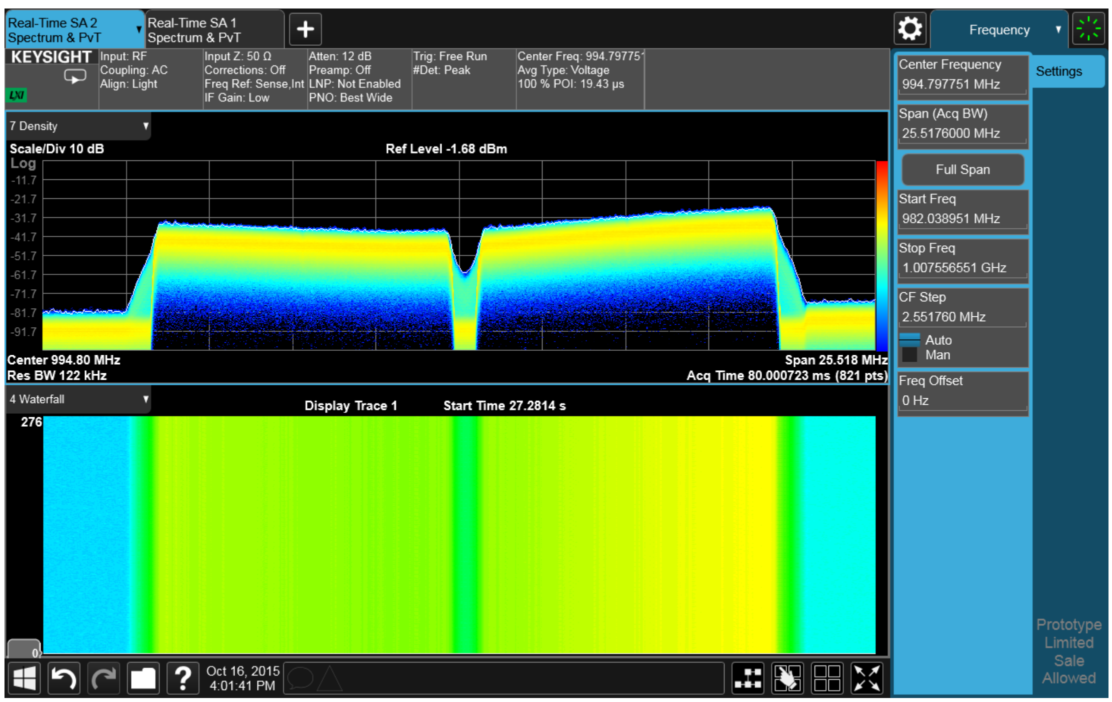
3.2.4 Density Spectrogram

Windows: "Density" on page 144, "Waterfall" on page 145

The Density Spectrogram provides a dual view with the top window showing the Density trace and the bottom window showing the Spectrogram trace.

In this view, the top window X axis represents frequency, the Y axis represents amplitude, and the Z axis represents number of hits. This view therefore displays three dimensional data on a two dimensional display, using color to represent the third dimension. The X axis for the bottom window represents frequency and the Y represents the Spectrogram trace history and the Z axis colors represent the signal amplitude.

As with the Density view, the top window will display a white trace over the bitmap. This trace shows the Spectrogram trace specified by the Display Trace parameter. The default will show the most current Spectrogram trace.



Example	`:DISP:VIEW DSGR`

3.2.5 Trace Zoom

Windows: "Spectrum" on page 143, "Marker Table" on page 151

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 (“Zoom Window”) shows a “zoomed” representation of the traces in the top window.

See the Zoomed Trace window description for more on Trace Zoom.

Example	`:DISP:VIEW TZO`

3.2.6 Zone Span

Windows: "Spectrum" on page 143, "Zone Spectrum" on page 153

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.

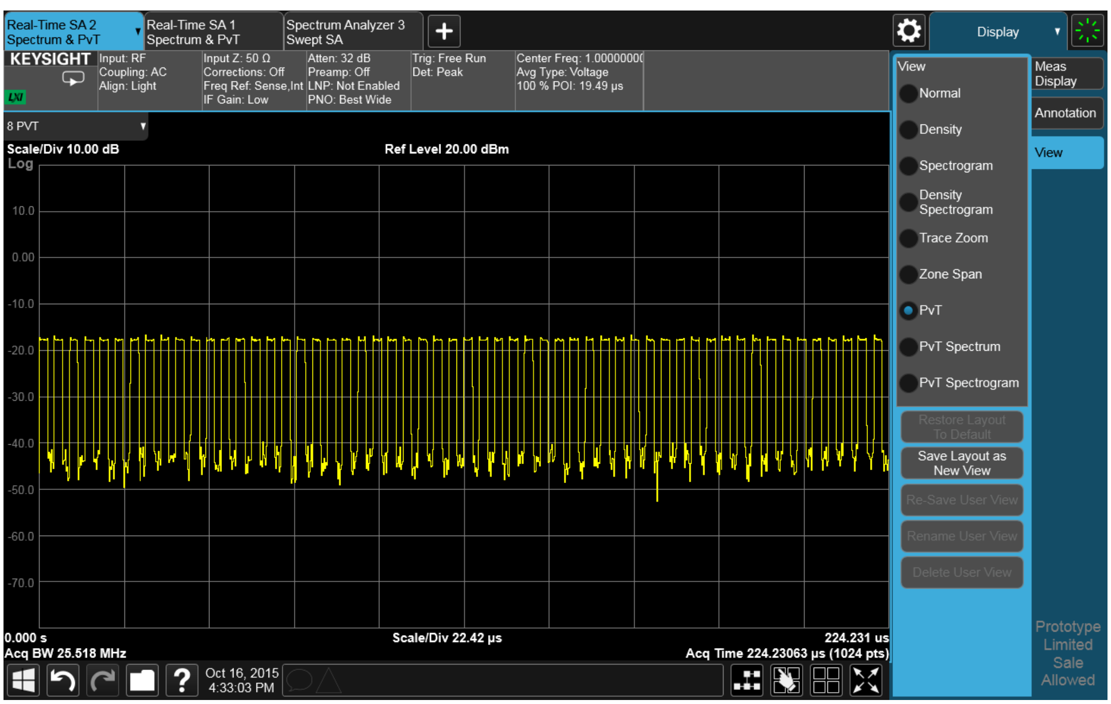
See the "Zone Spectrum" on page 153 window description for more on Trace Zoom.

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

3.2.7 PvT

Windows: "Spectrum" on page 143

The PvT view shows the RF envelope power over a user defined time period. The horizontal axis represents time and the vertical axis represents amplitude.



Example `:DISP:VIEW PVT`

3.2.8 PvT Spectrum

Windows: "PvT" on page 154, "Spectrum" on page 143

The PvT Spectrum provides a dual view with the top window showing the Power vs Time trace and the bottom window showing the Spectrum trace.

The horizontal axis for the top window represents time and for the bottom window represents frequency. In both the top and bottom windows, the vertical axis represents amplitude.

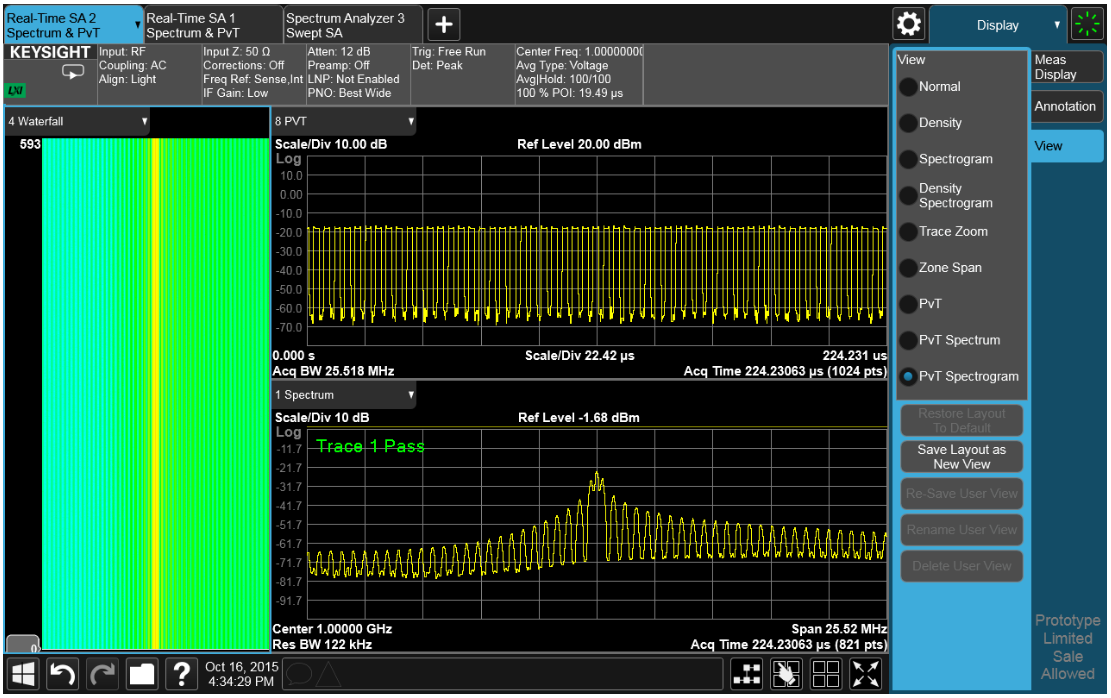
Example `:DISP:VIEW PSPectrum`

3.2.9 PvT Spectrogram

Windows: "PvT" on page 154, "Spectrum" on page 143, "Waterfall" on page 145

The PvT Spectrogram provides a tri view with the top window showing the PvT trace, the bottom window showing the Spectrum trace, and the left window showing the Spectrogram.

The horizontal axis for the top window represents time and for the bottom window represents frequency. In both the top and bottom windows, the vertical axis represents amplitude.



Example	`:DISP:VIEW PSGRam`

3.2.10 Powergram

Windows: "PvT" on page 154, "Waterfall PvT" on page 155

The Powergram provides a dual window view with the top window showing the PvT trace and the bottom window showing the Waterfall PvT trace data.

Example	`:DISP:VIEW POWergram`

3.2.11 Powergram Spectrogram

Windows: "PvT" on page 154, "Spectrum" on page 143, "Waterfall" on page 145, "Waterfall PvT" on page 155

The Powergram Spectrogram View provides a quad view with the Spectrum and Waterfall windows representing the frequency domain and the PvT and Waterfall PvT windows showing the time domain.

The Waterfall Window allows you to view a history of spectrum traces, with a subset displayed at any one time. In the Waterfall Window, each horizontal line in the waterfall display represents one historical Spectrum trace, which is the summary of an accumulation over an acquisition time interval. The Waterfall PvT window is similar to the Waterfall Window but shows the Power vs Time traces acquired over time.

The data streams upwards from newest to oldest; the latest trace displays on the bottom and the oldest trace on the top. The Display Trace controls in each Waterfall Window work independently and will correlate with the active window on which waterfall the display trace is being controlled.

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

Example	`:DISP:VIEW POSP`

3.3 Windows

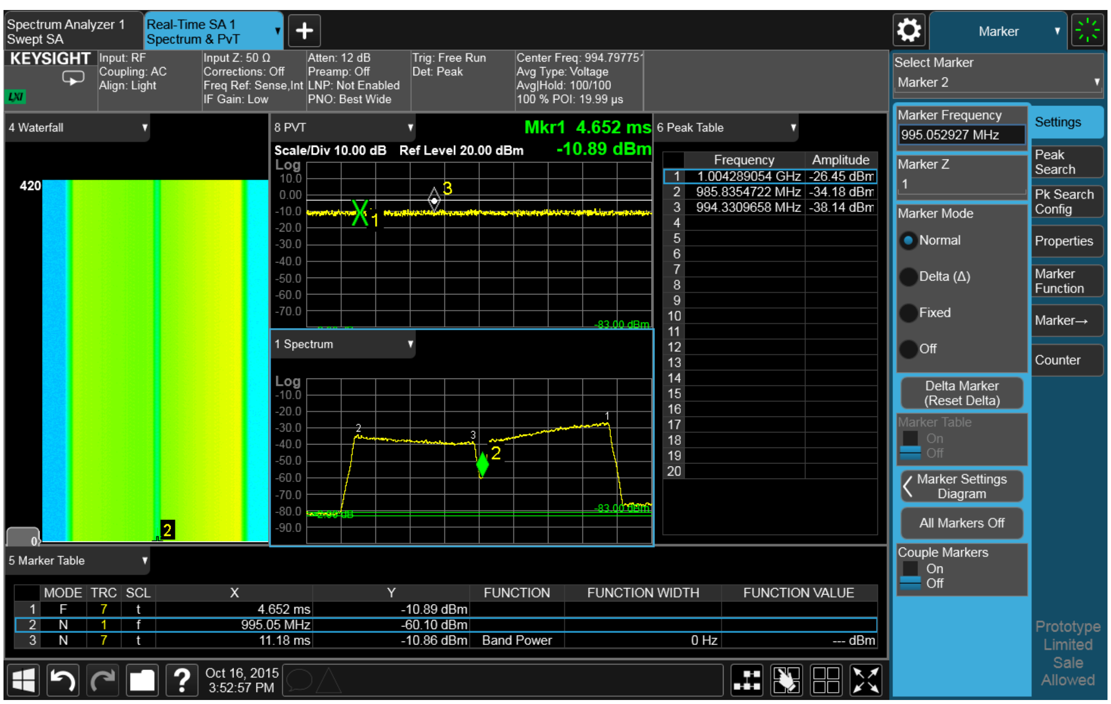
This section describes the windows that are available in the Spectrum & PvT (RTSA) measurement:

With the addition of User Views to the X-Series, RTSA can now display most of its available windows at the same time. Most of the available windows depend on the data in the Spectrum or Density window, and 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 or the Density window.
- The Zone Spectrum window depends on an orange bar in 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 (eg, Marker Table) rather than REPLACE the Spectrum or Density window with a new result.

Before the introduction of User Views the display was limited to the predefined Views (Normal, Density, Spectrogram, Density Spectrogram, Trace Zoom, Zone Span, PvT, PvT Spectrum and PvT Spectrogram). Now a display like the one below is possible:



The window numbers for RTSA are as shown in the figure above and the table below:

1	Spectrum

2	Zone Spectrum
3	Zoomed Trace
4	Waterfall
5	Marker Table
6	Peak Table
7	Density
8	PVT
9	Waterfall PVT

At present, the Zone Spectrum cannot be added using the Result dropdown. To get the Zone Spectrum window you need to select the Zone Span View.

For more on using the Window Title dropdown to change the window result or the Edit View screen to add and rearrange windows, see the information in the User Views section.

When using Remote Commands, you send the DISPlay:WINDow command to select a specific window, followed by the window number (for example, to select the Zoomed Trace window, the user sends DISP:WIND 2). You need to select a specific window in the following cases:

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

– Selecting the Zone Spectrum window activates that window and allows you to set the Y-Axis values of that window

– Selecting the Spectrum window activates that window (required if the Zone Spectrum window was active) and allows you to set the Y-Axis values of that window

3.3.1 Spectrum

The Spectrum window is the fundamental window used in spectrum analyzer measurements. It displays Amplitude versus frequency information. Unless otherwise noted, behaviors described in the measurement descriptions are assumed to be behaviors of the Spectrum window.

The Spectrum window appears in several Views, as follows:

View	Size	Position
Normal	Full	--
Spectrogram	Half height, full width	Top
Trace Zoom	Half height, full width	Top
Zone Span	Half height, full width	Top
PvT Spectrum	Half height, full width	Bottom

PvT Spectrogram	Half height, 2/3 width	Bottom Right
Powergram Spectrogram	Half height, half width	Top Left

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

3.3.2 Density

The Density window displays the instantaneous spectrum as a white trace and a probability density function in color. The key to the probability display is a color bar on the right side of the window. The color at the top of the color bar represents the lowest probability and the color at the bottom represent the highest probability.

When the Waterfall window is also displayed, as in the Density Spectrogram View, a color bar also appears on the left, which ties the colors in the waterfall window to the amplitude values in the Density window.

Fetch Density Results

You can query the Density window and return the data directly as a data block.

The returned data is a single array with values representing the fractional density at each pixel. The array is an implicit two-dimensional array, with lowest numbered scan lines stored first. Thus a general formula to retrieve the density for a specific x,y location is:

Density(x,y) = x + (SweepPoints * y)

where both x and y are zero-based indexes.

Remote Command	`:CALCulate:DATA:RTDensity?`

Example	:CALCulate:DATA:RTDensity? reads the results from the current Density display via a SCPI block data transfer This query honors the current byte order and data format settings

Views in which the Density window appears:

View	Size	Position
Density	Full height, full width	-
Density Spectrogram	Half height, full width	Top

3.3.3 Waterfall

The Waterfall window is an important component of the Spectrogram View. The Waterfall window shows a history of the last 10,000 traces, and the Spectrum window shows the trace indicated by the **Display Trace** function in the Display menu.

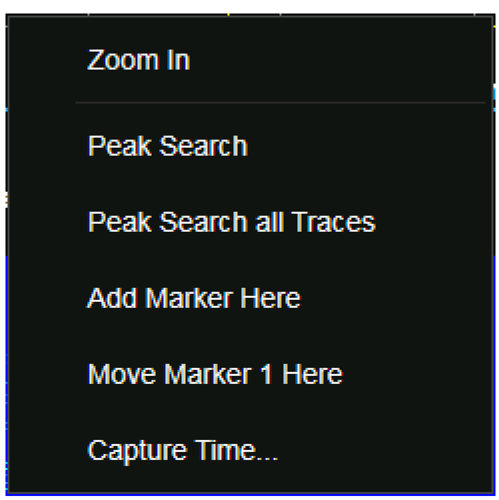
Views in which the Waterfall window appears:

View	Size	Position
Spectrogram	Half height, full width	Bottom
Density Spectrogram	Half height, full width	Bottom
PvT Spectrogram	Full height, 1/3 width	Left
Powergram Spectrogram	Full height, 1/3 width	Bottom Left

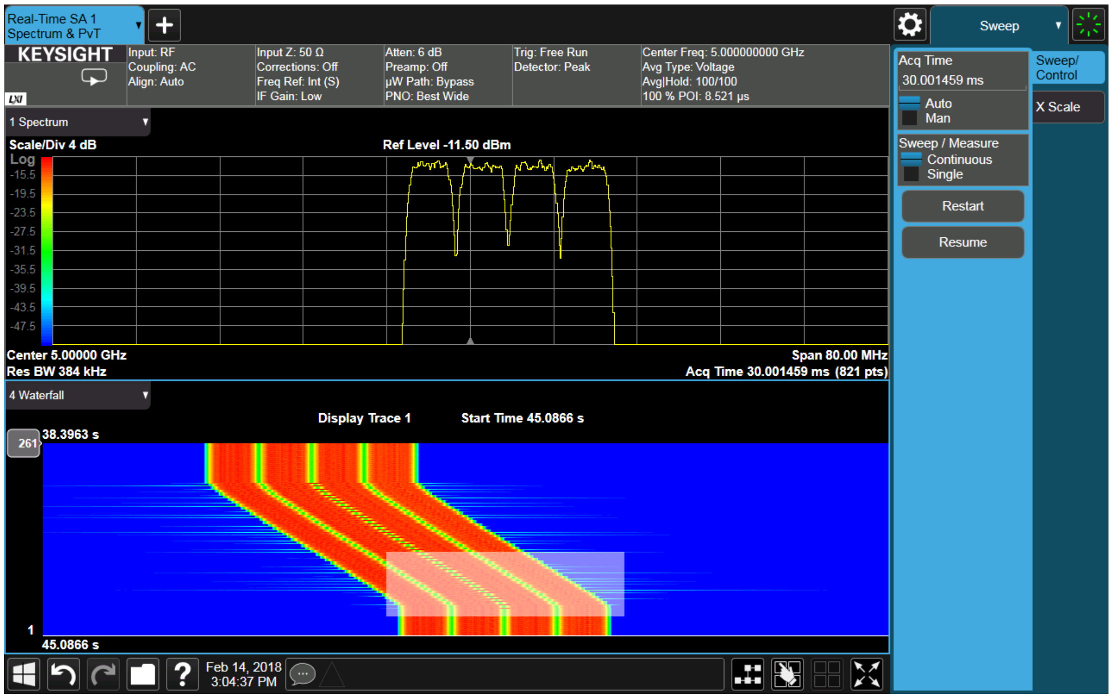
Waterfall Display Zoom

A Powergram or Spectrogram window can be zoomed in on the current data.

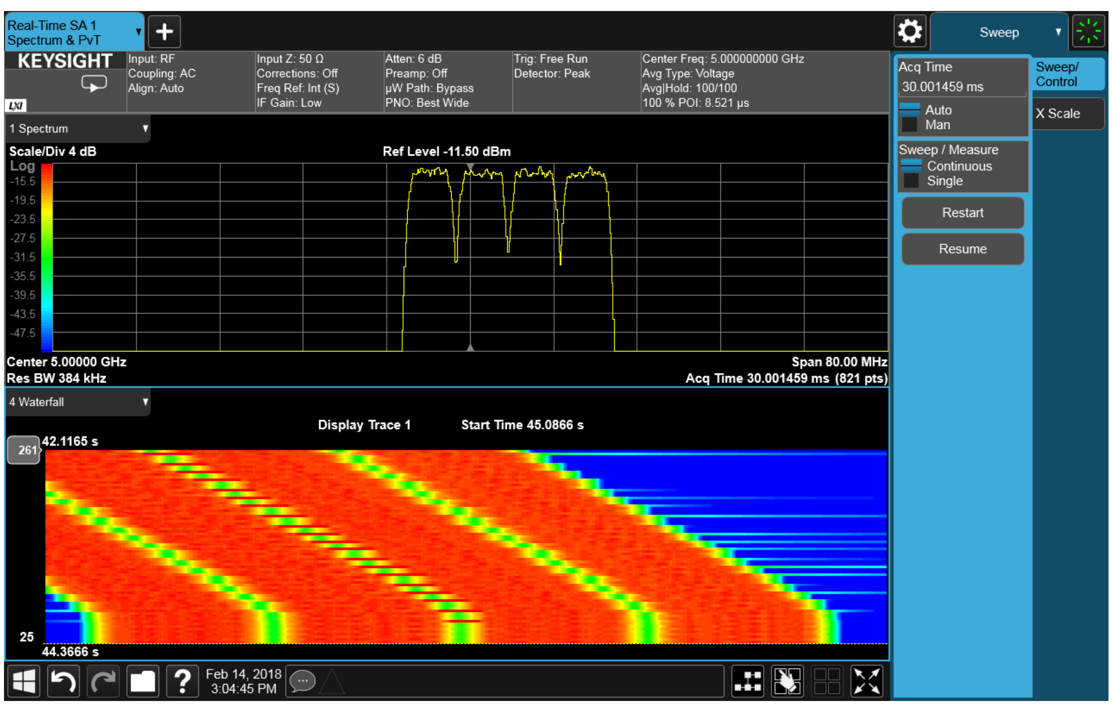
When the measurement is not running (either paused or in Single mode after all traces have been collected), right clicking on the waterfall result will display the “Zoom In” menu item.



Tapping “Zoom In” will activate zoom mode, where clicking on the waterfall window and dragging will display a gray rectangle overlay that will be the zoomed-in area when the mouse is released.



Releasing will change the waterfall X- and Y-axis to fit the selected area.



This action will not resample or recapture data; it will use existing data. To return to the default zoom state, right click the Waterfall again and select the “Zoom Out” menu item.

Restarting or resuming the measurement will use the current zoom state. When the measurement is running, the right click menu will not display the zoom options.

This is a user interface feature only; there are no SCPI commands to adjust the zoom parameters.

Display Trace

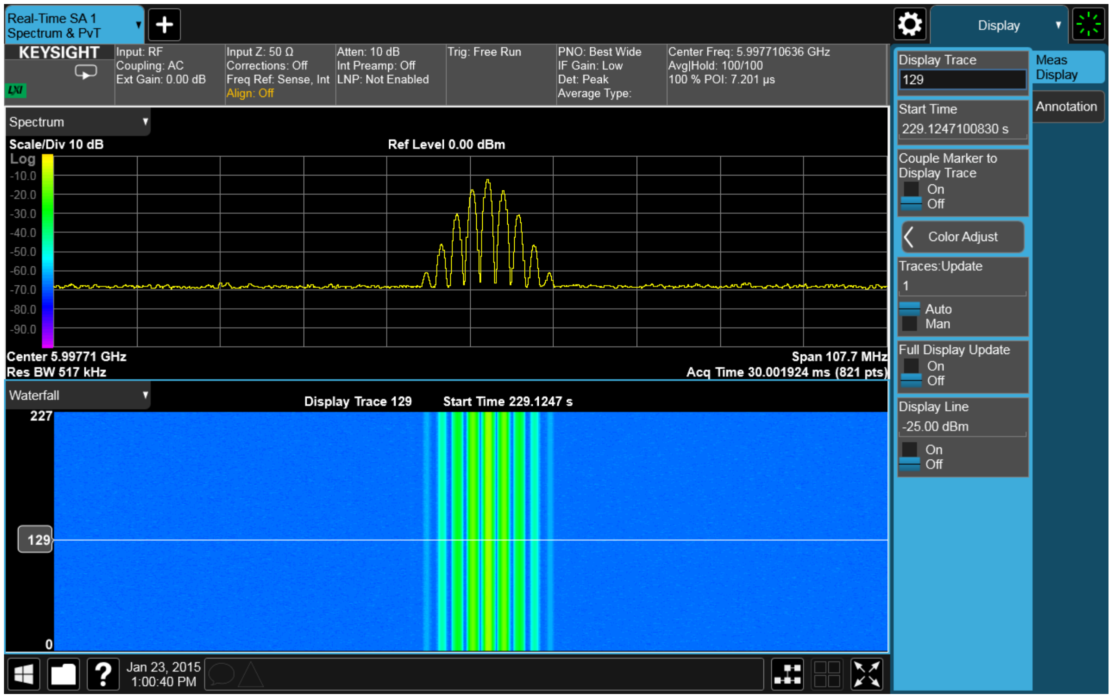
The Display Trace control determines which of the traces in the Waterfall (usually the lower) window is currently being viewed in the Spectrum (usually the top) window. A white line across the Waterfall window shows the current position of the Display Trace. On entry to the Spectrogram View, Display 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 trace completes, the data from Display Trace 0 is put into 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 10,000 traces, this means that often, many traces are offscreen 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 measurement will clear out the spectrogram and start it over, unless you are in the idle state (single or waiting for a trigger), in which case it will be cleared out when you start measuring again. The Restart key will clear 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 Ref Level or Scale/Div, the colors will get remapped to new Amplitude values. Note that this will not restart the Spectrogram unless the Attenuation changes.

As the traces roll up, the value of Display Trace does not change, so you will see a different trace in Trace 1 every time the live trace finishes. To freeze the spectrogram, put Trace 1 into View, or Pause the measurement using the Pause control in the Sweep menu.

Each trace has a time value, which represents the time from the start of the measurement to the time at which that trace was acquired. The time value of the Dsiplay Trace reads out at the top of the Waterfall window. The time value of the selected marker displays in the Marker readout region of the lower window when a Marker is selected.

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

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, will give the most predictable and consistent starting times for the traces. Other triggers, like Free Run or External Triggers, may give non-linear or less predictable times. Similarly, turning Auto Align off will improve the regularity of the trace starting times.

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, the **Single** key 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 with the “Average/Hold Number” key in the Meas Setup menu. For example, if you set the “Average/Hold Number” to 5, then every time you press Single, it will take 5 sweeps and put the 5 traces one by one into the Spectrogram; then it will stop sweeping. Note that you can set the “Average/Hold Number” to 1 to capture a single trace into the Spectrogram when the Single key is pressed, making the behavior similar to that of the Normal View

- In the 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 the user had a larger number of points on entry to Spectrogram, all the traces from the Normal View will be cleared out.

- In the 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.

- Copy Trace is available in Spectrogram. If Trace 1 is the “from” trace, Copy Trace will copy the Display Trace to any other trace; remember that the 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 will get 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 Exchange Trace; Trace 1 is not available to exchange

- Selecting or moving a marker which is turned on but not on the current Display Trace will NOT move the marker to the current Display Trace; it will select it, and/or move it, but it will stay on the Trace it is currently on.

- Turning on a marker which is turned off will turn 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 will cause all the coupled markers to move by the same number of traces.

NOTE

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

Markers

In the 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 the 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 will appears on the current Display Trace. Then when you move the Display Trace to other traces in the Waterfall window, the Marker will stay 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 which include

– 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: In Spectrogram View, 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 out of 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 same principle applies for powergrams with the PvT and Waterfall PvT windows

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 will see the delta which 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 a Spectrogram or Powergram View, all Trace 1 Markers that were not on Display Trace 0 are turned OFF.

3.3.4 Marker Table

The marker table 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 and off with the Marker Table switch 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 the 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 but the Normal View; in that case you have to use the Window Data dropdown to add a Marker Table window. (Although grayed out, the switches correctly display, eg, 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 can’t 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 doesn’t create a starred View; nor are you prompted to save the View when you leave the current measurement; and when you go back into that measurement the switch will be on and it will just add the window again.

For more on using the Window Title dropdown to change the window result or the Edit View screen to add and rearrange windows, see the information in the User Views section.

3.3.5 Zoomed Trace

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 (“Zoom Window”) shows a “zoomed” representation of the traces in the top window.

Views in which the Zoomed Trace window appears:

View	Size	Position
Trace Zoom	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 the Zoom Span control and you set the Center Frequency of the bottom window using the Zoom Center control (both in the Frequency menu). In Zero Span, you set the width of the bottom window using the Zoom Sweep Time control and the center using the Zoom Center control (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 are *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 the Zoom Span; hence the number of points in the bottom window will change by the same proportion as the change in the top window. Conversely, changing the number of points in the bottom window WILL change the 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 control in the Sweep/Control 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 will 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.

NOTE: If you have just switched to the Zoom Window via SCPI (using the :DISP:WIND function) 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 will have a different sweep time reflecting how much it is zoomed. When you go 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 of Trace Zoom takes on all of the traces, markers and settings that were present in the Normal View. The Zoom Center is the same as the analyzer Center Frequency, and the Zoom Span is 10 % of the analyzer 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 which has the focus is distinguished by a blue border.

3.3.6 Zone Spectrum

In the Zone Spectrum 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 Spectrum	Half height, full width	Bottom
Zone Span	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 the Zone Span control (in the Freq menu) and you can set the Center Frequency of the Zoom Window using the Zone Center control (in the Freq 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, the Span will revert to the last nonzero span. Also, if the Span of the top window is between 10 Hz and 100 Hz on transition, the Zone Span will initialize to 10 Hz, not 10% of Span.

More Information

In Zone Span, the window with the focus (the selected window) is the window which updates. You can tell which window is selected because 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 which is updating. To change the focus tap another window. Single and Continuous settings apply, so if the analyzer 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 like Center Frequency, Ref Level, etc, apply only to the selected window. Similarly, any traces which are exported or queried while in Zone Span will 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 the :DISP:WIND function) 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 of Zone Span takes on all of the traces, markers and settings that were present in the Normal View. The Zone Center is the same as the analyzer Center Frequency, and the Zone Span is 10 % of the analyzer 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, we note that whenever you save state while in Zone Span, and then recall the state, Zone Span comes back 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 the data in both windows is important to preserve, make sure you put the traces in View and save the state before you exit.

3.3.7 PvT

The PvT window shows the RF envelope power over a user defined time period. The horizontal axis represents time and the vertical axis represents amplitude.

View	Size	Position
PvT Spectrum	Half height, full width	Top

View	Size	Position
PvT Spectrogram	Half height, 2/3 width	Top Right
Powergram	Half height, full width	Top
Powergram Spectrogram	Half height, half width	Top Right

3.3.8 Waterfall PvT

The Waterfall PVT Window is very similar to the Waterfall Window with the exception that it represents a historical collection of PvT traces instead of Spectrum traces. The functionality and behavior of the Window is the same as Waterfall and follows the same explanation as the Waterfall Window.

View	Size	Position
Powergram	Half height, full width	Bottom
Powergram Spectrogram	Half height, half width	Bottom Right

3.4 Amplitude

The **Amplitude** control activates the **Amplitude** menu, and selects Reference Level or Reference Value (depending on the measurement) as the active function.

Some features in the Amplitude menu apply to multiple measurements. Other features apply only to specific measurements, and their controls are blanked or grayed out in measurements that do not support those controls.

3.4.1 Y Scale

The Y Scale Tab 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.

3.4.1.1 Ref Level

The Reference Level specifies the amplitude represented by the topmost graticule line.

In the Swept SA, 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 (e.g. through an auto coupling), then the measurement will be restarted.

In RTSA, changing the Reference Level restarts a measurement, because when a new Ref Level is set it requires that a completely new acquitition be taken. The exception to this is in a PvT window - changing the Power vs Time Reference Level does not restart the measurement, because it is a display function only; instead it vertically 'pans' all displayed traces and markers to the new value.

Remote Command	`:DISPlay:WINDow[1]:TRACe:Y[:SCALe]:RLEVel <real>` `:DISPlay:WINDow[1]:TRACe:Y[:SCALe]:RLEVel?`

Example	`:DISP:WIND:TRAC:Y:RLEV 20 dBm`
	Sets 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 will be displayed.
	`:DISP:WIND:TRAC:Y:RLEV?`

Couplings	If you reduce the attenuation, the analyzer 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. In RTSA, the Ref Level control is context sensitive. When in a spectral window, the Spectral Ref Level parameter is shown. When in a PVT window, the PVT Ref Level is shown.
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: EXA (except N9010N) and CXA: +23 dBm + RL Offset – External Gain - USB Preamp Gain All other models: +30 dBm + RL Offset – External Gain - USB Preamp 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. The parameter USB Preamp Gain depends on the frequency range of the USB Preamp being used. For no preamp connected, the value is 0 dB of course, the value is 10 dB for all frequency ranges.
Annotation	The reference level is displayed above and to the left of the graticule with the title “Ref”.
Backwards Compatibility Notes	1. In PSA, there was a restriction on Ref Level Max which was that it could not exceed 0 dBm when the preamp was on. This restriction does not apply to X-Series. 2. Ref Level – Ref Level is a display function, not a measurement control function, so a change in the setting does not start a new sweep (unless attenuation changes). This behavior differs from that of legacy analyzers

3.4.1.2 Scale/Div

Sets the units per vertical graticule division on the display. There are two separate Scale/Div values, one for spectral windows (Spectrum, Density) and one for time domain (PvT) windows. These values can be set independently.

From the front panel this control affects whichever window is selected. When the SCPI command is sent, you use the WINDow parameter to direct the command to the desired window, window 1 for spectral windows and window 8 for the PvT window.

This function is only available when Scale Type (Log) is selected and the vertical scale is power. When Scale Type (Lin) is selected, Scale/Div is grayed out.

Remote Command	Scale/Div for spectral windows
	`:DISPlay:WINDow[1]:TRACe:Y[:SCALe]:PDIVision <rel_ampl>`
	`:DISPlay:WINDow[1]:TRACe:Y[:SCALe]:PDIVision?`
	Scale/Div for PvT window
	`:DISPlay:WINDow8:TRACe:Y[:SCALe]:PDIVision <rel_ampl>`
	`:DISPlay:WINDow8:TRACe:Y[:SCALe]:PDIVision?`

Example	`:DISP:WIND:TRAC:Y:PDIV 5 DB`
Notes	Window 1 is the Spectrum window, which shares a value with the Density window, is thus Scale/Div for all spectral windows. Window 8 is the PvT window.
Dependencies	Scale/Div is grayed out in linear Y scale. Sending the equivalent SCPI command does change the Scale/Div, though it has no affect while in Lin.
Couplings	The Scale/Div control is context sensitive. When in a spectral window, Spectral Scale/Div parameter is shown. When in a PVT window, PVT Scale/Div is shown.
Preset	10.00 dB / Div
State Saved	Saved in instrument state
Min	0.50 dB
Max	20 dB
Annotation	In log scale, the Scale/Div is shown in the upper left side of the display. In Lin mode, no annotation is displayed.

3.4.1.3 Display Scale

Chooses a linear or logarithmic vertical scale for the display and for remote data readout.

When Display Scale (Log) is selected, the vertical graticule divisions are scaled in logarithmic units. The top line of the graticule is the Reference Level and uses the scaling per division Scale/Div to assign values to the other locations on the graticule.

When Display Scale (Lin) is selected, 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 analyzer remembers 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 is on, Display Scale is forced to Log and is grayed out.
Couplings	Changing the Display Scale always sets the 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.

3.4.1.4 Y Axis Unit

Displays a dropdown menu that enable you to change the vertical (Y) axis amplitude unit.

For measurements that support both Log and Lin scales, the analyzer 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.

NOTE If a Transducer Unit is set you will see it displayed as Xducer Unit in the Y Axis Unit dropdown. However, you can only change the Transducer Unit by going to the Input/Output, Corrections, Edit Correction dialog and tapping Settings and Transducer Unit. You can also turn it off there, by selecting None.

See also:

– "Remote Interface Examples" on page 160

– "Amplitude Data Query and Y Axis Unit" on page 161

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?`
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	If an amplitude correction with a Transducer Unit other than **None** is applied and enabled, then 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. All other Y Axis Unit choices are grayed out If an amplitude correction with a Transducer Unit other than **None** is applied and enabled, and you then turn off that correction or set **Apply Corrections** to **No**, the Y Axis Unit that existed before the Transducer Unit was applied is restored
Couplings	The analyzer 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

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 162 (see below) 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 an 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 162
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 162
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 162
dBG (Transducer Unit)	UNIT:POW DBG	Sets the amplitude unit for the selected amplitude scale (log/lin) to dBG (dB relative to one Guass). 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 162
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 162 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 analyzer 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 ohms input impedance.**

Transducer Unit

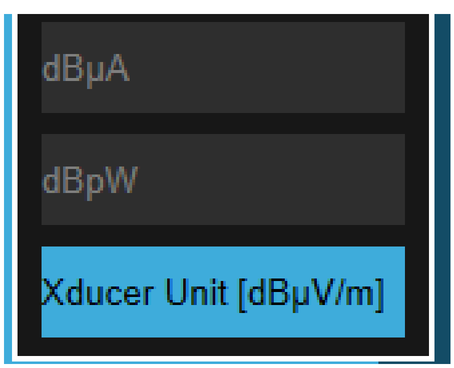
Transducer Units (formerly called Antenna Units) are units of field strength rather than amplitude, and are used when correcting the response of device such as antennas whose amplitude characteristics are measured in units of field strength. All five of the Transducer Units (dBmA/m, dBmV/m, dBG, dBpT,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

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

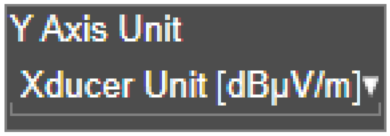
When a Correction is turned on that uses a Transducer Unit, the Y Axis Unit changes to that Transducer Unit. All of the selections in the Y-Axis Unit dropdown are then greyed out, except the Transducer Unit selection. The unit being used is shown on this selection in square brackets, and appears on the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

Example: the Transducer Unit in the Correction is dBmV/m.

The selection in the dropdown looks like this:



And on the control it looks like this:



To change the Transducer Unit you must go to the Input/Output, Corrections, Edit Correction dialog and tap Settings and Transducer Unit. You can also turn it off there, 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

3.4.1.5 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.

See "More Information" on page 164

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

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.
Backwards Compatibility Notes	1. In pre-X-Series instruments, Ref Level Offset could not be adjusted by the knob or step keys. That is no longer the case. 2. In ESA and PSA, Ref Level Offset was applied to the data as it was acquired; thus if the Offset changed the new offset was not applied until new trace data was taken. In X-Series, the offset is applied as the data is displayed/queried, so if you change the offset, it will change the data immediately.

More Information

Offsets are used when gain or loss occurs between a device under test and the analyzer input. Thus, the signal level measured by the analyzer 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 analyzer 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, Ref Level - Ref 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 the reference level offset can be set to values of -150 to +50 dB.

If the 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, the 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, the reference level offset is first set to 30 dB, then the reference level can be set to values of -140 to +60 dBm.

3.4.2 Attenuation

This menu 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 thatcontrols all the attenuation functions. Different models in the X-Series come with different configurations.

See "Dual Attenuator Configurations" on page 165

See "Single Attenuator Configuration" on page 166

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.

This tab is only available when the hardware set includes an input attenuator, which is typically only the case when using Keysight's box analyzers. For example, this tab does not appear in:

– VXT models M9420A/21A/10A/11A

– E7760

– M9391A

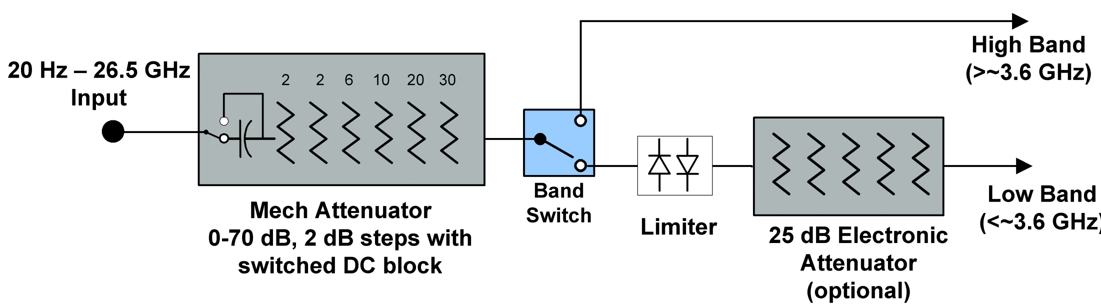
– M9393A

This tab also does not appear 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.

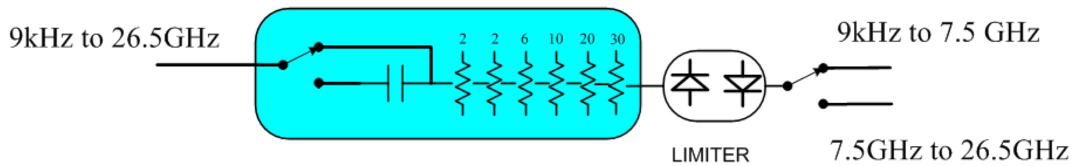
Dependencies	In measurements that support the I/Q inputs, this tab is unavailable when I/Q is the selected input, and is replaced by the Range tab in that case.

Dual Attenuator Configurations

Configuration 1: Mechanical attenuator + optional electronic attenuator

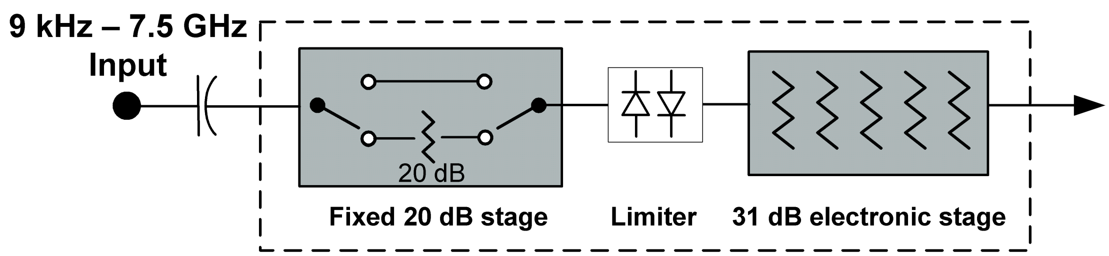


Configuration 2: Mechanical attenuator, no optional electronic attenuator



(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) opensthe 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, youcontrol 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.

3.4.2.1 Full Range Atten

The Full Range Atten control and Attenuator Summary only appear in the 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. 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.

Remote Command	`[:SENSe]:POWer[:RF]:FRATten <rel_ampl>` `[:SENSe]:POWer[:RF]:FRATten?`
Example	`:POW:FRAT 14` `:POW:FRAT?`
Notes	When the user enters between valid values, their value will be incremented to the next smallest valid value.
Dependencies	This control only appears if input RF is selected and RF Input Port 2 is selected and the Full Range Attenuator exists.
Couplings	This value is never changed by any coupling, however other couplings use this value. See the Reference Level and Mech Atten 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. On the Amplitude, Attenuation menu panel, 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

3.4.2.2 Mech Atten

This control is 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.

This control 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 169

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 sets it to Manual.
	`:POW:ATT:AUTO ON`
	Turn Auto Mech Atten ON

Dependencies	Some measurements do not support the Auto setting of **Mech Atten**. 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 decribed in more detail in the **Elec Atten** control description. See "Attenuator Configurations and Auto/Man" on page 169 for more information on the Auto/Man functionality of Attenuation. The POW:ATT:AUTO command 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).

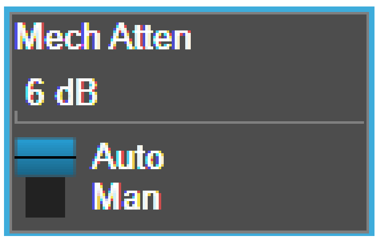
	In External Mixingand BBIQ, where the Attenuator is not in the signal path, the Attenuator setting changes as described above when **Mech Atten** is in Auto, but no changes are made to the actual attenuator hardware setting until the input is changed back to the RF Input. For CXA-m with option FSA (Fine-Step Attenuator or 2 dB steps), the FSA-like behavior is only available when the frequency setting is <= 7.5GHz. So when the frequency is changed from below 7.5GHz to above 7.5GHz, the attenuation setting will be changed to a multiple of 10dB which will be no smaller than the previous setting. For example, 4dB attenuation will be changed to 10dB.
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. To get to a value below 6 dB it has to 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: 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 in the Attenuation control description, 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 the **Mech Atten** control (or POW:ATT SCPI) as the "main" attenuation; and the attenuation that is set by the SCPI command POW:EATT as the "soft" attenuation (the POW:EATT command 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 the **Elec Atten** control description for more on "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 which 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 which include an Electronic Attenuator but when the Electronic Attenuator is enabled.

3.4.2.3 Elec Atten

Controls the Electronic Attenuator in dual attenuator configurations. This control does not appear in single attenuator configurations, as 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.

See "More Information" on page 172

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	This control 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). However, in the single attenuator configuration, EATT SCPI commands are accepted for compatibility with other X-series instruments and set a "soft" attenuation as described in "Attenuator Configurations and Auto/Man" on page 169. The "soft" attenuation is treated as an addition to the "main" attenuation value set by the Atten control or the POW:ATT SCPI command and affects the total attenuation displayed on the Atten control and the Meas Bar. The electronic attenuator (and the "soft" attenuation function provided in single attenuator configurations) is unavailable above the low band (0-3.6 GHz, 0-3.4 GHz 0-3GHz, depending on the model). If the low band ranges from 0-3.6GHz, and Stop Frequency of the analyzer is > 3.6 GHz, then the **Enabled/Disabled** section of the **Elec Atten** control will be OFF and grayed out. If the Internal Preamp is on, meaning it 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, if the SCPI command is sent, an error indicating that the electronic attenuator is unavailable will be sent. If both of the above are true, pressing the control will generate 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 analyzer is limited to 3.6 GHz and the Internal Preamp is unavailable. 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 the section "Attenuator Configurations and Auto/Man" on page 169
Preset	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 173 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 169

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 analyzer 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 analyzer calibration

3.4.2.4 Mech Atten Step

This controls thestep size used when making adjustments to the input attenuation.

This control is labeled **Mech Atten Step** in dual attenuator models and **Atten Step** in single attenuator models. In the dual attenuator configuration, this control 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	This feature has a toggle choice from the front panel, but it 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 will 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

3.4.2.5 Max Mixer Level

The Max Mixer Level control 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 thorugh the system.

The major impact of changes to Max Mixer Level is seen in changes to the value to which Ref Level is limited. Max Ref Level depends on Max Mixer Level and Attenuation, and thereore 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 the "Max Mixer Lvl Rules" on page 174 control.

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.
Preset	-10 dBm
State Saved	Saved in instrument state
Min	-50 dBm
Max	0 dBm

3.4.2.6 Max Mixer Lvl Rules

The Max Mixer Level Rules key allows you to optimize the Max Mixer Level setting for certain kinds of measurements.

Normal – Normal is the historical, and thus backwards compatible, setting range (–50 to 0 dBm) and default setting (–10 dBm). The analyzer has been designed so that, at the default setting, any signal below the reference level is extremely unlikely to give ADC overloads. At this mixer level the scale fidelity will be within specifications, thus compression with be negligible.

TOI – Choosing the setting "TOI-limited dynamic range" allows a range of settings of the Max Mixer Level, –50 to –10 dBm, that can be optimum for measurements limited by the analyzer 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 – Choosing the setting "Compression-limited dynamic range" 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 analyzer 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 Swept SA and RTSA.
Preset	NORM

3.4.3 Signal Path

The Signal Path Tab contains controls that pertain to the routing of the signal through the frontend of the instrument.

In general, this tab only appears in analyzers whose hardware supports this signal routing. For example, this tab does not appear in many of the modular analyzer products, including VXT Models M9420/21A. It also does not appear in the UXM.

This tab DOES appear in VXT Models M9410A/11A, because the Software Preselection control is in this tab, and VXT Models M9410A/11A implement a version of Software Preselection.

3.4.3.1 Presel Center

When this control is pressed, the centering of the preselector filter is adjusted 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 analyzer will turn on the selected marker, perform a peak search, and then perform centering on the marker's center frequency. If the selected marker is already on and between the start and stop frequencies of the analyzer, the analyzer 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 analyzer will first perform a peak search, and then perform centering on the marker's center frequency.

The value displayed on the **Presel Adjust** control will change to reflect the new preselector tuning (see **Presel Adjust**.

A number of considerations should be observed to ensure proper operation. See "Proper Preselector Operation" on page 177.

Remote Command	`[:SENSe]:POWer[:RF]:PCENter`
Example	`:POW:PCEN`
Notes	Note that the rules outlined above under the control description apply for the remote command as well as the key. The result of the command is dependent on marker position, and so forth. Any message shown by the control press is also shown in response to the remote command.
Dependencies	– Does not appear in CXA-m – Does not appear 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. – Blank 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. – Grayed out in the Spectrogram View.
Couplings	The active marker position determines where the centering will be attempted. If the analyzer is in a measurement such as averaging when centering is initiated, the act of centering the preselector will restart averaging but the first average trace will not be taken until the centering is completed. The offset applied to do the centering reads out on the Presel Adjust key.
Status Bits/OPC	When centering the preselector, *OPC will not return true until the process is complete and a

dependencies	subsequent measurement has completed, nor will results be returned to a READ or MEASure command. The Measuring bit should remain set while this command is operating and should not go false until the subsequent sweep/measurement has completed.

Proper Preselector Operation

A number of considerations should be observed to ensure proper operation:

1 If the selected marker is off, the analyzer will turn on a marker, perform a peak search, and adjust 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 analyzer will attempt the centering at that marker's frequency. There is no preselector for signals below about 3.6 GHz, therefore if the marker is on a signal below 3.6 GHz, no centering will be attempted and an advisory message generated

3 In some models, the preselector can be bypassed. If it is bypassed, no centering will be attempted in that range and a message will be generated.

3.4.3.2 Preselector Adjust

Allows you to manually adjust the preselector filter frequency to optimize its response to the signal of interest. This function is only available when "Presel Center" on page 176is available.

For general purpose signal analysis, using Presel Center is recommended. Centering the filter minimizes the impact of long-term preselector drift. Presel 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 Presel Adjust.

Remote Command	`[:SENSe]:POWer[:RF]:PADJust <freq>` `[:SENSe]:POWer[:RF]:PADJust?`
Example	`:POW:PADJ 100KHz` `:POW:PADJ?`
Notes	The value on the control reads out 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 below about 3.6 GHz. – Grayed out if entirely above 50 GHz, that is, if Start Freq is above 50 GHz. – Blank 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. – Grayed out in the Spectrogram View.
Preset	0 MHz
State Saved	The **Presel Adjust** value set by **Presel Center**, or by manually adjusting **Presel Adjust**, is 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`
Backwards Compatibility Notes	PSA had multiple preselectors, but the X-Series has only one. These commands simply alias to [:SENSe]:POWer[:RF]:PADJust

Remote Command	`[:SENSe]:POWer[:RF]:PADJust:PRESelector MWAVe | MMWave | EXTernal` `[:SENSe]:POWer[:RF]:PADJust:PRESelector?`
Notes	PSA had multiple preselectors, and you could select which preselector to adjust. Since the X-Series has only one mm/uW preselector, the preselector selection control is no longer available. However, to provide backward compatibility, we accept the legacy remote commands. The command form has no effect, the query always returns MWAVe In the future, when we support higher frequency and external mixing, we may modify the behavior of this legacy command.

3.4.3.3 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 particular 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 will always reflect 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, 0-3GHz, 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.

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	Preamp is not available on all hardware platforms. If the preamp is not present or is unlicensed, the control is not shown. Does not appear in VXT Models M9410A/11A/15A. If a POW:GAIN:BAND FULL command is sent when a low band preamp is available, the preamp band parameter is to LOW instead of FULL, and an "Option not installed" message is generated. The preamp is not available when the electronic/soft attenuator is enabled. In the past, the Internal Preamp was switched on when the USB Preamp was plugged in, however, that is no longer the case as of firmware A.16.00.
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)

3.4.3.4 LNA

This control lets you turn the Low Noise Amplifier (LNA) on and off.

The LNA is an additional preamplifier which provides superior DANL and frequency range compared to the Internal Preamp. The LNA provides lower system noise figure, especially at frequencies above 100 MHz, and can be operated up to the full range of 50 GHz analyzers.

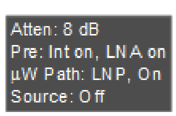
For best possible sensitivity, the LNA can be turned on together with the Internal Preamp, although when operating both preamps together, the user should note that the TOI (distortion) specifications are impacted. The sensitivity improvement of this combination is substantial when operating in high band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

See "More Information" on page 180

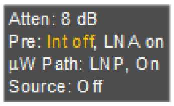
Remote Command	`[:SENSe]:POWer[:RF]:GAIN:LNA[:STATe] OFF | ON | 0 | 1` `[:SENSe]:POWer[:RF]:GAIN:LNA[:STATe]?`
Example	`:POW:GAIN:LNA ON`
Dependencies	Requires option LNA. Option LNA is not required by VXT model M9415A. Does not appear in VXT models M9420A/21A/10A/11A. May not appear in some measurements.
Preset	OFF
State Saved	Saved in State

More Information

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



Note that when operating entirely in the low band (below about 3.6 GHz), if the LNA is on, the 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 the Internal Preamp does not match the Internal Preamp switch in the UI:



3.4.3.5 µW Path Control

The **µW Path Control** functions include the **µW Preselector Bypass** (Option MPB), **Low Noise Path** (Option LNP) and **Full Bypass Enable** controls in the High Band path circuits.

When the µW Preselector is bypassed, the user has better flatness, but will be subject to spurs from out of band interfering signals. When the Low Noise Path is enabled, the analyzer automatically bypasses certain circuitry in the high frequency bands which can contribute to noise, when it is appropriate based on other analyzer settings.

For most applications, the preset state is Standard Path, which gives 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 the µW Preselector Bypass path, 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 the Low Noise Path. But the preamp's compression threshold and third-order intercept are much poorer than that of the Low Noise Path.

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	`:POW:MW:PATH`	See "Low Noise Path Enable" on page 185

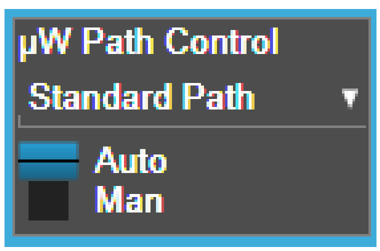
Path	Example	Note
Enable	LNP	
µW Preselector Bypass	:POW:MW:PATH MPB	See "µW Preselector Bypass" on page 187
Full Bypass Enable	:POW:MW:PATH FULL	See "Full Bypass Enable" on page 187

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 a Presel Center is performed, the analyzer 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 analyzer is now AC coupled. However, if the user has selected DC coupling, the UI will 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 analyzer 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 Does not appear in VXT Models M9410A/11A Does not appear in BBIQ and External Mixing The Low Noise Path 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 and Full Bypass Enable are grayed out if the current measurement does not support them. Low Noise Path and Full Bypass Enable are not supported in the Avionics and MMR modes. In any of these cases (i.e. 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	All except modes specified below: STD IQ Analyzer, VXA, Pulse and Avionics mode: MPB option present and licensed: MPB MPB option not present and licensed: 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, it says: µW Path: Standard If Low Noise Path is enabled but the LNP switch is not thrown, it shows: µW Path: LNP,Off If the Low Noise Path is enabled and the LNP switch IS thrown, it shows: µW Path: LNP,On If the preselctor is bypassed, it says: µW Path: Bypass If Full Bypass Enable is selected but the LNP switch is not thrown, it shows: µW Path: FByp,Off If Full Bypass Enable is selected and the LNP switch IS thrown, it shows: µW Path: FByp,On

µW Path Control Auto [Mode: VMA, WLAN, NR5G]

In VMA, WLAN and 5G NR 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 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

VMA measurement	When µW Path Control is in Auto:
Spurious Emissions	Always Standard Path

WLAN 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	Standard Path for 802.11be 320MHz radio format. Presel Bypass for other formats
Spurious Emissions	Always Standard Path

5G NR 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 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

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 and 5G NR Modes
Couplings	See the tables above.
Preset	ON
Range	Off|On

Low Noise Path Enable

You may choose Low Noise Path Enable, which gives 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 of the following are true:

– The analyzer 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 the 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 FFT's in the Swept SA measurement; they use the same rules as swept measurements.

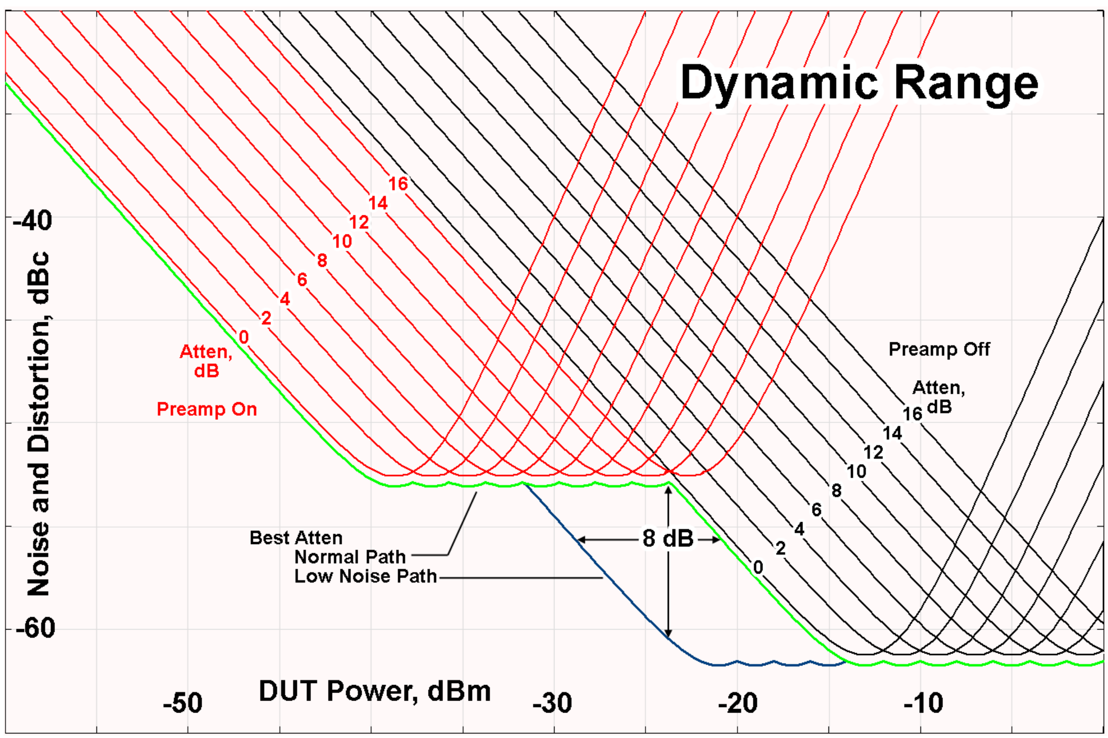
The user should understand that the Low Noise Path, while giving improved DANL, has the disadvantage of decreased TOI performance and decreased gain compression performance relative to the standard path.

The user should also understand that the bypass switch is a mechanical switch and has finite life, so if the **Low Noise Path** is enabled, it is possible to cause frequent cycling of this switch by frequently changing analyzer 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 analyzer 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 analyzer at different attenuation settings, both with the preamp on and off, in a measurement that is affected by both analyzer noise and analyzer 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 analyzer 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

This control 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 analyzer.

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 will appear lower in amplitude and have a much wider shape factor compared to the real signal.

Full Bypass Enable

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

– The analyzer 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.

NOTE

When Full Bypass Enable is selected, and Attenuation 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 high risk to be damaged by high AC power. Consequently, whenever Full Bypass is enabled, a warning message appears in the status bar:

Full Bypass Enabled, maximum safe input power reduced

Microwave Preselector Bypass Backwards Compatibility

Remote Command	`[:SENSe]:POWer[:RF]:MW:PRESelector[:STATe] ON | OFF | 0 | 1` `[:SENSe]:POWer[:RF]:MW:PRESelector[:STATe]?`
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

Frequency Extender Preselection Bypass

The Frequency Extender's Preselection Bypass only applies to the high frequency path of the Frequency Extender and only if the Frequency Extender's 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, the user has better flatness, 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.

Coupling with Microwave Preselector Control

The control of whether to apply or bypass the Frequency Extender's preselection is dependent on the Microwave Path Control setting.

The coupling between the Microwave Path Control and Frequency Extender Preselector Bypass is described below.

UW PATH CTRL	UW PRESELECTOR	VIKING PRESELECTOR
Standard Path	On	**On**
Low Noise Path Enable	On	**On**
uW Presel Bypass	Off	**Off**
Full Bypass Enable	Off	**Off**

In other words…

uW Path Ctrl == Standard
uW Path Ctrl == Low Noise
→ Viking PreselBypass == Off

uW Path Ctrl == Bypass
uW Path Ctrl == Full Bypass
→ Viking PreselBypass == On

For the Frequency Extender Preselector Bypass to take affect, it requires a Frequency Extender device (such as V3050A) be connected and External RF (ERFIN) selected as the input.

The Frequency Extender Preselector is applied or bypassed depending on the Microwave Path Control setting only when the acquisition is above 50 [GHz]. Hence, it will be bypassed only when the acquisition is above 50 [GHz].

Preselector and Bandwidth Conflict

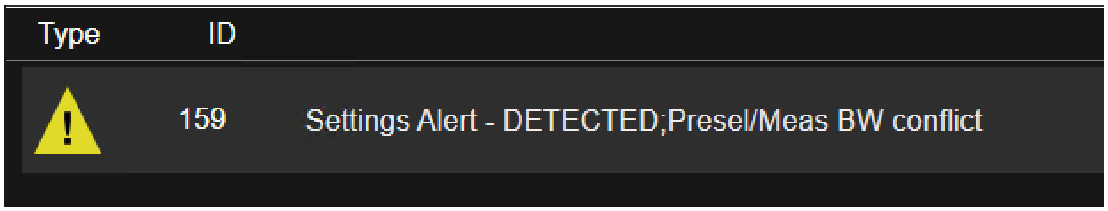
When the Frequency Extender Preselector is applied and the signal bandwidth is greater than 2.5 [GHz], then a settings alert message will show to warn the user that the signal may be distorted due to the limitation of the Frequency Extender Preselector bandwidth.

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

.



3.4.3.6 Software Preselection

Software Preselection is provided in some models 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 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 in N9041B, in Swept SA, Software Preselection will work even if the measurement is using an FFT sweep type. In measurements other than Swept SA, Software Preselection will not be 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 88 GHz, software preselection must be used to suppress and separate images above 88 GHz. The specific algorithm used for software preselection is specified by the SW Preselection Type: Normal or Advanced.

For N9042B+V3050A, Software Preselection only applies for frequencies above 88 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 88 GHz. This is why the label of this control contains the parenthetical note "(>~88 GHz)".

Note that for N9042B+V3050A, in Swept SA, Software Preselection will work even if the measurement is using an FFT sweep type. In measurements other than Swept

SA, Software Preselection will not be 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 encouraged 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, please 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	Sweep Time is affected by SW Preselection. Also Auto Tune supports SW Preselection, so set SW Preselection state and then do Auto Tune
Preset	N9041B: OFF N9042B+V3050A: ON M9410A/11A: ON
State Saved	Saved in instrument state

3.4.3.7 SW Preselection Type

Specifies the algorithm used for software preselection.

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. Other signals 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.

– 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 the N9041B and N9042B+V3050A. Only appears in measurements that use the Swept method. When Software Preselection is Disabled, this control is grayed out. Its grayout message is “Unavailable unless SW Presel enabled”.
Preset	N9041B: Advanced N9042B+V3050A: Normal
State Saved	Saved in instrument state

3.4.3.8 SW Preselection BW

Specifies the effective bandwidth to be used for Software Preselection.

The choices are Normal and Narrow.

– 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. When Software Preselection is Disabled, this control is grayed out. Its 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

3.4.3.9 High Freq Prefilter

The High Freq Prefilter key 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	For example, to enable High Freq Prefilter in IQ Analyzer Mode:
	Complex Spectrum Measurement
	`:SPEC:PFIL ON`
	IQ Waveform Measurement
	`:WAV:PFIL ON`

Dependencies	This control only appears in VXT models M9410A/11A with center frequency above 1310 MHz.
Preset	See "Prefilter Presets" 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

Meas	Mode	Preset
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 BW

The **BW** key opens the bandwidth 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 several filter types, including Gaussian, Flattop, Blackman-Harris, Rectangular, Hanning and Kaiser.

3.5.1 Settings

The controls on this tab enable you to configure the bandwidth parameters.

3.5.1.1 Res BW

This control allows you to display and adjust the currently selected calculated resolution bandwidth value.

In RTSA, Res BW allows you to select from a pre-calculated selection of Resolution Bandwidth (RBW) values which are computed using the following formula:

RBW = Span / Ratio, where Ratio is the Span/RBW ratio determined by the selected Filter Type

Pressing this control displays a dropdown menu that enables you to change the Res BW value (Res BW 1 through Res BW 6). The default selection is Res BW 2.

In instruments with B5X, for Span >255 MHz the number of Res BW selections is reduced. Higher selections are grayed out when the span is above the crossover frequency. For Span > 255 MHz the number of RBW's is limited to 4. If you have the Res BW manually set above the crossover when you adjust the Span the Advisory "Res BW changed" will be displayed in the status line and the Res BW set to the maximum allowed. If the Span is greater than the crossover, and you attempt to change the Res BW above the limit, the Warning message "-224, Illegal Parameter; Res BW value not allowed with current Span" is displayed.

The values of the RBW's available are updated on a Span or Filter Type change.

See "More Information" on page 196

Remote Command	`[:SENSe]:BANDwidth|BWIDth[:RESolution]:SELect RBW1 | RBW2 | RBW3 | RBW4 | RBW5 | RBW6` `[:SENSe]:BANDwidth|BWIDth[:RESolution]:SELect?`
Example	`:BAND:SEL RBW1` `:BAND:SEL?`
Notes	The SCPI command that returns the Res BW value is [:SENSe]:BANDwidth[:RESolution]?

Dependencies	This control does not appear if a PvT window is selected The max Span and max Res BW allowed depends on the installed BW option
Couplings	The actual Res BW value is calculated using the algorithm RBW = Span / Filter Type Ratio Therefore any changes to the Span or Filter Type may result in the computed Res BW value changing When Filter Type is set to RECTangular Res BW settings 2 – 6 are not supported
Preset	Auto Couple chooses the preset value
State Saved	Saved in instrument state

Remote Command	`[:SENSe]:BANDwidth|BWIDth[:RESolution]:SELect:AUTO[:STATe] OFF | ON | 0 | 1` `[:SENSe]:BANDwidth|BWIDth[:RESolution]:SELect:AUTO[:STATe]?`
Example	`:BAND:SEL:AUTO 1`
Preset	ON

More Information

By reducing the number of points used by the FFT windowing function by a factor of two, the ratio values are also reduced by a factor of two. The points can be reduced from 1024 down to 32 which allow six RBW values for each Filter Type based on the following ratio values:

Res BW	Example	Notes
Res BW 1	BAND:SEL RBW1	Res BW 1 uses Filter Type Ratio of the 1024 point FFT window function size
Res BW 2	BAND:SEL RBW2	Res BW 2 uses Filter Type Ratio of the 512 point FFT window function size. Not supported when Filter Type is RECTangular.
Res BW 3	BAND:SEL RBW3	Res BW 3 uses Filter Type Ratio of the 225 point FFT window function size. Not supported when Filter Type is RECTangular.
Res BW 4	BAND:SEL RBW4	Res BW 4 uses Filter Type Ratio of the 128 point FFT window function size. Not supported when Filter Type is RECTangular.
Res BW 5	BAND:SEL RBW5	Res BW 5 uses Filter Type Ratio of the 64 point FFT window function size. Not supported when Filter Type is RECTangular. Not allowed when the span is >255 MHz in instruments with option B5X
Res BW 6	BAND:SEL RBW6	Res BW 6 uses Filter Type Ratio of the 32 point FFT window function size. Not supported when Filter Type is RECTangular. Not allowed when the span is >255 MHz in instruments with option B5X

Details on the different bandwidths that correspond to each setting and each Window function are below:

Filter Type (FFT Windowing Function)	Ratio 1 (Max)	Ratio 2	Ratio 3	Ratio 4	Ratio 5	Ratio 6 (Min)
Instruments with						

B1X.						
Gaussian	418	209	104	52	26	13
Flattop	213	106	53	27	13	7
Blackman-Harris	418	209	104	52	26	13
Rectangular	821	N/A	N/A	N/A	N/A	N/A
Hanning	551	276	138	69	34	17
Kaiser	418	209	105	52	26	13

Filter Type (FFT Windowing Function) Span >255 MHz in instruments with B5X.	Ratio 1 (Max) 1024 length	Ratio 2 512	Ratio 3 256	Ratio 4 (Min) 128	Ratio 5 64	Ratio 6 32
Gaussian	836	418	208	104	52	26
Flattop	426	212	106	54	26	13
Blackman-Harris	836	418	208	104	52	26
Rectangular	1739	N/A	N/A	N/A	N/A	N/A
Hanning	1102	552	276	138	68	34
Kaiser	836	418	210	104	52	26

Filter Type (FFT Windowing Function) Span <=255 MHz in instruments with B5X.	Ratio 1 (Max) 1024 length	Ratio 2 512	Ratio 3 256	Ratio 4 128	Ratio 5 64	Ratio 6 (Min) 32
Gaussian	836	418	208	104	52	26
Flattop	426	212	106	54	26	13
Blackman-Harris	836	418	208	104	52	26
Rectangular	1739	N/A	N/A	N/A	N/A	N/A
Hanning	1102	552	276	138	68	34
Kaiser	836	418	210	104	52	26

3.5.1.2 Filter Type

Pressing this control displays a dropdown menu that enables you to select the FFT Windowing function used.

Filter	Example	Notes
Gaussian	BAND:SHAP GAUS	Selects Gaussian as the FFT window function
Flattop	BAND:SHAP FLAT	Selects Flattop as the FFT window function
Blackman-Harris	BAND:SHAP BHAR	Selects Blackman-Harris as the FFT window function
Rectangular	BAND:SHAP RECT	Selects Rectangular as the FFT window function
Hanning	BAND:SHAP HANN	Selects Hanning as the FFT window function
Kaiser	BAND:SHAP KAIS	Selects Kaiser as the FFT window function

Remote Command	`[:SENSe]:BANDwidth|BWIDth:SHAPe GAUSsian | FLATtop | BHARris | RECTangular | HANNing | KAISer`
	`[:SENSe]:BANDwidth|BWIDth:SHAPe?`
	You must send BAND:SEL RBW1 before using RECT filter type

Example	`:BAND:SHAP GAUS`
Notes	GAUSsian= Gaussian FLATtop = Flattop BHARris = Blackman-Harris RECTangular = Rectangular HANNing = Hanning KAISer = Kaiser We use SHAPe instead of TYPE (even though the control name uses Type) for backwards compatibility because TYPE is used in Swept SA measurement
Dependencies	This control does not appear if a PvT window is selected
Couplings	Changing the Filter Type will change the RBW values based on the formula: RBW = Span / Filter Type Ratio When you select Rectangular as the filter type, Res BW is automatically set to Res BW 1
Preset	`KAISer`
State Saved	Saved in instrument state

3.6 Display

Opens the **Display** Menu, which lets you configure display items for the current Mode, Measurement View, or Window.

3.6.1 Meas Display

Contains controls for setting up the display for the current Measurement, View or Window.

3.6.1.1 Persistence

Persistence allows the user to specify how long the frequency amplitude points displayed in the bitmap should take to fade. The persistence refers to the intensity of a pixel. Adding persistence controls the length of time it will take for a point to go from 100% intensity to 0% intensity, i.e. transparent, assuming the point does not get hit again during the persistence time. The amount the intensity will decrease is calculated using the following algorithm;

Intensity Reduction Value = Update Rate / Total Persistence Time

All points in the bitmap not hit during an update will have their intensity reduced by the Intensity Reduction Value and continue to do so until they reach 0% intensity, i.e. transparent. If the point is hit again, the new density value will be used to represent the particular frequency amplitude point, even if the density value is less, and it will be displayed at 100% intensity. Subsequent updates will repeat the process.

Persistence has two modes. A finite mode where the user defines the persistence time and an infinite mode, which allows the user to see the density of each point over the entire measurement time. Infinite mode shows the total number of times a frequency and amplitude point is hit during all the capture intervals since starting the measurement. This is the total time a signal spends at each frequency and amplitude point as a percentage of the complete measurement time, i.e. the averaged time. In infinite mode the intensity for all frequency amplitude points hit at any time since the measurement started will be 100%, i.e. there will be no fading.

Remote Command	`:DISPlay:VIEW:DENSity:PERSistence <time>`
	`:DISPlay:VIEW:DENSity:PERSistence?`
	`:DISPlay:VIEW:DENSity:PERSistence:INFinite OFF | ON | 0 | 1`
	`:DISPlay:VIEW:DENSity:PERSistence:INFinite?`

Example	`:DISP:VIEW:DENS:PERS 5`
Notes	When in Infinite mode, the active function is cleared and the infinity symbol ∞ will be displayed on the softkey where the time value is shown
Dependencies	This key only appears in the Density View. If the SCPI command is sent to any other View, it is

	accepted without error but you won't see the result until you go back to the Density View.
Couplings	The colors used by persistence are coupled to the Density Hue parameter settings. See section "Highest Density Hue" on page 200 and "Lowest Density Hue" on page 200.
Preset	300 ms
State Saved	Saved in instrument state
Min	0s
Max	10s

3.6.1.2 Highest Density Hue

Lets you adjust where, as a percentage of the density range, the Highest Density Hue appears. Above the Highest Density Hue, any density points simply map as black.

Remote Command	`:DISPlay:VIEW:DENSity:HDHue <real>` `:DISPlay:VIEW:DENSity:HDHue?`
Example	`:DISP:VIEW:DENS:HDH 60`
Preset	100.0
State Saved	Saved in State
Min	Lowest Density Hue + Resolution Note that the Highest Density Hue may not be set lower than or equal to Lowest Density Hue
Max	100.0

3.6.1.3 Lowest Density Hue

Lets you adjust where, as a percentage of the density range, the bottom of the color bar appears.

Remote Command	`:DISPlay:VIEW:DENSity:LDHue <real>` `:DISPlay:VIEW:DENSity:LDHue?`
Example	`:DISP:VIEW:DENS:LDH 40`
Notes	We send 40 to set 40%, although 40% is, strictly speaking, 0.4. This is inconsistent with the way percentages read back but, I think, more intuitive when you are setting a value
Preset	0.0
State Saved	Saved in instrument state
Min	0.0
Max	Highest Density Hue - Resolution Note that the Lowest Density Hue may not be set higher than or equal to Highest Density Hue

3.6.1.4 Curve Nonlinearity

Within the color range specified by the minimum and maximum density, this control allows a smooth weighting towards the higher or lower ends of the color gradient for the same density data. Larger values for curve nonlinearity will compress the colors used towards the higher end of the color bar, and smaller values will compress the colors towards the bottom.

Remote Command	`:DISPlay:VIEW:DENSity:CNONlinear <real>` `:DISPlay:VIEW:DENSity:CNONlinear?`
Example	`:DISP:VIEW:DENS:CNON 50`
Preset	0.0
State Saved	Saved in instrument state
Min	-100.0
Max	100.0

3.6.1.5 Color Palettes

Allows the selection of different color palettes which allows optimization of visibility and contrast for different signal environments

Remote Command	`:DISPlay:VIEW:DENSity:CPALettes COOL | WARM | GRAY | RADar | FIRE | FROSt` `:DISPlay:VIEW:DENSity:CPALettes?`
Example	`:DISP:VIEW:DENS:CPAL COOL`
Preset	WARM
State Saved	Saved in instrument state
Range	Cool|Warm|Grayscale|Radar|Fire|Frost

3.6.1.6 Auto Adjust Density Levels

Sets the "Highest Density Hue" on page 200 to the value of the highest density value found in the current density bitmap and sets the "Lowest Density Hue" on page 200 to the lowest non-zero density value.

Remote Command	`:DISPlay:VIEW:DENSity:AADJust`
Example	`:DISP:VIEW:DENSity:AADJ`

3.6.1.7 Display Trace

You can specify which Spectrogram or Powergram trace to display in the Spectrum window by using the Display Trace parameter. This function determines which of the traces stored in the waterfall window is currently being viewed in the Spectrum or PvT window. Display Trace 0 shows the latest trace.

The selection of the display trace can be by trace number or by trace start time. The TIME form (see Start Time) can be used to determine the time that the current trace in the spectrogram started or pick as the display trace the trace whose start time is closest to the specified time.

Window 4 is the Waterfall window, associated with the Spectrogram, and Window 9 is the Waterfall PvT window, associated with the Powergram.

Remote Command	Display Trace for Waterfall window
	`:DISPlay:WINDow4:TRACe:POSition <integer>`
	`:DISPlay:WINDow4:TRACe:POSition?`
	Display Trace for Waterfall PvT window
	`:DISPlay:WINDow9:TRACe:POSition <integer>`
	`:DISPlay:WINDow9:TRACe:POSition?`

Example	`:DISP:WIND4:TRAC:POS 146`
	Set Display Trace to 146 for the Waterfall window
	`:DISP:WIND4:TRAC:POS 23`
	Set Display Trace to 23 for the Waterfall PvT window

Notes	Window 4 is the Waterfall window, associated with the Spectrogram, and Window 9 is the Waterfall PvT window, associated with the Powergram.
Dependencies	Only appears when a Waterfall window is present, and either that window or its associated window (Spectrum or PvT) is selected. If the SCPI command is sent at any other time, it is accepted without error but you won't see the result until you once again display the Waterfall window.
Couplings	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 1 by Restore Mode Defaults. The value is remembered when you go in and out of Spectrogram View.
State Saved	Saved in instrument state
Min/Max	1/10,000 Option DP4: 1/50000
Backwards Compatibility SCPI	`:TRACe:DISPlay:VIEW:SPECtrogram:POSition <integer>`

3.6.1.8 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) can be used to pick as the display trace the trace with the desired number.

Remote Command	Start Time for Waterfall window
	`:DISPlay:WINDow4:TRACe:TIME <time>`
	`:DISPlay:WINDow4:TRACe:TIME?`
	Start Time for Waterfall PvT window
	`:DISPlay:WINDow9:TRACe:TIME <time>`
	`:DISPlay:WINDow9:TRACe:TIME?`

Example	`:DISP:WIND4:TRAC:TIME 250 ms`
	Sets the Waterfall display trace to be at the given start time. If the time is not exact, the approximate start will be calculated.
	`:DISP:WIND9:TRAC:TIME?`
	Returns the start time of the Waterfall PvT Display Trace relative to the start time of the “live” trace (Powergram Trace 1)

Notes	Window 4 is the Waterfall window, associated with the Spectrogram, and Window 9 is the Waterfall PvT window, associated with the Powergram.
Dependencies	Only appears when a Waterfall window is present, and either that window or its associated window (Spectrum or PvT) is selected. If the SCPI command is sent at any other time, it is accepted without error but you won’t see the result until you once again display the Waterfall window.
Preset	On Preset, the time for all indexes are set to NaN, 9.91E+37, upon clearing out all the Spectrogram or Powergram waterfall data. No Valid time data is present until data has been stored at an index. In RTSA, this is true for all indexes including index 1.
State Saved	Saved in instrument state
Backwards Compatibility SCPI	`:TRACe:DISPlay:VIEW:SPECtrogram:TIME <time>`

3.6.1.9 Couple Marker To Display Trace

Allows you to couple the maker to the selected Display Trace. When turned Off, this allows you to fix the marker to the Display Trace that was active when the marker was turned on. When turned On the Marker will stay with the selected Display Trace as it is changed.

Window 4 is the Waterfall window, associated with the Spectrogram, and Window 9 is the Waterfall PvT window, associated with the Powergram.

Remote Command	`:DISPlay:WINDow4:TRACe:COUPle ON | OFF | 1 | 0`
	`:DISPlay:WINDow4:TRACe:COUPle?`
	`:DISPlay:WINDow9:TRACe:COUPle ON | OFF | 1 | 0`
	`:DISPlay:WINDow9:TRACe:COUPle?`

Example	`:DISP:WIND4:TRAC:COUP ON`
Dependencies	Only appears when a Waterfall window is present, and either that window or its associated window (Spectrum or PvT) is selected.
Preset	OFF
State Saved	Saved in instrument state
Backwards Compatibility SCPI	`:DISPlay:VIEW:SPECtrogram:TRACe:COUPle ON|OFF|1|0`

3.6.1.10 Couple Display Trace Positions

When the Quad View with Spectrogram and Powergram is on, the two Display Traces can be coupled together by setting Couple Display Trace to true. Moving one Display Trace will cause the other Display Trace to follow on position. Both Display Traces will be synchronized in position.

Remote Command	`:DISPlay:TRACe:COUPle[:STATe] ON,OFF,0,1` `:DISPlay:TRACe:COUPle[:STATe]?`
Example	`:DISP:TRAC:COUP ON`
Dependencies	Only appears when the Waterfall windows are present. Both Spectrogram and Powergram Waterfalls must be on.
Couplings	When ON, the Spectrogram Display Trace and Powergram Display Trace are coupled and
State Saved	Saved in instrument state

3.6.1.11 Color Adjust

Color Adjust opens a Menu Panel dialog that enables you to adjust the color hue in the display. You can adjust the Reference Hue, the Reference Hue Position, and the Bottom Hug Position.

Reference Hue

Enables you to adjust 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.

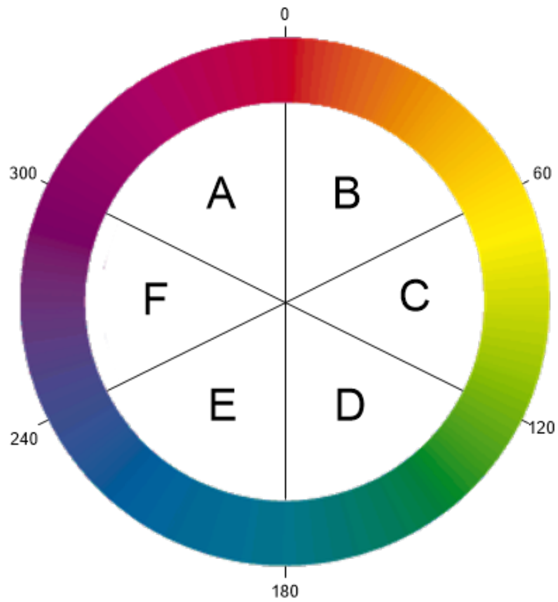
See "More Information" on page 205

Remote Command	set the Reference Hue for the Waterfall window
	`:DISPlay:WINDow4:HUE <real>`
	`:DISPlay:WINDow4:HUE?`
	set the Reference Hue for the Waterfall PvT window
	`:DISPlay:WINDow9:HUE <real>`
	`:DISPlay:WINDow9:HUE?`

Example	`:DISP:WIND4:HUE 120 sets the Reference Hue for the Waterfall window`
Notes	Window 4 is the Waterfall window, associated with the Spectrogram, and Window 9 is the Waterfall PvT window, associated with the Powergram.
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
Backwards Compatibility SCPI	`:DISPlay:VIEW:SPECtrogram:HUE <real>`

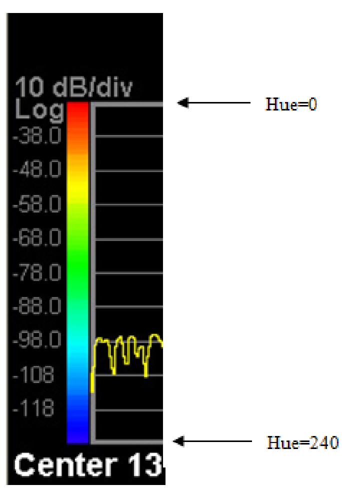
More Information

To understand how this works and understanding of the concept of “Hue” is necessary. The Hues of the colors run from 0 to 359 (360 is the same as 0) and are shown on the color wheel below:

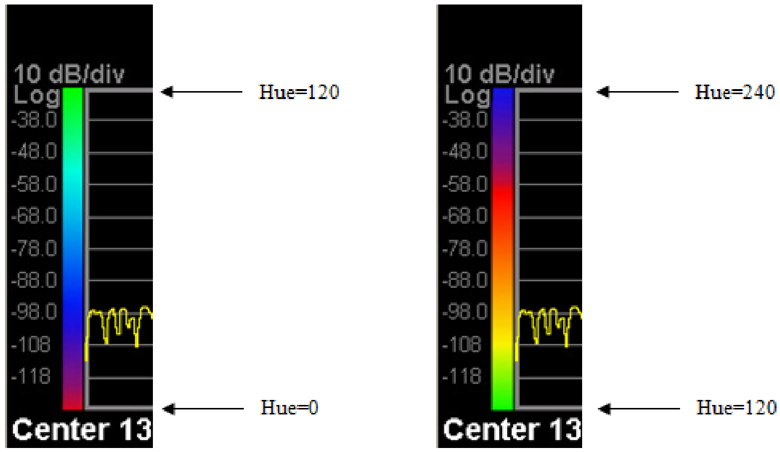


Hue 0 is Red (255,0,0), Hue 120 is Green (0,255,0) and Hue 240 is Blue (0,0,255). Hue 60 is Yellow (255,255,0), Hue 180 is Cyan (0,255,255) and Hue 300 is Magenta (255,0,255). In region A-B, the red value is constant (255), in C-D, the green value is constant (255), and in E-F, the blue value is constant (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 the 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 Ref Hue. Thus, in the normal case, the color bar appears like this:

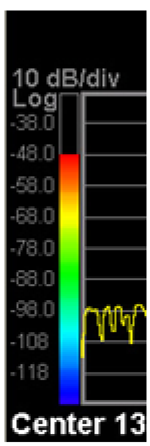


Here are other examples of Ref Hue settings:



Reference Hue Posn

This control lets you adjust where, as a percentage of the graticule, the Ref Hue appears. Above the Ref Hue Position, any amplitudes simply map as black. As an example, here is what the color bar looks like when the Ref Hue Position is set to 80%:



Remote Command	Set the Reference Hue Posn for the Waterfall window
	`:DISPlay:WINDow4:REFerence <integer>`
	`:DISPlay:WINDow4:REFerence?`
	Set the Reference Hue Posn for the Waterfall PvT window
	`:DISPlay:WINDow9:REFerence <integer>`
	`:DISPlay:WINDow9:REFerence?`

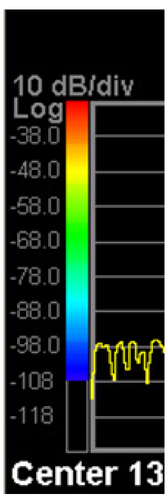
Example	`:DISP:WIND9:REF 60` `:Sets the Reference Hue Position for the Waterfall PvT window`
Notes	Window 4 is the Waterfall window, associated with the Spectrogram, and Window 9 is the Waterfall

	PvT window, associated with the Powergram.
Notes	We send 60 to set 60%, although 60% is, strictly speaking, 0.6. This is inconsistent with the way percentages read back but more intuitive when you are setting a value.
Preset	100
State Saved	Saved in instrument state
Min	Reference Hue Posn is not allowed to go any lower than 10% or Bottom Hue Position + 10, whichever is higher.
Max	100
Backwards Compatibility SCPI	`:DISPlay:VIEW:SPECtrogram:REFerence <integer>`

Bottom Hue Position

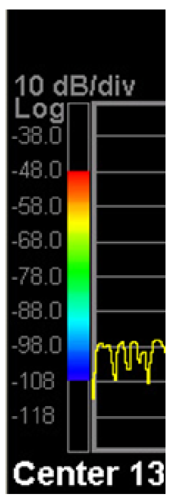
This control lets you adjust where, as a percentage of the graticule, the bottom of the color bar appears. Below the color bar is black, and any amplitudes in this region simply map as black.

Examples:



Ref Hue Position = 100%

Bottom Hue Position = 20%



Ref Hue Position = 80%

Bottom Hue Position = 20%

Each spectrograph window or PvT window associated with a Spectrogram or Powergram respectively will have its own color bar and independent control. The Waterfall RT Trace Result color adjustments are coupled to the Waterfall or Waterfall PVT result window control for their color bars. The frequency domain and time domain have the same color bar control so that their amplitudes are synchronized between Waterfall result displays for their respective domains.

Remote	Set the Bottom Hue Position for the Waterfall window

Command	`:DISPlay:WINDow4:BOTTom <integer>`
	`:DISPlay:WINDow4:BOTTom?`
	Set the Bottom Hue Position for the Waterfall PvT window
	`:DISPlay:WINDow9:BOTTom <integer>`
	`:DISPlay:WINDow9:BOTTom?`

Example	`:DISP:WIND4:BOTT 40 sets the Bottom Hue Position for the Waterfall window`
Notes	Window 4 is the Waterfall window, associated with the Spectrogram, and Window 9 is the Waterfall PvT window, associated with the Powergram.
Notes	We send 40 to set 40%, although 40% is, strictly speaking, 0.4. This is inconsistent with the way percentages read back but more intuitive when you are setting a value.
Preset	0
State Saved	Saved in instrument state
Min	0
Max	Bottom Hue Position is not allowed to go any higher than 90% or Ref Position - 10, whichever is lower.
Backwards Compatibility SCPI	`:DISPlay:VIEW:SPECtrogram:BOTTom <integer>`

Auto Adjust Hue Positions

Sets the Ref Hue Position (see "Reference Hue Posn" on page 207) to the highest amplitude value found in the Spectrogram or Powergram and sets the Bottom Hue Position (see "Bottom Hue Position" on page 208) to the lowest amplitude value found in the Waterfall or Waterfall PvT window.

Remote Command	`:DISPlay:WINDow4:AADJust` `:DISPlay:WINDow9:AADJust`
Example	`:DISP:WIND4:AADJ`
Notes	Window 4 is the Waterfall window, associated with the Spectrogram, and Window 9 is the Waterfall PvT window, associated with the Powergram.
Backwards Compatibility SCPI	`:DISPlay:VIEW:SPECtrogram:AADJust`

3.6.1.12 Traces:Update

Traces:Update (or Traces Per Update) allows you to manually control the number of traces (scans, slices, or frames) for each update to the display. When in the Auto state, the algorithm tries to pick the fastest traces per update for a given acquisition time. The Manual state gives you control over how many traces per update can be configured in order to enhance the responsiveness of the display for the signal being observed.

Preset	Auto

3.6.1.13 Full Display Update

The update algorithm can be configured to do an update representing the entire screen size of traces. By default, it is turned off. If turned on, it will adjust the updates to take up the full screen meaning that one contiguous block of traces will be updated at a time. For slower acquisition times where the update interval is faster, the difference between the on and off states will not be noticeable. If the acquisition time is significantly fast, the whole spectrogram screen will be one contiguous snapshot of the data.

Preset	Off

3.6.1.14 Select Display Line

This control allows you to select the display line currently being controlled by the **Display Line** control.

Preset	1

3.6.1.15 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, or marked “DL1” for Display Line 1, “DL2” for display line 2, etc.

In measurements which support multiple Display Lines, this control affects whichever Display Line has been selected by the **Select Display Line** Control.

The display line can be adjusted using the step keys, knob, or numeric keypad. The unit of the Display Line is determined by the **Y axis unit** setting 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.

The display line is unaffected by Auto Couple.

Remote Command	`:DISPlay:WINDow[1]:TRACe:Y:DLINe[1]|2|...|4 <ampl>`
	`:DISPlay:WINDow[1]:TRACe:Y:DLINe[1]|2|...|4?`
	`:DISPlay:WINDow[1]:TRACe:Y: DLINe[1] | 2 | ... | 4:STATe OFF | ON | 0 | 1`
	`:DISPlay:WINDow[1]:TRACe:Y: DLINe[1] | 2 | ... | 4:STATe?`

Example	`:DISP:WIND:TRAC:Y:DLIN:STAT ON`
	Turns on Display Line; if multiple display lines, turns on Display Line 1
	`:DISP:WIND:TRAC:Y:DLIN2 -32 dBm`
	Adjust Display Line 2

Couplings	When a value is set for the display line, turn it On. When the Display Line goes from Off to On, if it is off screen, set it 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	–¥ (minus infinity) in current units
Max	+¥ (plus infinity) in current units

3.6.1.16 Select Freq Line

This control allows you to select the display line currently being controlled by the **Freq Line** control.

Preset	1

3.6.1.17 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 the **Select Freq Line** key.

The Freq Line can be adjusted using the step keys, knob, or numeric keypad. If more than one window has a Freq Line, the Freq Line of the selected window is controlled.

If the Freq Line is off the 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.

The Freq Line is unaffected by Auto Couple.

Remote Command	`:DISPlay:WINDow[1]:TRACe:X:FLINe[1]|2|...|4 <ampl>`
	`:DISPlay:WINDow[1]:TRACe:X:FLINe[1]|2|...|4?`
	`:DISPlay:WINDow[1]:TRACe:X:FLINe[1]|2|...|4:STATe OFF | ON | 0 | 1`
	`:DISPlay:WINDow[1]:TRACe:X:FLINe[1]|2|...|4:STATe?`

Example	`:DISP:WIND:TRAC:X:FLIN:STAT ON`
	Turn Freq Line 1 on
	`:DISP:WIND:TRAC:X:FLIN3 1 GHz`
	Set Freq line 3 to 1 GHz

Dependencies	Freq Lines and this control only display in Frequency Domain windows
Couplings	When a value is set for the Freq Line, turn it On. When the Freq Line goes from Off to On, if it is off screen, set it 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.

3.6.1.18 Select Time Line

This control allows you to select the display line currently being controlled by the **Time Line** control.

Preset	1

3.6.1.19 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 the **Select Time Line** key.

The Time Line can be adjusted using the step keys, knob, or numeric keypad. If more than one window has a Time Line, the Time Line of the selected window is controlled.

If the Time Line is off the 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.

The Time Line is unaffected by Auto Couple.

Remote Command	`:DISPlay:WINDow[1]:TRACe:X:TLINe[1]|2|...|4 <ampl>`
	`:DISPlay:WINDow[1]:TRACe:X:TLINe[1]|2|...|4?`
	`:DISPlay:WINDow[1]:TRACe:X:TLINe[1]|2|...|4:STATe OFF | ON | 0 | 1`
	`:DISPlay:WINDow[1]:TRACe:X:TLINe[1]|2|...|4:STATe?`

Example	`:DISP:WIND:TRAC:X:TLIN:STAT ON`
	Turn Time Line 1 on
	`:DISP:WIND:TRAC:X:TLIN3 1.2 ms`
	Set Time Line 3 to 1.2 ms

Dependencies	Time Lines and this control only display when in a time-domain window, such as PvT or Waterfall PvT, is selected.
Couplings	When a value is set for the Time Line, turn it On. When the Time Line goes from Off to On, if it is off screen, set it 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.

3.6.2 View

The View tab contains controls for selecting the current View and for editing User Views.

3.6.2.1 Views

The Spectrum & PvT measurement has eleven views.

Some of 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.

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 | DENSity | DSGRam | PVTime | PSPectrum | PSGRam | POWergram | POSPectro`
Example	Set Normal view: `:DISP:VIEW NORM`

	Set Powergram Spectrogram view: `:DISP:VIEW POSP`
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 -221, "Option not available" is generated
Preset	`NORMal`
State Saved	Saved in instrument state

3.6.2.2 User View

The User View radio button panel 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	`:DISP:VIEW:ADV:SEL "Baseband"` Select Baseband as the current View

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 do NOT use the legacy View parameter (which in this case would be TZOom) with the :DISP:VIEW:ADV:SEL command.
	<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 will return the error message "-224.XXXX,Illegal parameter value; View with the name <alphanumeric> does not exist" 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.

Backwards Compatibility SCPI	The legacy node `:DISPlay:VIEW[:SELect]` is retained for backwards compatibility, but it only knows about the predefined views.

3.6.2.3 Restore Layout to Default

When you are finished with it, you can restore the Layout to the default for Basic by pressing “Restore Layout to Default”. Modified Views are very temporary; if you exit the current measurement they are discarded, and they are not saved in State. Since you will often want to keep this View for later use, and since you probably would like to get back your original Basic View, you can save your edited View as a “User View”.

3.6.2.4 Save Layout as New View

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.

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.XXXX,Illegal parameter value;View <alphanumeric> already exists” is generated. If the display is disabled (via DISP:ENAB OFF) then the error message “-221.XXXX,Settings conflict;User View SCPI cannot be used while Display is disabled” is generated.

3.6.2.5 Re-Save User View

You can 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.

This is a front panel function only, there is no SCPI remote command available to perform this function. To do this remotely, you have to first perform a “Save Layout as New View” function, then delete the old User View and rename the new one with the name of the View you just deleted.

3.6.2.6 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, you will get an error.

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.XXXX,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.

3.6.2.7 Delete User View

You can delete the current View if it is a User View. The default view become 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.

3.6.3 Annotation

The Annotation tab contains controls for setting up the annotation for the current Mode or Measurement.

3.6.3.1 Graticule

Pressing **Graticule** turns the display graticule On or Off for all windows with graticules in all measurements in the current Mode. It 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

3.6.3.2 Screen Annotation

This 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/Detector chapter.

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 set to Off.
Preset	On This should remain Off through a Preset when **System Display Settings**, **Annotation** is set to Off
State Saved	Saved in instrument state.

3.6.3.3 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 set to Off.
Preset	On This should remain Off through a Preset when **System Display Settings**, **Annotation** is set to Off
State Saved	Saved in instrument state.

3.6.3.4 Meas Bar

This function 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 set to Off.
Preset	On This should remain Off through a Preset when **System Display Settings**, **Annotation** is set to Off.
State Saved	Saved in instrument state.

3.7 Frequency

Accesses a menu of 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.

3.7.1 Settings

The Settings Tab 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.

3.7.1.1 Center Frequency

Sets the frequency that corresponds to the horizontal center of the graticule (when frequency Scale Type is set to linear). While adjusting the Center Frequency the Span is held constant, this means that both Start Frequency and Stop Frequency will change.

In measurements that also have Start Freq and Stop Freq controls, pressing Center Freq 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 Freq**. In the Start/Stop annotation mode, Start Freq and Stop Freq are displayed below the graticule instead of Center Freq and Span.

Pressing Center Freq 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 Freq**.

When frequency Scale Type is set to log, pressing Center Freq 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 will have a **Global** tab in its **Meas Setup** menu.

The **Center Freq** function sets (and queries) the Center Frequency for the currently selected input. If your analyzer 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 223

– Ext Mix Center Freq

– "Center Frequency Presets" on page 221

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
Dependencies	The Center Frequency can be limited by Start or Stop Freq limits, if the Span is so large that Start or Stop reaches their limit
Couplings	When operating in frequency domain, any value of the Center Frequency or Span that is within the frequency range of the analyzer is allowed when 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 the Start and the Stop Frequencies within the analyzer'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 analyzer) is allowed. The other parameter is forced, as necessary, to keep the Start Freq and Stop Freq within the analyzer 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 get back to the initial Center Freq and Span by changing only the current parameter
Preset	Depends on instrument maximum frequency, mode, measurement, and selected input See "Center Frequency Presets" on page 221 and "RF Center Freq" on page 223 and Ext Mix Center Freq
State Saved	Saved in instrument state
Min/Max	Depends on instrument maximum frequency, mode, measurement, and selected input See "Center Frequency Presets" on page 221 and "RF Center Freq" on page 223
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

Freq Option	CF after Mode Preset	Stop Freq after Mode Preset	Max Freq (can't tune above)
504 (M9420A/21A, M8920A)	2.145 GHz	3.88GHz	3.88 GHz
506 (M9420A/21A, 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

RF Center Freq

SCPI command for specifying the RF Center Frequency. This command will set 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

SCPI command for specifying the External Mixer Center Frequency. This command will set 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
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 analyzer 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: 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 analyzer 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	Saved in instrument state
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

3.7.1.2 Span

Changes the displayed frequency range symmetrically about the center frequency. While adjusting the Span, the Center Frequency is held constant, this means that both Start Frequency and Stop Frequency will change.

In measurements that also have Start Freq and Stop Freq controls, pressing Span 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 Freq**. In the Start/Stop annotation mode, Start Freq and Stop Freq are displayed below the graticule instead of Center Freq and Span.

If the 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 Span set is determined by the instrument based upon the inter-dependencies of Span PvT (if PvT results are active), Acquisition Time and Points. The Span will be adjusted as close to the entered Span as determined by the interdependency algorithms of the instrument.

Remote Command	`[:SENSe]:<meas>:FREQuency:SPAN <freq>` `[:SENSe]:<meas>:FREQuency:SPAN?`
Example	`:FREQ:SPAN 10 MHz` `: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
Couplings	– In instruments with Option B5X, PvT has a maximum Span of 255 MHz. If the Span is greater than 255 MHz when going into a View which contains PvT, the Span will be set to 255 MHz. Attempts to set the Span greater than 255 MHz will generate the message "-221, Settings conflict; > 255 MHz unavailable in PvT". When leaving such a View, the span remains at the current value – Any value of the Center Frequency or Span that is within the frequency range of the analyzer is allowed when 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 the Start and the Stop Frequencies within the analyzer'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 i.e. the Center Frequency or Span, is limited so that the other parameter is not forced to a new value
Preset	Max IF BW of the installed option, for example, for Opt B2X (255 MHz), Preset Span will be 255.176 MHz
State Saved	Saved in instrument state
Min	100 Hz
Max	Depends on instrument maximum frequency 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, Acquisition Time, Points , and Span PvT (if IF Duplex and PvT results are active) The maximum value to acquire data with a single acquisition is the Max IF BW of the installed option, for example, for Opt B2X (255 MHz), a Span of 255.176 MHz will still allow single acquisition. For this reason, Full Span sets this value.
Annotation	Span <value> appears on the first line of the annotation in the lower right corner of display

3.7.1.3 Span PvT

The Span PvT control is used to set the Span/Acquisition Bandwidth of the Time Domain windows, separately from the Span/Acquisition Bandwidth of the Frequency Domain windows, which are set by the Span control. In other words, one Span/IF Bandwidth is used for the frequency domain windows (Span) and one for the time domain windows (Span PvT).

The Span and Span PvT controls are independent only if the IF Duplex function (in the Meas Setup menu under the Advanced tab) is set to ON (the default). In this case the Span parameter will control the Spectrum, Density, and Spectrogram windows, and the Span PvT parameter will control the PvT and Powergram windows.

If IF Duplex is set to OFF, the Digital IFs work together to build one large contiguous IF, and the Span/IF Bandwidth functions cannot be controlled independently; Span and Span PvT will be linked and show the same value and for Real Time Spectrum, Spectrogram, Density, PvT or Powergram based results, the same Span (IF acquisition bandwidth) applies to all windows.

The Span PvT and IF Duplex controls only appear if Option DUA is present.

Remote Command	`[:SENSe]:FREQuency:PVTime:SPAN <freq>` `[:SENSe]:FREQuency:PVTime:SPAN?`
Example	`:FREQ:PVT:SPAN 2GHz` `:Sets the span to 2GHz`
Dependencies	Requires Option DUA. If Option DUA is not present, this control does not appear. If IF Duplex (in the Meas Setup menu under the Advanced tab) is OFF, Span and Span PvT will have the same value, and this command will change both Span and Span PvT together.
Preset	Depends on instrument maximum frequency, mode, measurement, and selected input See Span Presets for RTSA
State Saved	Saved in instrument state
Min	0 Hz
Max	Depends on instrument maximum frequency, mode, measurement, and selected input. See Span Presets for RTSA.

3.7.1.4 Full Span

Changes the frequency span to the Preset frequency span and sets the Frequency entry mode to Center/Span. In RTSA, the maximum Span to acquire data with a single acquisition is the Max IF BW of the installed option, for example, for Opt B2X (255 MHz), a Span of 255.176 MHz will still allow single acquisition. For this reason, Full Span sets this value.

The span is dependent on the currently selected Input (see the Section "Input/Output"). For example, when using external mixing, it changes the frequency to the Preset frequency range specified for the selected external mixing band.

Remote Command	`[:SENSe]:FREQuency:SPAN:FULL`
Example	`:FREQ:SPAN:FULL` Sets the span to full bandwidth of the widest IF
Couplings	Full Span does NOT turn off the markers, or the current active function.

3.7.1.5 Start Freq

Sets the frequency at the left side of the graticule. While adjusting the start frequency, the stop frequency is held constant, which means that both the center frequency and span 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.**

See "RTSA Start Freq Presets" on page 228

Remote Command	`[:SENSe]:FREQuency:STARt <freq>` `[:SENSe]:FREQuency:STARt?`
Example	`:FREQ:STAR 200 MHz` `:FREQ:STAR?`
Notes	Max values depends on Hardware Options (5xx)
Dependencies	By direct entry: You cannot set Start frequency > Stop frequency. You cannot set Start frequency = Stop frequency. You cannot set Start Frequency to a value that would create a span of less than 100 Hz. If you try to do any of these, Stop Frequency will change to maintain a minimum value of 100 Hz for the difference between Start and Stop. With the knob or step keys: Cannot increment Start Freq to a value greater than Stop Freq – 100 Hz The Start Frequency can be limited by Span limits, if the Stop Frequency is below its preset value. If the electronic/soft attenuator is enabled, any attempt to set the Start 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.
Couplings	The parameters Center Freq, Start Freq, Stop Freq, Span, Span PvT (if IF Duplex and PvT results are active), Acquisition Time, and Points are interdependent, as changing one necessarily affects one or more of the others. The couplings between Center Freq 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 & CF preset, and Start Freq is derived. On a Meas Preset only Span presets, CF does not, so Start Freq will vary depending on CF. 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. 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 analyzer uses the maximum Span the measurement allows, and sets the Center Freq to the midpoint of the Start and Stop Freq values in the Harmonic Table. Thus, in this case, the Start Freq will preset to a frequency below the preset Center Freq 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 a Restore Input/Output Defaults, if you go into External Mixing and do a Mode Preset while in the RTSA Mode, the resulting Start Freq is 26.5 GHz.
State Saved	Saved in instrument state
Min	-80 MHz
Max	Depends on the instrument maximum frequency – 10 Hz. If the knob or step keys are being used, it depends on the value of the other three interdependent parameters(Stop Freq, Span and Center Freq). 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 the SCPI command :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

RTSA Start Freq Presets

Freq Option	Start Freq after Mode Preset (Opt B85)	Start Freq after Mode Preset (Opt B1X 140 MHz)	Start Freq after Mode Preset (Opt B1Y 160 MHz)	Start Freq after Mode Preset (Opt B2X 255 MHz)	Start Freq after Mode Preset (Opt B5X 510 MHz)
503	1.7625 GHz	1.735 GHz	1.725 GHz	1.6775	1.5500
507	3.4625 GHz	3.435 GHz	3.425 GHz	3.3775	3.2500
508	4.1625 GHz	4.135 GHz	4.125 GHz	4.0775	3.9500
513	6.7625 GHz	6.735 GHz	6.725 GHz	6.6775	6.5500
526	13.2125 GHz	13.185 GHz	13.175 GHz	13.1275	13.0000
532	15.9625 GHz	15.935 GHz	15.925 GHz	15.8775	15.7500
543	21.4625 GHz	21.435 GHz	21.425 GHz	21.3775	21.2500
544	21.9625 GHz	21.935 GHz	21.925 GHz	21.8775	21.7500
550	24.9625 GHz	24.935 GHz	24.925 GHz	24.8775	24.7500

Note that the above table is built with the assumption that RT2 license is installed.

3.7.1.6 Stop Freq

Sets the frequency at the right side of the graticule. While adjusting the stop Frequency, the start frequency is held constant, which means that both the center frequency and span 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**.

See "Zoom Center " on page 230

Remote Command	`[:SENSe]:FREQuency:STOP <freq>` `[:SENSe]:FREQuency:STOP?`
Example	`:FREQ:STOP 220 MHz` `:FREQ:STOP?`
Notes	Preset and Max values are dependent on Hardware Options (5xx)
Dependencies	By direct entry: You cannot set the Stop frequency < Start frequency. You cannot set Start frequency = Stop frequency. You cannot set Stop Frequency to a value that would create a span of less than 100 Hz. If you try to do any of these, Start Frequency will change to maintain a minimum value of 100 Hz for the difference between Start and Stop. With the knob or step keys: Cannot decrement Stop Freq to a value less than Start Freq + 100 Hz. If the electronic/soft attenuator is enabled, any attempt to set the Stop Frequency >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.
Couplings	The parameters Center Freq, Start Freq, Stop Freq, Span, Span PvT (if IF Duplex and PvT results are active),), Acquisition Time, and Points are interdependent, as changing one necessarily affects one or more of the others.
Preset	On Mode Preset, Span & CF preset, and Stop Freq is derived. See "Center Frequency Presets" on page 221 for a table which shows the Stop Freq after Preset for various model and option numbers). On a Meas Preset only Span presets, CF does not, so Stop Freq will vary depending on CF. When a Mode Preset is performed while in External Mixing, the Stop frequency 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. NOTE: 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 analyzer uses the maximum Span the measurement allows, and sets the Center Freq to the midpoint of the Start and Stop Freq values in the Harmonic Table. Thus, in this case, the Stop Freq will preset to a frequency above the preset Center Freq 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 a Restore Input/Output Defaults, if you go into External Mixing and do a Mode Preset while in the RTSA Mode, the resulting Stop Freq is 40 GHz.
State Saved	Saved in instrument state
Min	If the knob or step keys are being used, depends on the value of the other three interdependent parameters(Start Freq, Span and Center Freq).

	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 the SCPI command :FREQ:STOP? MIN.
Max	Depends on instrument maximum frequency. If the knob or step keys are being used, depends on the value of the other three interdependent parameters(Start Freq, Span and Center Freq). 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 the SCPI command :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

RTSA Stop Freq Presets

Freq Option	Stop Freq after Mode Preset (Opt B85)	Stop Freq after Mode Preset (Opt B1X 140 MHz)	Stop Freq after Mode Preset (Opt B1Y 160 MHz)	Stop Freq after Mode Preset (Opt B2X 255 MHz)	Stop Freq after Mode Preset (Opt B5X 510 MHz)
503	1.8475 GHz	1.875 GHz	1.885 GHz	1.9325	2.0600
507	3.5475 GHz	3.575 GHz	3.585 GHz	3.6325	3.7600
508	4.2475 GHz	4.275 GHz	4.285 GHz	4.3325	4.4600
513	6.8475 GHz	6.875 GHz	6.885 GHz	6.9325	7.0600
526	13.2975 GHz	13.325 GHz	13.335 GHz	13.3825	13.5100
532	16.0475 GHz	16.075 GHz	16.085 GHz	16.1325	16.2600
543	21.5475 GHz	21.575 GHz	21.585 GHz	21.6325	21.7600
544	22.0475 GHz	22.075 GHz	22.085 GHz	22.1325	22.2600
550	25.0475 GHz	25.075 GHz	25.085 GHz	25.1325	25.2600

Note that the above table is built with the assumption that RT2 license is installed.

3.7.1.7 Zoom Center

Zoom Center allows you to change the frequency of the zoom region, and hence of the lower window, without changing the Zoom Span, when you are in a 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 Freq or Span 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 or Stop Freq 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 present
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 analyzer 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 exactly the same as is Center Frequency.
Preset	On entry to Trace Zoom, the Zoom Center frequency is the same as the analyzer Center Frequency. So if you do a Mode Preset and then immediately go into Trace Zoom, Zoom Center matches the Preset values listed in the table under the Center Freq control description.
State Saved	Saved in instrument state
Min	Start Frequency of top window
Max	The maximum Zoom Center frequency is the same as the maximum analyzer Center Frequency, which is basically the instrument maximum frequency - 5 Hz. See the table under the Center Freq control description.
Annotation	In the Center Freq position of the Zoom Window

3.7.1.8 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, the 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 Freq or Span sets the frequency entry mode to Center/Span). When the frequency entry mode is Start/Stop, **Zoom Stop** is displayed in this lower right annotation position (pressing Start Freq or Stop Freq 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 the Zoom Span increases, if the edge of the zoom region hits either edge of the graticule, then as the Zoom Span continues to increase, the Zoom Center will change to keep the zoom region from leaving the upper window.
Dependencies	Only appears if the Zoomed Trace window is present
Preset	On entry to Trace Zoom, Zoom Span is 10% of the span of the upper window. So if you do a Mode Preset and then immediately go into Trace Zoom, Zoom Span is 10% of the Span Preset value listed in the table under the Span control description.
State Saved	Saved in instrument state
Min	10 Hz
Max	The Zoom Span is constrained by the top window (analyzer) span. It cannot get so large that Zoom Start goes below the analyzer Start Freq, or so that Zoom Stop goes above the analyzer 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

3.7.1.9 Zone Center

Zone center allows you to change the frequency of the zone without changing the zone span. As the zone center is changed, the center frequency of the lower window is changed. Note that the lower window will not be 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 will be 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 the Hardware Options (5xx)
Dependencies	Only appears if the Zone Spectrum window is present
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 analyzer Center Frequency. So if you do a Mode Preset and then immediately go into Zone Span, Zone Center matches the Preset values

	listed in the table under the Center Freq control description.
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 analyzer Center Frequency, which is basically the instrument maximum frequency - 5 Hz. See the table under the Center Freq control description.
Annotation	As the Center Freq of the Zone Window
Status Bits/OPC dependencies	Non-overlapped

3.7.1.10 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 analyzer. 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 will be 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 the Hardware Options (5xx)
Dependencies	Only appears if the Zone Spectrum window is present
Dependencies	Only appears in the **Zone Span** View in measurements that support this View. If the SCPI command is sent in other Views, gives 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, the Zone Span is 10% of the span of the upper window. So if you do a Mode Preset and then immediately go into Zone Span, the Zone Span is 10% of the Span Preset value listed in the table under the Span control description.
State Saved	Saved in instrument state

Min	0 Hz
Max	Zone Span 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

3.7.1.11 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 analyzer.

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 (503, 507, 508, 513, 526)
Notes	Preset and Max values are dependent on Hardware Options (5xx)
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
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

3.7.1.12 Freq Offset

Enables you to set a frequency offset value to account for frequency conversions outside of the analyzer. 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 analyzer 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 236.

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)
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 the user switches back to the RF Input. Freq Offset is not available when the frequency scale is set to Log, or segmented sweep is enabled. Forceful message -221.6700
Preset	See "Center Frequency Presets" on page 221
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	1. In pre-X-Series instruments, Frequency Offset could not be adjusted by the knob or step keys. That is no longer the case. 2. Some previous spectrum analyzers did not adjust frequency counter results for the Frequency 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 analyzer, 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.

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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 analyzer, 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 Marker

The **Marker** key 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.

When **Marker** is pressed, 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. If the selected marker is already **On** it will remain at the frequency/time and amplitude to which it is already set, even if this means it will be offscreen.

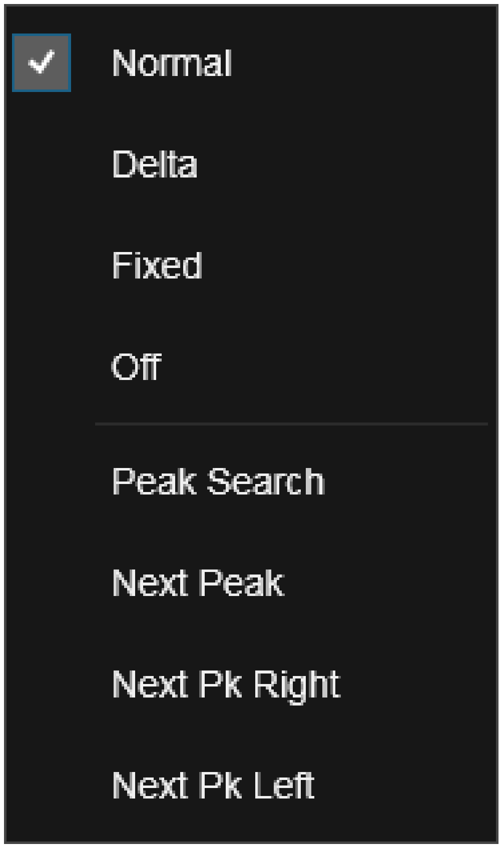
The fundamental marker operation involves setting a Marker's X-Axis value and then reading the marker's Y-Axis value. From the front panel you do this using the Marker menu, the knob and the green marker readout in the upper right corner of the display.

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.

Programmatically, to set the Marker's control mode, use the `:CALCulate:MARKer[n]:MODE` command. To set the Marker's X-Axis value use the `:CALCulate:MARKer[n]:X <freq|time>` command. To query the Marker's Y-Axis value, use the `:CALCulate:MARKer[n]:Y?` query. See "More Information" on page 246 and Setting/Querying the Marker X Axis Value for information on these functions.

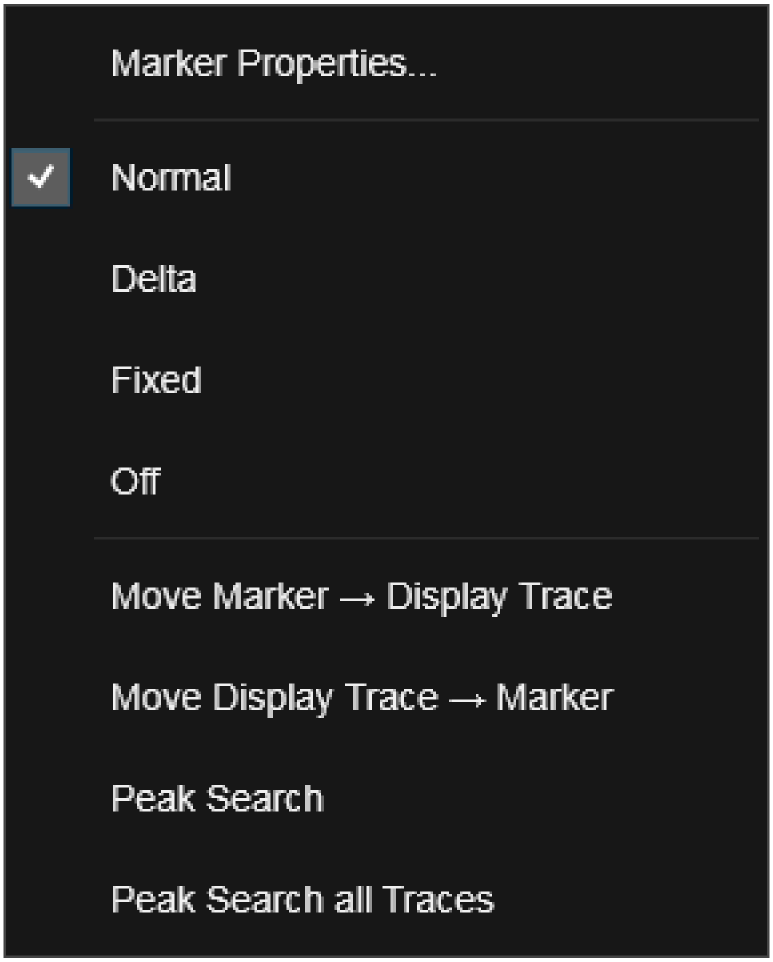
Marker right-click menu

If you right-click on a marker (or touch and hold a marker and wait for the circle to close) you will see the Marker Right-Click Menu:



If you now tap or click on one of the items in this menu, it will perform the corresponding function. Normal, Delta, Fixed or Off will set the Marker Mode (see "Marker Mode" on page 245). Peak Search, Next Peak, Next Pk Right or Next Pk Left will move the Marker to the appropriate peak (see "Peak Search" on page 251).

If you right-click on a marker (or touch and hold a marker and wait for the circle to close) in a Waterfall window (for example, in a Spectrogram or Powergram View) you will see the Waterfall Marker Right-Click Menu:



Normal, Delta, Fixed and Off work as above. Marker Properties opens the Marker Properties tab (see "Properties" on page 267). Move Marker -> Display Trace and Move Display Trace -> Marker work the same way as the corresponding controls in the Marker -> menu (see "Marker To" on page 293). 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 253).

When a marker is in a Waterfall window (either a Spectrogram or Powergram waterfall), the marker result annotation for the active marker in that window will display. If both Spectrogram and Powergram and assocated displays are on and a marker is on in each window, both the Spectral Graph Window and PvT Window will have Marker Result Annotations. The window that does not have the active marker will display the last active marker that was displayed in that window. When enough space is available, all three annotation results lines will be visible, otherwise only lines 1 & 2 of the Meaker result will be visible (using User Views, windows can be placed on separate monitors to show all three marker results).

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.

See:

– "More Information" on page 246

– Setting the Marker X Axis Value

– "Marker Backwards Compatibility" on page 241

3.8.1 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 (e.g., Counter).

On any menu tab for which Select Marker displays, the first control is always Marker Freqeuncy|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.

3.8.2 Settings

The controls on the Settings tab include the Marker active function and a radio button selection of the marker control mode (Normal, Delta, Fixed, or Off) for the selected marker, as well as additional functions that help you use markers.

3.8.2.1 Marker Frequency|Time

The Marker Frequency control is the fundamental control that you use to move a marker around on the trace. Because it is the default active function in the Marker menu, 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 which follows the Selected Marker.

If the marker is on a time domain trace, the label on this control changes to "Marker Time". When the Marker Mode is Delta, the label changes to "Marker D Frequency" or Marker D Time"

The SCPI 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?`
Notes	If no suffix is sent it will use 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 will be 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.
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 which has a marker function turned on. If an attempt is made to actually adjust it while a Marker Function is on, a warning message is generated.
Preset	After a preset, if X is queried with no value sent first, the center of screen value will be returned. This will depend on the frequency range of the instrument. 13.255 GHz is correct for the 26 GHz instruments only (Option 526).
Min	– ¥ (minus infinity)
Max	+ ¥ (plus 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 analyzer'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 or not you change the Center Frequency of the analyzer, 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, the user must turn the marker off and then back on after changing the center frequency of the analyzer. 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 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 to force markers to the edges of the screen will have to rewrite their code. Furthermore, since markers could never be offscreen they always returned a valid result. In the X-Series, markers which 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

The command below 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** or **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, will be 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 the Start Frequency 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
Preset	After a preset, if X is queried with no value sent first, the center of screen value will be returned. So if per default, the number of Trace points is 1001, the center value will be 500.
Min	0
Max	Number of trace points – 1
Backwards Compatibility SCPI	`:CALCulate:MARKer[1]|2|...|4:X:POSition:CENTer` This alias is provided for compatibility with the Band Power function in PSA and ESA. See details in the "Marker Function" section under "Band Function Backwards Compatibility" on page 278

3.8.2.2 Marker Amplitude

The fundamental item of marker data accessed by users is the marker's Y-Axis value, which is usually the Marker Amplitude. The query below is used to select the marker and read the marker's Y-Axis value.

When the Marker Mode 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 form has no effect (other than selecting the marker) unless the marker control mode is **Fixed.**

Remote Command	`:CALCulate:MARKer[1]|2|...|12:Y <real>` `:CALCulate:MARKer[1]|2|...|12:Y?`

Example	`:CALC:MARK2:MODE POS`
	Turns on marker 2 as a normal marker.
	`:CALC:MARK2:X 20 GHZ`
	Moves marker 2 to 20 GHz if X Axis Scale is Frequency. If X Axis Scale is Time, an Invalid Suffix error is generated.

Notes	The command `:CALCulate:MARKer[1]|2|3|4|5|6|7|8|9|10|11|12:Y?` returns the marker Y-axis result, if the control mode is **Normal, Fixed** or **Delta**. If the marker is **Off** the response is 9.91e37 ("not a number"). If no suffix is sent it will use the current Y Axis unit. If a suffix is sent that does not have units of absolute amplitude, an invalid suffix error will be 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 which has a marker function turned onIf an attempt is made to actually 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	– ¥ (minus infinity)
Max	+ ¥ (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 the X-Series, markers which 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. – Also, in some previous analyzers linear ratios read out on the display in %. In the X-Series they display as dimensionless quantities. E.g., a quantity that used to display as 52% now displays as .52. The SCPI behavior is unaffected as it has always read out the ratio rather than the percentage.

3.8.2.3 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 and you can use Marker Z to choose on which trace in a historical set of traces you want to place the Marker.

The command below 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** it 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	`:CALC:MARK2:MODE FIX`
	Sets Marker 2 to Fixed.
	`:CALC:MARK2:Z:POS 150`

	Puts Marker 2 on Trace 150
Notes	The command 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

The command below queries the Z-axis time value of the marker in the Spectrogram View only (see “Representation of Time” under the Spectrogram View description). The marker that is addressed becomes the selected marker.

Remote Command	`:CALCulate:MARKer[1]|2|...|12:Z?`
Notes	The query 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 present and either the Waterfall or Spectrum windows is selected. If the SCPI command is sent at any other time, it is accepted without error but you won’t see the result until you once again displays the Waterfall window.
Preset	9.91E+37
Min	-Infinity
Max	+Infinity

3.8.2.4 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 who's absolute Y Axis valueis 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 value is 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 which is not in use.

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.

See "More Information" on page 246

Remote Command	`:CALCulate:MARKer[1]|2|...|12:MODE POSition | DELTa | FIXed | OFF` `:CALCulate:MARKer[1]|2|...|12:MODE?`
Notes	Upon receipt of this command, for any parameter but **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 addressed 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` Setting a marker which is OFF to ON or 1 selects the marker, puts it in Normal mode and places it at the center of the screen. Setting a marker which is not OFF to ON has no effect (does not change its control mode). Example: CALC:MARK2:STAT ON sets Marker 2 to Normal if it was off; otherwise it does nothing. The response to the query will be ON unless the marker is OFF.
Backwards Compatibility SCPI	`:CALCulate:MARKer[1]|2|...|12:MODE SPAN|BAND` To support band function backwards compatibility, both of these legacy parameters are accepted and aliased to POSition. They are never returned to a query. See "Band Function Backwards Compatibility" on page 278 for more information.

Remote Command	`:CALCulate:MARKer[1]|2|...|12:STATe OFF | ON | 0 | 1` `:CALCulate:MARKer[1]|2|...|12:STATe?`
Preset	OFF

More Information

Value	Example	Notes
Normal	CALC:MARK2:MODE 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	:CALC:MARK2:MODE DELT	In Delta mode the marker result shows the relative result between the selected (Delta) marker and its reference markerA 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	:CALC:MARK2:MODE 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 with 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	:CALC:MARK2:MODE 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 as specified in “Fractional Trace Points”, above. 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 as specified in "Fractional Trace Points", above. 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. It can be directly moved in both X and Y by the user, and it can be indirectly moved through interactions with other markers and instrument settings, for example by re-zeroing the delta if it is a relative marker, or through Coupled Markers. 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 as specified in "Fractional Trace Points", above. 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.

3.8.2.5 Delta Marker (Reset Delta)

Pressing this control is exactly the same as pressing the “Delta” selection on the Marker Mode radio button. See "Marker Mode" on page 245.

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.

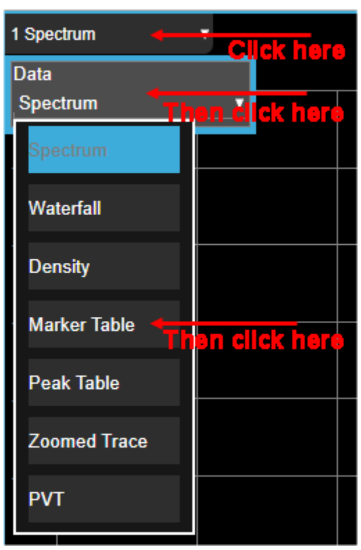
3.8.2.6 Marker Table

When set to On, the display is split into a measurement window and a marker data display window. For each marker which 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 which have marker functions turned on.

Turning the Marker Table on turns the Peak Table off and vice versa.

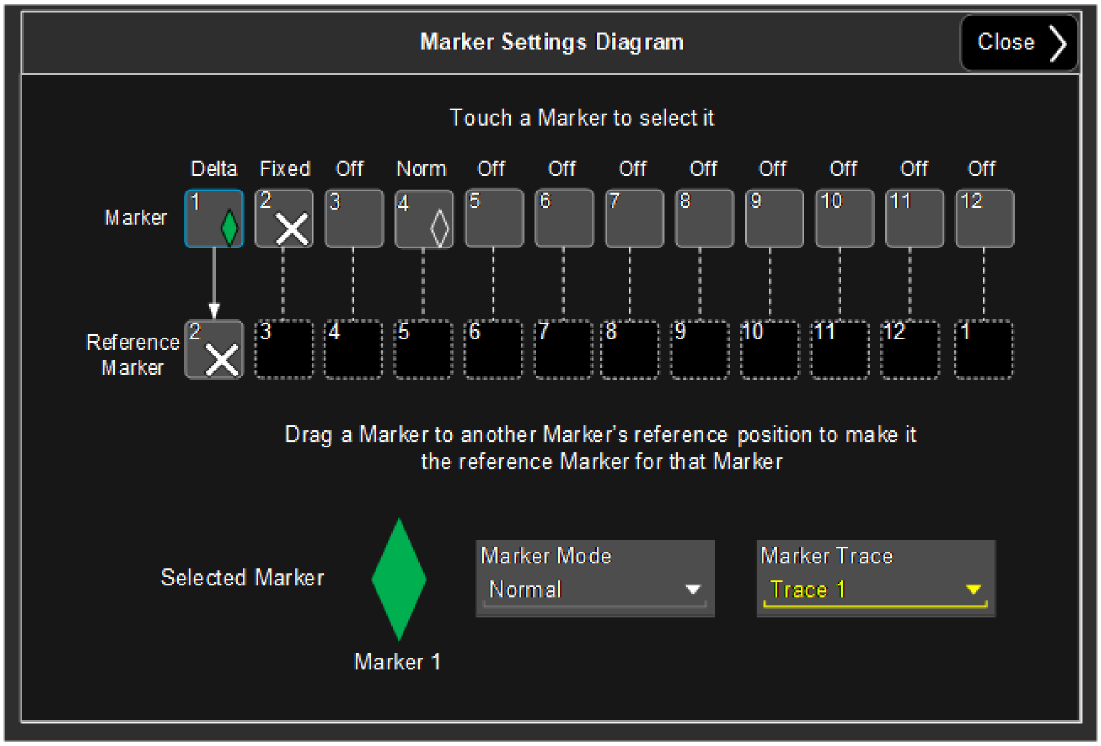
Remote Command	`:CALCulate:MARKer:TABLe[:STATe] OFF | ON | 0 | 1` `:CALCulate:MARKer:TABLe[:STATe]?`

Example	`:CALC:MARK:TABL ON`
	Turns on the marker table.
	`:CALC:MARK:TABL?`

Dependencies	This switch is only available in the Normal View. Marker Table is also available as a selection in the Window Data dropdown (in the upper left corner of the window) in all Views. 
Preset	OFF
State Saved	The on/off state of the Marker Table is saved in instrument state

3.8.2.7 Marker Settings Diagram

The Marker Settings Diagram lets you configure the Marker system using a visual utility.



3.8.2.8 All Markers Off

Turns off all markers.

Remote Command	form used in Swept SA & Spectrum & PvT measurements:
	`:CALCulate:MARKer:AOFF`
	form used in all other measurements. Replace <meas> with the meas name, eg CHPower
	`:CALCulate:<meas>:MARKer:AOFF`

Example	`:CALC:MARK:AOFF` Swept SA & RTSA turns off all markers.
Dependencies	In the ACP measurement, this control is unavailable when Meas Method is set to RBW.
Couplings	In the Swept SA measurements, sets the selected marker to 1.
Backwards Compatibility SCPI	`:CALCulate:BPOWer:MARKer:AOFF` Burst Power

3.8.2.9 Couple Markers

When this function is On, moving any marker causes an equal X Axis movement of every other marker which 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).

In the WCDMA mode, when the marker is assigned to the Polar graph, a symbol value (Code Domain measurement) /a chip value (Mod Accuracy and QPSK EVM measurement) is coupled instead of an X axis value.

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	form used in Swept SA & Spectrum & PvT measurements:
	`:CALCulate:MARKer:COUPle[:STATe] OFF | ON | 0 | 1`
	`:CALCulate:MARKer:COUPle[:STATe]?`

Example	`:CALC:MARK:COUP ON`
	Sets Couple Markers on.
	`:CALC:MARK:COUP?`

Preset	OFF, presets on Mode Preset and All Markers Off
State Saved	Saved in instrument state

3.8.3 Peak Search

The controls on the Peak Search 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 and peak threshold are both off:

– **Peak Search, Continuous Peak Search,** and maximum part of **Pk-Pk Search** will search the trace for the point with the highest y-axis value which 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. will only consider trace points which 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.

NOTE

For all Peak Search functions, if you are in the Trace Zoom View, and the bottom window is selected, the search function will 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.

Pressing the Peak Search tab once you are already IN the Marker menu does NOT perform a Peak Search.

3.8.3.1 Marker Frequency|Time

The Marker Frequency control is the fundamental control that you use to move a marker around on the trace. This is the same as the Marker Frequency|Time control on the Settings tab. See "Marker Frequency|Time" on page 240

3.8.3.2 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, subject to the "Peak Search Mode" setting 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.

NOTE

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.

See "More Information" on page 253.

Remote Command	form used in Swept SA & Spectrum & PvT measurements:

	`:CALCulate:MARKer[1]|2|...|12:MAXimum`

Example	`:CALC:MARK2:MAX`
	Performs a peak search using marker 2.
	`:CALC:MARK2:Y?`
	Queries the marker amplitude (Y-axis) value for marker 2.
	`:CALC:MARK2:X?`
	Queries the marker frequency or time (X-axis) value for marker 2.
	`: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 the WCDMA mode, this command does not work when the selected marker is located on the polar trace. In this case, the command is ignored.

More Information

The behavior of a **Peak Search** is dependent 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 criteriato 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 will display without performing a **Peak Search.**

3.8.3.3 Peak Search All Traces

In the Spectrogram View, when the Peak Search All Traces control 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 as 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” will be 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

3.8.3.4 Next Peak

Pressing Next Peak moves the selected marker to the peak that is next lower in amplitude than the current marker value. Only peaks which meet all enabled peak criteria are considered. 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` `:CALCulate:<meas>:MARKer[1]|2|...|12:MAXimum:NEXT`
Example	`:CALC:MARK2:MAX:NEXT` Sselects marker 2 and moves it to the peak that is closest in amplitude to the current peak, but the next lower value.
Notes	Sending this command selects the subopcoded marker.
State Saved	Not part of saved state.

3.8.3.5 Next Pk Right

Pressing Next Pk Right moves the selected marker to the nearest peak right of the current marker that meets all enabled peak criteria. 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	:CALC:MARK2:MAX:RIGH Selects marker 2 and moves it to the next peak to the right of the current marker position.
Notes	Sending this command selects the subopcoded marker.
State Saved	Not part of saved state.

3.8.3.6 Next Pk Left

Pressing Next Pk Left moves the selected marker to the nearest peak left of the current marker that meets all enabled peak criteria. 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	:CALC:MARK2:MAX:LEFT Selects marker 2 and moves it to the next peak to the left of the current marker position.
State Saved	Not part of saved state.

3.8.3.7 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	:CALC:MARK:MIN Selects marker 1 and moves it to the minimum amplitude value.
Notes	Sending this command selects the subopcoded marker.
State Saved	Not part of saved state.

3.8.3.8 Pk-Pk Search

Finds and displays the amplitude and frequency (or time, if the marker is on a time domain trace) 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 exactly 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	`:CALC:MARK:PTP`
	`:CALC:MARK:Y?`
	Queries the delta amplitude value for marker 1.

Notes	Turns on the Marker D active function.
Notes	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.

3.8.3.9 Marker Delta

Pressing this control is exactly the same as pressing the “Delta” selection on the Marker Mode radio button on the Settings tab. The selected marker becomes a Delta Marker. See "Delta Marker (Reset Delta)" on page 249

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 in the Peak Search Menu 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.

3.8.3.10 Mkr->CF

Assigns the selected marker's frequency to the Center Frequency setting.

The control is duplicated here in the Peak Search Menu to allow you to conveniently perform a peak search and marker to CF without having to access two separate menus.

3.8.3.11 Mkr->Ref Lvl

Assigns the selected marker's level to the Reference Level setting. See the Section ""Marker To" on page 293" for the description of this function. The control is duplicated here in the Peak Search Menu to allow you to conveniently perform a peak search and marker to RL without having to access two separate menus.

3.8.3.12 Continuous Peak Search

Turns Continuous Peak Search on or off. When Continuous Peak Search is on, a peak search is automatically performed for the selected marker after each sweep. The rules for finding the peak are exactly 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.

Remote Command	`:CALCulate:MARKer[1]|2|...|12:CPSearch[:STATe] ON | OFF | 1 | 0` `:CALCulate:MARKer[1]|2|...|12:CPSearch[:STATe]?`
Example	`:CALC:MARK:CPS ON` Turns on Continuous Peak Search
Notes	Sending this command selects the subopcoded marker
Couplings	The Continuous Peak Search control is grayed out when the selected marker is a **Fixed** marker. 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 grayed out **Signal Track** and **Continuous Peak Search** are mutually exclusive so if **Signal Track** is on, **Continuous Peak Search** will be grayed out and *vice versa*
Preset	Mode Preset
State Saved	Saved in instrument state
Status Bits/OPC dependencies	The Measuring bit should remain set while this command is operating and should not go false until the marker position has been updated
Backwards Compatibility Notes	In ESA and PSA, the Continuous Pk function would only consider a peak within a small window relative to the marker's previous position, and thus was designed to track a signal drifting in frequency but with similar amplitude. The new Continuous Peak Search function simply performs a Peak Search operation

after each sweep with no regard for the marker's previous position. Because of this difference, the SCPI commands for the old command (CPEak) is not accepted by the X-Series

Also in ESA and PSA, turning Continuous Pk on would not automatically execute a peak search. A peak search would not be performed until the end of the next sweep. The new Continuous Peak Search function will perform a peak search when it is turned on, without waiting for the next sweep to complete

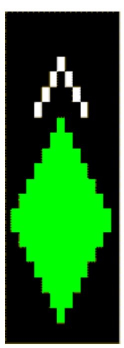
More Information

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 analyzer is in a measurement such as averaging, and Continuous Peak Search is on, the entire measurement will be allowed to complete (i.e., 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 little "hat" is placed above the marker.



3.8.4 Pk Search Config

The Pk Search Config tab 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.

3.8.4.1 Pk 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 Pk Excursion and Pk Threshold are on, a signal must rise above the Pk 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 which 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?`
	`:CALCulate:MARKer:PEAK:THReshold:STATe OFF | ON | 0 | 1`
	`:CALCulate:MARKer:PEAK:THReshold:STATe?`

Example	`:CALC:MARK:PEAK:THR:STAT ON`
	Turns on the threshold criterion.
	`:CALC:MARK:PEAK:THR -60 dBm`
	Sets the threshold to –60 dBm.

Dependencies	When Ref Level Offset changes, Peak Threshold must change by the same amount.
Couplings	Whenever you adjust the value of Pk Threshold, the Peak Threshold Line is turned on and, if Peak Excursion is also on, the Peak Excursion Region is displayed
Preset	–90.0 dBm
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.

3.8.4.2 Pk 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 Pk Excursion and Pk Threshold are on, a signal must rise above the Pk 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 261.

Remote Command	`:CALCulate:MARKer:PEAK:EXCursion <rel_ampl>`
	`:CALCulate:MARKer:PEAK:EXCursion?`
	`:CALCulate:MARKer:PEAK:EXCursion:STATe OFF | ON | 0 | 1`
	`:CALCulate:MARKer:PEAK:EXCursion:STATe?`

Example	`:CALC:MARK:PEAK:EXC:STAT ON`
	`:CALC:MARK:PEAK:EXC 30 DB`
	Sets the minimum peak excursion requirement to 30 dB

Dependencies	Available only when Y axis unit is amplitude units, otherwise grayed out.
Couplings	Whenever you adjust the value of Pk Excursion (with the knob, step keys, or by completing a numeric entry), if the Peak Threshold is turned ON, the Peak Threshold Line is turned on and the Peak Excursion Region is displayed
Preset	6.0 dB
Preset	6.0 dB
State Saved	Saved in instrument state
Min	0.0 dB
Max	100.0 dB

More Information

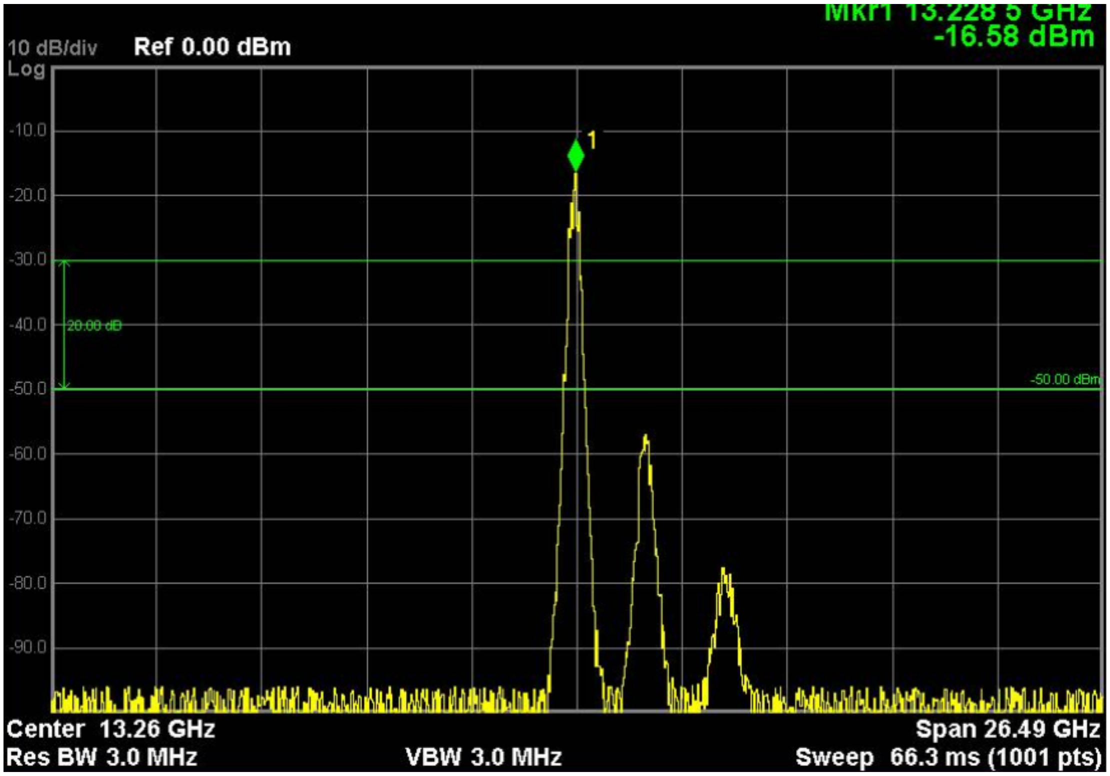
If two signals are very close together and the peak excursion and threshold criteria are met at the outside edges of the combined signals, this function finds the highest of these two signals as a peak (or next peak). However, if a signal appears near the edge of the screen such that the full extent 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.

3.8.4.3 Pk Threshold Line

Turns the peak threshold line on or off. Preset state is Off. No equivalent SCPI command.

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 Peak Threshold line. As with all such lines (Display Line, Trigger Level line, etc.) it is drawn on top of all traces.



This function is automatically set to 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 to OFF whenever Peak Threshold is set to OFF. Manually turning it ON automatically turns on Pk Threshold.

The Peak Excursion part is on whenever the Pk Threshold part is on, unless Peak Excursion is OFF.

3.8.4.4 Peak Search Mode

This control lets you decide what kind of search you want to do when the Peak Search key is pressed (or the equivalent SCPI 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 the Continuous Peak Search and the Peak Search half of Pk-Pk search.

Remote Command	:CALCulate:MARKer:PEAK:SEARch:MODE MAXimum | PARameter :CALCulate:MARKer:PEAK:SEARch:MODE?
Example	:CALC:MARK:PEAK:SEAR:MODE MAX Sets Highest Peak mode :CALC:MARK:PEAK:SEAR:MODE PAR Sets Excursion & Threshold mode :CALC:MARK:PEAK:SEAR:MODE PAR For Complex Spectrum this sets Same as Next PK mode
Preset	MAXimum
State Saved	Saved in instrument state.
Range	Highest Peak|Excursion & Thr Highest Peak|Same as Next PK Complex Spectrum
Backwards Compatibility Notes	This control was a submenu called "Peak Search" Criteria in the X-Series A-models, was a submenu called **Peak Search Type** in the ESA, and in the PSA was not a submenu but a single control called **Peak Search** with a toggle between **Param** and **Max**. Nonetheless, the functionality and SCPI commands are identical in all four, only the structure of the user interface is different

3.8.4.5 Peak Table On/Off

Turns Peak Table on/off. When turned on, the display is split into a measurement window and a peak table display window.

Turning the Peak Table on turns the Marker Table off and vice versa.

Remote Command	:CALCulate:MARKer:PEAK:TABLe:STATe OFF | ON | 0 | 1 :CALCulate:MARKer:PEAK:TABLe:STATe?
Example	:CALC:MARK:PEAK:TABL:STAT ON Turns on and displays the peak table.
Dependencies	When the Peak Table turns on, if Peak Threshold is On then it becomes the active function.
Preset	OFF
State Saved	Saved in instrument state.

3.8.4.6 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 the :CALCulate:DATA:PEAKs command (see the Trace key documentation).

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	`:CALC:MARK:PEAK:SORT AMPL`
	Sets sorting routine to list peaks in order of descending amplitude.
	`:CALC:MARK:PEAK:SORT?`

Preset	AMPLitude
Preset	AMPLitude
State Saved	Saved in instrument state.
Backwards Compatibility SCPI	`:TRACe:MATH:PEAK:SORT` For ESA backward compatibility.
Backwards Compatibility Notes	In the ESA, when Peak Sort was set to ascending frequency, the Peak Table search algorithm would search left to right, including every peak which met the search criteria until the table was full, even if that meant only part of the trace was searched. In the X-Series, the sort is done correctly, sorting the top 20 peaks by ascending frequency.

3.8.4.7 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 the Peak Threshold and/or the Peak Excursion are turned on, then only peaks that meet the defined criteria will be found.

See "More Information" on page 265.

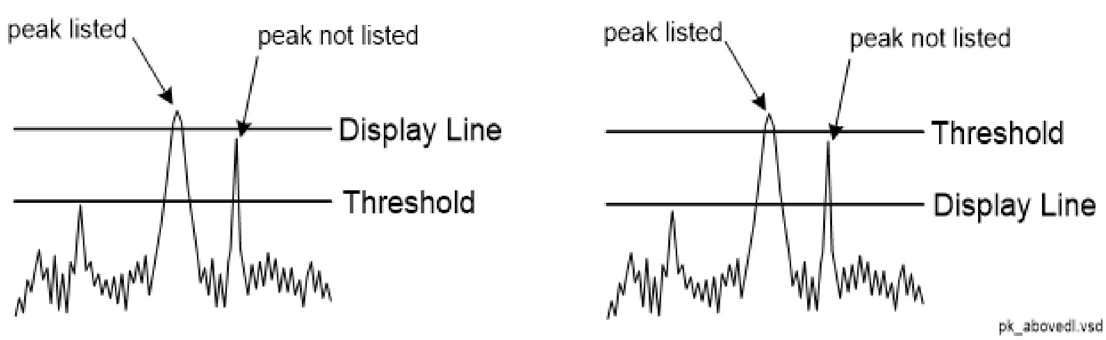
Remote Command	`:CALCulate:MARKer:PEAK:TABLe:READout ALL | GTDLine | LTDLine` `:CALCulate:MARKer:PEAK:TABLe:READout?`

Example	`:CALC:MARK:PEAK:TABL:READ ALL`
	All peaks
	`:CALC:MARK:PEAK:TABL:READ GTDL`
	Peaks above display line 1
	`:CALC:MARK:PEAK:TABL:READ LTDL`
	Peaks below display line 1

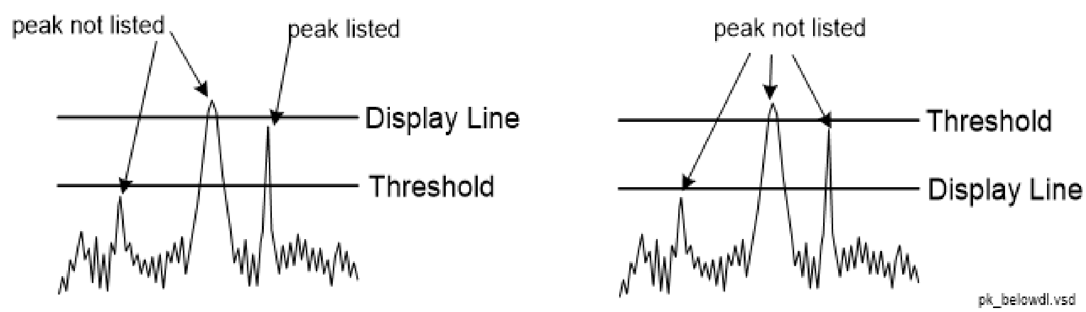
Dependencies	Turning Display Line 1 off forces Readout to `ALL`
Couplings	If `GTDL` or `LTDL`, then if Display Line 1 is not already on, it is turned on (it has to be on or it cannot be used to exclude peaks)
Preset	`ALL`
State Saved	Saved in instrument state
Backwards Compatibility Notes	In ESA the display line does not have to be on for a peak to be qualified “above display line” or “below display line.” In X-Series the display line has to be on to be used to exclude peaks

More Information

If the Display Line (see the Section “Display”) is turned on, the Peak Table can be selected to include all peaks, 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 Pk Threshold are turned on.



Above Display Line Peak Identification



Below Display Line Peak Identification

3.8.4.8 Δ to Limit

Selects the Limit to be used for the Δ to Limit column in the Peak Table and turns the D 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 | LLINE2 | LLINE3 | LLINE4 | LLINE5 | LLINE6`
	`:CALCulate:MARKer:PEAK:TABLe:DTLimit?`
	`:CALCulate:MARKer:PEAK:TABLe:DTLimit:STATe ON | OFF`
	`:CALCulate:MARKer:PEAK:TABLe:DTLimit:STATe?`

Example	`:CALC:MARK:PEAK:TABL:DTL:STAT ON` `:CALC:MARK:PEAK:TABL:DTL LLINE1`
Preset	`LLINE1`

3.8.4.9 Query the Signal Peaks (Remote Command Only)

Provided for backwards compatibility with ESA and PSA. It is recommended that you use `:CALC:DATA:PEAK` instead.

Outputs the signal peaks by frequency or by amplitude. This command uses only Trace 1 data. The sort mode is determined by the command :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 get the number of signals found meeting the specified limits, use the query :TRACe:MATH:PEAK:POINts?

Remote Command	`:TRACe:MATH:PEAK[:DATA]?`

Example	`:TRAC:MATH:PEAK?` Identifies the peaks of Trace 1 that are above the Peak Threshold (if Threshold is ON) and have an excursion above the Peak Excursion (if Excursion is ON)

3.8.4.10 Query Number of Peaks Found (Remote Command Only)

Provided for backwards compatibility with ESA and PSA. It is recommended that you use `:CALC:DATA:PEAK` instead.

Outputs the number of signal peaks identified. The amplitude of the peaks can then be queried with `:TRACe:MATH:PEAK:DATA?` This command uses only Trace 1 data.

Remote Command	`:TRACe:MATH:PEAK:POINts?`
Example	`:TRAC:MATH:PEAK:POINts?` Identifies the number of peaks of Trace 1 that are above the Peak Threshold (if Threshold is ON) and have an excursion above the Peak Excursion (if Excursion is ON)

3.8.5 Properties

The controls on the **Properties** tab are used to set certain properties of the selected marker.

3.8.5.1 Marker Frequency|Time

The Marker Frequency control is the fundamental control that you use to move a marker around on the trace. This is the same as the Marker Frequency|Time control on the Settings tab. See "Marker Frequency|Time" on page 240

3.8.5.2 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:MARKer[1]|2|...|12:REFerence <integer>` `:CALCulate:MARKer[1]|2|...|12:REFerence?`
Example	`:CALC:MARK1:REF 2`

	Sets the marker 1 reference marker to 2 and turns marker 1 on as a delta marker
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)
Dependencies	In the ACP measurement, this control is unavailable when Meas Method is set to 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 **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

3.8.5.3 X Axis Scale

Accesses a menu that enables you to affect 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.

See "More Information" on page 269.

Remote Command	`:CALCulate:MARKer[1]|2|...|12:X:READout FREQuency | TIME | ITIMe | PERiod`
	`:CALCulate:MARKer[1]|2|...|12:X:READout?`
	`:CALCulate:MARKer[1]|2|...|12:X:READout:AUTO ON | OFF | 1 | 0`
	`:CALCulate:MARKer[1]|2|...|12:X:READout:AUTO?`

Example	`:CALC:MARK3:X:READ TIME` Sets the marker 3 X Axis Scale to Time
Notes	This command causes the specified marker to become selected
Preset	AUTO Marker Preset (selected when a marker is turned **Off**): **Auto** (see below). In most measurements the Auto settings results in Frequency being the preset readout
State Saved	Saved in instrument state

More Information

Value	Example	Notes
Frequency	`:CALC:MARK2:X:READ FREQ`	Displays the absolute frequency of a normal marker or the frequency of the delta marker relative to the reference marker
Period	`:CALC:MARK2:X:READ PER`	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 will be the reciprocal of 0, which is infinitely large. The display will show "---" and a SCPI query will return infinity
Time	`:CALC:MARK2:X:READ 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	`:CALC:MARK2:X:READ ITIM`	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 a 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 the Marker, Properties, X Axis Scale key.

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 of the points in the trace will 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 will have no effect but will generate 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.

3.8.5.4 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 in color.

If the marker is off screen the lines should be extended from the marker so that they go thru the screen area if possible. This is really useful for off screen Fixed markers as it lets you see their amplitude even though they are off the X Axis.

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

3.8.5.5 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 271.

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.

Traces 1-6 are Spectrum traces and Traces 7-12 are PvT traces. Thus, selecting Marker Trace 7 is equivalent to selecting Trace 1 of the PvT trace.

Remote Command	`:CALCulate:MARKer[1]|2|...|12:TRACe 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12` `:CALCulate:MARKer[1]|2|...|12:TRACe?`
Example	`:CALC:MARK1:TRAC 2` Places marker 1 on trace 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 the **Auto Couple** key If a Marker Trace is chosen 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 Init** for each marker is saved in instrument state
Min	1
Max	6 Swept SA 12 Spectrum & PvT 3 ACP, Monitor Spectrum, Log Plot

3.8.5.6 Auto Initialize

When **Auto Initialize** is true for a given marker, the marker's trace is re-determined automatically by the analyzer 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 Init** 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 is used to directly specify a marker's trace. See "Marker Trace " on page 270 and "More Information" on page 272

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 Init `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 Init is not affected by the Auto Couple key. Auto Init is set to True on a Preset or All Markers Off. If Auto Init is set to 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
Backwards Compatibility Notes	The Marker Trace Auto function in legacy analyzers has been replaced by Marker Trace Auto Init, but the same SCPI command is used for the new function. This should work fine for most legacy users.

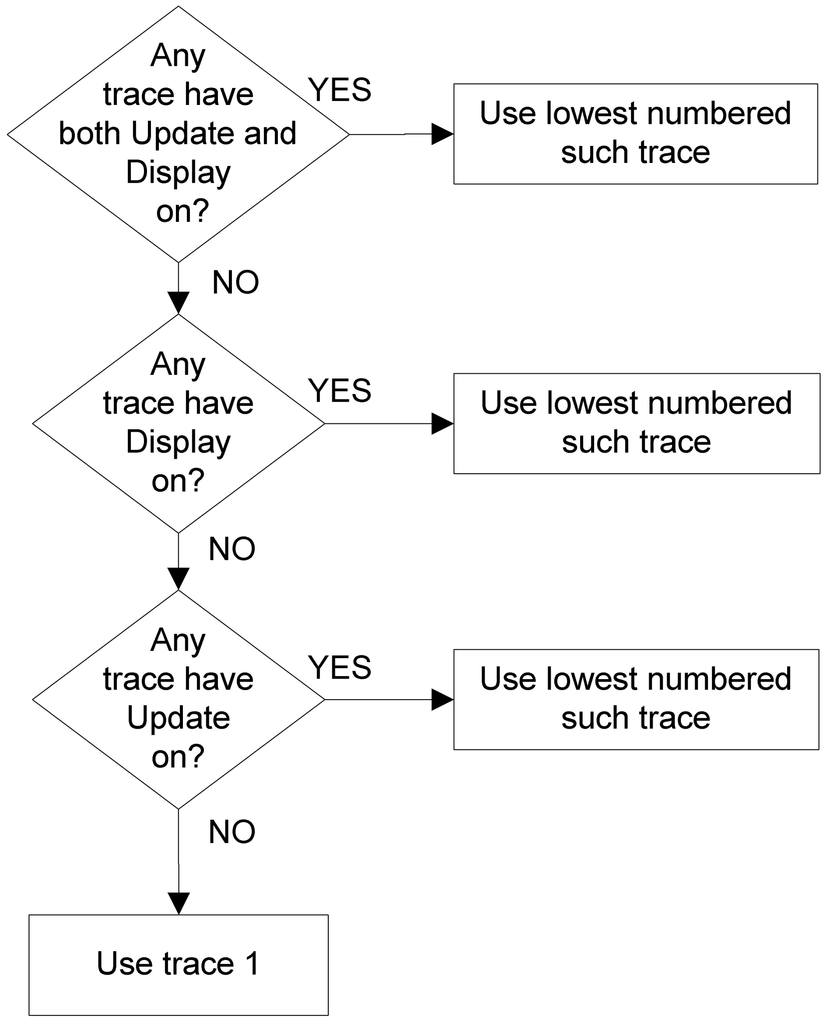
More Information

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 will not change. But for moving to or from an inactive trace, the x-axis value will take 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 will be at negative time!

Auto Init Rules Flowchart

The following flowchart depicts the Auto Init 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.

3.8.5.7 Marker Settings Diagram

Lets you configure the Marker system using a visual utility. This is the same as the "Marker Settings Diagram" on page 250 control on the **Settings** tab.

3.8.6 Marker Function

The controls on the **Marker Function** 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

3.8.6.1 Marker Frequency|Time

The Marker Frequency control is the fundamental control that you use to move a marker around on the trace. This is the same as the Marker Frequency|Time control on the **Settings** tab. See "Marker Frequency|Time" on page 240

3.8.6.2 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.

:CALC:MARK:FUNC BDEN turns on marker 1 as a band density marker.

:CALC:MARK:FUNC OFF turns off marker functions for marker 1

See:

- "More Information" on page 276.
- "Fixed marker functions" on page 277.
- "Interval Markers" on page 277.
- "Offscreen Markers and Band Functions" on page 278.
- "Band Function Backwards Compatibility" on page 278

Remote Command	`:CALCulate:MARKer[1]|2|...|12:FUNCtion NOISe|BPOWer|BDENsity|OFF` `:CALCulate:MARKer[1]|2|...|12:FUNCtion?`
Example	`:CALC:MARK:FUNC NOIS`

	`:CALC:MARK:FUNC?`
	Returns the current band function for marker 1. For Marker Noise it returns NOIS, for Band Power it returns BPOW, and for Band Density it returns BDEN
	`:CALC:MARK:Y?`
	Returns 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 Watt is the square of the delta value when the Y axis unit is Volt. For example, when the percent ratio with Y axis unit in Volt is 0.2, the percent ratio with Y axis unit in Watt will be 0.22 = 0.04. When you read the value out remotely you have to know whether your Y Axis Unit is log (dB), linear (V or A), or power (W)

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 trace Sending 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 the CALC:MARK:Y? command
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 will turn 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** will stay at 5% of the new span If the selected (specified) marker is off, selecting a Band Function via front panel or SCPI will turn 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 will usually 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
Backwards Compatibility Notes	The introduction of adjustable-width Band Functions in the X-Series fundamentally changes the way Band Power markers are controlled. See the section entitled "Band Function Backwards Compatibility" on page 278 below for a complete discussion of programming Band Functions in a backwards compatible fashion

More Information

The Band Functions are **Marker Noise**, **Band Power**, and **Band Density,** only one of which can be on for a given marker.

Value	Example	Notes
Marker Noise	`:CALC:MARK:FUNC NOIS` Turns on marker 1 as a noise marker	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 analyzer 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	`:CALC:MARK:FUNC BPOW` Turns on marker 1 as a band power marker	The band power marker computes the total power within a span on frequency domain traces . The results computation must include the RBW On time domain traces the band power marker measures the average power across a time interval. This is sometimes referred to as the interval power
Band Density	`:CALC:MARK3:FUNC BDEN` Turns on marker 3 as a band density marker	On frequency domain traces, the band density across a band is the total band power divided by the bandwidth over which it is measured On time domain traces the band density marker 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

Value	Example	Notes
		noise-like and applies a correction based on that assumption. The Band Density markers make no assumption about the statistics of the signal
Off	`:CALC:MARK:FUNC OFF`	Off turns off all Band Functions
	Turns off band functions for marker 1	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 will be 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 on time domain traces.

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.

In older analyzers, Band Power and Band Density were actually referred to as Interval Power and Interval Density when the marker was on a time domain trace but this practice is no longer observed, however it should be understood that in time domain measurements, the Band Power and Band Density functions are actually Interval Power and Interval Density functions.

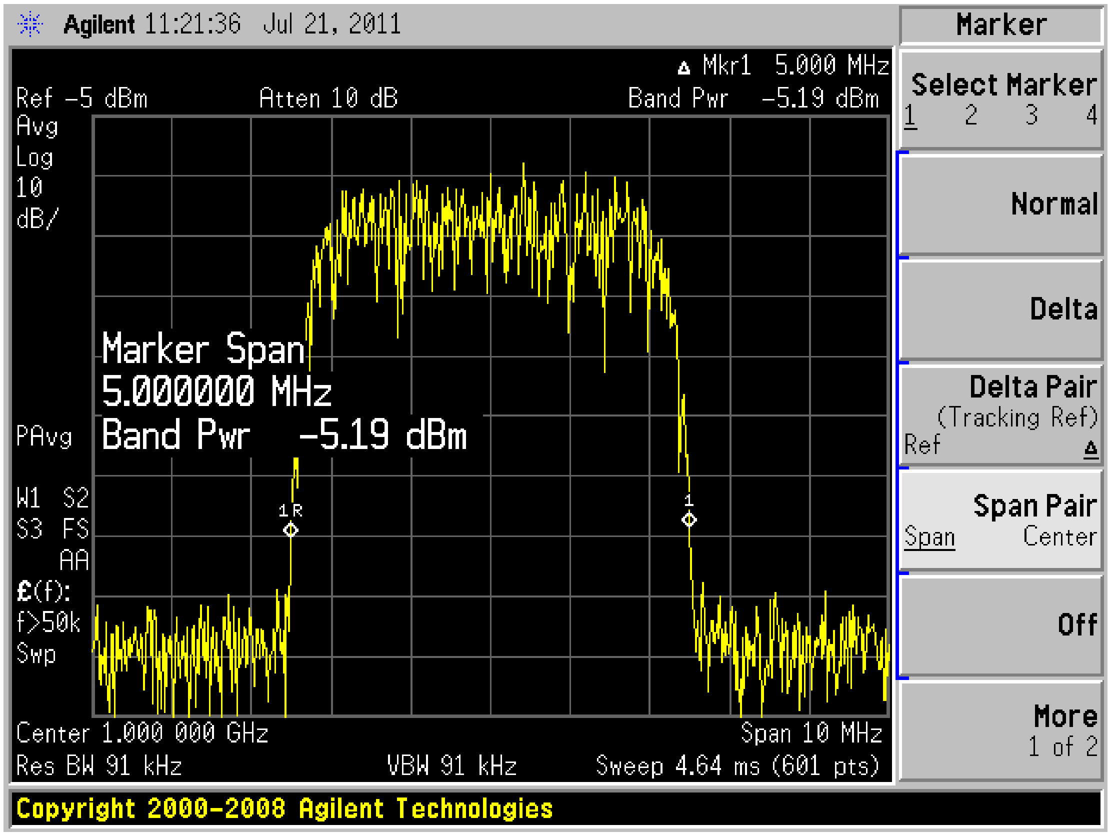
Offscreen Markers and Band Functions

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 the 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 analyzer or in the controlling computer, the result will still be 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:



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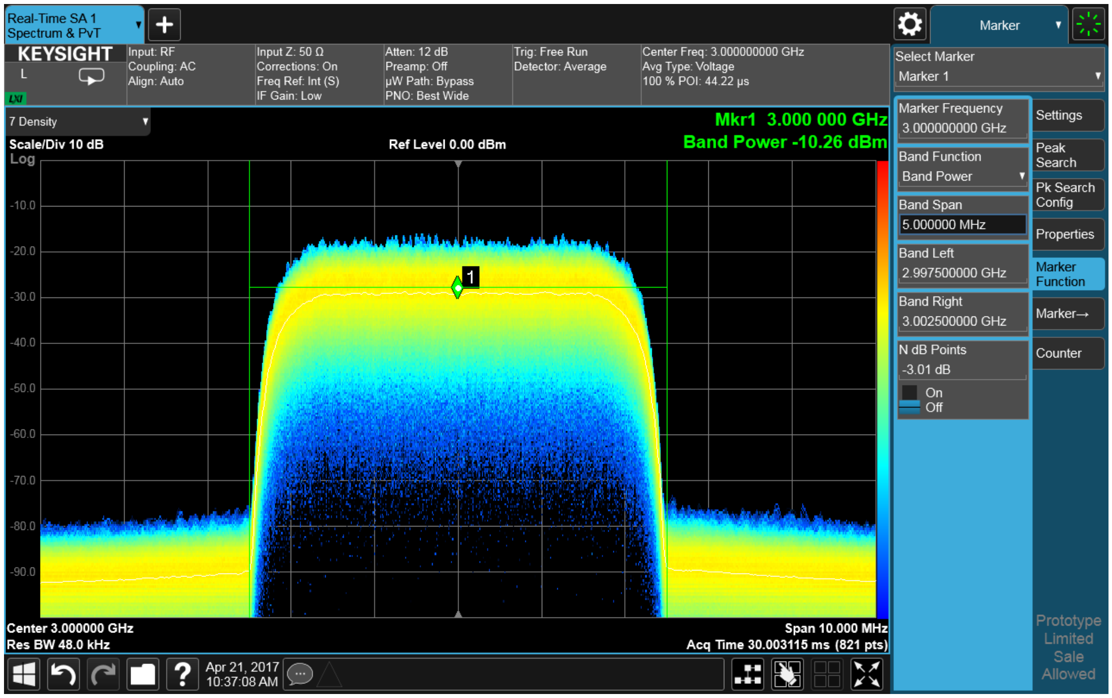
The marker modes known as Span Pair and Delta Pair (Band Pair in ESA) were used to set two markers for the primary purpose of defining the band of a Band Power function. The two markers were set by adjusting their span and center point (Span Pair mode) or by adjusting their locations independently to directly define the Start and Stop edges of the band (Band Pair/Delta Pair modes).

In the 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 the 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 of the alias commands described below cause the specified marker to become selected.

1. Marker Mode compatibility

To set up Band Power measurements in the ESA and PSA, you had to send :CALCulate:MARKer[1]|2|3|4:MODE POSition|DELTa|BAND|SPAN|OFF 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|3|4:MODE:BAND`	`:CALCulate:MARKer[1]|2|3|4:MODE:POSition`
`:CALCulate:MARKer[1]|2|3|4:MODE:SPAN`	`:CALCulate:MARKer[1]|2|3|4:MODE:POSition`

2. 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|3|4:X:CENTer <param>
:CALCulate:MARKer[1]|2|3|4:X:CENTer?
:CALCulate:MARKer[1]|2|3|4:X:SPAN <param>
:CALCulate:MARKer[1]|2|3|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|3|4:X:CENTer`	`:CALCulate:MARKer[1]|2|3|4:X`
`:CALCulate:MARKer[1]|2|3|4:X:SPAN`	`:CALCulate:MARKer[1]|2|3|4:FUNCtion:BAND:SPAN`

3. 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|3|4:X:STARt <param>
:CALCulate:MARKer[1]|2|3|4:X:STARt?
:CALCulate:MARKer[1]|2|3|4:X:STOP <param>
```

:CALCulate:MARKer[1]|2|3|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|3|4:X:STARt	:CALCulate:MARKer [1]|2|3|4:FUNCtion:BAND:LEFT
:CALCulate:MARKer [1]|2|3|4:X:STOP	:CALCulate:MARKer [1]|2|3|4:FUNCtion:BAND:RIGHt

4. 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	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

5. Band changes with analyzer 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 analyzer 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 analyzer change.

6. 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|3|4:X:POSition:CENTer <param>
:CALCulate:MARKer[1]|2|3|4:X:POSition:CENTer?
:CALCulate:MARKer[1]|2|3|4:X:POSition:SPAN <param>
:CALCulate:MARKer[1]|2|3|4:X:POSition:SPAN?
:CALCulate:MARKer[1]|2|3|4:X:POSition:STARt <param>
:CALCulate:MARKer[1]|2|3|4:X:POSition:STARt?
:CALCulate:MARKer[1]|2|3|4:X:POSition:STOP <param>
:CALCulate:MARKer[1]|2|3|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|3|4:X:POSition:CENTer	:CALCulate:MARKer [1]|2|3|4:X:POSition
:CALCulate:MARKer [1]|2|3|4:X:POSition:SPAN	:CALCulate:MARKer [1]|2|3|4:FUNC:BAND:SPAN
:CALCulate:MARKer [1]|2|3|4:X:POSition:STARt	:CALCulate:MARKer [1]|2|3|4:FUNC:BAND:LEFT
:CALCulate:MARKer [1]|2|3|4:X:POSition:STOP	:CALCulate:MARKer [1]|2|3|4:FUNC:BAND:RIGHt

In each case but the first (:X:POSition:CENTer),the analyzer first converts the specified value in trace points to the current X Axis Scale Units (e.g., 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, will be 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 analyzer's Start Frequency 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.

The UP/DOWN parameters will increment/decrement by one bucket. For this the analyzer performs a conversion to buckets and back.

3.8.6.3 Band Span

Sets the width of the span for the selected marker. The "Band Span" control name is used for all measurements even though some (PvT) are in time domain.

Remote Command	`:CALCulate:MARKer[1]|2|...|12:FUNCtion:BAND:SPAN <freq>` `:CALCulate:MARKer[1]|2|...|12:FUNCtion:BAND:SPAN?`

Example	`:CALC:MARK12:FUNC:BAND:SPAN 20 MHz`
	Sets the band span of marker 12 to 20 MHz
	`:CALC:MARK:FUNC:BAND:SPAN?`
	Queries the band span of Marker 1

Notes	Units are those of the trace's domain, Hz for frequency domain, s for time domain 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 will be generated. If no unit is sent the fundamental unit for the trace domain will be 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 will be 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 analyzer 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 analyzers, 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` See "Band Function Backwards Compatibility" on page 278 If any of the band adjust SCPI commands (including the legacy compatibility commands documented under "Band Function Backwards Compatibility" on page 278) are sent while the marker function is off,

	they will be accepted and the value stored. If sent while the marker is off, they will be accepted and ignored

Remote Command	`:CALCulate:MARKer[1]|2|...|4:X:POSition:SPAN <param>` `:CALCulate:MARKer[1]|2|...|4:X:POSition:SPAN?`
Preset	50

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 analyzer first converts the specified span in trace points to the current X Axis Scale Units (e.g., 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 278 for more information

3.8.6.4 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
Notes	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 will be generated.If no unit is sent the fundamental unit for the trace domain will be 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 will be 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 the Band Left necessarily changes the Band Span and Band Center values Band Span is set to 0 when the marker is turned off so that 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 analyzers, 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:STARt` See "Band Function Backwards Compatibility" on page 278

Remote Command	`:CALCulate:MARKer[1]|2|...|4:X:POSition:STARt <integer>` `:CALCulate:MARKer[1]|2|...|4:X:POSition:STARt?`
Preset	0

Backwards Compatibility SCPI	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 analyzer first converts the specified span in trace points to the current X Axis Scale Units (e.g., frequency or time) of the trace upon which the marker resides
	`: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 278 for more information

3.8.6.5 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	`:CALC:MARK12:FUNC:BAND:RIGHt 20 GHz`
	Sets the right edge of the band span of marker 12 to 20 GHz
	`:CALC:MARK:FUNC:BAND:RIGHt?`
	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 right edge

	is moved, the left edge stays anchored; thus, the marker's frequency will change
Notes	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 will be generated. If no unit is sent the fundamental unit for the trace domain will be 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 will be 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 the Band Right necessarily changes the Band Span and Band Center values Band Span is set to 0 when the marker is turned off so that 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 analyzers, 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:STOP` See "Band Function Backwards Compatibility" on page 278

Remote Command	`:CALCulate:MARKer[1]|2|...|4:X:POSition:STOP <integer>` `:CALCulate:MARKer[1]|2|...|4:X:POSition:STOP?`
Preset	1000, the actual value is dependent on the selected number of sweep points

Backwards Compatibility SCPI	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 analyzer first converts the specified span in trace points to the current X Axis Scale Units (e.g., 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 form of the command will return 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 278 for more information

3.8.6.6 Band Span Auto/Man

Determines whether the Band Span for Marker Noise will track the analyzer'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 analyzer 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 the Span is changed. Also, if any Band Function but Marker Noise is in effect, the Band Span does not change when the 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 time domain measurement, “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	`:CALC:MARK12:FUNC:BAND:SPAN:AUTO ON`
	Sets the band span of marker 12 to Auto
	`:CALC:MARK:FUNC:BAND:SPAN:AUTO?`
	Queries the auto band span state of Marker 1

Dependencies	This only appears when the Marker Function for the selected marker is Marker Noise. If the SCPI command is sent to a marker that does not have Marker Noise selected, it is honored but of course, the user will not see any indication of this
Couplings	When Auto Band Span is turned on, it immediately adjusts the band span to 5% of the Span. If you select Marker Noise, and Auto Band Span is on, the Band Span will immediately change to 5% of Span If the Band Span is changed, either by the Band Span key, the Band Left key, or the Band Right key, or the equivalent SCPI commands, this function is set to OFF This function is set to ON when the Marker is turned off, and is also set to ON on Preset and when the **Auto Couple** control is pressed Sending this command selects the subopcoded marker
Preset	Auto (ON)
State Saved	Saved in instrument state

3.8.6.7 N dB Points

Turns N dB points on and 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.

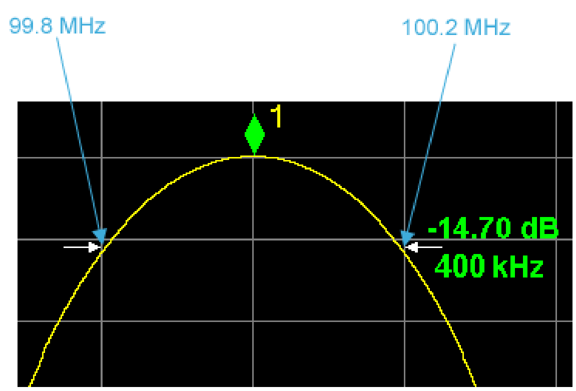
See "N dB Points Results Queries" on page 289.

See "More Information" on page 290.

Remote Command	:CALCulate:BWIDth|BANDwidth:NDB <rel_ampl> :CALCulate:BWIDth|BANDwidth:NDB? :CALCulate:BWIDth|BANDwidth[:STATe] OFF | ON | 0 | 1 :CALCulate:BWIDth|BANDwidth[:STATe]?
Notes	If the selected marker is turned OFF it turns off N dB Points N DB Points is unaffected by Auto Couple
Preset	–3.01dB
Preset	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

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 NdB 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	:CALC:MARK:AOFF Set selected marker to 1 :CALC:MARK:MAX

	Put marker 1 on peak
	`:CALC:BWID ON`
	Tturn on N dB for the selected marker (1)
	`:CALC:BWID:NDB-3.01`
	Set the offset to –3.01 dB
	`:CALC:BWID:RES?`
	Query the result

Notes	–100 returned if invalid reading

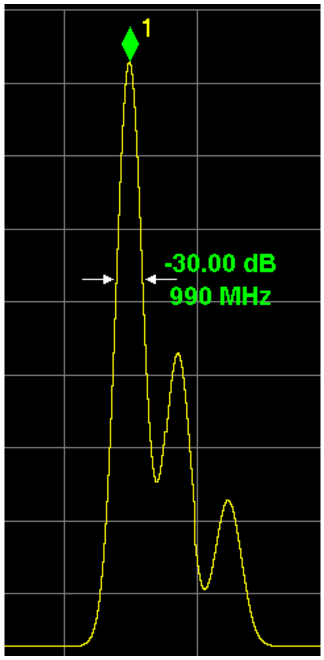
Remote Command	`:CALCulate:BWIDth|BANDwidth:RLEFt?`
Example	`:CALC:BWID:RLEF?` Return the leftmost X Axis value for the N dB band
Notes	–100 returned if invalid reading

Remote Command	`:CALCulate:BWIDth|BANDwidth:RRIGht?`
Example	`:CALC:BWID:RRIG?` Return the rightmost X Axis value for the N dB band
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 will be 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.



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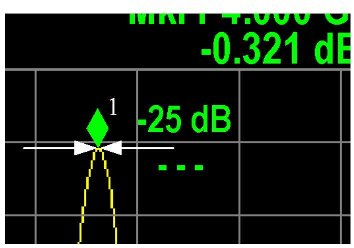
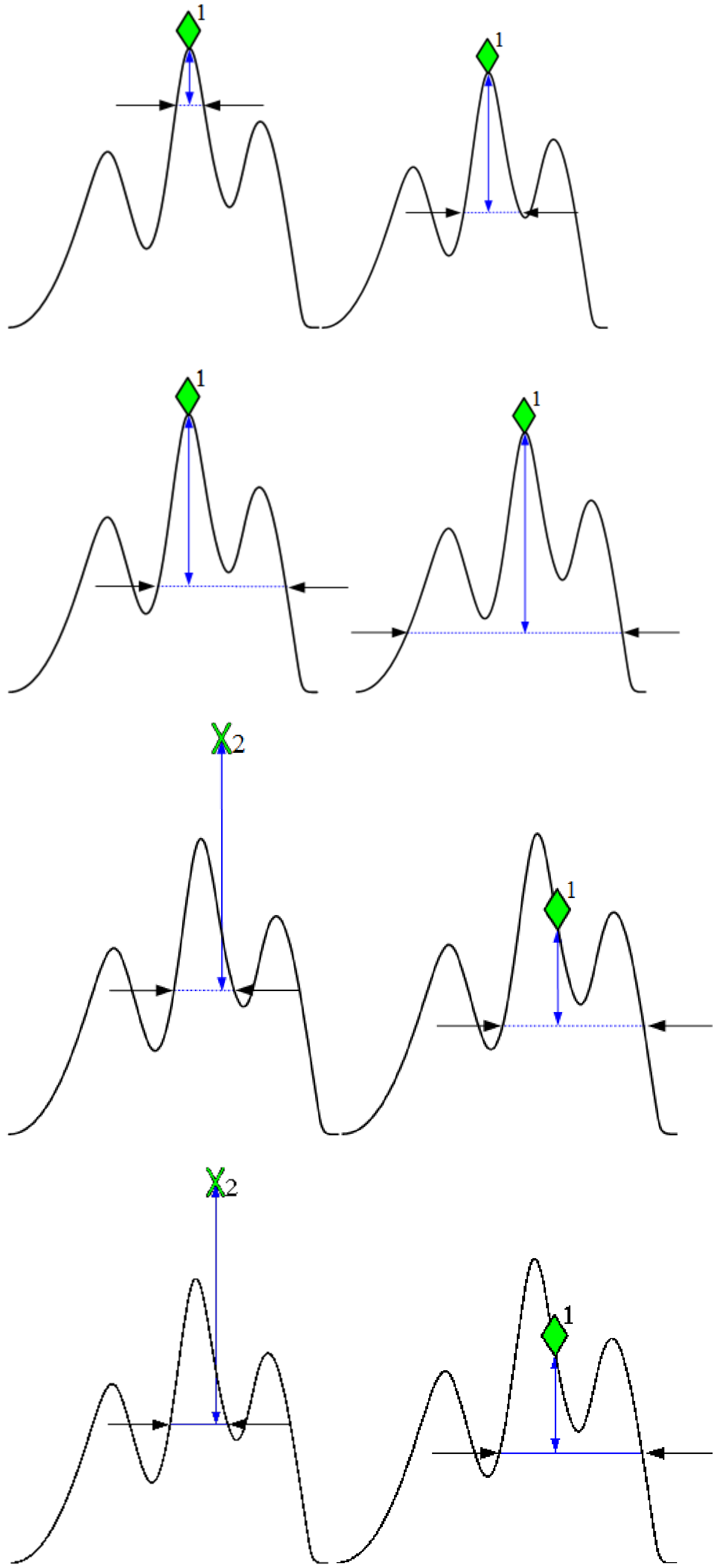
N dB Points can be used to measure the bandwidth of a signal; it is commonly used in conjunction with a tracking generator to measure filter bandwidths.

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 analyzer 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 (---) will be 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
1
1
2
1
2
1

3.8.7 Marker To

The controls on the **Marker ->** tab enable you to copy the current marker value into other instrument parameters (for example, Center Freq). 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 will be turned on at the center of the screen as a normal type marker and 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 would assign 500 MHz to Center Freq and pressing **Mkr - >Ref Lvl** would assign –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.

NOTE: Marker To functionality in Real Time SA measurement for the Spectrum trace is identical to Swept SA measurements. However, for Power versus Time trace, only "Mkr->Ref Lvl" on page 257 is enabled and all other control and commands are unavailable. If anything other than "Mkr->Ref Lvl" on page 257 is executed as a remote command for PvT, the error "-221, Settings conflict. Feature not available for this trace" is generated.

3.8.7.1 Marker Frequency|Time

The Marker Frequency control is the fundamental control that you use to move a marker around on the trace. This is the same as the Marker Frequency|Time control on the Settings tab. See "Marker Frequency|Time" on page 240

3.8.7.2 Mkr->CF

Sets the center frequency of the analyzer 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 will be turned on at the center of the screen as a normal type marker.

Remote Command	Form used in Swept SA & RTSA measurements `:CALCulate:MARKer[1]|2|...|12[:SET]:CENTer`
Example	`:CALC:MARK2:CENT` Sets the CF of the analyzer to the value of marker 2

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 type marker
Dependencies	This function is not available (control is grayed out) when x-axis is the time domain
Couplings	All the usual couplings associated with setting Center Frequency apply (see Center Frequency command description)

3.8.7.3 Mkr->CF Step

Sets the center frequency (CF) step size of the analyzer 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 will be turned on at the center of the screen as a normal type marker.

Remote Command	`:CALCulate:MARKer[1]|2|...|12[:SET]:STEP`
Example	`:CALC:MARK1:STEP` Sets the CF step to the value (or delta value) of marker 1
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 type marker
Dependencies	This function is not available (control is grayed out) when x-axis is the time domain
Couplings	All the usual couplings associated with setting CF Step apply (see CF Step command description)

3.8.7.4 Mkr->Start

Changes the start frequency 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 will be turned on at the center of the screen as a normal type marker.

Remote Command	`:CALCulate:MARKer[1]|2|...|12[:SET]:STARt`
Example	`:CALC:MARK1:STAR` Sets the start frequency to the value (or delta value) of marker 1
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 type marker
Dependencies	This function is not available (control is grayed out) when x-axis is the time domain
Couplings	All the usual couplings associated with setting Start Frequency apply (see Start Frequency command description)

3.8.7.5 Mkr->Stop

Changes the stop frequency 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 will be turned on at the center of the screen as a normal type marker.

Remote Command	`:CALCulate:MARKer[1]|2|...|12[:SET]:STOP`
Example	`:CALC:MARK3:STOP` Sets the stop frequency to the value (or delta value) of marker 3
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 type marker
Dependencies	This function is not available (control is grayed out) when x-axis is the time domain
Couplings	All the usual couplings associated with setting Stop Frequency apply (see Stop Frequency command description)

3.8.7.6 Mkr->Ref Lvl

Sets the 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) doesn't 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 will be turned on at the center of the screen as a normal type marker, and its amplitude applied to the reference level.

Remote Command	Form used in Swept SA & RTSA measurements `:CALCulate:MARKer[1]|2|...|12[:SET]:RLEVel`
Example	`:CALC:MARK2:RLEV` Sets the reference level of the analyzer to the amplitude of marker 2
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 type marker
Couplings	All the usual couplings associated with setting Reference Level apply

3.8.7.7 MkrD->CF

Sets the 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	`:CALC:MARK2:CENT` Sets the CF of the analyzer to the value of marker 2
Notes	Sending this command selects the subopcoded marker
Dependencies	This function is only available when the selected marker is a delta marker. Otherwise the control is grayed out In addition, this function is not available when x-axis is the time domain

3.8.7.8 MkrΔ->Span

Sets the start and stop frequencies 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	`:CALC:MARK2:DELT:SPAN` Sets the start and stop frequencies to the values of marker 2 and its reference marker
Notes	Sending this command selects the subopcoded marker
Dependencies	This function is only available when the selected marker is a delta marker. Otherwise the control is grayed out In addition, this function is not available when x-axis is the time domain
Couplings	All the usual couplings associated with setting Span apply (see the Freq key documentation)
Backwards Compatibility SCPI	`:CALCulate:MARKer[1]|2|...|12[:SET]:SPAN`

3.8.7.9 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. The **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 analyzer (top window) Start and Stop frequencies, a Mkr->CF function 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 analyzer Center Freq with a span of 10% of the analyzer Span). After the Mkr->CF is performed, the Mkr->Zoom Center is performed.

Remote Command	:CALCulate:MARKer[1]|2|...|12[:SET]:TZOom:CENTer
Example	:CALC:MARK2:TZO:CENT Sets the Zoom CF to the value of marker 2
Notes	Sending this command selects the subopcoded marker If specified marker is off, this command will first turn it on at the center of the screen as a normal type marker. Then the Mkr->Zoom Center function is performed
Dependencies	Only appears in the **Trace Zoom** View. If the SCPI command is sent in other Views, gives an error

3.8.7.10 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	:CALC:MARK2:ZSP:CENT Sets the Zone CF to the value of marker 2
Notes	Sending this command selects the subopcoded marker If specified marker is off, this command will first turn it on at the center of the screen as a normal type marker. Then the Mkr->Zone Center function is performed
Dependencies	Only appears in the **Zone Span** View. If the SCPI command is sent in other Views, gives an error

3.8.7.11 Move Display Trace -> Marker

Moves the Display Trace in a Waterfall window to the waterfall trace containing the currently selected marker.

Remote Command	:CALCulate:MARKer[1]|2|...|12[:SET]:DTRAce
Example	:CALC:MARK2:DTRA Moves the Display Trace to Marker 2's trace in whichever Waterfall window contains Marker 2
Notes	Sending this command selects the subopcoded marker If the specified marker is off, this command will simply turn it on at the center of the screen on the current Display Trace in the currently selected Waterfall window or the Waterfall window associated with the currently selected spectral or PvT window
Dependencies	This control only appears when a Waterfall window is being displayed

3.8.7.12 Move Marker -> Display Trace

Moves the Marker in a Waterfall window to the current Display Trace for that Waterfall window.

Remote Command	`:CALCulate:MARKer[1]|2|...|12[:SET]:MTRAce`
Example	`:CALC:MARK2:MTRA` Moves Marker 2 to the Display Trace in whichever Waterfall window contains Marker 2
Notes	Sending this command selects the subopcoded marker If the specified marker is off, this command will simply turn it on at the center of the screen on the current Display Trace in the currently selected Waterfall window or the Waterfall window associated with the currently selected spectral or PvT window
Dependencies	This control only appears when a Waterfall window is being displayed

3.9 Meas Setup

The Meas Setup menu panel contains functions for setting up the measurement parameters and also contains functions 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.

3.9.1 Settings

Contains frequently used Meas Setup functions to which you will want the fastest access.

3.9.1.1 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 300 and "AVER:CLE command" on page 300

Remote Command	`[:SENSe]:AVERage:COUNt <integer>` `[:SENSe]:AVERage:COUNt?`
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

More Information

When in **Single**, the sweep stops when N is reached. You can add more sweeps by increasing the 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.

The Average/Hold Number is not affected by Auto Couple. Average Type for all averaging in RTSA is fixed to Voltage.

AVER:CLE command

The AVER:CLE command (below) resets the average/hold count and does an 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 an INIT:IMM, if and only if there is an active trace in Max Hold, Min Hold, or Average type

3.9.1.2 Acq Time

This control is the same as the Acq Time control in the **Sweep** menu. See "Acq Time" on page 331.

3.9.1.3 Capture Time

Sets the amount of time that the Waterfall storages for Spectrogram or Powergram will accumulate data for Single mode. It is intended to be used with Triggers and a single capture of data for a trigger. When the Capture Time is set, the Avg|Hold Number (Number of Traces) and/or Acq Time will be adjusted automatically for the requested Capture Time. The couplings and dependencies are described below in the parameter table.

Remote Command	`[:SENSe]:ACQuisition:TIME:CAPTure <time>` `[:SENSe]:ACQuisition:TIME:CAPTure?`
Example	`:ACQ:TIME:CAPT 5 s`

	`:ACQ:TIME:CAPT?`
Dependencies	It can be set in any RTSA View, but will only function in any View that has the Avg|Hold Number such as Spectrogram or Powergram
Couplings	The Capture Time is the product of the Hold Number (Number of Traces) and Acquisition Time. A change in the Hold Number and Acq Time will modify the Capture Time. If the Capture Time is modified, emphasis is placed on modifying the Hold Number and keeping the Acquisition Time. The acquisition time will be modified if the max number of traces has been achieved and acquisition time needs to be increased to get entered Capture Time
Preset	Automatically calculated from preset acquisition time and hold number
State Saved	Saved in instrument state
Min	Minimum Acquisition Time
Max	Maximum Acquisition Time times Maximum Hold Number (Number of Traces)
Status Bits/OPC dependencies	Meas Uncal is Bit 0 in the STATus:QUEStionable:INTegrity:UNCalibrated register

3.9.1.4 Couple Trigger To Number of Traces

This switch modifies the data collection behavior of Powergram or Spectrogram after a trigger.

– When the switch is `OFF`, the normal default behavior of each trigger representing one Avg|Hold number (count) functions as in previous iterations. In this case, the #Acq/Trigger (Number of Acquisitions per Trigger) will take in that many acquisitions for each Avg|Hold number. This means the number of traces collected in Spectrogram and Powergram is equal to `Avg|Hold number x #Acq/Trigger`. In addition, the Capture Time does not reflect the total time of the data collected because of the unknown asynchronous timing of external trigger events

– When the switch is `ON`, each trigger represents the whole set of Avg|Hold numbers (Number of Traces). In other words, the Avg|Hold number and #Acq/Trigger are equivalent. In this case, the Capture Time represents the whole time captured for a single trigger event. The Capture Time can be adjusted to change how long a single trigger event will collect data after a trigger event

Remote Command	`:TRACe:TRIGger:COUPle ON,OFF,0,1` `:TRACe:TRIGger:COUPle?`
Example	`:TRAC:TRIG:COUP ON` `:TRAC:TRIG:COUP?`
Dependencies	Can be set in any RTSA View, but will only function in any View that has the Avg|Hold Number, such as Spectrogram or Powergram
Couplings	When on, the Avg|Hold Number (Number of Traces) is coupled to the #Acq/Trig for the selected trigger
Preset	Defaulted off in all preset cases
State Saved	Saved in instrument state

3.9.1.5 # Acqs/Trigger

The Number of Acquisitions Per Trigger selection on the Meas Setup Settings panel represents the number of acquisition per trigger for the current selected trigger, except for “Free Run” which does not use this value. Free Run does not have the number of acquisitions per trigger parameter.

This is identical to the control that appears in the **Trigger** menu. More detailed documentation can be found in the Trigger section.

Couplings	The value visible for number of acquisitions is based upon the acquisition per trigger set for the selected trigger. When Free Run is selected, the acquisition per trigger value is not used and the key is grayed out. The SCPI to control the value is based upon the individual triggers

3.9.1.6 Max Traces

Max Traces is maximum number of traces that can be stored in the Powergram or Spectrogram waterfalls. When set, the maximum number of traces (Avg|Hold Number), will be set to the maximum value automatically.

Remote Command	`:TRACe:CAPTure:MAXimum`
Example	`:TRAC:CAPT:MAX`

3.9.1.7 Auto Couple

Immediately puts all Auto/Man functions into Auto. The Auto Couple action 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 value will change depending on changes you make 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 value.

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 This option is retained for backwards compatibility, and is *not* recommended for making measurements or for new designs

3.9.1.8 Meas Preset

This control returns the Meas Local variables in the Real Time SA measurement to their preset values. This is the same as sending the SCPI command `:CONF:SAN`.

The only exception is Limits On/Off, which is a persistent Meas Local variable. It will be set to Off by a Mode Preset but not by Meas Preset.

3.9.2 Limits

The Limits tab contains controls for the Limit Lines of the current measurement. Limits arrays can be entered by you, sent over SCPI, or loaded from a file.

Limits are not supported in Power vs Time measurements. If a PvT window is selected, the Limits tab will have no controls on it. If remote commands are sent for the trace indexes 7-12, then the error “-221, Settings conflict. Feature not available for this trace” is generated.

Dependencies	This tab will only appear if you have the proper option installed in your instrument
Preset	Limits are turned off by a Preset, but the Limits arrays (data) are only reset (deleted) by Restore Mode Defaults. They survive shutdown and restarting of the analyzer application, which means they will survive a power cycle

3.9.2.1 Select Limit

Specifies the selected limit. The term “selected limit” is used throughout this document to specify which limit will be 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.

3.9.2.2 Limit On/Off

Selects whether the limit and margin are displayed. If Test Limits is on, this also determines whether the test trace (see "Test Trace" on page 312) will be 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 which fail the limits will be displayed in red.
- The margin line is displayed if Margin is on and the Margin Value is non-zero (see "Margin" on page 305). The margin line is displayed in the same color as the limit

line, but paler still and dashed. Portions of traces which pass the limits but fail the margin will be 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 (see** "Test Limits" on page 317**)** 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 of Limit Pass/Fail are independent of these conditions; the test is always performed when queried over 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 which fail the limits and/or margins only applies to traces whose X-axis corresponds to the current analyzer X-axis. Traces which are not updating (in View, for example) will not change color if the analyzer X-axis settings (e.g., start and stop frequency) 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 (*) will appear 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	`:CALC:LLIN2:DISP ON` Turns on the display for limit line 2.
Dependencies	This command will generate 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 GUI 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` In the past you had to send the DISP command as well as the STATe command in order to get a limit on and testing. Now, the DISP command is sufficient, but we accept the state command and map it to DISP

3.9.2.3 Margin

Selects a margin for this limit, which will cause a trace to Fail Margin when the trace is between the limit line and the margin line. Portions of the traces which pass the limit but fail the margin will be displayed in an amber color.

A margin is always specified in dB relative to a limit – an upper limit will always have a negative margin, and a lower limit will always have a positive margin. If a value is entered with the incorrect sign, the system will automatically take the negative of the entered value.

If the limit type is switched from lower to upper while margin is present, the margin will reverse sign.

When the Margin is selected, it may be turned off by pressing the Margin key until Off is underlined. 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.

The 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 will be blanked as well.

Remote Command	`:CALCulate:LLINe[1]|2|...|6:MARGin <rel_ampl>`
	`:CALCulate:LLINe[1]|2|...|6:MARGin?`
	`:CALCulate:LLINe[1]|2|...|6:MARGin:STATe OFF | ON | 0 | 1`
	`:CALCulate:LLINe[1]|2|...|6:MARGin:STATe?`

Example	`:CALC:LLIN1:MARG -2dB`
	Sets limit line 1's margin to –2 dB (Limit Line 1 is by default an upper limit).
	`:CALC:LLIN2:MARG 1dB`
	Sets limit line 2's margin to 1 dB (Limit Line 2 is by default a lower limit).
	`:CALC:LLIN2:MARG:STAT OFF`
	Turns off the margin for limit line 2 and removes any tests associated with that margin line.

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?) will return 1 if the margin fails.
Couplings	This will affect `: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);

3.9.2.4 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	`:CALC:LLIN2:TYPE LOW` Sets limit line 2 to act as a lower limit.
Couplings	If a margin has already been set for this limit line, and this key is used to change the limit type, then the margin value will reverse 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.

3.9.2.5 Edit Limit

The Edit Limit dialog allows you to 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 it's display will be on, and it's 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 analyzer 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.

NOTE A remote user can enter or access limit line data via "Limit Line Data (Remote Command Only)" on page 319 , :CALCulate:LLINe[1]|2|3|4|5|6:DATA

After exiting the editor, the Limit is still on and displayed and the amplitude scale remains **Log**.

Limits are turned off by a Preset, but the Limits arrays (data) are only reset (deleted) by Restore Mode Defaults. They survive shutdown and restarting of the analyzer 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.

Select Limit

Specifies the selected limit. The term “selected limit” is used throughout this document to specify which limit will be 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

Pressing this control 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 and edit it.

Scale X Axis

Matches the X Axis to the selected Limit, as well as possible.

For frequency limits and a frequency-domain X-axis, sets the Start and Stop Frequency to contain the minimum and maximum Frequency of the selected Limit.

– For linear Frequency Scale, 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 (but never set Start Frequency below 0 Hz nor Stop Frequency above the maximum analyzer frequency).

– For log Frequency Scale, the Start Frequency is set to the bottom of the decade in which the minimum frequency of the Limit appears, and the Stop Frequency 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	`:CALC:LLIN:OFFS:X -50MHZ`
	Sets the X axis offset to -50 MHz.
	`:CALC:LLIN:OFFS:UPD`
	Will apply the X axis offset to all points in the limit line, then reset the X axis offset to zero.

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

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	`:CALC:LLIN:OFFS:Y -3 dB`
	Sets the Y axis offset to -3 dB.
	`:CALC:LLIN:OFFSet:UPD`
	Will apply the Y axis offset to all points in the limit line, then reset the Y axis offset to zero.

Preset	0 dB
State Saved	Saved in instrument state.
Min	-Infinity
Max	+Infinity

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 will be updated as follows: 10 MHz will be subtracted from each X value, 1 dB will be added to each Y value. The offset values will then be reset to zero. The limit trace will not be moved and the limit table will be updated to accurately reflect the currently-displayed limit trace.

Remote Command	`:CALCulate:LLINe[1]|2|...|6:OFFSet:UPDate`
Example	`:CALC:LLIN:OFFS:UPD` Sets updates the limit table to reflect the X and Y offsets, then resets the offsets to zero.
State Saved	No state

Delete Row

This is an immediate action key. It will immediately delete 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) will be 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. - will be 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; if so, after the deletion, the informational message “Limit deleted” appears in the MSG line.

Remote Command	`:CALCulate:LLINe[1]|2|...|6:DELete`
Example	`:CALC:LLIN2:DEL` Deletes all data for limit line 2.

Limit Table

The following selections are available:

Frequency

Lets you edit the frequency of the current row.

Min	0
Max	1 THz

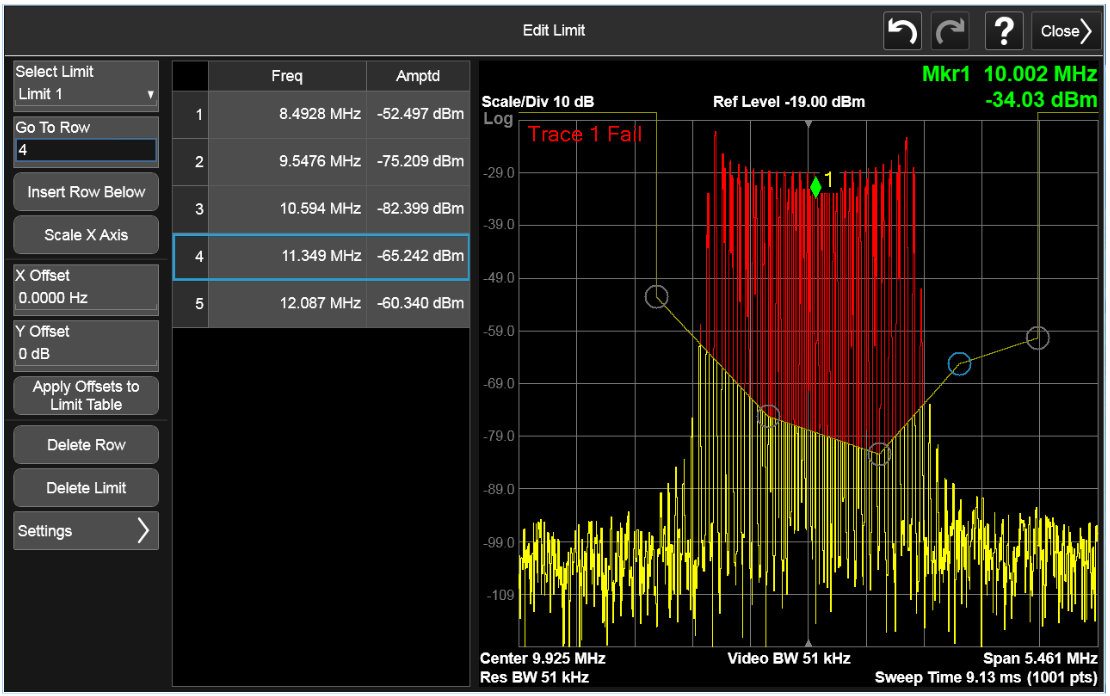
Amplitude

Lets you edit the Amplitude of the current row.

Min	–1000 dBm
Max	1000 dBm

Limit Graph

The Limit Graph embedded in the Edit Limit dialog 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.



3.9.2.6 Edit Limit Settings

The Settings control on the Edit Limits dialog opens up another menu page which 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 will be 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 will be 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 | 2 | 3 | 4 | 5 | 6` `:CALCulate:LLINe[1]|2|...|6:TRACe?`
Example	`:CALC:LLIN3:TRAC 2` applies limit 3 to trace 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 (see "Test Limits" on page 317) 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 Units. 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	`:CALC:LLIN:CONT:INT:TYPE LIN` Sets limit line 1 frequency interpolation to linear.
Preset	Linear, not affected by Mode Preset, preset by Restore Mode Defaults.
State Saved	Saved in instrument state.

Freq Reference

Chooses 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 analyzer center frequency is at 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 will not change frequency if the 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 the center frequency changes to 2 GHz, the limit line segment will be 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 analyzer.

Pressing this control 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	`:CALC:LLIN:FREQ:CMOD:REL ON` Makes limit line 1 relative to the center frequency.
Notes	If the Trace Domain is changed to Time (:CALCulate:LLINe:CONTrol:DOMain TIME), the command : :CALCulate:LLINe[1]|2|3|4|5|6:FREQuency:CMODe:RELative ON|OFF|1|0 will have 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	`:CALC:LLIN:AMPL:INT:TYPE LIN` Sets limit line 1 amplitude interpolation to linear.
Preset	Logarithmic, not affected by Mode Preset, preset by Restore Mode Defaults.
State Saved	Saved in instrument state.

Amptd Reference

Chooses 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 will be 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 analyzer.

Remote Command	`:CALCulate:LLINe[1]|2|...|6:AMPLitude:CMODe:RELative ON | OFF | 1 | 0` `:CALCulate:LLINe[1]|2|...|6:AMPLitude:CMODe:RELative?`
Example	`:CALC:LLIN:AMPL:CMOD:REL ON` Makes limit line 1 relative to the reference level amplitude.
Couplings	Pressing this control makes Reference level the active function.
Preset	Off, not affected by Mode Preset, preset by Restore Mode Defaults.
State Saved	Saved in instrument state.

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 | 2 | 3 | 4 | 5 | 6`
Example	`:CALC:LLINE2:COPY 1` Copies the data from line 1 into line 2.
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 will overwrite all data in the limit. Since a straight copy would typically have hundreds or thousands of segments, the data will be approximated to better represent a limit line; small excursions whose width is less than 10 trace buckets will sometimes not be captured. Secondary parameters which are not associated with traces (Description, Associated Trace, Type, Margin, Interpolation, Relative to CF/RL) will be unchanged.

When taking a trace in order to build a limit, it will often work 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 will be built above the trace, while a lower limit will be 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 | TRACE2 | TRACE3 | TRACE4 | TRACE5 | TRACE6`
Example	`:CALC:LLIN2:BUIL TRACE1` Builds limit line 2 based on the data in trace 1. This will overwrite the data in the table editor.

Build

Builds a Limit from the Trace specified in Build From Trace

Description

Provides a description of up to 60 characters by which the operator can easily identify the limit. Will be stored in the exported file. Can be displayed in the active function area by selecting as the active function, if desired to be in a screen capture.

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.

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 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.

3.9.2.7 Test Limits

Selects whether displayed traces are tested against displayed limits (i.e. those for which Limit On/Off is set to On).

For each displayed trace for which a Limit is turned on, a message will be 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" will be 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" will be 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" will be 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: the query :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	`:CALC:LLIN:TEST ON` Turns on testing, and displays the results in the upper left corner.
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 will display the information above regarding pass/fail for each displayed limit.

3.9.2.8 X-Axis Unit

Selects how the limit-line segments are defined. Pressing X Axis Unit selects whether the limit lines will be 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 softkey in the Limit Table Editor will read Time instead of Frequency

Switching the limit-line definition between Freq and Time will erase all of the current limit lines. When you do this from the front panel, a warning dialog will pop up 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 the X Axis Unit will erase 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	This 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.

3.9.2.9 Delete All Limits

Deletes all limit lines. Pressing Delete All Limits purges the data from all limit line tables.

All limit data will be cleared and returned to factory preset settings.

When this key is pressed a prompt is placed on the screen that says “Please press Enter or OK key to delete all limits. Press ESC or Cancel to close this dialog.” The deletion is only performed if you press OK or Enter; if so, after the 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.

3.9.2.10 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 default to Hz (for frequency) and seconds (for time).

  Range: –30 Gs to +30 Gs for time limits, –3 kHz to +350 GHz for frequency limits.

- `<ampl>` Amplitude values units default to dBm. 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 will be 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.

Remote Command	`:CALCulate:LLINe[1]|2|...|6:DATA <x>,<ampl>,<connect>` `:CALCulate:LLINe[1]|2|...|6:DATA?`

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 analyzer application (including power cycle)

State Saved	Saved in instrument state
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

3.9.2.11 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.

Remote Command	`:CALCulate:LLINe[1]|2|...|6:DATA:MERGe <x-axis>,<ampl>,<connected>`
Example	`:CALC:LLIN1:DATA:MERG 1000000000, -20, 0, 2000000000, -30, 1` Merges the 10GHz segment and the 20GHz segment into limit line 1. Note that the 20GHz segment will be connected to the next lower point, which may or may not be the 10GHz point
Notes	This SCPI command is supported for Backwards Compatibility Although PSA had a limit of 200 points, it is acceptable to increase that limit
Preset	Fixed

3.9.2.12 Limit Test Current Results (Remote Command Only)

Queries the status of the current measurement limit testing.

- Returns 0 if the measured results pass when compared with the current limits.
- Returns 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: 0 = Pass, or 1 = Fail

3.9.3 Advanced

The Advanced tab contains Meas Setup functions for access by the experienced user.

3.9.3.1 Phase Noise Optimization

Selects the LO (local oscillator) phase noise behavior for various desired operating conditions.

See "More Information" on page 322

Remote Command	`[:SENSe]:FREQuency:SYNThesis[:STATe] 1 | 2 | 3 | 4 | 5`
	`[:SENSe]:FREQuency:SYNThesis[:STATe]?`
	`[:SENSe]:FREQuency:SYNThesis:AUTO[:STATe] OFF | ON | 0 | 1`
	`[:SENSe]:FREQuency:SYNThesis:AUTO[:STATe]?`

Example	`:FREQ:SYNT 2`
	Selects optimization for best wide offset phase noise
	`:FREQ:SYNT:AUTO ON`

Notes	Parameter: 1: optimizes phase noise for small frequency offsets from the carrier. 2: optimizes phase noise for wide frequency offsets from the carrier. 3: optimizes LO for tuning speed 4: In instruments with EP0, balances close-in phase noise with spur avoidance. In instruments without EP0 this setting is accepted but no action taken. 5: In instruments with EP0, emphasizes spur avoidance with close-in phase noise performance. In instruments without EP0 this setting is accepted but no action taken. The actual behavior varies somewhat depending on model number and option; you always get fast tuning by choosing #3, but in some models, the “Fast Tuning” choice is identical to the “Best Close-In” choice. Specifically: – Models with option EP0 (for example UXA), have a two stage local oscillator, which switches to a single loop for fast tuning – Models with option EP1 (for example PXA), have a two-loop local oscillator, which switches to a single loop for fast tuning – Models with option EP2 (available, for example, for MXA), 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 Close-In; this is useful when you have to look across a wide range of spans – In all other cases, Fast Tuning is the same as Best Close-In.
Dependencies	Does not appear in all models. The key is blank in those models, but the SCPI 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	All but EP0: Best Close-In|Best Wide-Offset|Fast Tuning EP0:

	Best Close-In|Best Wide-Offset|Fast Tuning|Balanced|Best Spurs
Annunciation	EP0: Best Close | Best Wide | Fast | Balanced | Best Spurs Other than EP0: Best Close | Best Wide | Fast Found in the Meas Bar under **PNO** When not in Auto, label changes to **#PNO**

More Information

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.

Here is detail about the various settings you can choose:

"Auto " on page 322

"Best Close-in Φ Noise" on page 322

"Best Wide-offset Φ Noise" on page 323

"Fast Tuning" on page 323

"Phase Noise Optimization Auto Rules" on page 324

"Models with Option EP0" on page 324

"Models with Option EP1" on page 324

"Models with Option EP2" on page 325

Auto

Selects the LO (local oscillator) phase noise behavior to optimize dynamic range and speed for various instrument operating conditions. See "Phase Noise Optimization Auto Rules" on page 324 for details on the Auto rules.

Best Close-in Φ Noise

Example	`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 analyzers this annotation appears as [offset <20 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, regardless of spurious products that occur with some center frequencies.

Best Wide-offset Φ Noise

Example	`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 analyzers 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

Example	`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” 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 the Best Spurs configuration. It is available with this “Fast Tuning” label to inform the user, and to make the user interface more consistent with other X-Series analyzer family members.

(In models whose hardware does not provide for a fast tuning option, the settings for Best Close-in Φ Noise are used if Fast Tuning is selected. This gives the fastest possible tuning for that hardware set.)

Phase Noise Optimization Auto Rules

The X-Series has several grades of LO that offer different configurations when in the Auto Mode.

- "Models with Option EP0" on page 324 (available in UXA)
- "Models with Option EP1" on page 324 (available in PXA)
- "Models with Option EP2" on page 325 (available, for example, in MXA for excellent phase noise)

Models with Option EP0

Auto will choose:

Best Close-in Φ Noise whenever:

Center frequency is < 699.9 kHz

Otherwise, Auto will choose Fast Tuning whenever:

Span > 114.1 MHz, or when

RBW > 800 kHz

Otherwise, Auto will choose Best Wide-offset Φ Noise whenever:

RBW > 290 kHz, or when

Span > 4.2 MHz

Otherwise, Auto will choose Best Close-in Φ Noise.

The RBW to be used in the calculations above is the equivalent –3 dB bandwidth of the current RBW filter.

These rules apply whether in swept spans, zero span, or FFT spans.

Models with Option EP1

Auto will choose:

Fast Tuning whenever:

Span > 44.44 MHz, or when

RBW > 1.9 MHz, or if

Source Mode is set to “Tracking”

otherwise Auto will choose Best Close in Phase Noise whenever:

Center frequency is < 195 kHz, or when

CF >= 1 MHz and Span <= 1.3 MHz and RBW <= 75 kHz

otherwise, Auto will choose Best Wide-offset Phase Noise

The RBW to be used in the calculations above is the equivalent –3 dB bandwidth of the current RBW filter.

These rules apply whether in swept spans, zero span, or FFT spans.

Models with Option EP2

Auto will choose:

Best Close-in Φ Noise whenever:

CF <130 kHz , or when

CF > 12 MHz and Span < 495 kHz and RBW < 40 kHz

Otherwise, Auto will choose Fast Tuning whenever:

Span > 22 MHz, or when

RBW > 400 kHz, or when

CF ≤ 12 MHz and Span < 495 kHz and RBW < 23 kHz

Otherwise, Auto will choose Best Wide-offset Φ Noise.

The RBW to be used in the calculations above is the equivalent –3 dB bandwidth of the current RBW filter.

These rules apply whether in swept spans, zero span, or FFT spans.

The RBW to be used in the calculations above is the equivalent –3 dB bandwidth of the current RBW filter.

These rules apply whether in swept spans, zero span, or FFT spans.

3.9.3.2 IF Gain

Accesses the keys to take full advantage of the RF dynamic range of the analyzer, there is an added switched IF amplifier with approximately 10 dB of gain. When you can turn it on without overloading the analyzer, the dynamic range is always better with it on than off. The **IF Gain** key can be used to set the IF Gain function to High Gain (the extra 10 dB), or to Low Gain. These settings affect sensitivity and IF overloads.

"Auto" on page 326

"Low Gain (Best for Large Signals)" on page 326

"High Gain (Best Noise Level)" on page 326

Remote Command	[:SENSe]:IF:GAIN[:STATe] LOW | HIGH [:SENSe]:IF:GAIN[:STATe]? [:SENSe]:IF:GAIN:FFT:AUTO[:STATe] OFF | ON | 0 | 1 [:SENSe]:IF:GAIN:FFT:AUTO[:STATe]?
Example	:IF:GAIN:FFT ON :IF:GAIN:FFT:AUTO 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 softkey; there are neither keys grayed out nor any SCPI locked out. The analyzer simply behaves as though IF Gain is set to Low regardless of the setting on the keys.
Couplings	As with most parameters with an AUTO state, AUTO COUPLE sets it to Auto, which then picks LOW, and setting any specific value (LOW or HIGH) will set the AUTO state to false.
Preset	LOW
State Saved	Saved in instrument state.
Range	Low Gain | High Gain
Annunciation	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 Included for ESA compatibility
Backwards Compatibility SCPI	[:SENSe]:ADC:RANGe AUTO|NONE Included for PSA compatibility. Accepted without error but ignored; the query is ignored as well

Auto

Allows the instrument to pick the FFT IF Gain method as appropriate. This “Auto” state is set by the Auto Couple key, and it puts it in Low Gain

Low Gain (Best for Large Signals)

Forces FFT IF Gain to be off.

Example	IF:GAIN:FFT LOW

High Gain (Best Noise Level)

Forces FFT IF Gain to be on.

Example	`IF:GAIN:FFT HIGH`

3.9.3.3 ACP Enhanced Dynamic Range On/Off

The ACP Enhanced Dynamic Range function 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 RBW ≤ 300 kHz, the “ACP filter” is switched in. This means that the RBW shape is affected, but not excessively.
- When RBW > 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, RBW 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.

3.9.3.4 IF Duplex

IF Duplexing allows for two IF paths with two separate Digital IFs that can work independently in parallel with different IF Bandwidths at the same tuning center frequency. One IF Bandwidth is used for the frequency domain windows (Span) and one for the time domain windows (Span PvT).

IF Duplex ON: the IF bandwidths can be adjusted independently, one with with Span and the other with Span PvT.

IF Duplex OFF: the Digital IFs (if two digital IF paths are present) work together to build one large contiguous IF. The IF Bandwidths cannot be controlled independently when IF Duplex is OFF. Span and Span PvT will be linked and show the same value.

Remote Command	`[:SENSe]:IF:DUPLex ON | OFF | 1 | 0` `[:SENSe]:IF:DUPLex?`
Example	`:IF:DUPL ON`
Dependencies	Requires Option DUA. If Option DUA is not present, this control does not appear.
Preset	ON
State Saved	Saved in instrument state

3.9.3.5 Acquisition Sample Rate (Remote Command only)

The analyzer can be queried for the Sample Rate used during the measurement acquisition; Sample Rate is affected by Resolution Bandwidth and FFT processing.

Remote Command	`[SENSe]:ACQuisition:SRATe?`
Example	`:ACQ:SRAT?`
Notes	Value is returned as a Double parameter, indicating the current RTSA sample rate. It should be queried after any measurement setting is changed
State Saved	Not saved in State

3.9.4 Global

The controls in this menu apply to all Modes in the instrument.

Some controls (e.g., Global center Freq) 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 the “Global Center Frequency” switch to on, it applies to all Modes that support Global Settings.

Other controls (e.g., Extend Low Band) are actually set in this menu but apply to all Modes.

3.9.4.1 Global Center Freq

The software maintains a Mode Global value called “Global Center Freq”.

When the **Global Center Freq** control is switched to **On** in any mode, 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 Freq will remain unchanged.

Adjusting the Center Freq of any mode which supports Global Settings, while **Global Center Freq** is **On**, will modify the Global Center Frequency.

When **Global Center Freq** is turned **Off**, the Center Freq of the current mode is unchanged, but now the Center Freq 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 Freq of the current mode.

This function is reset to Off when the Restore Defaults control is pressed in the Global Settings menu, 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	On|Off

Remote Command	`:GLOBal:FREQuency:CENTer[:STATe] 1 | 0 | ON | OFF` `:GLOBal:FREQuency:CENTer[:STATe]?`
Preset	Off

3.9.4.2 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 analyzer checks whether one band can cover the whole sweep frequency range or not. If it's true, the analyzer locks the band; otherwise, does nothing (the band crossover occurs).

This function doesn’t work when Band Lock under [System]-[Service]-[Lock Functions] is not -1 (no band lock). In that case, Band Lock takes priority of Extend Low Band.

This function is reset to Off when the Restore Defaults control is pressed in the Global Settings menu, or when **System**, **Restore Defaults**, **All Modes** is pressed.

This parameter is available for SA, RTSA, WCDMA, WIMAX OFDMA, LTEAFDD, LTEATDD modes.

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?`

Dependencies	Only applies to UXA, PXA, MXA and EXA.
Preset	Set to Off by pressing Global Settings > Restore Defaults and System > Restore Defaults > All Modes
Range	On|Off

3.9.4.3 Restore Defaults

This control resets all of the functions in the Global Settings menu to Off. This also occurs when **System**, **Restore Defaults**, **All Modes** is pressed.

Remote Command	`:INSTrument:COUPle:DEFault`
Example	`:INST:COUP:DEF`
Backwards Compatibility SCPI	`:GLOBal:DEFault`

3.10 Sweep

The Sweep key accesses controls that enable you 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.

3.10.1 Sweep Control

This tab accesses controls that enable you to operate the Sweep and Control functions of the analyzer, such as Acq Time and Continuous/Single.

The Acquisition Time for the Spectrum and Power vs Time measurements are independent. That means each measurement can have a different setting for Acquisition Time. The Acq Time parameter is context sensitive based on the type of measurement. Therefore, when in Spectrum measurement, the Frequency Acq Time parameter value is shown as the Acq Time value. Conversely, when in the Power vs Time measurement, the PvT Acq Time value is shown as the Acq Time value.

Frequency Acquisition Time and Power vs Time Acquisition Time parameters are two separate parameters and are not coupled together. This means that a change in value of one parameter does not affect the value of the other.

3.10.1.1 Acq Time

The Acq Time control is used to control the frequency acquisition time when in Spectrum measurements and the acquisition time parameter for all traces when in the Power vs Time measurement.

The parameter has a different value and SCPI command depending on whether or not a PvT window is showing. See "Acq Time (PvT measurements)" on page 332 for the PvT case.

Acq Time (Spectrum measurements)

The Acq Time control is used to control the frequency acquisition time when in Spectrum measurements.

This is the time the user wants to use for a single trace or bitmap in the Density view. This trace will be a combination of multiple, overlapped Fast Fourier Transformations (FFTs).

The Auto setting for this parameter is simply the default value.

This parameter is also the acquisition time parameter used when in the Spectrum measurement.

The Acquisition Time set is determined by the instrument based upon the interdependencies of Span, PvT Span, and Points. The Acquisition Time will be adjusted as close to the entered Time as determined by the interdependency algorithms of the instrument.

Remote Command	`[:SENSe]:ACQuisition:TIME <time>`
	`[:SENSe]:ACQuisition:TIME?`
	`[:SENSe]:ACQuisition:TIME:AUTO OFF | ON | 0 | 1`
	`[:SENSe]:ACQuisition:TIME:AUTO?`

Example	`:ACQ:TIME 500 ms` `:ACQ:TIME:AUTO OFF`
Dependencies	Set to Auto when Auto Couple is pressed or sent remotely
Couplings	This parameter is context sensitive. It will be used when any of the Frequency Measurement views are the active view.
Preset	30 ms
State Saved	Saved in instrument state
Min	The minimum Acquisition Time depends on the currently selected View. For Density View, the minimum Acquisition Time will be 30 ms. For Density/Spectrogram View, the minimum Acquisition Time will be 70 ms. For all other Spectrum Measurement views the minimum Acquisition Time is 100 us.
Max	40 s
Annunciation	A “#” mark appears before “Acquisition Time” in the annotation when it is switched from Auto to Manual coupling.
Annotation	The capture time is displayed in the lower-right corner of the screen. The number of points is displayed parenthetically, as Acquisition 13.3 ms (821 points)
Status Bits/OPC dependencies	Meas Uncal is Bit 0 in the STATus:QUEStionable:INTegrity:UNCalibrated register

Acq Time (PvT measurements)

The Acq Time control is used to control the acquisition time parameter used for all traces when in the Power vs Time measurement, that is, when a PvT window is showing.

The acquisition time parameter used by the Power vs Time Measurement views can be different from the acquisition time used by the Spectrum measurement views. It applies to all traces in the Power versus Time measurement including the Spectrum and Spectrogram traces. For instance, even if the Spectrum window of the Power vs Time – Spectrum dual view is selected, the acquisition time used for the Spectrum trace is not Frequency Acquisition Time but is the Power vs Time Acquisition Time.

The PvT Acquisition Time set is determined by the instrument based upon the interdependencies of Span, PvT Span, and Points. The Acquisition Time will be adjusted as close to the entered Time as determined by the interdependency algorithms of the instrument.

Remote Command	`[:SENSe]:ACQuisition:TIME:PVTime <time>`
	`[:SENSe]:ACQuisition:TIME:PVTime?`
	`[:SENSe]:ACQuisition:TIME:PVTime:AUTO OFF | ON | 0 | 1`
	`[:SENSe]:ACQuisition:TIME:PVTime:AUTO?`

Example	`:ACQ:TIME:PVT 500 ms` `:ACQ:TIME:PVT:AUTO OFF`
Dependencies	Set to Auto when Auto Couple is pressed or sent remotely
Couplings	This parameter is context sensitive. It will be used when a PvT window is active. When Power vs Time Acquisition Time Auto State is On, this parameter is coupled to the Frequency Acquisition Time parameter
Preset	30 ms
State Saved	Saved in instrument state
Min	200[us] is the absolute minimum, but the actual value will be the next available value greater than 200 [us] based on other parameter settings.
Max	40 s
Annunciation	A “#” mark appears before “Acquisition” in the annotation when it is switched from Auto to Manual coupling.
Annotation	The capture time is displayed in the lower-right corner of the screen. The number of points is displayed parenthetically, as Acquisition 13.3 ms (1024 points)
Status Bits/OPC dependencies	Meas Uncal is Bit 0 in the STATus:QUEStionable:INTegrity:UNCalibrated register

3.10.1.2 Sweep/Measure

Allows you to 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

NOTE: **In the `WAVeform` measurement, this control only appears in the Meas Bar, and not in the Sweep/Control tab.**

See "More Information" on page 334

Remote Command	`:INITiate:CONTinuous OFF | ON | 0 | 1` `:INITiate:CONTinuous?`

Example	`:INIT:CONT 0`
	`:INIT:CONT OFF`
	puts instrument into Single measurement operation
	`:INIT:CONT 1`
	`:INIT:CONT ON`
	puts instrument into Continuous measurement operation

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

More Information

With **Avg/Hold Num** (in the **Meas Setup** menu) set to **Off** or set to **On** with a value of 1, a sweep is taken after the trigger condition is met; and the instrument continues to take new sweeps after the current sweep has completed and the trigger condition is again met. However, with **Avg/Hold Num** set to On with a value >1, multiple sweeps (data acquisitions) are taken for the measurement. The trigger condition must be met prior to each sweep. The sweep is not stopped when the average count k equals the number N set for Avg/Hold Num is reached, but the number k stops incrementing. A measurement average usually applies to all traces, marker results, and numeric results, but sometimes only applies to the numeric results.

If the instrument is in Single measurement, pressing the **Cont/Single** toggle control does not change k and does not cause the sweep to be reset; the only action is to put the instrument into Continuous measurement operation.

If it is already in Continuous sweep:

- the `:INIT:CONT 1` command has no effect
- the `:INIT:CONT 0` command will place the instrument in Single Sweep but will have 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 336 control description for details on the `:INIT:IMM` (Restart) function.

If you are already in Single sweep, the `:INIT:CONT OFF` command has no effect.

If you are already in Single Sweep, then pressing the **Cont/Single** toggle control in the middle of a sweep does not restart the sweep or sequence. Similarly, pressing the **Cont/Single** toggle control 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 the **Cont/Single** toggle control in the middle of a sweep does *not* restart the sweep, sending `:INIT:IMM` *does* reset it.

3.10.1.3 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.

3.10.1.4 Zoom Center

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 SCPI 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

3.10.1.5 Restart

The **Restart** function restarts the current sweep, or measurement, or set of averaged/held sweeps or measurements. In measurements that support pausing, if you are Paused, pressing **Restart** performs a **Resume**.

The Restart function is accessed in several ways:

- Pressing the **Restart** key
- Sending the remote command `:INIT:IMM`
- Sending the remote command `:INIT:REST`

See "More Information" on page 337

Remote Command	`:INITiate[:IMMediate]` `:INITiate:RESTart`

Example	`:INIT:IMM` `:INIT:REST`
Notes	`:INIT:REST` and `:INIT:IMM` and the front-panel **Restart** key 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, 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 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 restart trace averages (displayed average count reset to 1) for a trace in **Clear Write**, but did not restart **Max Hold** and **Min Hold** In the X-Series, the **Restart** hardkey and the `:INIT:REST` command restart not only **Trace Average**, but **Max Hold** and **Min Hold** traces as well For wireless comms modes in ESA and PSA, the **Restart** hardkey and the `:INIT:REST` command restarted every measurement, including all traces and numeric results. There is no change to this operation

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:

- It restarts the current sweep
- It restarts the current measurement
- It restarts the current set of sweeps if any trace is in Trace Average, Max Hold or Min Hold
- It restarts the current set of measurements if Averaging, or Max Hold, or Min Hold is on for the measurement

With Average/Hold Number (in Meas Setup menu) set to 1, or Averaging off, or no trace in Trace Average or Hold, 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 Number >1 and at least one trace set to Trace Average, Max Hold, or Min Hold (SA Measurement) or Averaging on (most other measurements), 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 Number. A measurement average usually applies to all traces, marker results, and numeric results, but sometimes only applies to the numeric results.

Once the full set of sweeps has been taken, the instrument will go 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`.

3.10.1.6 Pause/Resume

Pauses a measurement after the current data acquisition is complete.

When a measurement is paused:

- The label on this control changes to **Resume**. Pressing **Resume** un-pauses the measurement.
- Pressing **Restart** also performs a **Resume**.

Remote Command	`:INITiate:PAUSe` `:INITiate:RESume`
Example	`:INIT:PAUS` `:INIT:RES`
Dependencies	Not displayed in Modes that do not support pausing
Couplings	When Averaging is On, if the measurement is paused no more updates will occur until either a Resume or Restart occurs If the measurement is resumed, the averaging continues to use the traces from before the Pause occurred and continues to use the traces from the point where the Resume occurred. This still provides real-time traces, but they will no longer be gap free In a view with a Waterfall window, when the measurement is paused, the Waterfall stops updating. When Resume is selected, the Waterfall will retain the existing traces and continue updating using traces from the point at which Resume was selected. The time stamp of the individual Waterfall traces will show the time from the beginning of the measurement the trace relates to, showing there was a gap in the Waterfall capture In Density view, when the measurement is paused, the Density Display stops updating. When the measurement is resumed, if Persistence is ON, the persistence fading will continue from the point when the measurement was paused If a Restart occurs, the average counter is reset and all results are discarded. The measurement begins again, using traces after the Restart occurred

3.10.1.7 Spectrum Acquisition Points (Remote Command Only)

Returns the number of points of the Spectrum trace. This is a query only command and the number of points of the Spectrum trace cannot be changed.

For instruments with options B2X or B5X, the acquisition points will change based on frequency span.

Note that prior to querying measurement results, you should always query Acquisition Points, to determine the number of data elements in the result.

Remote Command	`[:SENSe]:ACQuisition:POINts?`
Example	`:ACQ:POIN?`
Notes	For instruments with options B85, B1A, B1X, or B1Y the Acquisition Points will always be 821
Dependencies	For instruments with options B2X or B5X, the Acquisition Points are dependent upon Span
Preset	821 for B85, B1A, B1X, or B1Y 871 for B2X 1739 for B5X
State Saved	Saved in instrument state
Min	821
Max	821

3.10.1.8 Power vs Time Acquisition Points (Remote Command Only)

Returns the number of points of the Power vs Time trace. This is a query only, and the number of points of the Power vs Time trace cannot be changed.

Remote Command	`[:SENSe]:ACQuisition:POINts:PVTime?`
Example	`:ACQ:POIN:PVT?`
Preset	1024
State Saved	Saved in instrument state
Min	1024
Max	1024

3.10.1.9 Minimum Signal Duration for 100 % POI (Remote Query Only)

Returns the minimum signal duration to achieve 100 % probability of intercept. This is a query only, and the value is affected by Span and Rbw.

Remote Command	`[:SENSe]:MinSigDUR?`

Example	`:MSDUR?`
Couplings	Span, RBW and Filter Type cause this value to change. Max Span and narrowest window length from RBW6 gives the min value. Max value occurs at narrowest Span and widest window length of RBW1
Preset	5.97 usec
State Saved	Saved in instrument state
Min	3.57 usec
Max	8.192 sec
Annotation	Meas Bar

3.10.2 X-Scale

This tab accesses controls that enable you to configure the Sweep and Control functions of the analyzer, such as Sweep Rules.

3.10.2.1 Ref Value

Sets the horizontal scale reference value for the Power vs Time window. Changing the reference level does not restart the measurement because it is a display function only; instead, it horizontally ‘pans’ all display traces and markers to the new value. This value will change if Auto Scaling is on and the Ref Position is changed.

Remote Command	None
Example	None
Couplings	If the Auto Scaling is set to On, this value is automatically determined by the measurement result and Ref Position. When set manually, Auto Scaling automatically changes to Off.
Preset	0.000 s
State Saved	Saved in instrument state.
Min	-1.00 s
Max	57 s Determined by the PvT Acq Time max value

3.10.2.2 Scale/Div

Sets the horizontal scale in the Power vs Time window by changing the time value per division. There are ten graticule division for the x scale. The default value for Power vs Time Scale/Div is 10% of the Reference value. By decreasing the Scale/Div value, you will be able to zoom in on a selected portion of the trace.

Remote Command	None

Example	None
Couplings	If the Auto Scaling is set to On, this value is automatically determined by the measurement result. When set manually, Auto Scaling automatically changes to Off. When Auto Scaling is changed from Off to On, then it is set
Preset	3 ms
State Saved	Saved in instrument state.
Min	1.000 ns
Max	5.7 s Determined by the Max Ref value / 10

3.10.2.3 Ref Position

Sets the X scale reference position in the Power vs Time window to Left, Ctr (center) or Right.

When Auto Scaling is on, changing the reference position will show the current Reference value at the specified position. For instance, when the reference position is set to Left, the Reference value will show the left most value (typically 0[s]) of the display grid. When the reference position is changed from Left à Ctr, then the Reference value changes and will show the current value of the center point of the grid which will be half the value of the Pvt acq time. If the reference position is further toggled and set to Right, then the Reference value changes and will show the current value of the right most point of the grid which will be the Pvt acq time.

When Auto Scaling is off, then changing the reference position will set the display grid to the current Reference value. For instance, if the Reference value is set to 0[s] and the Reference position is changed from Left à Ctr, then the display grid shifts and the center of the grid will now become 0[s]. If the reference position is further toggled and set to Right, then the display grid shifts and the right most point of the grid now becomes 0[s].

Remote Command	None
Example	None
Preset	LEFT
State Saved	Saved in instrument state.
Range	Left | Ctr | Right

3.10.2.4 Auto Scaling

Allows toggling of the Auto Scaling function in the Power vs Time window between On and Off. When Auto Scaling is turned on, the left most portion of the display grid will be set to the start of the trace (usually 0[s]) and the right most portion of the display grid will be set to the Pvt Acq Time value. The values of the Reference Level and Scale/Div are dependent on the current Reference position setting, which does not change when Auto Scaling is toggled.

Remote Command	None
Example	None
Couplings	Upon pressing the Restart front-panel key, this function automatically determines the scale per division and reference values based on the measurement results. When a value is set manually to either Scale/Div or Ref Value parameters, Auto Scaling automatically changes to Off.
Preset	ON
State Saved	Saved in instrument state.
Range	On | Off

3.11 Trace

The **Trace** 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 time domain measurements like PvT) 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 analyzer is sweeping across the bucket. How it is measured depends on which detector is selected.

Differences with Swept SA

The Trace system in RTSA functions the same as in the Swept SA measurement with the following exceptions:

– Multiple simultaneous detectors are not supported in RTSA. Therefore, when a detector is selected, it applies to all traces. However, the detectors for spectral and PvT acquisitions are independent, and it is possible to have different detector selections for the same acquisition.

– There is no Normal detector available in Real Time SA. Default detector is Peak.

– RTSA does not support the EMI detectors (Quasi Peak, EMI Average or RMS Average detectors).

– In Density View, the Real Time (white) trace is derived from the density values for Average, Peak and Negative Peak Detectors and is the last FFT that was used to construct the bitmap for Sample Detector.

– RTSA supports 12 traces, 6 traces for Spectrum and 6 traces for Power versus Time

– Trace types for the Spectrum trace will differ if in Spectrogram view

– Power versus Time does not support Trace Operations. Namely, the following features are not be supported and do not appear when PvT is selected:

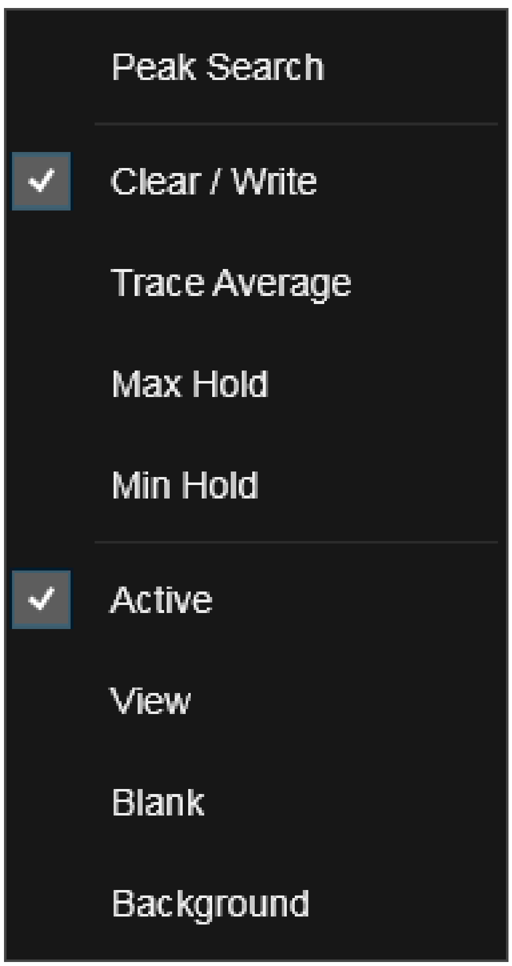
– Trace Math

– Trace Normalize

- Only Trace 1 is supported in Density View. Attempting to change the Trace in Density View or Sending/Querying any other Trace will result in the error -221.5000, Settings Conflict; Only Trace 1 available in Density View
- Trace Smooth is not supported
- Trace Math Mean is not supported
- The default number of trace data is fixed as 821. Default trace data querying (TRACe:DATA?) will return 821 values of -1000. Note that [:SENSe]:SWEep:POINts is not supported in RTSA mode.

Trace right-click menu

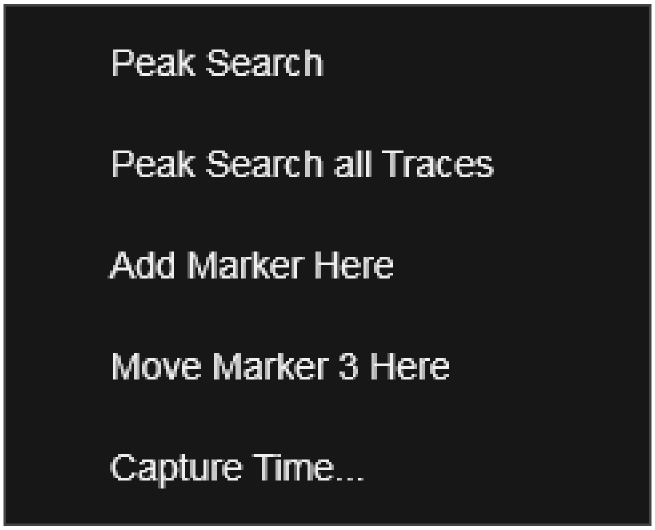
If you right-click on a trace (or touch and hold a trace and wait for the circle to close) you will see the Trace Right-Click Menu:



If you now tap or click on one of the items in this menu, it will perform the corresponding function. Peak Search finds the highest peak on the selected Trace (see "Peak Search" on page 251). Clear/Write, Trace Average, Max Hold and Min

Hold will set the Trace Type (see "Trace Type" on page 346). Active, View, Blank, and Background will set the View/Blank type (see "View/Blank " on page 350).

If you right-click on the trace (or touch and hold the trace and wait for the circle to close) in a Waterfall window (for example, in a Spectrogram or Powergram View) you will see the Waterfall Trace Right-Click Menu:



Peak Search works as above. Peak Search all Traces finds the highest peak in the Waterfall window (see "Peak Search All Traces" on page 253). Add Marker Here takes the lowest numbered Marker which 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). Capture Time changes the menu panel to Meas Setup, Settings and selects Capture Time as the active function (see "Capture Time" on page 300).

3.11.1 Select Trace

Specifies the selected trace. The term “selected trace” is used to specify which trace will be affected when you change trace settings, perform a math operation, etc.

The Select Trace control 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 (e.g., Normalize).

In RTSA, there is a set of 6 traces for Spectrum (frequency domain) windows. These traces are called “Spectrum Trace 1”, “Spectrum Trace 2”, and so on, through “Spectrum Trace 6”. There is also a set of 6 traces for PvT (power vs time or time domain) windows. These traces are called “PvT Trace 1”, “PvT Trace 2”, and so on, through “PvT Trace 6”. By convention, since we need a way to refer to these traces in SCPI commands, the Spectrum traces are traces 1-6, and the PvT traces are 7-12, as seen in this table:

Trace Name	Trace Subopcode	Trace Parameter
Spectrum Trace 1	1	TRACE1
Spectrum Trace 2	2	TRACE2
Spectrum Trace 3	3	TRACE3
Spectrum Trace 4	4	TRACE4
Spectrum Trace 5	5	TRACE5
Spectrum Trace 6	6	TRACE6
PvT Trace 1	7	TRACE7
PvT Trace 2	8	TRACE8
PvT Trace 3	9	TRACE9
PvT Trace 4	10	TRACE10
PvT Trace 5	11	TRACE11
PvT Trace 6	12	TRACE12

Notes	The selected trace is remembered even when not in the trace menu
Preset	Spectrum Trace 1
State Saved	The number of the selected trace is saved in instrument state.
Annunciation	A box is drawn around the selected trace number in the trace panel in the Meas Bar

3.11.2 Trace Control

The controls on the Trace Control tab allow you to set the type of the Trace and its update mode.

There are four trace Types: **Clear/Write, Trace Average, Max Hold** and **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 more fully in the View/Blank control description, but suffice it to say that when **Update** is On a trace is updating and when **Update** is Off it is not; and when **Display** is On it is visible and when **Display** is Off it is not. These terms are used throughout the descriptions below.

3.11.2.1 Trace Type

There are four trace Types: **Clear/Write, Trace Average, Max Hold** and **Min Hold**.

These types are 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 will nonetheless clear the trace and begin rewriting it.

This control and command are only available for the Spectrum Traces (1-6), not for the PvT Traces (7-12).

Besides the Trace Type, the View/Blank 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 the View/Blank menu description.

See:

- "Trace Writing Types" on page 347
- "Clear/Write" on page 348
- "Trace Average" on page 348
- "Max Hold" on page 349
- "Min Hold" on page 349

Remote Command	`:TRACe[1]|2|...|6:TYPE WRITe | AVERage | MAXHold | MINHold` `:TRACe[1]|2|...|6:TYPE?`

Example	`:TRAC:TYPE WRIT`
	Sets Spectrum Trace 1 to Clear/Write
	`:TRAC:TYPE?`

Notes	WRITe = Clear/Write AVERage = Trace Average MAXHold = Maximum Hold MINHold = Minimum Hold
Couplings	Selecting a trace type (pressing any of the four Trace Type selections or sending a TRAC:TYPE command) sets the Trace to **Active** (**Update** On, **Display** On), even if that trace type was already selected.
Preset	`WRITe` After a Preset, all traces are cleared (all trace points set to `mintracevalue`)
State Saved	The type of each trace is saved in instrument state

Trace Writing Types

Value	Example	Notes
Clear/Write	:TRAC2:TYPE WRIT	In **Clear/Write** type each trace update replaces the old data in the trace with new data Selecting Clear/Write clears the trace and initiates a new

		sweep
Trace Average	:TRAC2:TYPE AVER	In **Trace Average** type the analyzer 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 Selecting **Trace Average** will clear the trace, initiate a new sweep, and restart the Average sequence
Max Hold	:TRAC3:TYPE MAXH	In **Max Hold** type the analyzer 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** will clear the trace, initiate a new sweep, and restart the hold sequence
Min Hold	:TRAC5:TYPE MINH	In **Min Hold** type the analyzer 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 Selecting **Min Hold** will clear the trace, initiate a new sweep, and restart the hold sequence

Clear/Write

In Clear/Write type each trace update replaces the old data in the trace with new data. Pressing the **Clear/Write** selection for the selected trace, or sending the TRAC:TYPE WRIT command for the specified trace, 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 won't start until Restart is pressed.

Because pressing Clear/Write stops the current sweep and initiates a new one, 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, a new sweep is initiated but the trace is not cleared.

Trace Average

In **Trace Average** type the analyzer 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 the **Trace Average** key (for the selected trace), or sending the TRAC:TYPE AVER command (for the specified trace), sets the trace type to **Trace Average** and causes the average to be restarted

Details of the count limiting behavior and the averaging calculations may be found under Avg|Hold Number and Average Type in the Meas Setup Section.

When in Trace Average, if a measurement-related instrument setting is changed, 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

In Max Hold type the analyzer 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 in the Meas Setup section.

Pressing the Max Hold key for the selected trace, or sending the :TRAC:TYPE MAXH command for the specified trace, 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.

When in Max Hold, if a measurement-related instrument setting is changed, 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

In Min Hold type the analyzer 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 in the Meas Setup section.

Pressing the Min Hold key for the selected trace, or sending the TRAC:TYPE MINH command for the specified trace, sets the trace type to Min Hold, causes the trace to be cleared, and causes the Min Hold sequence to be (re)started, even if you are already in Min Hold.

When in **Min Hold**, if a measurement-related instrument setting is changed (such as Center Freq), 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, as there is only one count for Trace Average and Hold.

3.11.2.2 Clear and Write | Restart Averaging | Restart Max/Min Hold

Starts the trace writing as though the trace type had just been selected. Pressing this control is exactly like selecting the current trace type again – the control is provided because it may not be obvious that re-selecting the current selection from a radio button menu will take an action.

This button takes on different labels depending on the Trace Type:

- Clear/Write: Clear and Write
- Trace Average: Restart Averaging
- Max Hold: Restart Max Hold
- Min Hold: Restart Min Hold

3.11.2.3 View/Blank

The four choices available with radio buttons in this menu are:

- Active: Update and Display both On
- View: Update Off and Display On
- Blank: Update Off and Display Off
- Background: Update On, Display Off (this allows a trace to be blanked and continue to update “in the background”, which was not possible in the past)

See:

- "Trace Update State On/Off" on page 351
- "Trace Display State On/Off" on page 351
- "More Information" on page 352

Notes	The four states actually set two variables, Update and Display, to their four possible combinations: – Active: Update and Display both On – View: Update Off and Display On – Blank: Update Off and Display Off – Background: Update On, Display Off See tables below for detail on the SCPI to control these two variables
Dependencies	When Signal ID is on, this panel is grayed out
Couplings	Selecting a trace type (Clear/Write, Trace Average, Max Hold, Min Hold) for a trace (pressing the key or sending the equivalent SCPI 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 a [:SENS]:DET:TRAC command) puts the trace in Active (Update On and Display On), even if that detector was already selected Selecting a math mode other than Off for a trace (pressing the key or sending the equivalent SCPI 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	`:TRACe[1]|2|...|6:UPDate[:STATe] ON | OFF | 0 | 1` `:TRACe[1]|2|...|6:UPDate[:STATe]?`
Example	`:TRAC2:UPD 0 Makes trace 2 inactive (stops updating)`
Couplings	Whenever you set Update to On for any trace, the Display is set to On for that trace
Preset	1|0|0|0|0|0 (On for Trace 1; Off for 2–6)
State Saved	Saved in instrument state
Backwards Compatibility SCPI	`:TRACe:MODE VIEW` Sets :TRACe:UPDate OFF, :TRACe:DISPlay ON, for the selected trace. In earlier analyzers, View and Blank were trace modes, set by TRACe:MODE command. In the X-Series, View and Blank are two of the states set by the :TRACe:UPDate and :TRACe:DISPlay commands. The TRACe:MODE VIEW command will yield its new equivalent, which is Update=Off, Display=On

Trace Display State On/Off

Remote Command	`:TRACe[1]|2|...|6:DISPlay[:STATe] ON | OFF | 0 | 1` `:TRACe[1]|2|...|6:DISPlay[:STATe]?`
Example	`:TRAC2:DISP,1 Makes trace 2 visible` `:TRAC3:DISP,0 Blanks trace 3`
Couplings	Whenever you set Update to On for any trace, the Display is set to On for that trace

Preset	1|0|0|0|0|0 (On for Trace 1; Off for 2–6)
State Saved	Saved in instrument state
Backwards Compatibility SCPI	`:TRACe:MODE BLANk` Sets :TRACe:UPDate OFF, :TRACe:DISPlay OFF, for the selected trace. In earlier analyzers, View and Blank were trace modes, set by TRACe:MODE command. In the X-Series, View and Blank are two of the states set by the :TRACe:UPDate and :TRACe:DISPlay commands. The TRACe:MODE BLANk command will yield its new equivalent, which is Update=Off, Display=Off

More Information

When a trace becomes inactive, any update from the SENSe system (detectors) immediately stops – this does not wait 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 which are blanked (Display=off) do not display nor appear on printouts but their data stays intact and 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 the Clear Trace function (below)

Inactive traces which 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 will 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 the action of putting a trace in Display=Off and/or Update=Off does not restart the sweep and does not restart Averaging or Hold functions for any traces.

3.11.2.4 Trace Settings Table

The Trace Settings Table lets you configure the Trace system using a visual utility.

3.11.3 Detector

The Detector tab lets you choose and configure detectors for the selected trace.

3.11.3.1 Detector

Displays a radio button box that enables you to select a specific detector for the current measurement. The same detector is applied to all Spectrum traces. You can have a different detector for PvT measurements than for Spectrum measurements, so a different command is used to select the detector for PvT measurements.

If a PvT window is being displayed along with a Spectrum window, you can only have one detector, which applies to all windows. You use the regular detector command (`:DETector:TRACe`) to select the detector in this case, NOT the PvT detector command (`:DETector:TRACe:PVTime`).

The analyzer 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 turns Auto detection off for the selected trace.

See:

– "PvT Detector command" on page 354

– "More Information" on page 354

– "Detector Basics" on page 354

– "Detector Notes" on page 355

Remote Command	`[:SENSe]:DETector:TRACe AVERage | NEGative | POSitive | SAMPle` `[:SENSe]:DETector:TRACe?`
Example	`:DET:TRAC AVER` Sets all spectrum trace detectors to average
Notes	The query returns a name that corresponds to the detector type as shown below, and indicates the setting for Trace 1. The same detector is applied to all Spectrum traces. String Returned Definition AVER = Average POS = Positive peak SAMP = Sample NEG = Negative peak
Couplings	Selecting a detector for a trace (pressing the key or sending a [:SENS]:DET:TRAC command) 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 SCPI command, will turn trace math to Off for the selected/specified trace.

Preset	POS
State Saved	Saved in instrument state

PvT Detector command

Remote Command	[:SENSe]:DETector:TRACe:PVTime AVERage | NEGative | POSitive | SAMPle [:SENSe]:DETector:TRACe:PVTime?
Example	:DET:TRAC:PVT AVER Sets PVT detector to average
Notes	The query returns a name that corresponds to the detector type as shown below. The same detector is applied to all PVT traces String Returned Definition AVER = Average (Voltage) POS = (Positive) Peak SAMP = Sample NEG = Negative Peak
Couplings	The auto detector rules depend upon marker type, trace state writing mode, and trace active state. The Pvt detectors and non-Pvt detectors are independent.
Preset	POS
State Saved	Saved in instrument state

More Information

Value	Example	Notes
Average	:DET:TRAC AVER	Determines the average of the signal within the bucket.
Peak	:DET:TRAC POS	Determines the highest signal within the bucket.
Sample	:DET:TRAC SAMP	Determines the instantaneous level of the signal at the center of the bucket
Negative Peak	:DET:TRAC NEG	Determines the minimum of the signal within the bucket

Detector Basics

To understand detectors you must understand the concept of trace buckets. For every trace point, there is a finite time during which the data for that point is collected. The analyzer 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

– 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, 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 analyzer settings.

3.11.3.2 Detector Select Auto/Man

This toggle 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 analyzer settings.

When any detector is selected by the user, this toggles automatically to Man (manual).

You can have a different detector for PvT measurements than for Spectrum measurements, including a different Auto/Man setting, so a different command is used to select the detector Auto state for PvT measurements. See the "PvT Detector Auto command" on page 356.

If a PvT window is being displayed along with a Spectrum window, you can only have one detector, which means one Auto detector state, which applies to all windows. You use the regular detector command (`:DETector:TRACe:AUTO`) to select the auto detector state in this case, NOT the PvT auto detector command (`:DETector:TRACe:PVTime:AUTO`).

Remote Command	`[:SENSe]:DETector:TRACe:AUTO ON | OFF | 1 | 0` `[:SENSe]:DETector:TRACe:AUTO?`
Example	`:DET:TRAC:AUTO ON` Sets trace detection to automatic
Dependencies	The auto detector rules depend upon marker type, averaging state and type, trace state writing mode, and trace active state
Couplings	Selecting `ON`, whether by pressing the control or sending the equivalent SCPI command, will turn trace math to Off for the selected/specified trace
Preset	Auto (`ON`) for all detectors
State Saved	Saved in instrument state

PvT Detector Auto command

Remote Command	`[:SENSe]:DETector:TRACe:PVTime:AUTO ON | OFF | 1 | 0` `[:SENSe]:DETector:TRACe:PVTime:AUTO?`
Example	`:DET:TRACE:PVT:AUTO ON` Sets pvt detection to automatic
Dependencies	The auto detector rules depend upon marker type, trace state writing mode, and trace active state
Couplings	Selecting `ON`, whether by pressing the control or sending the equivalent SCPI command, will turn trace math to Off for the selected/specified trace
Preset	Auto (`ON`) for all detectors
State Saved	Saved in instrument state

3.11.4 Math

The Math tab lets you turn on and configure trace math functions.

3.11.4.1 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 **Trace Operands** key. In RTSA, only Spectrum traces can participate in Trace Math functions.

See "Math: More Information" on page 358.

Remote Command	`:CALCulate:MATH TRACE1 | TRACE2 | TRACE3 | TRACE4 | TRACE5 | TRACE6, PDIFference | PSUM | LOFFset | LDIFference | OFF, TRACE1 | TRACE2 | TRACE3 | TRACE4 | TRACE5 | TRACE6, TRACE1 | TRACE2 | TRACE3 | TRACE4 | TRACE5 | TRACE6, <real>,<real>` `:CALCulate:MATH? TRACE1 | TRACE2 | TRACE3 | TRACE4 | TRACE5 | TRACE6`

Example	`:CALC:MATH TRACE1,PDIF,TRACE4,TRACE5,,`
	Sets Trace 1 to Power Diff trace math function, and sets the First Trace operand (for Trace 1) to Trace 4 and the Second Trace operand (for Trace 1) to Trace 5
	`:CALC:MATH TRACE1,PSUM,TRACE4,TRACE5,,`
	Sets Trace 1 to Power Sum trace math function and sets the First Trace operand (for Trace 1) to Trace 4 and the Second Trace operand (for Trace 1) to Trace 5
	`:CALC:MATH TRACE1,LOFF,TRACE4,,-6.00,`
	Sets Trace 1 to Log Offset trace math function, sets the First Trace operand (for Trace 1) to Trace 4, leaves the Second Trace operand (for Trace 1) unchanged (it is irrelevant for this function) and sets the Log Offset (for Trace 1) to –6 dB
	`:CALC:MATH TRACE1, LDIF, TRACE4, TRACE5, , -6.00`
	Sets Trace 1 to Log Diff trace math function, sets the First Trace operand (for Trace 1) to Trace 4, sets the Second Trace operand (for Trace 1) to Trace 5, and sets the Log Difference reference for Trace 1 to –6 dBm
	`:CALC:MATH TRACE1 OFF`
	Turns off trace math for trace 1

Notes	The Trace Math Function command has 6 main sets of parameters: Set 1 defines the "result trace": TRACE1|TRACE2|TRACE3|TRACE4|TRACE5|TRACE6 Set 2 defines the "function": PDIFference|PSUM|LOFFset|LDIFference|OFF Set 3 is a "trace operand" (1): TRACE1|TRACE2|TRACE3|TRACE4|TRACE5|TRACE6 Set 4 is a "trace operand" (2): TRACE1|TRACE2|TRACE3|TRACE4|TRACE5|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 and 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

	Note that for some of the math modes some of the parameters are not relevant. For those modes, the parameters are ignored, and sending ",," is sufficient for those parameters The query returns the math mode, the operand traces, the offset and the reference for the specified trace, all separated by commas. The return value of irrelevant parameters is undefined; empty fields (",,") would be desirable Remote command examples are included in each section below
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	Whenever a math function other than "Off" is selected for a trace, that trace is set to Display=On and Update=On
Preset	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
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
Backwards Compatibility Notes	The legacy TRACE:MATH:ADD and TRACE:MATH:SUBTract commands have been eliminated

Math: More Information

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:

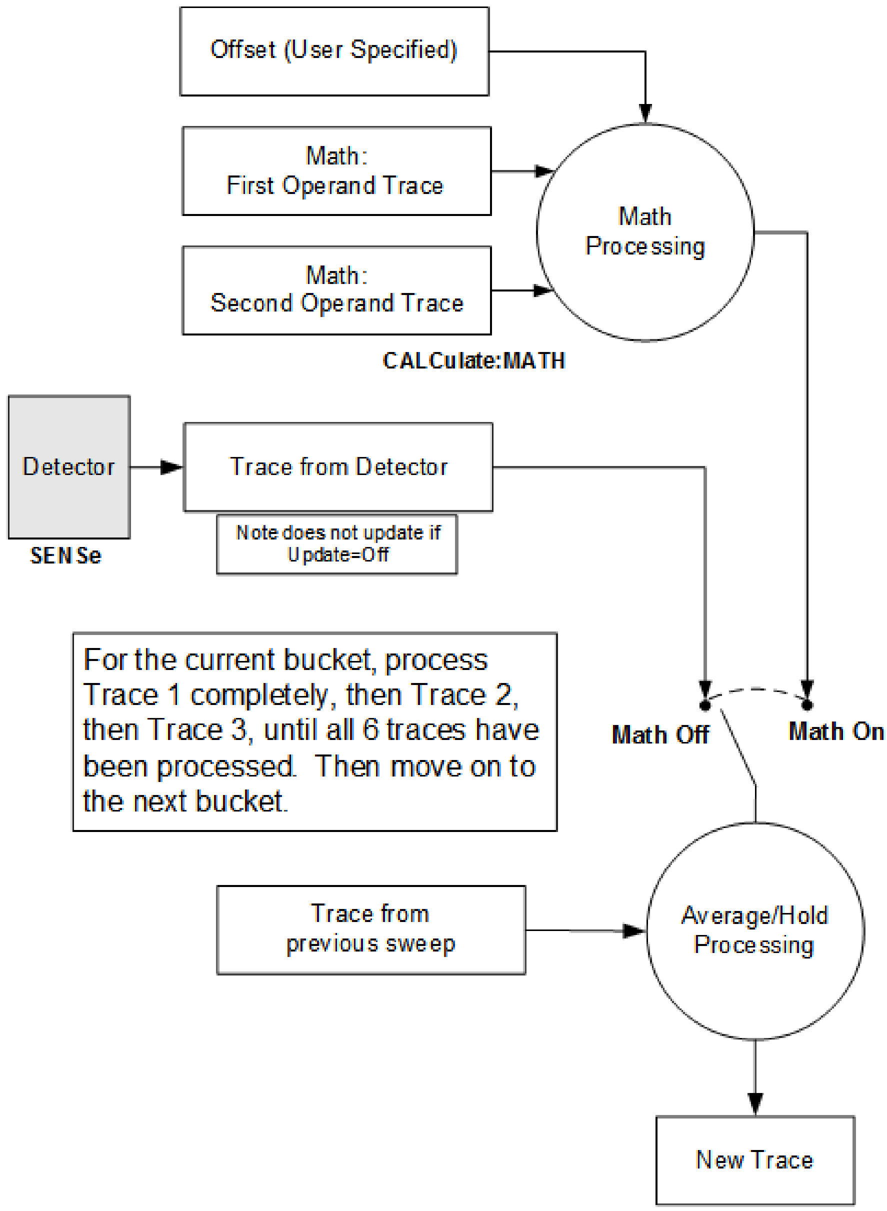
– If that point in `SecondTrace` is equal to `maxtracevalue`, the resultant point is `mintracevalue`.

– 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).

3.11.4.2 Operand 1

Selects the first trace operand to be used for the trace math functions for the destination trace.

Example	`:CALC:MATH TRACE1,PDIF,TRACE4,TRACE5,,`
	Sets Trace 1 to Power Diff trace math function, and sets the First Trace operand (for Trace 1) to Trace 4 and the Second Trace operand (for Trace 1) to Trace 5
	`:CALC:MATH TRACE1,LOFF,TRACE4,,-6.00,`
	Sets Trace 1 to Log Offset trace math function, sets the First Trace operand (for Trace 1) to Trace 4, leaves the Second Trace operand (for Trace 1) unchanged (it is irrelevant for this function) and sets the Log Offset (for Trace 1) to –6 dB

Notes	See the Math Function section for how to specify Operand 2 using the `:CALCulate:MATH` SCPI command
Dependencies	The destination trace cannot be an operand. The destination trace number is gray on the dropdown
Preset	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
State Saved	Operand 1 for each trace is stored in instrument state

3.11.4.3 Operand 2

Selects the second trace operand 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 and will be reflected on the trace operand controls for that trace.

Example	`:CALC:MATH TRACE1,PDIF,TRACE4,TRACE5,,` Sets Trace 1 to Power Diff trace math function, and sets the First Trace operand (for Trace 1) to Trace 4 and the Second Trace operand (for Trace 1) to Trace 5
Notes	See the Math Function section for how to specify Operand 2 using the `:CALCulate:MATH` SCPI command
Dependencies	The destination trace cannot be an operand. The destination trace number is gray on the dropdown
Preset	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	Operand 2 for each trace is stored in instrument state

3.11.4.4 Offset

The Offset value is used by the Log Offset math function. See "Operand 1" on page 362.

Example	`:CALC:MATH TRACE1,LOFF,TRACE4,,-6.00,` Sets Trace 1 to Log Offset trace math function, sets the First Trace operand (for Trace 1) to Trace 4, leaves the Second Trace operand (for Trace 1) unchanged (it is irrelevant for this function) and sets the Log Offset (for Trace 1) to –6 dB
State Saved	The Log Offset value for each trace is saved in Instrument State
Min	–100 dB
Max	100 dB

3.11.4.5 Reference

The Reference value is used by the Log Diff math function. See "Math Function" on page 356

Example	`:CALC:MATH TRACE1, LDIF, TRACE4, TRACE5, , -6.00` Sets Trace 1 to Log Diff trace math function, sets the First Trace operand (for Trace 1) to Trace 4, sets the Second Trace operand (for Trace 1) to Trace 5, and sets the Log Difference reference for Trace 1 to –6 dBm
State Saved	The Log Difference reference value for each trace is saved in instrument state
Min/Max	Same as reference level

3.11.5 Trace Function

The Trace Function tab lets you copy and exchange traces and preset or clear all traces.

3.11.5.1 From Trace

Selects the trace to be copied to or exchanged with the **To Trace**

Notes	See "Copy/Exchange"
Preset	1

3.11.5.2 To Trace

Selects the trace to be copied from or exchanged with the **From Trace**

Notes	See "Copy/Exchange"
Preset	2

3.11.5.3 Copy

This control executes a Trace Copy based on the From Trace and To Trace parameters. The Copy is done from the From Trace to the To Trace. The action is performed once.

The X-Axis settings and domain of a trace go with it when it is copied.

In RTSA, only traces of the same type can participate in Copy and Exchange functions.

Remote Command	`:TRACe:COPY TRACE1 | TRACE2 | TRACE3 | TRACE4 | TRACE5 | TRACE6 | TRACE7 | TRACE8 | TRACE9 | TRACE10 | TRACE11 | TRACE12, TRACE1 | TRACE2 | TRACE3 | TRACE4 | TRACE5 | TRACE6 | TRACE7 | TRACE8 | TRACE9 | TRACE10 | TRACE11 | TRACE12` `:TRACe:COPY?`
Example	`:TRAC:COPY TRACE1,TRACE3` Copies Trace 1 to Trace 3 and puts Trace 3 in Update=Off, Display=On
Notes	The TRACe:COPY 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	TRACE1, TRACE2
Backwards	The copy and exchange operations menu in ESA and PSA is replaced with the more general purpose

Compatibility Notes	Trace Function menu. The remote commands are unaffected, as they were already general The 2-DL->2 function in ESA and PSA (which was really a trace math function) has been eliminated, because its use case was very rare.. It actually subtracted the dB-equivalent of the dBm-expressed display line, regardless of the y axis unit. For example, if DL = +21.99 dBmV, it subtracted –25.00 dB (i.e. add +25.00 dB) to trace 2. New, more useful functions are provided in the new Trace, Math menu

3.11.5.4 Exchange

This control executes a Trace Exchange based on the From Trace and To Trace parameters. The From Trace and To Trace are exchanged with each other. The action is performed once.

The X-Axis settings and domain of a trace go with it when it is exchanged with another trace.

In RTSA, only traces of the same type can participate in Copy and Exchange functions.

Remote Command	`:TRACe:EXCHange TRACE1 | TRACE2 | TRACE3 | TRACE4 | TRACE5 | TRACE6 | TRACE7 | TRACE8 | TRACE9 | TRACE10 | TRACE11 | TRACE12, TRACE1 | TRACE2 | TRACE3 | TRACE4 | TRACE5 | TRACE6 | TRACE7 | TRACE8 | TRACE9 | TRACE10 | TRACE11 | TRACE12` `:TRACe:EXCHange?`
Example	`:TRAC:EXCH TRACE1,TRACE2` Exchanges Trace 1 and Trace 2 and puts both traces in Update=Off, Display=On
Notes	The TRACe:EXCHange 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
Backwards Compatibility Notes	The copy and exchange operations menu in ESA and PSA is replaced with the more general purpose Trace Function menu. The remote commands are unaffected, as they were already general

3.11.5.5 Preset All Traces

Turns on Trace 1 and blanks all other traces. Useful when you have many traces on and you want to go back 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:PRESet:ALL` When Signal ID is on, this key is grayed out
Example	`:TRAC:PRES:ALL`

3.11.5.6 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 all traces, except traces in Min Hold in which case it loads maxtracevalue. Does so even if Update=Off.

Remote Command	`:TRACe:CLEar:ALL`
	`:TRACe:PRESet:ALL`
	When Signal ID is on, this key is grayed out

Example	`:TRAC:CLE:ALL` Clears all traces

3.11.6 Normalize

The Normalize tab lets you configure and execute Normalize functions to display one trace relative to a reference trace.

3.11.6.1 Normalize On/Off

Normalize (On) activates the normalize function. 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 the Normalize function are:

1. Store the current Trace 1 into the reference trace, which is Trace 3
2. Turn on Normalize

If you try to turn on Normalize without first storing a reference trace, you will get an error.

In RTSA, only Spectrum traces can participate in Normalize functions.

See:

– "More Information" on page 367.

– "Normalize Block Diagram" on page 368

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 turned on, Trace 1 is placed in Clear/Write with Update = On and Display = On
Preset	`OFF`
State Saved	Saved in instrument state

More Information

The normalize function 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 analyzer 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 analyzer. Now press Store Ref (1→ 3), Normalize On. 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.

The normalize function 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 1 0 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.

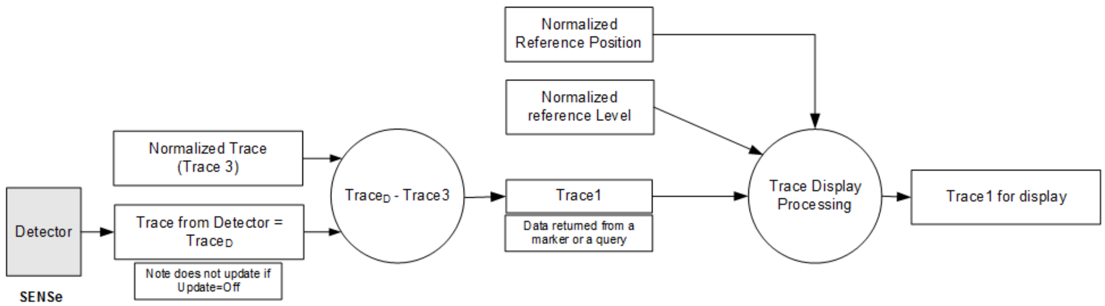
As Normalize displays a ratio between two traces (a difference, in dB) the Y-Axis Unit while in Normalize is dB in Log Amplitude and dimensionless in Linear. The Y Axis Unit chosen in the Y Axis Unit menu is unaffected by Normalize. When you leave Normalize the Y Axis Unit returns to the value set in 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 will be 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

A block diagram showing how Normalize works is presented below:



3.11.6.2 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, however 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

3.11.6.3 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

3.11.6.4 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

3.11.6.5 Norm Ref Position

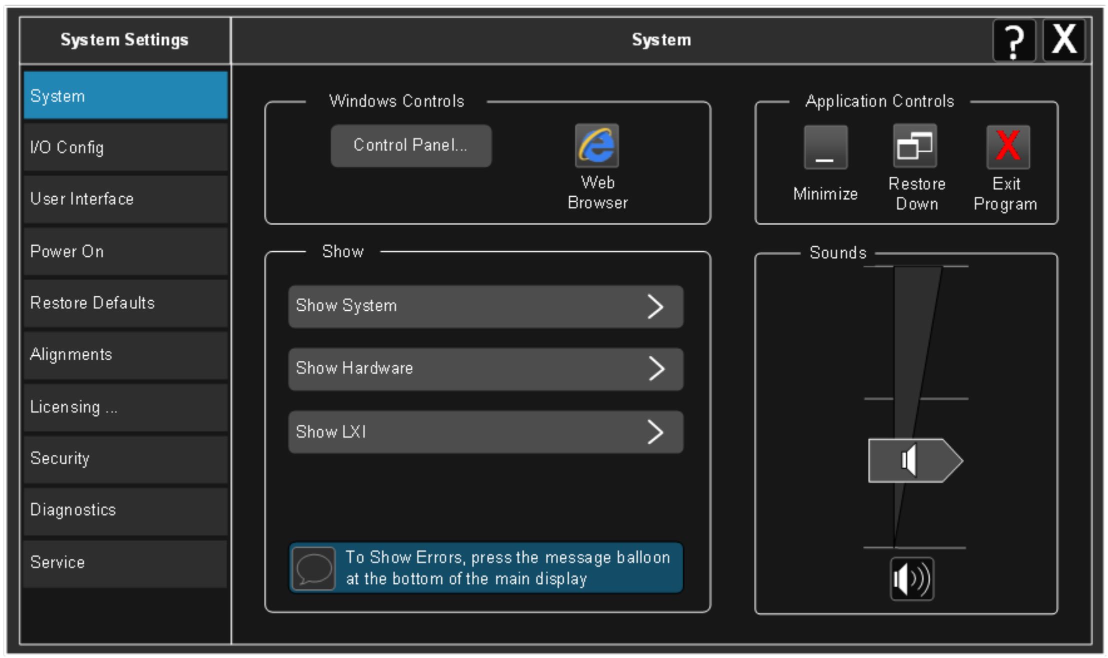
Sets the graticule line that represents the Norm Ref Lvl: 10 is the top line and 0 is the bottom line. The normalized reference position is indicated with a white right arrow on the left side of the display and a white left arrow on the right side of the display, just inside the graticule.

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

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. There are a line of tabs down the left side that let you choose various pages for configuring your instrument.



Notes	No remote command for this key specifically

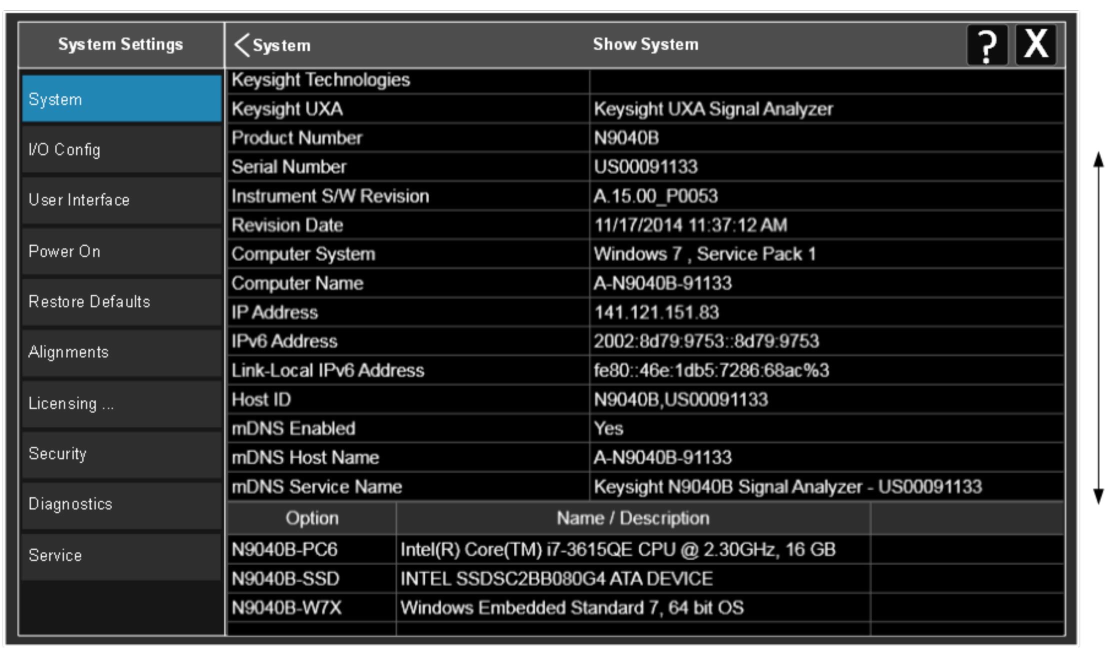
4.1 System

The System page 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 following SCPI command:

Remote Command	`:SYSTem:SHOW OFF | ERRor | SYSTem | HARDware | LXI | HWSTatistics | ALIGnment | SOFTware | CAPPlication` `:SYSTem:SHOW?`
Example	`:SYST:SHOW SYST`
Notes	This command displays (or exits) the various System information screens
Preset	`OFF`
State Saved	No
Range	`OFF| ERRor | SYSTem | HARDware | LXI | HWSTatistics | ALIGNment | SOFTware | CAPPlication`

4.1.1 Show System

The Show System screen is formatted into three groupings: product descriptive information, options tied to the hardware, and software products. Swipe up and down on this screen with your finger to scroll the display and see more information.



Example	`:SYST:SHOW SYST`

Backwards Compatibility Notes	The hardware statistics that are displayed in the PSA Show System screen have been moved to a dedicated Show Hardware Statistics screen in the Service Menu

4.1.1.1 Show System contents (Remote Command Only)

A remote command is available to obtain 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 with a new-line character

4.1.1.2 Computer System description (Remote Command Only)

A remote command is available to obtain the Computer System description. The Computer System is the operating system and patch level as reported by operating system.

Remote Command	`:SYSTem:CSYStem?`
Example	`:SYST:CSYS?`
Notes	The return value is the Computer System name and service pack level

4.1.2 Show Hardware

The show hardware screen is used to view 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 formatted into two groupings: product descriptive information and hardware information. The hardware information is listed in a table format.

Example	`:SYST:SHOW HARD`

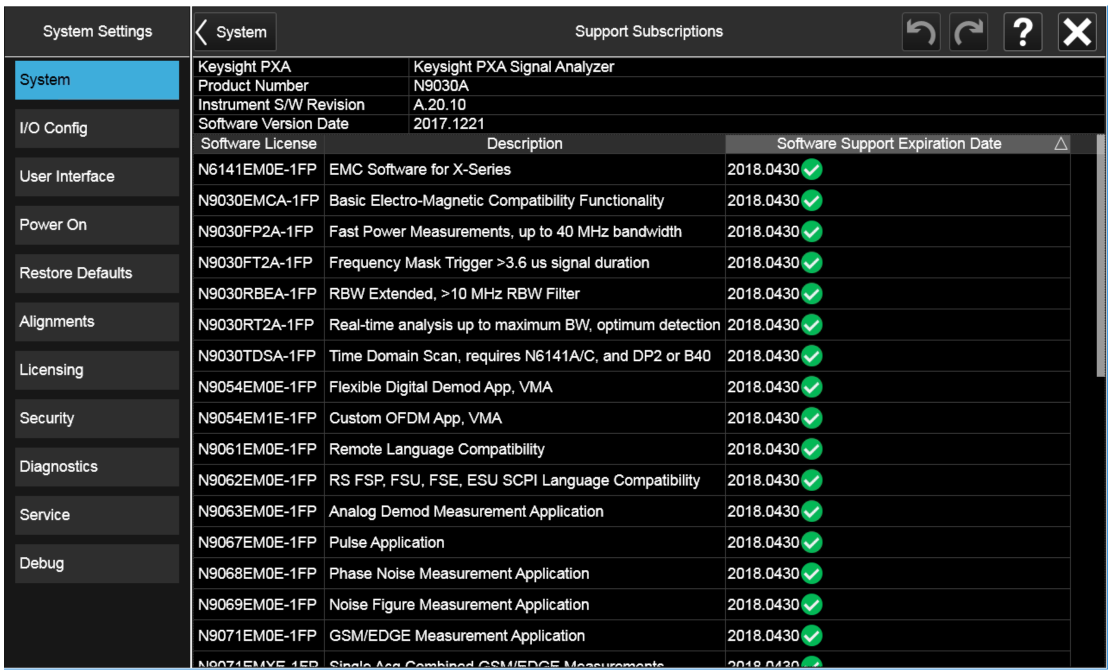
4.1.3 Show LXI

Shows you 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

Shows you the software support subscription information for the licenses you have available on the instrument. It 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 there may be enhancements available that the license does not enable.



Example	`:SYST:SHOW SSINformation`

4.1.5 Show Support ID

This key shows you the Support ID for each license available for the instrument. It shows the software license, descriptions, software support expiration date, and the 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 the Support ID into another program or web site.

The “Copy all to clipboard ...” button copies all the data in comma-separated values (CSV) format to the Windows clipboard.

Example	`:SYST:SHOW SID`

4.1.6 Control Panel...

Opens the Windows Control Panel. The Control Panel is used to configure certain elements of Windows that are not configured through the Multitouch UI System menus.

NOTE This feature is not available if option SF1 is installed.

The Control Panel is a separate Windows application, so to return to the analyzer once you are in the Control Panel, you may either:

Exit the Control Panel by tapping on the red X in the upper right hand corner.

Or use **Alt+Tab**: press and hold the **Alt** key and press and release the **Tab** key until the Analyzer logo is showing in the window in the center of the screen, then release the **Alt** key.

Notes	No remote command for this key

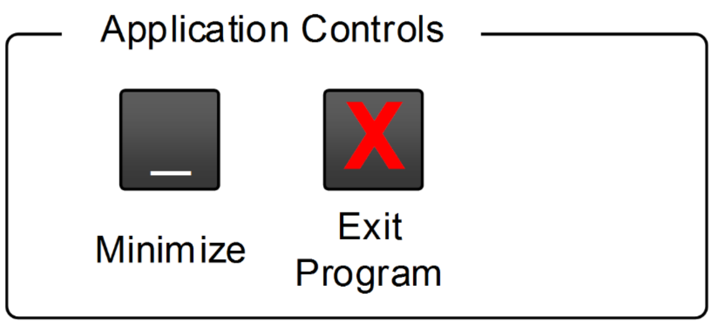
4.1.7 Web Browser

This launches whatever Web Browser you have defined as your default, usually Microsoft Internet Explorer. A mouse and external keyboard are highly desired for using Internet Explorer. Close Internet Explorer to return focus to the Instrument Application (or use Alt-Tab).

NOTE This feature is not available if option SF1 is installed.

4.1.8 Application Controls

The Application controls let you Minimize and Exit the application.



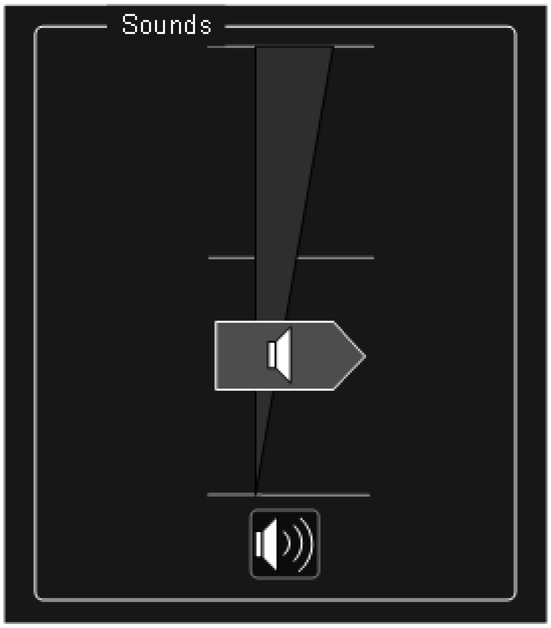
Pressing the Exit Program icon will put up a prompt asking if you are sure you want to close the program. If you choose “OK” the entire analyzer application will shut down, and you will lose any unsaved trace or measurement data.

Notes	No equivalent remote command for this key

4.1.9 Sounds

The Sounds panel lets you adjust the speaker volume with the slider and Mute/Unmute the speaker by tapping the Speaker icon.

Moving the slider up and down changes the speaker volume. It unmutes the speaker if muted.



Icon when muted

4.2 I/O Config

Activates a menu for identifying and changing 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 the I/O Config menu, but configuration of the 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

Activates a menu for configuring the GPIB I/O port.

Dependencies	This control is not available on the M9391A, M9393A, UXM or E7760

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	Changing the Address on the GPIB port requires all further communication to use the new address
Dependencies	This control is not available on the M9391A, M9393A, or E7760
Preset	This is unaffected by Preset but is set to 18 on a “Restore System Defaults->Misc”
State Saved	No
Min	0
Max	30

4.2.1.2 GPIB Controller

Sets the GPIB port into controller or device mode. In the normal state, GPIB controller is disabled, which allows the analyzer to be controlled by a remote computer. When GPIB Controller is enabled, the instrument can run software applications that use the instrument's computer as a GPIB controller; controlling devices connected to the instrument's GPIB port.

NOTE	When GPIB Controller is enabled, the analyzer application itself cannot be controlled over GPIB. In this case it can easily 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 analyzer is the controller, an external PC cannot 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 address TCPIP0:localhost:inst0:INSTR to send SCPI commands to the analyzer application.

Remote Command	`:SYSTem:COMMunicate:GPIB[1][:SELF]:CONTroller[:ENABle] ON | OFF | 0 | 1` `:SYSTem:COMMunicate:GPIB[1][:SELF]:CONTroller[:ENABle]?`

Example	`:SYST:COMM:GPIB:CONT ON`
	Will set GPIB port to Controller
	`:SYST:COMM:GPIB:CONT OFF`
	Will set GPIB port to Device

Notes	When the instrument becomes the Controller bit 0 in the Standard Event Status Register is set (and when the instrument relinquishes Controller capability bit 0 is cleared in the Standard Event Status Register)
Dependencies	This control is not available on the M9391A, M9393A, or E7760
Preset	This is unaffected by Preset but is set to OFF on a “Restore System Defaults->Misc”
State Saved	No
Range	Disabled|Enabled

4.2.2 SCPI LAN

Activates a menu for identifying and changing the SCPI over a LAN configuration. There are a number of different ways to send SCPI remote commands to the instrument over LAN. It can be a problem to have multiple users simultaneously accessing the instrument over the LAN. These controls limit that somewhat 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 380

– "SCPI Socket" on page 380

– "SICL Server" on page 381
– "HiSLIP Server" on page 381
– "Verbose SCPI On/Off" on page 382
– "SCPI Socket Control Port (Remote Command Only)" on page 383

4.2.2.1 SCPI Telnet

Turns the 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	This is unaffected by Preset but is set to ON with a “Restore System Defaults->Misc” Secure Instrument Communications configuration setting: if not set up or specified, it is ON
State Saved	No
Range	On | Off

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.

Configuration String & Copy Button

In the SCPI LAN dialog, to the right of the **SCPI Socket**ON/OFF control, the full SCPI connection string is displayed. Pressing the **Copy** button to the right of the string copies the displayed 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	This is unaffected by **Preset** but is set to ON by **Restore System Defaults->Misc** 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 instrumentwhen 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

Configuration String & Copy Button

In the SCPI LAN dialog, to the right of the **SICL Server**`ON/OFF` control, the full connection string is displayed. Pressing the **Copy** button to the right of the string copies the displayed 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	This control is not available on the M9391A or M9393A or 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	This is unaffected by **Preset**, but is set to `ON` by **Restore System Defaults->Misc** Secure Instrument Communications configuration setting: is `ON` if not set up or specified
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.

Here is an 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.

Configuration String & Copy Button

In the SCPI LAN dialog, to the right of the **HiSLIP Server**`ON/OFF` control, the full connection string is displayed. Pressing the **Copy** button to the right of the string copies the displayed 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	This is unaffected by **Preset**, but is set to `ON` by **Restore System Defaults->Misc** Secure Instrument Communications configuration setting: is `ON` if not set up or specified
State Saved	No
Range	`OFF`|`ON`

4.2.2.5 Verbose SCPI On/Off

When you turn Verbose SCPI on, additional information is returned when you send the :SYSTem:ERRor? query. 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, the SYSTem:ERRor? query 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; it only changes the response to the :SYST:ERR? query.

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"
```

Now 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	This is unaffected by Preset but is set to OFF on a “Restore System Defaults->Misc”
State Saved	No
Range	On | Off

4.2.2.6 Device Clear on Disconnect

When using HiSLIP (High Speed LAN Instrument Protocol), Telnet, or Sockets, a communication session with the analyzer 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 analyzer is running.

When a session is closed, a Device Clear function is generated, which affects the entire analyzer, not just the current connection. So 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 will not be 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	This is unaffected by Preset but is set to OFF on a “Restore System Defaults->Misc”
State Saved	No
Range	On | Off

4.2.2.7 SCPI Socket Control Port (Remote Command Only)

Returns the TCP/IP port number of the control socket associated with the SCPI socket session. This query enables you to 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 SCPI command 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	This is unaffected by Preset or “Restore System Defaults->Misc”
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 Command 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 capability which 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’ (without the quotes). The control provided here is the means to set the web password as desired, or to reset the password to the factory default.

Selecting Reset web password 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	This control is not available on the M9391A or M9393A or UXM

4.2.4 LXI

Opens a menu that allows you to access the various LXI configuration properties.

Dependencies	This control is not available on the M9391A or M9393A or UXM

4.2.4.1 LAN Reset

Resets the LAN connection. This will result in the following settings and will restart 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.

4.2.4.2 Device Identification (Remote Command Only)

Enabling the LXI device identification will place the LXI Status Indicator to the 'Identify' state. Disabling the LXI device identification will place the LXI Status Indicator to the 'No Fault' state. The LXI Status indicator is in the upper left region of the instrument's graphical user interface.

For the EXT-C (E6607C), the controlling test software can use this capability to instruct the operator that the instrument is under remote operation. For example, the test software can enable identification to indicate the instrument is in use, and disable identification when the test procedure is finished.

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 on Restore System Defaults All
State Saved	No
Range	On | Off

4.2.5 System IDN Response

This control allows you to specify a response to the *IDN? query, return the analyzer 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.

4.2.5.1 System IDN Response

To choose the factory-set response, select **Factory**. To specify your own response, select **User**. You can enter your desired response using the next control (User IDN).

If your test software is expecting the response to indicate Agilent Technologies as the Manufacturer, you can configure this response by selecting Agilent.

See "More Information" on page 386

Remote Command	`:SYSTem:IDN:CONFigure FACTory | AGILent | USER` `:SYSTem:IDN:CONFigure?`
Example	`:SYST:IDN:CONF FACT`
Notes	This affects the response given in all Modes of the Analyzer, 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 the current Mode It survives shutdown and restart of the software and therefore survives a power cycle
Preset	The *IDN response is reset to FACTory by Restore Misc Defaults or Restore System Defaults All and survives subsequent running of the software

More Information

Here are details about the several 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 will indicate the Manufacturer as Keysight Technologies. If your test software is expecting the response to indicate Agilent Technologies you can conveniently 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 the User IDN control.

4.2.5.2 User IDN

This control allows you to specify your own response to the *IDN? query. 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 analyzer 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 format of the <string> must be 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>. Thus, the text within a field cannot contain a comma This affects the response given in all Modes of the Analyzer, 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 the current Mode It 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	This is unaffected by Preset but is set to the original factory setting on a “Restore System Defaults->Misc”

4.2.5.3 SYSTem:PERSona (Remote Commands Only)

The SYSTem:PERSona set of commands permit setting of individual fields of the *IDN? Response.

- "SYSTem:PERSona:DEFault" on page 388
- "SYSTem:PERSona:MANufacturer" on page 388
- "SYSTem:PERSona:MANufacturer:DEFault" on page 389
- "SYSTem:PERSona:MODel" on page 389
- "SYSTem:PERSona:MODel:DEFault" on page 389

SYSTem:PERSona:DEFault

This command will reset the *IDN response to the instrument default.

Remote Command	`:SYSTem:PERSona:DEFault` `:SYSTem:PERSona:DEFault?`
Notes	The query SYST:PERS:DEF? returns the default value of *IDN? even if the current setting of *IDN? is the non-default value. The return value of SYST:PERS:DEF? is a <string> SYST:PERS:DEF is equivalent to: SYSTem:IDN “” SYSTem:IDN:CONF DEF

SYSTem:PERSona:MANufacturer

This command will set the Manufacturer field of the *IDN? response. The Manufacturer field 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 (SYSTem:IDN:CONFigure FACT | AGIL), then the SYSTem:IDN:CONFigure is set to the corresponding value. If the IDN response with the new manufacturer field is not one of the predefined values, then SYSTem:IDN:CONFigure will be set to USER and SYSTem:IDN will be set to the new IDN response string The query SYST:PERS:MAN? returns the current value of the *IDN? Manufacturer field

SYSTem:PERSona:MANufacturer:DEFault

This command will reset the Manufacturer field of the *IDN? response to the default value.

Remote Command	`:SYSTem:PERSona:MANufacturer:DEFault` `:SYSTem:PERSona:MANufacturer:DEFault?`
Notes	The query SYST:PERS:MAN:DEF? returns the default Manufacturer Field value of *IDN? even if the current setting of *IDN? is the non-default value. The return value of SYST:PERS:MAN:DEF? is a <string>

SYSTem:PERSona:MODel

This command will set the Model field of the *IDN? response. The Model field 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 (SYSTem:IDN:CONFigure FACT | AGIL), then the SYSTem:IDN:CONFigure is set to the corresponding value. If the IDN response with the new model field is not one of the predefined values, then SYSTem:IDN:CONFigure will be set to USER and SYSTem:IDN will be set to the new IDN response string The query SYST:PERS:MOD? returns the current value of the *IDN? Model field

SYSTem:PERSona:MODel:DEFault

This command will reset the Model field of the *IDN? response to the default value.

Remote Command	`:SYSTem:PERSona:MODel:DEFault` `:SYSTem:PERSona:MODel:DEFault?`
Notes	The query SYST:PERS:MOD:DEF? returns the default Model Field value of *IDN? even if the current setting of *IDN? is the non-default value. The return value of SYST:PERS:MOD:DEF? is a <string>

1.

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 a 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 an OK and Cancel button for you to affirm or cancel the operation.

4.2.7 Query USB Connection (Remote Command 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: 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
Dependencies	This control is not available in E7760
State Saved	No
Range	NONE|LSPeed|HSPeed|FSPeed

4.2.8 USB Connection Status (Remote Command Only)

Enables you to 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 is receiving periodic start of frames but it isn't necessarily receiving or transmitting data
Dependencies	This control is not available in E7760

State Saved	No
Range	SUSPended|ACTive

4.2.9 USB Packet Count (Remote Command Only)

Enables you to 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. The first is the number of packets received since application invocation, the second is 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
Dependencies	This control is not available in E7760
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.

Care must be taken so 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 Command only)" on page 393
– "Unlock Remote I/O Session (Remote Command only)" on page 394
– "Remote I/O Session Lock Name (Remote Command only)" on page 394
– "Remote I/O Session Lock Owner (Remote Command only)" on page 394

Example of Lock Usage

1. Each session tries to obtain a lock by sending a :SYSTem:LOCK:REQuest? query
   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?` queries, trying to obtain the lock

4. When the active session finishes its task, it releases the lock by sending a `:SYSTem:LOCK:RELease` command
5. Now the lock has become available, so when one of the waiting sessions sends a `:SYSTem:LOCK:REQuest?` query, 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 a `:SYSTem:LOCK:NAME?` query. This session name is determined by the instrument.

A session also can query the name of the currently granted session by sending a `:SYSTem:LOCK:OWNer?` query.

NOTE

Remote I/O interfaces are grouped in two types: single-session interface and multi-session interface. Both types of interface 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 Command only)

You can lock the SCPI control of the instrument to the I/O Interface and Session by performing a `:SYSTem:LOCK:REQuest?` query. 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	The command returns a 1 if the lock request is granted, 0 is returned 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, you will need to perform a SYSTem:LOCK:RELease 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 will release the lock if the lock is granted to the interface and session A Device Clear over any interface and session will release 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 will result in the 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 a :SYSTem:LOCK:RELease command. 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, you will need to perform a release. The lock is not relinquished until the internal lock count is at 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 Command only)

You can obtain the name of the current I/O Interface and Session with the query :SYSTem:LOCK:NAME?.

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 The 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 the 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 Command only)

You can determine which I/O Interface and Session has the SCPI locked with the query :SYSTem:LOCK:OWNer?.

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

	The 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 the 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 Command Only)" on page 395
- "Config IPV4 Address (Remote Command Only)" on page 396
- "Config IPV6 Address (Remote Command Only)" on page 396
- "List All Physical Network Adapter IP Addresses (Remote Command Only)" on page 396

4.2.11.1 Multiple Network Adapters Enabled (Remote Command 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: – 1if 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 This command can set the valid IPV4 address, passed in as string in the config file Query returns IPV4 address as string. If config file is missing, "" (empty string) is returned Or the IP Address in IP V4 format Configuring 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 "2001:0d-b8:85a3:0000:0000:8a2e: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 This command can set the valid IPV6 address, passed in as string in the config file Query returns IPV6 address as string. If config file is missing, "" (empty string) is returned Or the IP Address in IP v6 format Configuring 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 Command Only)

Remote	`:SYSTem:COMMunicate:LAN:PHYSical:IPADdress:LIST?`

Command	
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 User Interface

The User Interface panel lets you configure functions specific to the User Interface, such as the menu panel orientation and the display color theme.

4.3.1 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 a Preset but is set to RIGHt on a "Restore User Interface Defaults" or "Restore System Defaults->All"
State Saved	Power On Persistent (survives shutdown and restart)

4.3.2 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 a Preset but is set to RIGHt on a "Restore User Interface Defaults" or "Restore System Defaults->All"
State Saved	Power On Persistent (survives shutdown and restart)

4.3.3 Annotations Local Settings/All Off

This function 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 analyzers; 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 are able to 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 a Preset but is set to ON on a "Restore User Interface Defaults", "Restore Misc Defaults" or "Restore System Defaults->All"
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

4.3.4 Display Theme

This control 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 the Display Theme to Outline will not affect screen image saves or prints, it will 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, 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.

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 will be 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 a Preset but is set to FILLed on a "Restore User Interface Defaults", “Restore Misc Defaults” or "Restore System Defaults->All"
State Saved	Power On Persistent (survives shutdown and restart)

4.3.5 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 will turn backlight on and could potentially perform the action as well.

Remote Command	`:DISPlay:BACKlight ON | OFF` `:DISPlay:BACKlight?`

Example	`:DISP:BACK ON`
	Turns backlight on
	`:DISP:BACK OFF`
	Turns backlight off

Preset	Pressing any key turns the backlight back on, and so does "Restore User Interface Defaults", “Restore Misc Defaults” or "Restore System Defaults->All"
State Saved	Not saved in State

4.3.6 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 Hints

Hints are descriptions that provide additional information for a control. This function allows you to have Hints enabled or disabled.

Remote Command	`:SYSTem:DISPlay:HINTs[:STATe] OFF | ON | 0 | 1` `:SYSTem:DISPlay:HINTs[:STATe]?`
Example	`:SYST:DISP:HINT OFF`
Preset	This is unaffected by a Preset but is set to ON on a "Restore User Interface Defaults" or "Restore System Defaults->All"
State Saved	Power On Persistent (survives shutdown and restart)

4.3.8 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 will hide 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 a Preset but is set to ON on a "Restore User Interface Defaults" or "Restore System Defaults->All"
State Saved	Power On Persistent (survives shutdown and restart)

4.3.9 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 a Preset but is turned on by "Restore User Interface Defaults" or "Restore System Defaults->All"
State Saved	Not saved in state, not affected by preset, not Power On Persistent (does not survive shutdown and restart)

4.3.10 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 a Preset but is set to SMALl on a "Restore User Interface Defaults" or "Restore System Defaults->All"
State Saved	Power On Persistent (survives shutdown and restart)

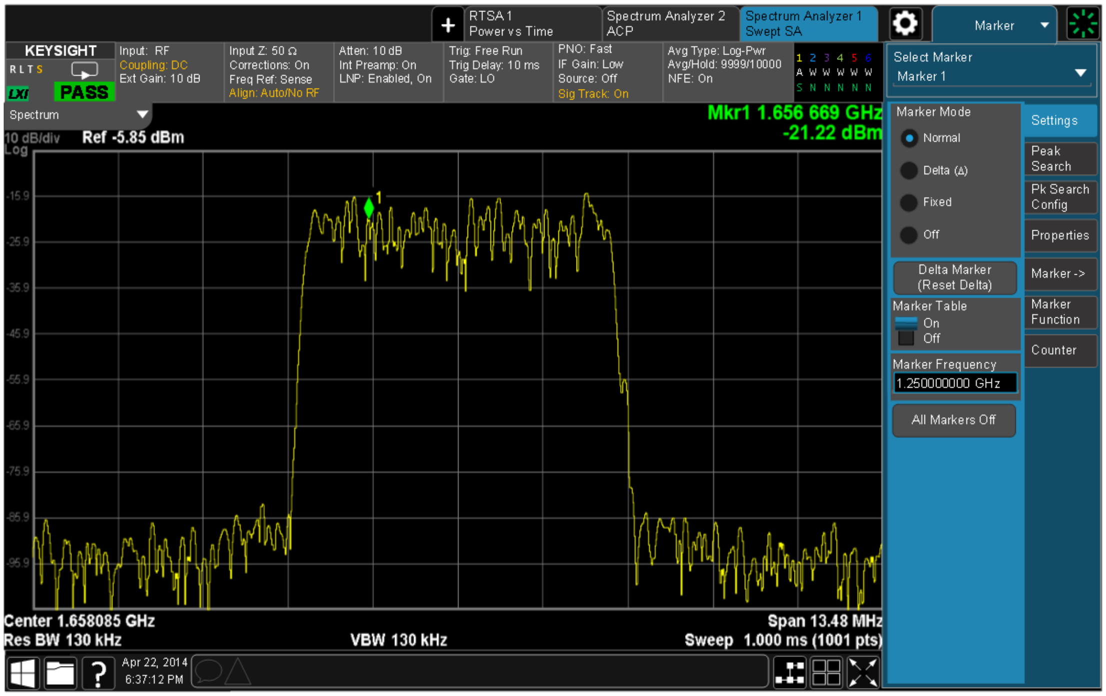
4.3.11 Quick Save Mode

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 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 a Preset but is set to NORMal on a "Restore User Interface Defaults" or "Restore System Defaults->All"
State Saved	Power On Persistent (survives shutdown and restart)

4.3.12 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:

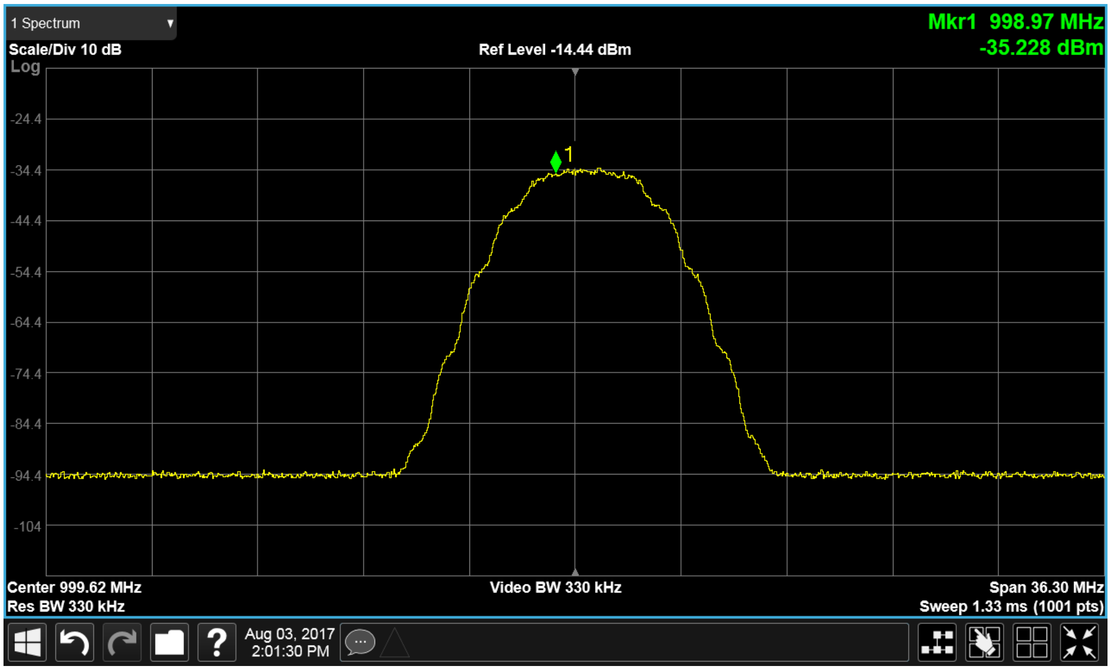


The default is the “Left” position.

Remote Command	`:DISPlay:UINTerface:STAB RIGHt | LEFT` `:INSTrument:SCReen:STAB?`
Example	`:DISP:UINT:STAB RIGH`
Preset	This is unaffected by a Preset but is set to LEFT on a "Restore User Interface Defaults" or "Restore System Defaults->All"
State Saved	Power On Persistent (survives shutdown and restart)

4.3.13 Hide Screen Tabs in Full Screen

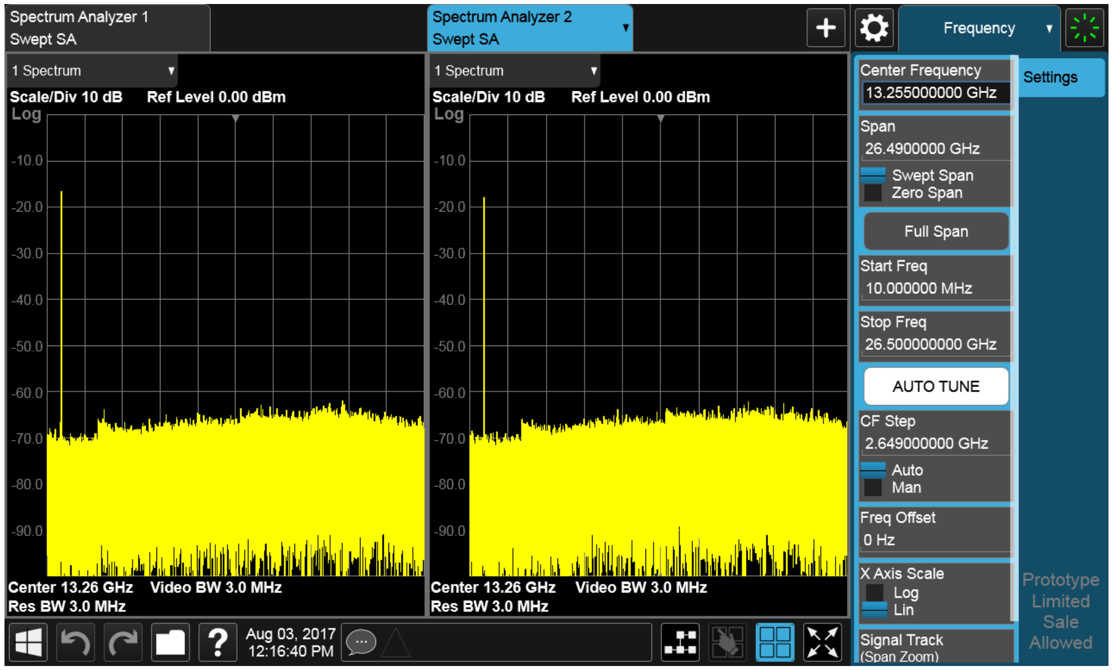
This switch, when in the “True” position, causes the Screen Tabs to be hidden when in Full Screen view, thus maximizing the display area available for results. If you also turn off the Meas Bar (in the Display, Annotation menu), you get the maximum available area for results, as shown below:



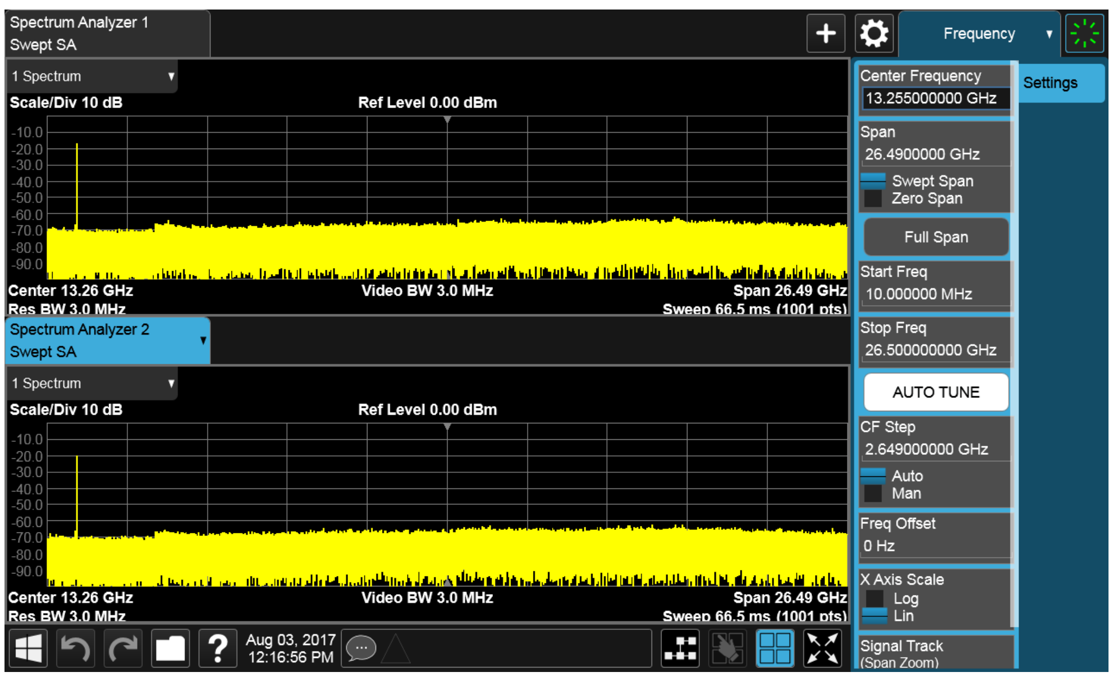
Remote Command	`:DISPlay:UINTerface:HTABs ON | OFF | 1 | 0` `:DISPlay:UINTerface:HTABs?`
Example	`:DISP:UINT:HTAB ON` Hide the tabs in full screen
Preset	This is unaffected by a Preset but is set to OFF on a "Restore User Interface Defaults" or "Restore System Defaults->All"
State Saved	Power On Persistent (survives shutdown and restart)

4.3.14 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	`:INSTrument:SCReen:ORIentation VERTical | HORizontal`

Command	
Example	`:INST:SCR:ORI VERT` Set the 2 screens to be above/below each other
Preset	`HOR` This is unaffected by a Preset but is set to HORizontal on a "Restore User Interface Defaults" or "Restore System Defaults->All"

4.3.15 Clock Format

Allows the Clock Format to be switched between 12-Hour Format and 24-Hour Format.

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

4.3.16 Language

Accesses the selection of language displayed on the menus and controls. English is the default language.

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 which are shorter or longer than the equivalent label in English. Any localized text on the controls that does not fit the label size will remain in English. Thus for any given menu, controls may be displayed in English and the selected language. Also, labels that are acronyms, engineering, or technology specific terms may remain in English.

All Application and Measurement names will remain in English.

All data in exported files will remain in English.

The Diagnostic and Service menus in the System Subsystem will 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 presented to the user that any external keyboards must remain English.

Other aspects of the Graphical User Interface remain in the English language. 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 a Preset but is set to ENGLish on a "Restore User Interface Defaults", "Restore Misc Defaults" or "Restore System Defaults->All"

4.3.17 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 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 message provides an OK and Cancel button for you to affirm or cancel the operation.

Example	`:SYST:DEF UINT`

4.3.18 User Interface Type (Remote only command)

This query-only command can be used 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 instruments and Touch UI 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

Enables you to 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.

Dependencies	This menu is not available on the M9391A or M9393A

4.4.1 Power On State

Enables you to select whether the instrument powers up in a default state or some other state. The options are: Mode and Input/Output Defaults, User Preset and 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 a Preset but is set to Mode on a “Restore System Defaults->All”
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 analyzer is powered on in Mode and Input/Output Defaults, it performs a Restore Mode Defaults to all modes in the instrument and also performs a 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 to User Preset. When the analyzer is powered on in User Preset, it will User Preset each mode and switch to the power-on mode. Power On User Preset will not affect any settings beyond what a normal User Preset affects.

Backward Compatibility Note: Power On User Preset will cause the instrument to power up in the power-on mode, not the last mode the instrument was in prior to shut down. 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 could never power up for the first time in User Preset.

Last State

Sets **Power On** to **Last**. When the analyzer is powered on, it will put all modes in the last state they were in prior to when the analyzer was put into Power Standby and it will wake 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 by using the front panel power **Standby** key or by using 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 have done a controlled shutdown prior to powering on in Last. If a controlled shutdown is not done when in Power On Last State, the instrument will power 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 will occur. To control the shutdown under remote control use the :SYSTem:PDOWn command.

Backward Compatibility Note: It is no longer possible to power-up the analyzer in the last mode the analyzer was running with that mode in the preset state. (ESA/PSA SYST:PRESET:TYPE MODE with SYST:PON:PRESET) You can power-on the analyzer 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 analyzer is interrupted, for example by pulling the line cord plug or by switching off power to a test rack, Power On Last 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 SCPI 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 the identical list from the :INSTrument[:SELect] command
	`:SYSTem:PON:MODE?`

Example	`:SYST:PON:MODE SA`
Notes	The list of possible modes (and remote parameters) to choose from is dependent on which modes are installed in the instrument
Preset	This is unaffected by a Preset but is set on a "Restore System Defaults->All" to SA, except in the cases noted below: – For N8973B, N8974B, N8975B, or N8976B: NFIG – For E7760: BASIC
State Saved	No

4.4.3 FPGA Configuration

The FPGA Configuration dialog lets you choose which FPGA image you want loaded into the analyzer.

Depending on your hardware configuration, your analyzer 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 have to 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 which 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 will not present the Preference group and will show a message about unlicensed/licensed capabilities. You can dismiss the dialog if the licensed capability isn't currently needed and you don't want to take the time to load the licensed FPGA image. However, this dialog will continue to pop-up 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:

- FS2 gives full FPGA enhanced sweep speed
- FS1 gives software implemented enhanced sweep speed
- Neither FS1 nor FS2 – no enhanced sweep speed
- Both FS1 and FS2 – same as FS2, the full FPGA enhanced sweep speed

If the EMI Receiver application 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 the EMI Receiver application. In particular, the Frequency Scan measurement cannot use the Scan Type of "Time Domain Scan" (this is the normally the default Scan Type for instruments with the TDS option). Instead, the EMI Receiver Application will behave 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, The EMI Receiver application will work as expected with the TDS option licensed, but the FS2 capability will silently revert back to FS1 behavior.

Switching Between Enhanced Sweep Speed and Time Domain Scan FPGA Images

You can't 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 or issuing the "Load FPGA" SCPI command below with the proper parameter.

Incorrect FPGA Configuration

If the EMI Receiver application, TDS, or 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 will automatically enter 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.

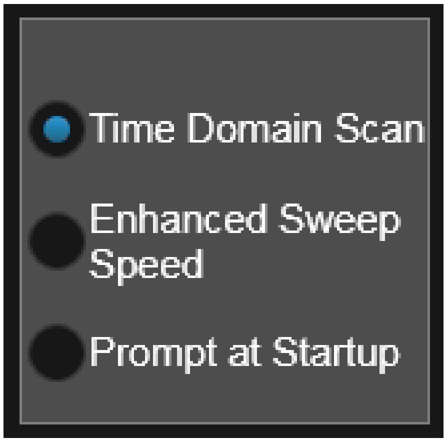
FPGA Updates When Firmware Installs

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 as:

1. Always use Time Domain Scan FPGA image for MXE
2. If neither the EMC Application nor TDS nor FS2 are licensed, the Enhanced Sweep Speed FPGA image is loaded
3. If EMC Application and TDS are licensed and FS2 is not licensed, the Time Domain Scan FPGA image is loaded
4. If EMC Application and TDS are not licensed and FS2 is licensed, the Enhanced Sweep Speed FPGA image is loaded
5. If all are licensed
   a. If the FPGA Configuration Preference is Time Domain Scan, the Time Domain Scan FPGA image is loaded
   b. If the FPGA Configuration Preference is Enhanced Sweep Speed, the Enhanced Sweep Speed FPGA image is loaded
   c. If FPGA Configuration Preference is Prompt
      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

You may choose one image or the other from the radio buttons at the top of the dialog:



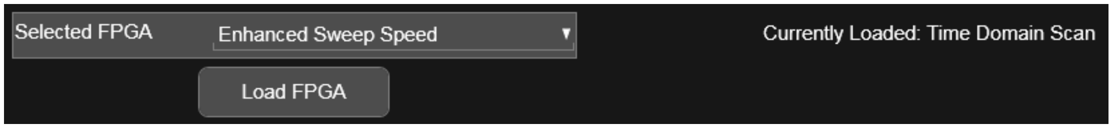
If you choose the one that is already loaded, you will not be prompted again. If you choose the other one, the Selected FPGA control will change to that one and the **Load FPGA** button will become active; you must press it to load the other image.

When installing new firmware, the FPGA Load Preference setting will be used to load the preferred FPGA image version if more than one version is available. It also allows you to be prompted at each startup which version of the FPGA image is wanted at that time, by selecting "Prompt at Startup".

Remote Command	`:SYSTem:PON:FPGA:PREFerence TDS | FS2 | PROMpt`
Example	`:SYST:PON:FPGA:PREF TDS` `:SYST:PON:FPGA:PREF?`
Notes	– TDS = Load the Time Domain Scan version of the FPGA image – FS2 = Load the Enhanced Sweep Speed version of the FPGA image – PROMpt = Prompt at each startup, show the FPGA Configuration dialog. The user can choose to continue with the currently loaded FPGA image version or load a different version This SCPI is always available, but if the hardware does not support multiple FPGA image choices, the value will always be: – NA = Not available for this hardware Also when not supported, any attempt to change away from NA will result in the error -224, "Illegal parameter value"
Dependencies	Dialogs and menus available only when EMC Application, TDS and FS2 are all licensed
Preset	PROMpt (not affected by Mode Preset but set to PROMpt by "Restore System Default" -> "All" or "Power On")

4.4.3.2 Load FPGA

Depending on what you choose under FPGA Load Preferences, you may end up with a mismatch between the desired FPGA image and the one that is currently loaded. In that case the **Load FPGA** button at the bottom of the dialog will not be grayed out, and you must press it in order to actually load the desired FPGA image. The one that is currently loaded shows to the right:



If you have a mismatch but don’t actually load the other image, the FPGA Load Preference will be remembered, but the image you had before will remain until you return to this dialog and press **Load FPGA**, or until the next time the analyzer firmware is updated.

If you press **Load FPGA**, the X-series software will exit, the FPGA update program will run, and the analyzer will reboot. 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, and the only fix is to return it to Keysight for servicing.

Remote Command	`:SYSTem:PON:FPGA:LOAD TDS | FS2`
Example	`:SYST:PON:FPGA:LOAD TDS` `: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, it will exit the analyzer software (terminating the SCPI session) and launch the FPGA update utility. When the FPGA is updated, the instrument will reboot This SCPI is always available, but if the hardware does not support multiple FPGA image choices, the value returned will always be: NA = Not available for this hardware Also when not supported, any attempt to change away from NA results in the 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 the EMC Application and the TDS hardware option – FS2 requires the FS2 hardware option 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 or any Restore Defaults

4.4.4 Restore Power On Defaults

This selection causes the Power On settings to be reset to their default value.

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 an OK and Cancel button for you to affirm or cancel the operation.

Example	`:SYST:DEF PON`

4.4.5 Configure Applications – Desktop application

The Configure Applications utility is run from the Desktop of the instrument. You must close the analyzer application before running Configure Applications.

Configure Applications can be used to:

- select applications for preload
- determine how many applications can fit in memory at one time
- specify the order of the Modes in the Mode menu.

This 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 information, see the following topics:

- "Preloading Applications" on page 415
- "Access to Configure Applications utility" on page 416
- "Virtual memory usage" on page 417

Example	`:SYST:SHOW CAPP` Displays the Config Applications screen

Preloading Applications

During runtime, if a Mode that is not preloaded is selected using the Mode menu or 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 enables you to “preload” at startup, to eliminate the runtime delay. Preloading an application will cause it to be loaded into the analyzer’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.

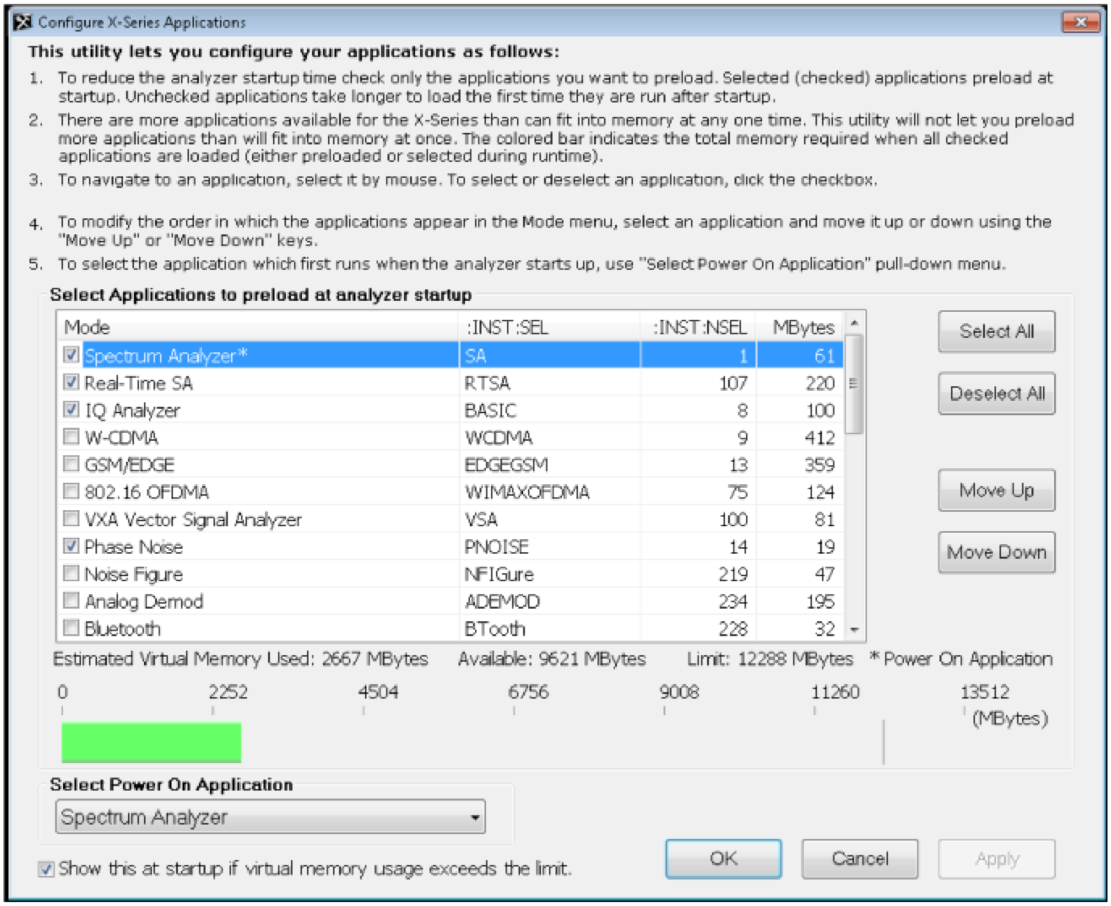
Note that there are more applications available for the X-Series than can fit into Windows Virtual Memory. By allowing you to choose which licensed applications to load at startup, the Configure Applications utility allows you to make optimal use of your memory.

Access to Configure Applications utility

A version of the utility runs the first time you power up the analyzer 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.

You may, at any time, manually call up the Configure Applications utility by closing the analyzer application and double-tapping the Configure Applications icon on the desktop.

When you run it, the utility looks like this:



Instructions are provided below and on 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 enables you to 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 the 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 memory in question here is Virtual memory and is a limitation imposed by the operating system, not by the amount of physical memory you have in your analyzer). 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 analyzer’s memory. You must deselect applications until the fuel bar turns yellow.

YELLOW: the applications you have selected can all fit into the analyzer’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 analyzer 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 analyzer’s memory with room to spare. You will likely be able to load one or more other applications without running out of memory.

All apps that are part of the sequencer mode (GSM/EDGE, WCDMA, CDMA2K and 1xEVDO) will be preloaded (if licensed) if Sequence Analyzer is selected to be preloaded.

4.4.6 Configure Applications - Instrument boot-up

At start-up of the analyzer programa dialog box similar to the one you see when you run **Configure Applications** will be displayed allowing you to choose which licensed applications are to be loaded. This dialog will only be displayed if the memory required to pre-load all of 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 419
– "Configuration Memory Available (Remote Command Only)" on page 419

– "Configuration Memory Total (Remote Command Only)" on page 419

– "Configuration Memory Used (Remote Command Only)" on page 419

– "Configuration Application Memory (Remote Command Only)" on page 420

4.4.7.1 Configuration list (Remote Command Only)

This remote command is 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> are from the enums of the :INSTrument:SELect command The order of the <INSTrument:SELect names> is the order that 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 Command Only)

This remote command is used to query 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 Command Only)

This remote command is used to query 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 Command Only)

This remote command is a query of 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 Command Only)

This remote command is used to query 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 from the enums of the :INSTrument:SELect command If the name provided is invalid, the value 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 generally associated with connections to the instrument, and most users would not want these resetting every time they pressed the Mode Preset key.

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.

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 message provides an OK and Cancel button for you to affirm 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 a 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 message provides an **OK** and **Cancel** button for you to affirm or cancel the operation.

Dependencies	This control is not available on the M9391A or M9393A

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 message provides an **OK** and **Cancel** button for you to affirm or cancel the operation.

Example	`:SYST:DEF UINT`

4.5.4 Power On

This selection causes the Power On settings to be reset to their default value.

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 message provides an **OK** and **Cancel** button for you to affirm or cancel the operation.

Example	`:SYST:DEF PON`
Dependencies	This control is not available on the M9391A or M9393A

4.5.5 Alignments

This selection 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 message provides an **OK** and **Cancel** button for you to affirm or cancel the operation.

Example	`:SYST:DEF ALIG`

4.5.6 Misc

This selection causes miscellaneous system settings to be reset to their default values. With this reset, you lose the GPIB address and it is reset to 18, so this should be used with caution.

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 message provides an **OK** and **Cancel** button for you to affirm or cancel the operation.

This miscellaneous group contains the rest of the settings that have not been part of the other Restore System 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

This performs a comprehensive reset of ALL analyzer settings to their factory default values. It resets all of the system setting groups, causes a Restore Mode Defaults for all modes in the instrument, and switches back to the power-on mode. It does not affect the User Preset file or any user saved files.

When All is selected, a message appears saying:

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 message provides an **OK** and **Cancel** button for you to affirm or cancel the operation.

NOTE **If you are using a Keysight USB External Mixer, then you will need to perform a Refresh USB Mixer Connection after Restoring All Defaults.**

Example	`:SYST:DEF ALL`
Notes	If using a Keysight USB External Mixer, perform a Refresh USB Mixer Connection (SCPI command

	:MIX:BAND USB) following a Restore All Defaults
Couplings	An All causes the currently running measurement to be aborted, and gets all modes to a consistent state, so it is unnecessary to couple any settings

Remote Command	`:SYSTem:PRESet:PERSistent`
Example	`:SYST:PRES:PERS`
Notes	`:SYST:PRES:PERS` is exactly the same as `:SYST:DEF ALL`

4.6 Alignments

The Alignments menu gives you access to 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. This annotation will be in amber for conditions that may cause specifications to be impacted.

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

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.

An Auto Align execution cannot be aborted with the Cancel (ESC) key. To interrupt an Auto Align execution, select **Auto Align Off**.

Remote Command	`:CALibration:AUTO ON | LIGHt | PARTial | OFF` `: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 upon a "Restore System Defaults->Align"
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	When Auto Align is executing, bit 0 in the Status Operational register is set

dependencies	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 backward compatibility only and is mapped to PARTial
Backwards Compatibility Notes	ESA SCPI for Auto Align is :CALibration:AUTO <Boolean>. The command for X-Series is an enumeration. Thus the parameters of “0” and “1” are not possible in X-Series Similarly, the ESA SCPI for :CALibration:AUTO? returned the Boolean value 1 or 0, in X-Series it is an Enumeration (string). Thus, queries by customer applications into numeric variables will result in an error In PSA Auto Align OFF was not completely off, it is equivalent to `PARTial` in X-Series. In X-Series, `OFF` will be fully OFF. This means users of PSA SCPI who choose `OFF` may see degraded performance and should migrate their software to use `PARTial`

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. The Auto Align, Normal selection maintains the instrument in warranted operation across varying temperature and over time.

If the condition “Align Now All required” is set, transition to Auto Align, Normal will perform the required alignments and clear the “Align Now All required” condition and then continue 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 is intended to inform you that you are responsible for maintaining the RF alignment of the instrument.

Alignment processing as a result of the transition to Normal will be 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 considerably more drift in amplitude accuracy in order 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, transition to Auto Align, Light will perform the required alignments and clear the "Align Now, All required" condition and then continue with further alignments as required to maintain the instrument adequately aligned for warranted operation.

Alignment processing as a result of the transition to LIGHT will be 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 is to inform the operator that they 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 like 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 is to inform the operator that they are responsible for maintaining the warranted operation of the instrument.

4.6.1.2 All but RF

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 is selected, the operator is responsible for performing an Align Now RF when RF-related alignments expire. The Auto Align, Alert mechanism will notify the operator 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 is intended to inform 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	This is unaffected by Preset but is set to ALL on a “Restore System Defaults->Align”
State Saved	No

4.6.1.3 Alert

The instrument will signal an Alert when conditions exist such that you will need to perform a full alignment (for example, Align Now All). The Alert can be configured in one of four settings; Time & Temperature, 24 hours, 7 days, or 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 Time & Temperature is chosen. This prevents accidental deactivation of alerts. When setting Alert from the front panel to any value but Time and Temperature, 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 message provides an **OK** and **Cancel** button for you to affirm or cancel the setting change.

No confirmation is required when Alert is configured through a remote command.

For more information see "Time & Temperature" on page 430

Remote Command	`:CALibration:AUTO:ALERt TTEMperature | DAY | WEEK | NONE` `:CALibration:AUTO:ALERt?`
Example	`:CAL:AUTO:ALER TTEM`
Preset	This is unaffected by Preset but is set to `TTEMperature` on a “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`

With Auto Align Alert set to Time & Temperature the instrument will signal 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 analyzer alignment is sufficiently up-to-date to maintain warranted accuracy.

24 hours

SCPI example `CAL:AUTO:ALER DAY`

With Auto Align Alert set to 24 Hours the instrument will signal 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 choose this selection 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`

With Auto Align Alert is set to 7 days the instrument will signal 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 choose this selection 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`

With Auto Align Alert set to None the instrument will not signal an alert. This is provided for rare occasions where you are making a long measurement which 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.

4.6.1.4 Execute Expired Alignments (Remote Command Only)

Alignments can be expired in the situation where Auto Align is in the state of Partial or Off. This feature runs the alignments that have expired. This is different than performing an Align All, Now operation. Align All, Now performs an alignment of all subsystems regardless of whether they are needed or not, with Execute Expired Alignments, only the individual subsystems that have become due are aligned.

Remote Command	`:CALibration:EXPired?`
Example	`:CAL:EXP?`
Notes	`:CALibration:EXPired?` returns 0 if successful, or 1 if failed

4.6.2 Align Now

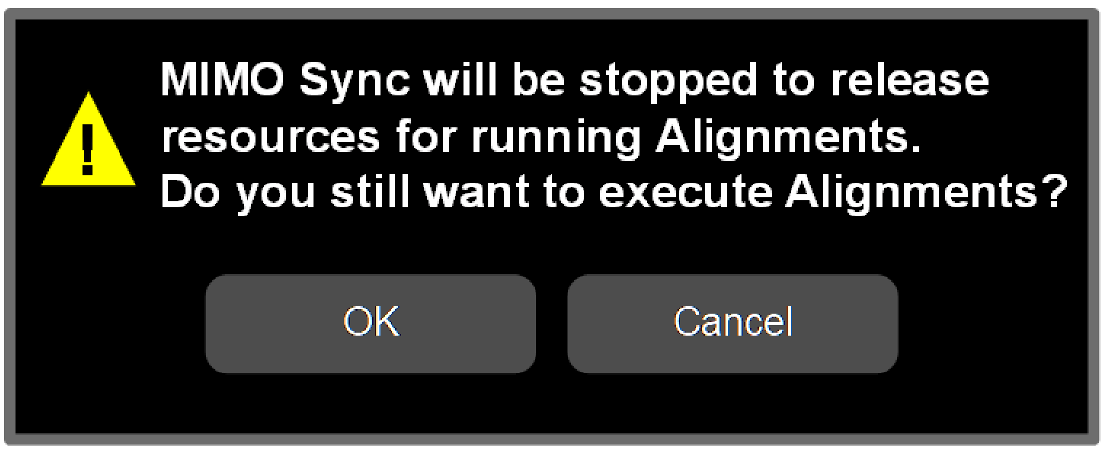
Accesses alignment processes that are immediate action operations. They perform complete operations and run until they are complete.

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 of :CALibration[:ALL].

While the alignment is performing, the coming NOP calibration will be ignored, and error message "SettingConflict, 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. So to avoid unexpected timeouts and results, these operations are not suggested during any such alignments.

NOTE The Alignments will not be performed if the MIMO Sync is running. As 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 will be shown as below. Click the OK button 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 will not be executed and a warning will be generated . To execute Alignments, you must stop MIMO by SCPI (or manually) firstly.

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 analyzer 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

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]?`

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 if 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) :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 analyzer input.

The query form of the remote commands (:CALibration:NRF?) will invoke the alignment and return a success or failure value.

Successful completion of Align Now All but RF will clear the "Align Now All required" Error Condition, and clear bit 14 in the Status Questionable Calibration register. If "Align Now All required" was in effect prior to executing the 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 will clear bit 14 in the Status Questionable Calibration register and set 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

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 if 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?) will invoke the alignment of the RF subsystem and return a success or failure value. An interfering user signal is grounds for failure.

Successful completion of Align Now, RF will begin 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, 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 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 will generate the Error Condition message "Align RF failed" and set bit 3 in the Status Questionable Calibration register An interfering user signal will result in bits 11 and 12 to be 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, 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

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 if 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 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 form of the remote commands (:CALibration:EMIXer?) will invoke the alignment of the External Mixer and return 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, Ext Mix 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 A failure encountered during alignment will generate the Error Condition message “Align LO failed” and set bit 5 in the Status Questionable Calibration register. Successful completion will clear 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

4.6.2.5 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. The operators have the responsibility to check temperature shift since last Align Now, Source to determine if 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

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, the user should repeat this query until the bit is cleare) :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.

4.6.2.6 Align Analyzer

Accesses analyzer 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 analyzer alignment. The operators have the responsibility to check temperature shift since last Align Now, Align Analyzer to determine if the receiver alignment needs to be executed.

Remote Command	`:CALibration:INTernal:RECeiver[:ALL]` `:CALibration:INTernal:RECeiver[:ALL]?`
Example	`:CAL:INT:REC`
Notes	`:CAL:INT:REC?` 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

4.6.2.7 Align Fast

Accesses fast alignment processes that are immediate action operations. They perform complete operations and run until they are complete.

Remote Command	`:CALibration:INTernal:FAST[:ALL]` `:CALibration:INTernal:FAST[:ALL]?`
Example	`:CAL:INT:FAST`
Notes	`:CAL:INT:FAST?` Initiates an Alignment and returns 0 if successful, or 1 if failed
Dependencies	Only appears in VXT models M9410A/11A

4.6.2.8 Align LO Leakage

Accesses LO Leakage alignment processes that are immediate action operations. They perform complete operations and run until they are complete.

Remote Command	`:CALibration:INTernal:LOLeakage` `:CALibration:INTernal:LOLeakage?`

Example	:CAL:INT:LOL
Notes	:CAL:INT:LOL? Initiates an Alignment and returns 0 if successful, or 1 if failed
Dependencies	Only appears in VXT models M9410A/11A

4.6.2.9 Align IF Cable

Accesses IF Cable alignment processes that are immediate action operations. They perform complete operations and run until they are complete.

Remote Command	:CALibration:INTernal:IFCable :CALibration:INTernal:IFCable?
Example	:CAL:INT:IFC
Notes	:CAL:INT:IFC? Initiates an Alignment and returns 0 if successful, or 1 if failed
Dependencies	Only appears in S9100

4.6.2.10 Align Now All but RF Preselector

This menu is only available in models with the RF Preselector, such as the N9048B. It is identical to the Align Now All (plus RF Presel) function described above, 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. Setting or querying the SCPI in other models generates an error
Status Bits/OPC dependencies	Bits 12 or 14 may be set in the Status Questionable Calibration register

4.6.2.11 Align Now RF Presel Only (20 Hz to 3.6 GHz)

This menu is 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 form of the remote commands (:CALibration:RFPSelector:ONLY?) will invoke the alignment of the RF Preselector on both Conducted and Radiated Band

and return a success or failure value. Successful completion will clear the "Align 20 Hz to 3.6 GHz required" Error Condition, and clear 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 will clear 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 will set the Error Condition "20 Hz to 3.6 GHz Alignment Failure" and set bit1, bit 2 in the Status Questionable Calibration Extended Needed register and bit 9 in Status Questionable Calibration register
Dependencies	For model N9048B only. Setting or querying the SCPI in other models generates an error This key is grayed out if the analyzer is displaying an "Align Now All required" message. If the user presses the key while it is grayed out they will receive 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

4.6.2.12 Align Selected Freq Ranges

VXT models M9410A/11A provide five alignments: Align Now All, Align Source, Align Analyzer, 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 Analyzer on VXT models 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 Analyzer**. 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 will be displayed to setup the frequency ranges to be aligned
Dependencies	Only available in: – VXT models M9410A/11A/15A – VXT models M9410A/11A/15A with RRH and/or CIU Only functional for the following alignments: – Align Now All of VXT models M9410A/11A/15A. – Align Source – Align Receiver – Align Fast – Align LO Leakage 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 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>: set the start frequency of an alignment <stopFreq>: set the stop frequency of an alignment To process alignment for a single frequency point, set startFreq = stopFreq
Dependencies	Only appears when Align Selected Freq Ranges is On Error message “Invalid alignment frequency range” will be reported when the start and stop frequency 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, Refer to "More Information" on page 443 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 is not active, the frequency range depends on the VXT models. The table below lists the Start and Stop Frequency Range of 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
M9415A	F06	330 MHz	6.6 GHz
M9415A	F08	330 MHz	8.6 GHz
M9415A	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

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.

Enable

Enable or disable the selected frequency ranges.

Preset	OFF

4.6.2.13 Align External Mixer Path

Immediately executes an alignment of the External Mixer Path inside the VXT model M9415A. 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 available for the External Mixer Path alignment. You are responsible for checking the temperature shift since last Align Now, External Mixer Path, to determine if 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 model M9415A 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

4.6.2.14 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 available for the Low Band alignment. You are responsible for checking the temperature shift since last Align Now, Align Low Band, to determine if 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 model M9415A
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

4.6.2.15 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 available for the High Band alignment. You are responsible for checking the temperature shift since last Align Now, Align High Band, to determine if 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 model M9415A
Couplings	Initializes theexterna time for the Last Align High Band Now, All Time Records the temperature for the Last Align High Band Now, All Temperature

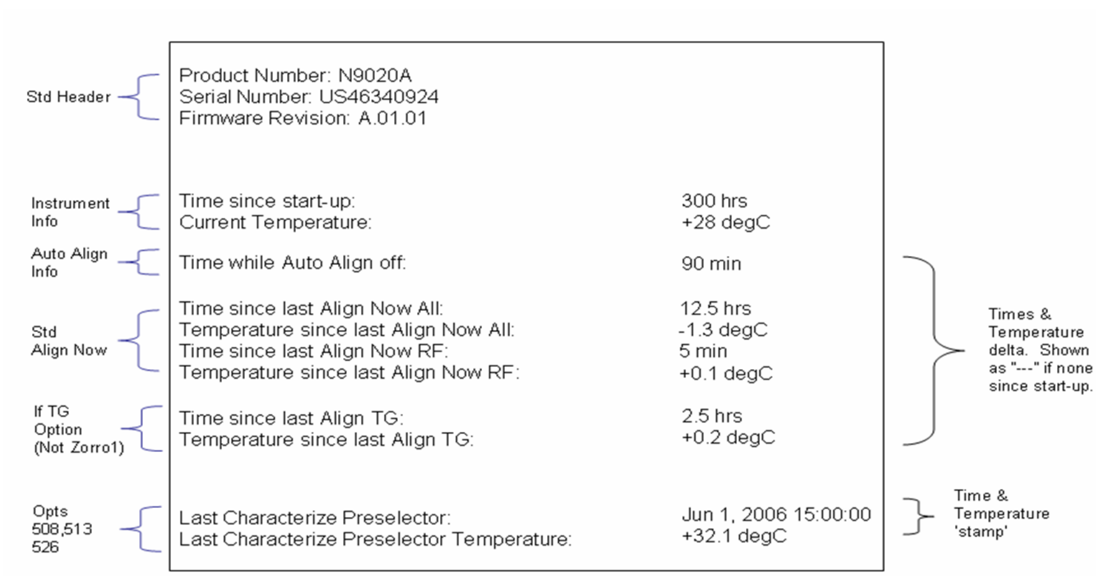
4.6.3 Show Alignment Statistics

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 which are 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 will set the Last Align RF temperature to the current temperature, and reset the Last Align RF time. A successful Align Now All or Align Now All but RF will set the Last Align Now All temperature to the current temperature, and reset the Last Align Now All time. A successful Align Now All will also reset 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 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 Analyzer

Remote Command	:CALibration:TIME:INTernal:RECeiver?
Example	:CAL:TIME:INT:REC?
Notes	Value is the elapsed time, in hours, since the last successful Align Now Analyzer
Dependencies	Only appears in VXT models M9410/11A
State Saved	No

Query Temperature of Last Align Now Analyzer

Remote Command	:CALibration:TEMPerature:INTernal:RECeiver?
Example	:CAL:TEMP:INT:REC?
Notes	Value is in degrees Centigrade at which the last successful Align Now Analyzer was executed
Dependencies	Only appears in VXT models M9410/11A
State Saved	No

Query Time since Last Align Now Source

Remote Command	:CALibration:TIME:INTernal:SOURce?
Example	:CAL:TIME:INT:SOUR?
Notes	Value is the elapsed time, in hours, since the last successful Align Now Source
Dependencies	Only appears in VXT models M9410/11A
State Saved	No

Query Temperature of Last Align Now Source

Remote Command	:CALibration:TEMPerature:INTernal:SOURce?
Example	:CAL:TEMP:INT:SOUR?
Notes	Value is in degrees Centigrade at which the last successful Align Now Source was executed
Dependencies	Only appears in VXT models M9410/11A
State Saved	No

Query Time since Last Align Now Fast

Remote Command	:CALibration:TIME:INTernal:FAST?
Example	:CAL:TIME:INT:FAST?
Notes	Value is the elapsed time, in hours, since the last successful Align Now Fast
Dependencies	Only appears in VXT models M9410/11A
State Saved	No

Query Temperature of Last Align Now Fast

Remote Command	:CALibration:TEMPerature:INTernal:FAST?
Example	:CAL:TEMP:INT:FAST?
Notes	Value is in degrees Centigrade at which the last successful Align Now Fast was executed
Dependencies	Only appears in VXT models M9410/11A
State Saved	No

Query Time since Last Align Now LO Leakage

Remote Command	:CALibration:TIME:INTernal:LOLeakage?
Example	:CAL:TIME:INT:LOL?
Notes	Value is the elapsed time, in hours, since the last successful Align Now LO Leakage
Dependencies	Only appears in VXT models M9410/11A
State Saved	No

Query Temperature of Last Align Now LO Leakage

Remote Command	:CALibration:TEMPerature:INTernal:LOLeakage?
Example	:CAL:TEMP:INT:LOL?
Notes	Value is in degrees Centigrade at which the last successful Align Now LO Leakage was executed
Dependencies	Only appears in VXT models M9410/11A
State Saved	No

Query Time since Last Align Now IF Cable

Remote Command	:CALibration:TIME:INTernal:IFCable?
Example	:CAL:TIME:INT:IFC?
Notes	Value is the elapsed time, in hours, since the last successful Align Now IF Cable
Dependencies	Only appears in S9100
State Saved	No

Query Temperature of Last Align Now IF Cable

Remote Command	:CALibration:TEMPerature:INTernal:IFCable?
Example	:CAL:TEMP:INT:IFC?
Notes	Value is in degrees Centigrade at which the last successful Align Now IF Cable was executed
Dependencies	Only appears in S9100
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 will yield 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 will yield 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?` This query 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 users “date” is representation of the date the task will run in the form of “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 of “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 For model N9038A only
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 is the elapsed time, in hours, since the last successful Align Now External Mixer Path Returns NaN if no Align Now External Mixer Path has ever been performed on the instrument
Dependencies	Only appears in VXT model M9415A, when 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 is in degrees Centigrade at which the last successful Align Now External Mixer Path was executed Returns NaN if no Align External Mixer Path has ever been performed on the instrument
Dependencies	Only appears in VXT model M9415A, when 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 is the elapsed time, in hours, since the last successful Align Now Low Band Returns NaN if no Align Now Now Low Band has ever been performed on the instrument
Dependencies	Only appears in VXT model M9415A
State Saved	No

Query Temperature of Last Align Now Low Band

Remote Command	:CALibration:TEMPerature:INTernal:LBANd?
Example	:CAL:TEMP:INT:LBAN?
Notes	Value is in degrees Centigrade at which the last successful Align Now Low Band was executed Returns NaN if no Align Now Now Low Band has ever been performed on the instrument
Dependencies	Only appears in VXT model M9415A
State Saved	No

Query Time since Last Align Now High Band

Remote Command	:CALibration:TIME:INTernal:HBAN?
Example	:CAL:TIME:INT:HBAN?
Notes	Value is the elapsed time, in hours, since the last successful Align Now High Band Returns NaN if no Align Now High Band has ever been performed on the instrument
Dependencies	Only appears in VXT model M9415A
State Saved	No

Query Temperature of Last Align Now High Band

Remote Command	:CALibration:TEMPerature:INTernal:HBANd?
Example	:CAL:TEMP:INT:HBAN?
Notes	Value is in degrees Centigrade at which the last successful Align Now High Band was executed Returns NaN if no Align Now High Band has ever been performed on the instrument

Dependencies	Only appears in VXT model M9415A
State Saved	No

4.6.4 Timebase DAC

This screen allows you to 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

4.6.4.1 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	This menu is not available on the M9391A or M9393A or UXM
Preset	This is unaffected by Preset but is set to CALibrated on a "Restore System Defaults->Align"
State Saved	No

4.6.4.2 User Value

Allows setting 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	This is unaffected by Preset but is set to the factory setting on a “Restore System Defaults->Align”
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

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`

4.6.5 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	This menu is not available on VXT or M9391A or M9393A or UXM

4.6.5.1 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 form of the remote command (`: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, 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 9 in the Status Questionable Calibration register A failure encountered during alignment will generate the Error Condition message “Characterize Preselector failed” and set 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

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, you should repeat this query until the bit is cleared) 3. :STATus:QUEStionable:CALibration:EXTended:FAILure:CONDition? (Check if bit 2 is set or not. If this bit is set, that means there are some errors in previous internal source calibration)

4.6.5.2 Characterize Reference Clock

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 458

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 the `:CAL:REF:CLOC?` query. 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

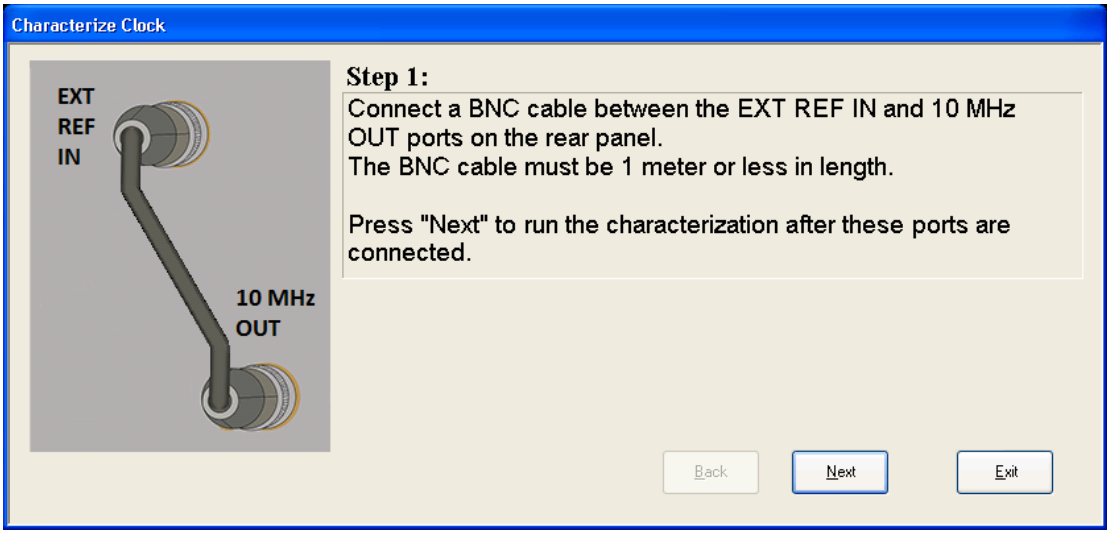
Remote Command	`:CALibration:REFerence:CLOCk:END?`
Example	`:CAL:REF:CLOC:END?`
Notes	Returns 0 if successful, or 1 if failed
Dependencies	Option DP2 or B40
Couplings	Expected to be run after sending the `:CAL:REF:CLOC?` query, and after removing the cable used in that Characterize Reference Clock step. 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

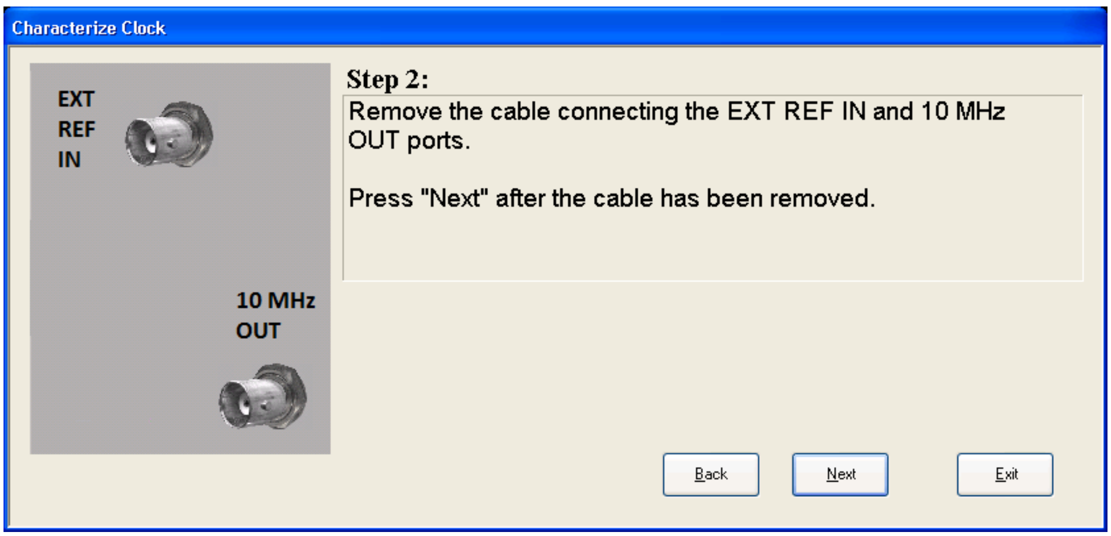
Front panel guided calibration sequence

When selecting “Characterize Reference Clock” through the front panel, the following form will be shown.

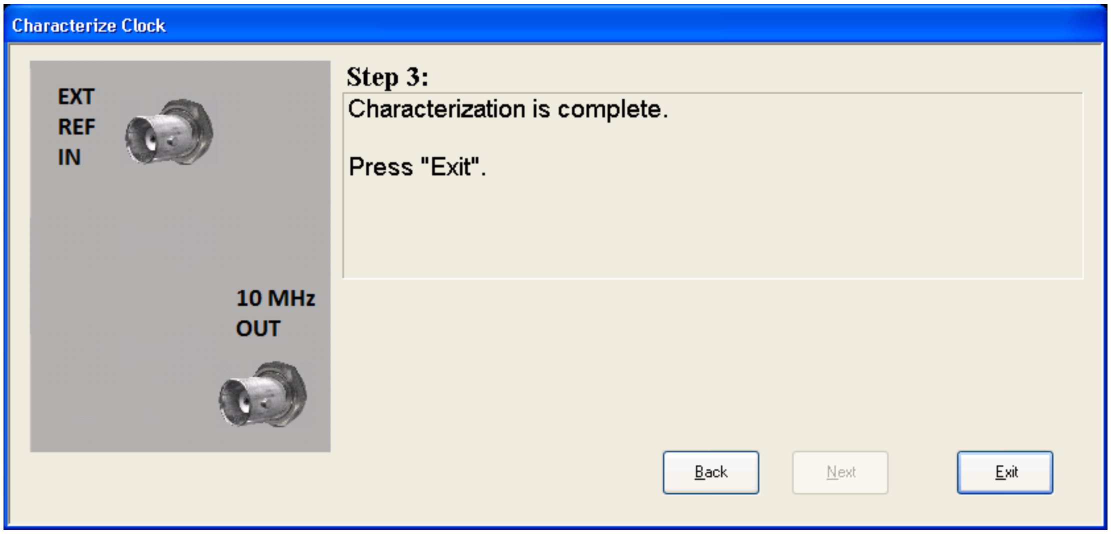
Step 1 of the guided calibration sequence:



Step 2 of the guided calibration sequence:



Step 3 of the guided calibration sequence:



4.6.5.3 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 the **Characterize Noise Floor** control. 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 analyzer 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 analyzer 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 analyzer 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) While Characterize Noise Floor is performing the alignment, bit ? in the Status Operation register is set. Completion, or termination, will clear bit ? 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 characterization will generate the Error Condition message "Characterize Noise Floor failed" message and set bit ? in the Status Questionable Calibration register. Successful completion will clear bit ? in the Status Questionable Calibration register
Dependencies	This control does not appear in models that do not contain NF2. In these models the SCPI command is accepted without error but no action is taken
Couplings	Successful completion of Characterize Noise Floor will begin the elapsed time counter or the Last Characterize Noise Floor Time

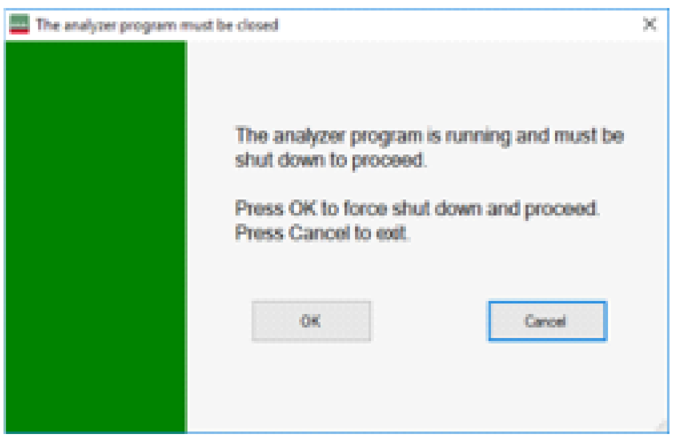
Remote Command	:CALibration:TIME:NFLoor?
Example	:CAL:TIME:NFL?
Notes	Value is the date and time the last successful Characterize Noise Floor was executed. The date is separated from the time by a space character. Returns "" if no Characterize Noise Floor has ever been performed on the instrument
Dependencies	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 Backup or Restore Align Data...

Opens the utility for backing-up or restoring the 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 463) 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 473) will be invoked and will prompt you to restore that backup.

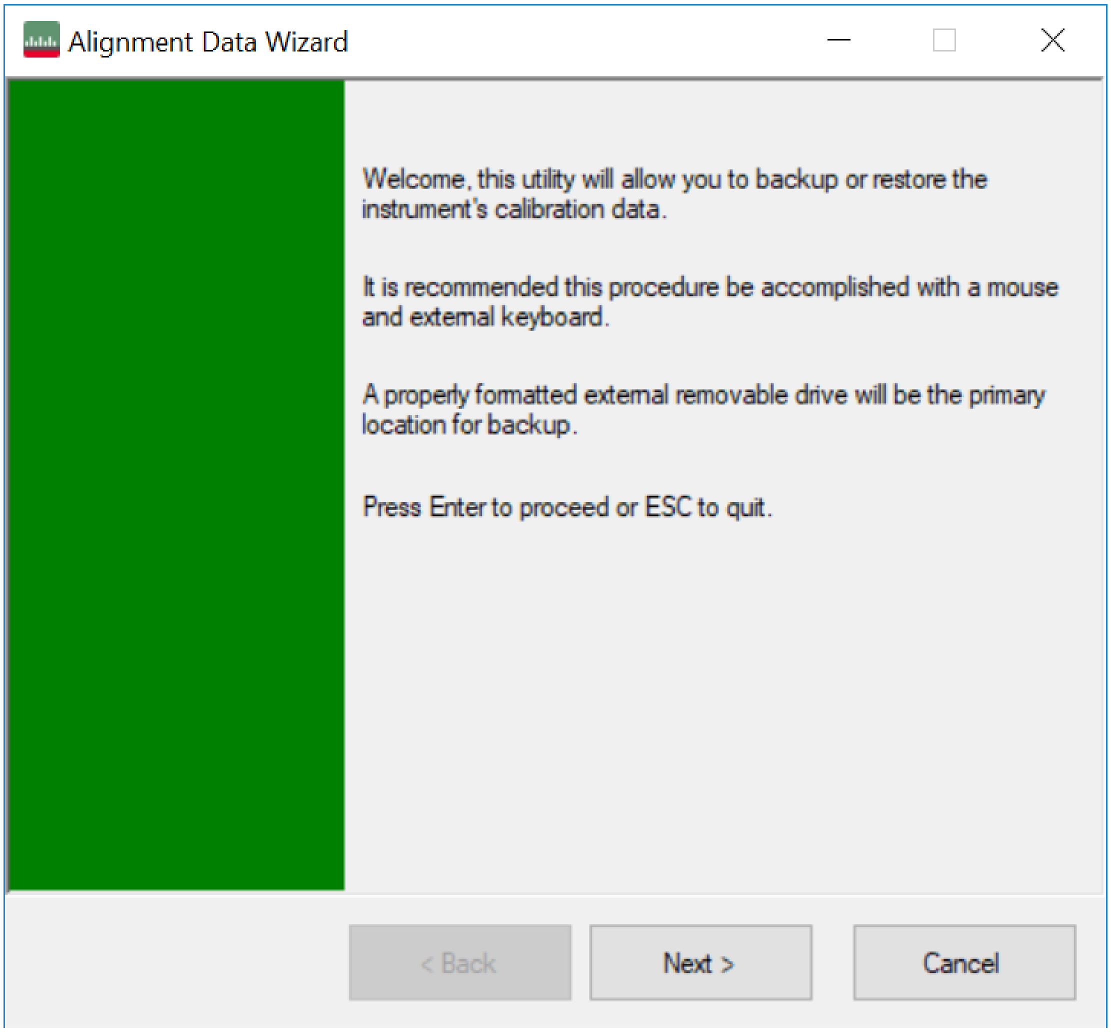
For purposes of these instructions, “alignment data” and “calibration data” are used interchangeably.

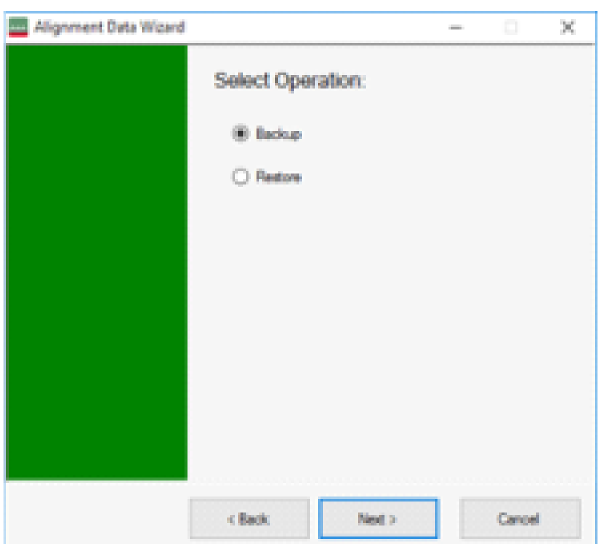
Dependencies	This menu is not available on the M9391A or M9393A or UXM

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

4.6.6.1 Alignment Data Wizard (without Flash)

The Backup or Restore Alignment Data wizard guides you through the operation of backing-up or restoring the alignment data.

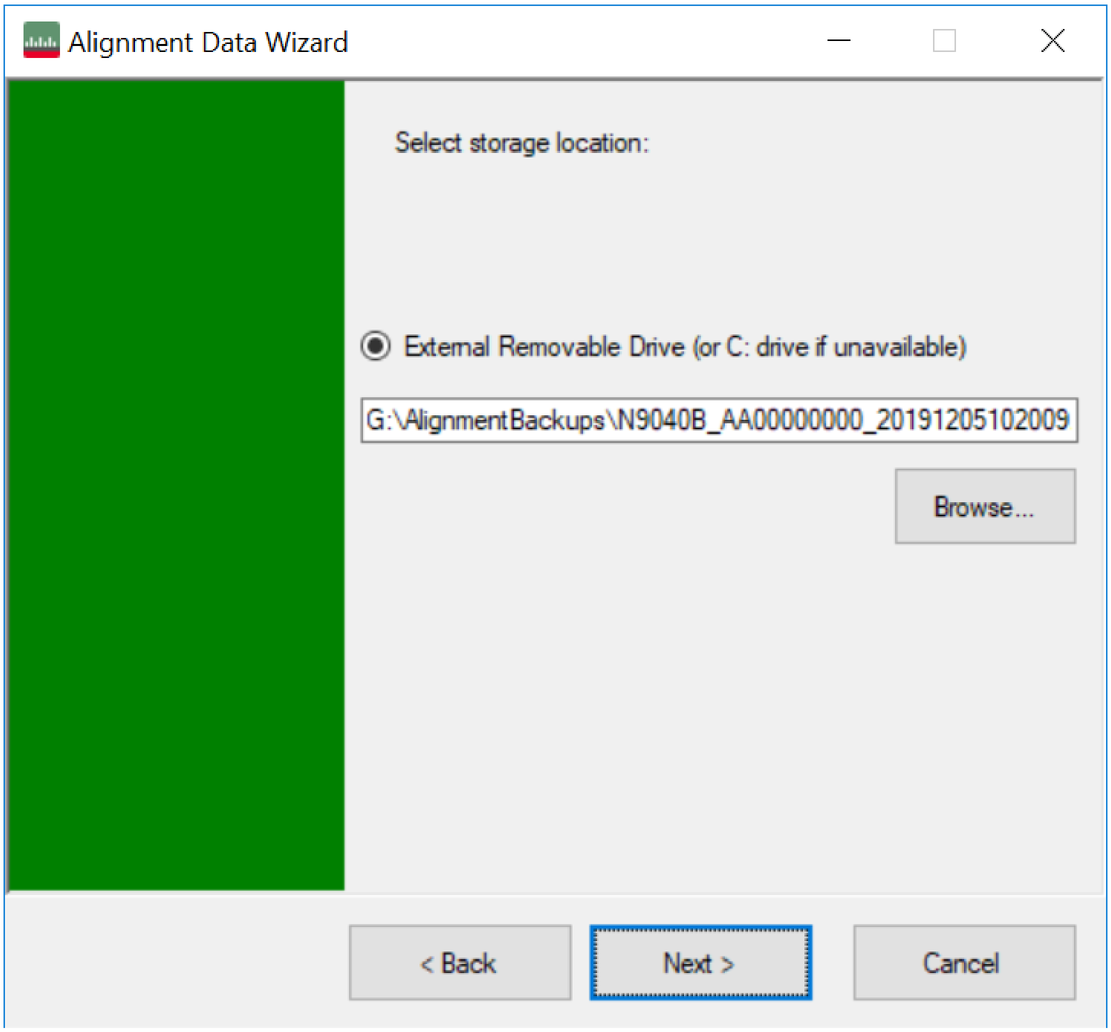

Alignment Data Wizard
Welcome, this utility will allow you to backup or restore the instrument's calibration data.
It is recommended this procedure be accomplished with a mouse and external keyboard.
A properly formatted external removable drive will be the primary location for backup.
Press Enter to proceed or ESC to quit.
< Back
Next >
Cancel


Alignment Data Wizard
Select Operation:
Backup
Restore
< Back
Next >
Cancel

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.

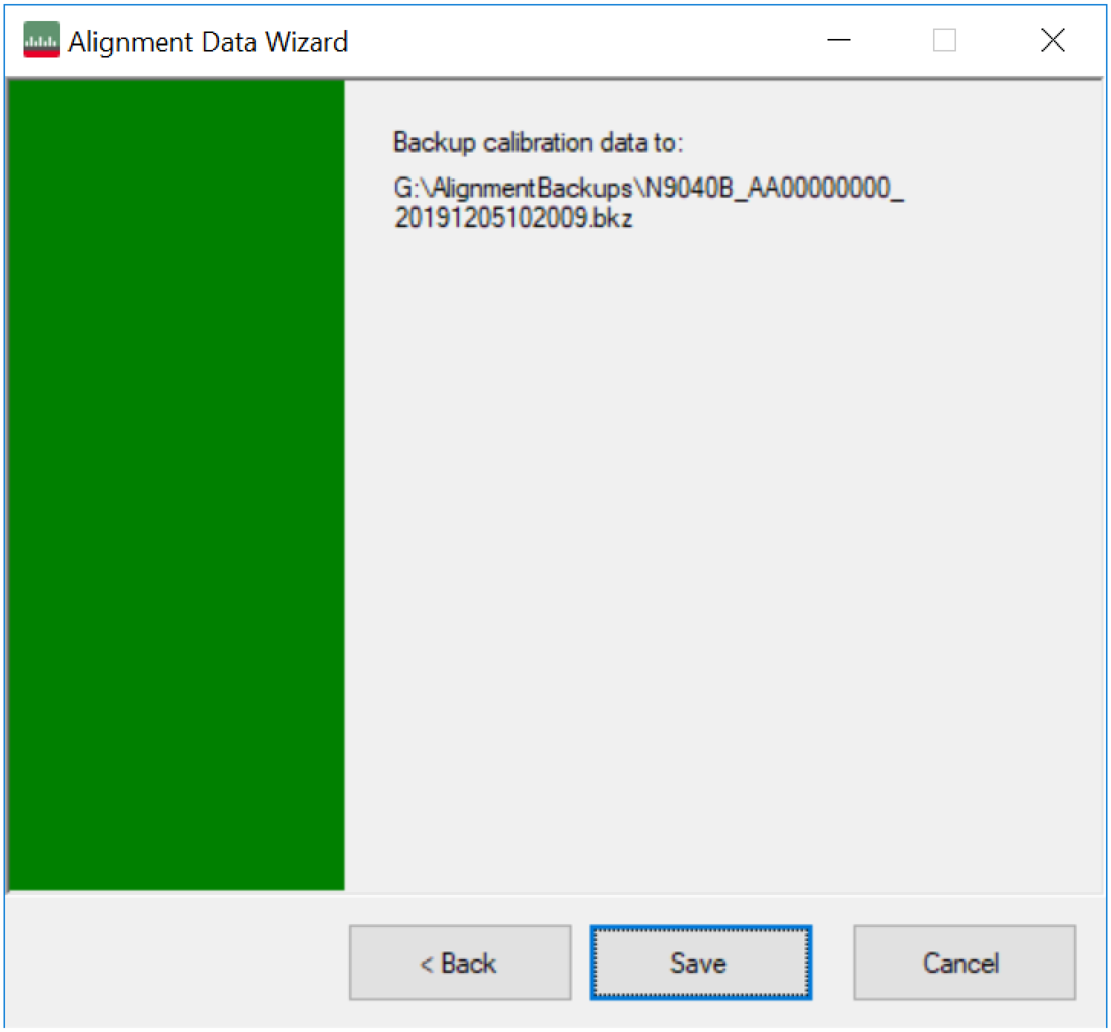
The default file extension for legacy backup files was `.bak`. The Backup and Restore operations support both the `.bak` (legacy format) and `.bkz` formats.

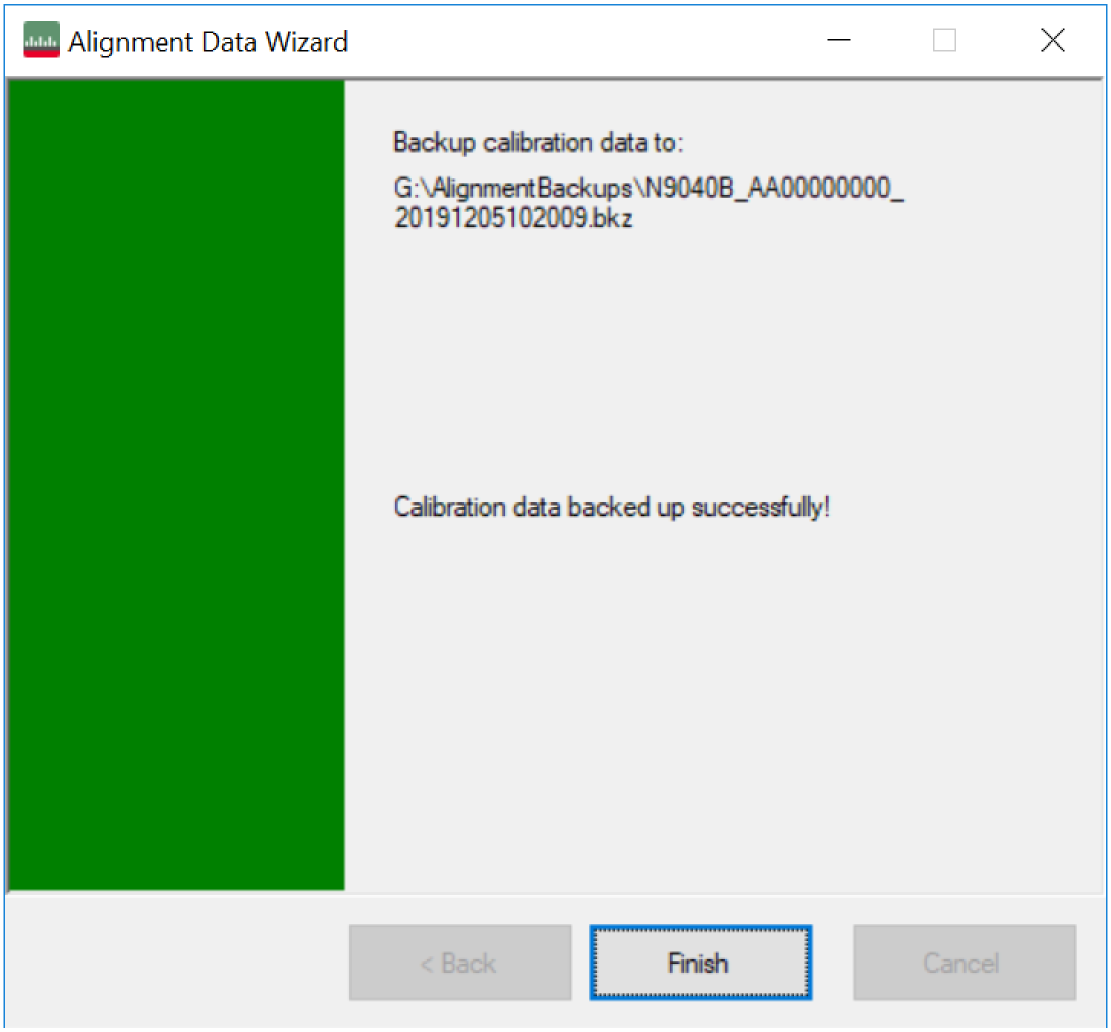


If a USB drive is present, it will be selected by default. The path defaults to the `AlignmentBackups` folder, and a filename is automatically created, in the form: <model>_<serial number>_<date><time>.bkz

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:

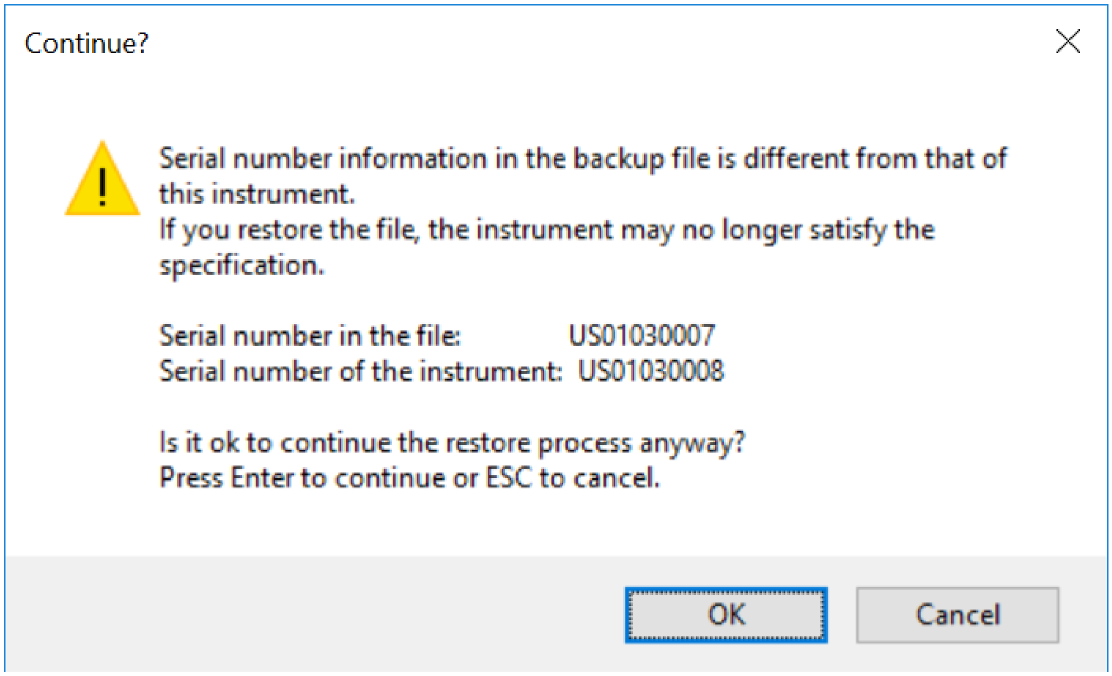
When the **Next >** button is pressed, you will be prompted to create a new folder if the chosen path does not yet exist.



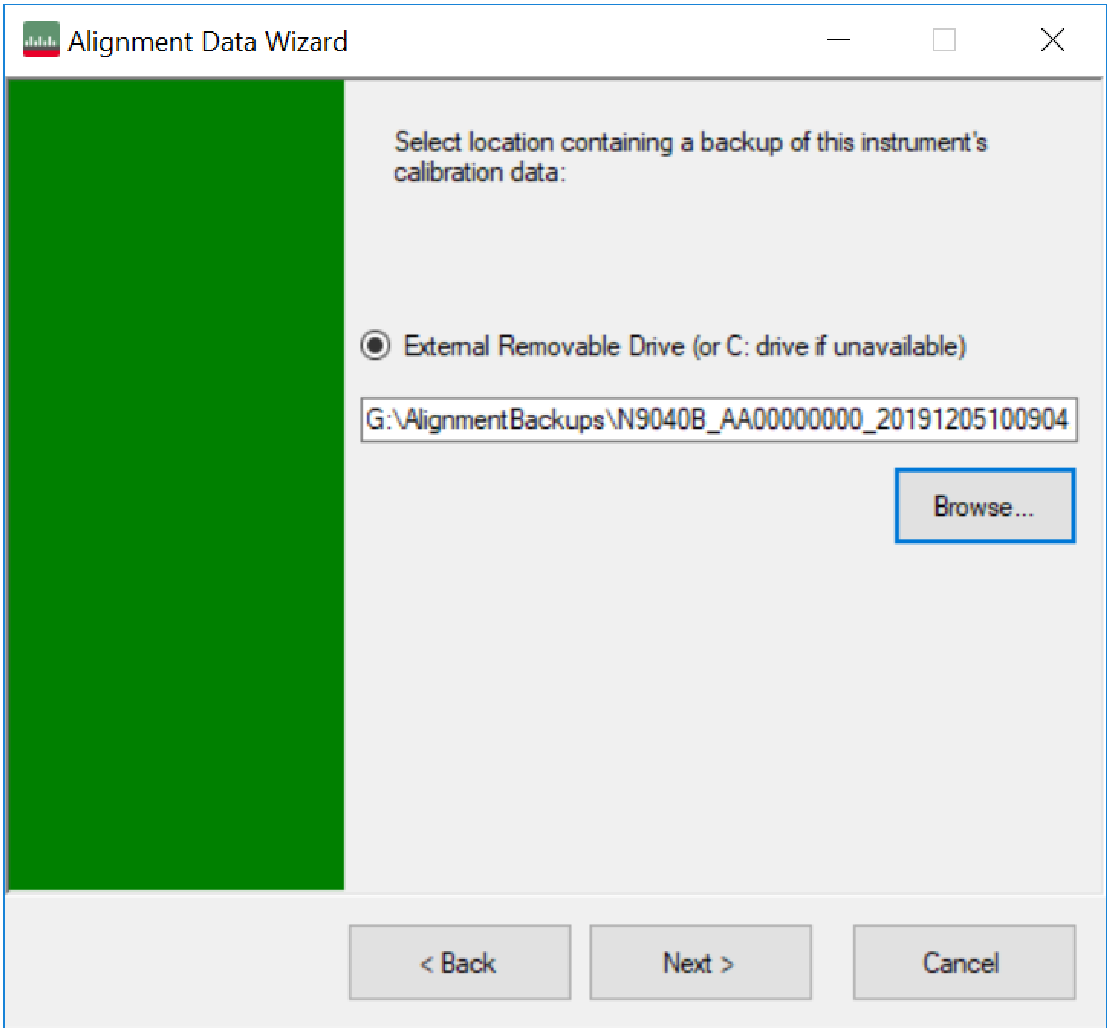


The restore operation checks the validity of the restore file using the database's built-in file validation. If the restore file is corrupt, the existing alignment data will remain in use.

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):

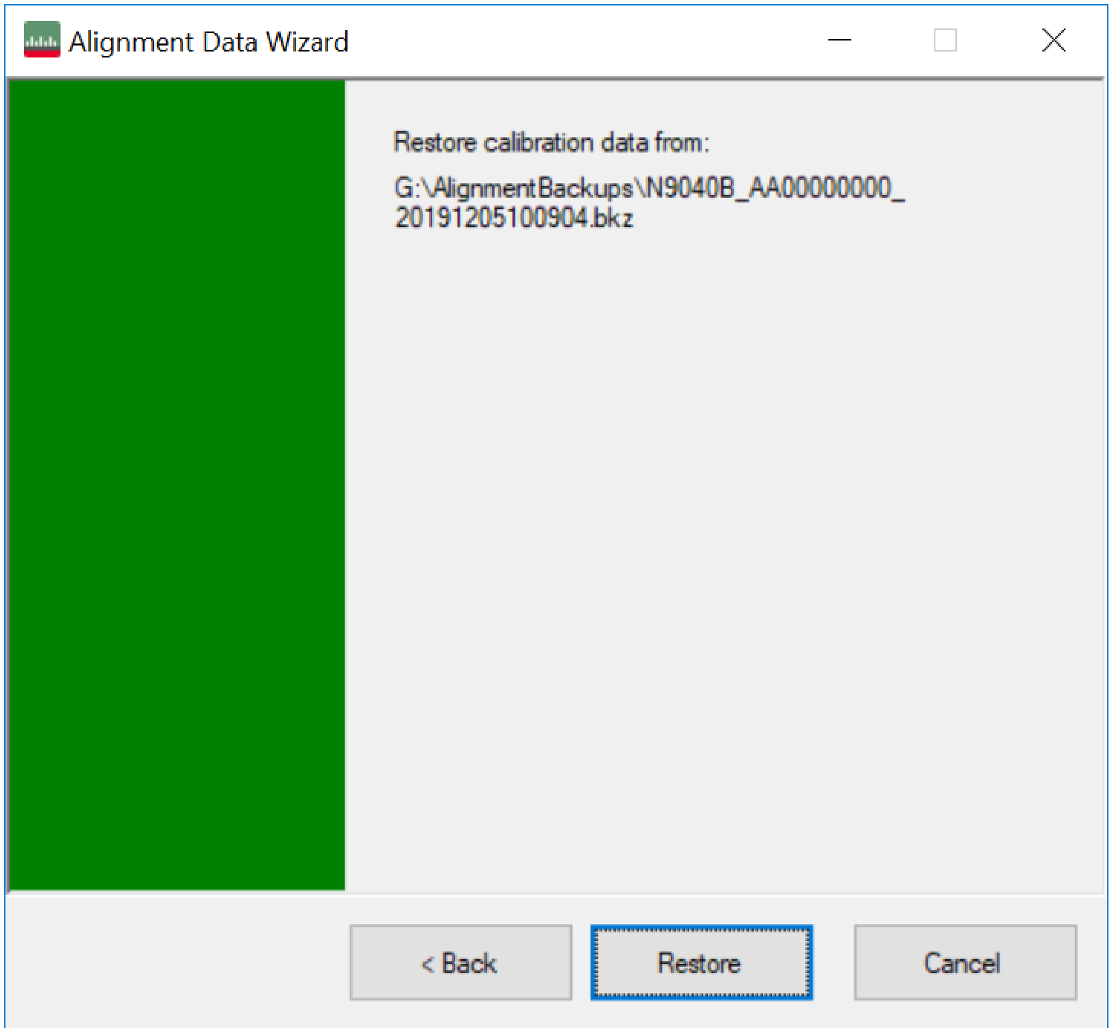


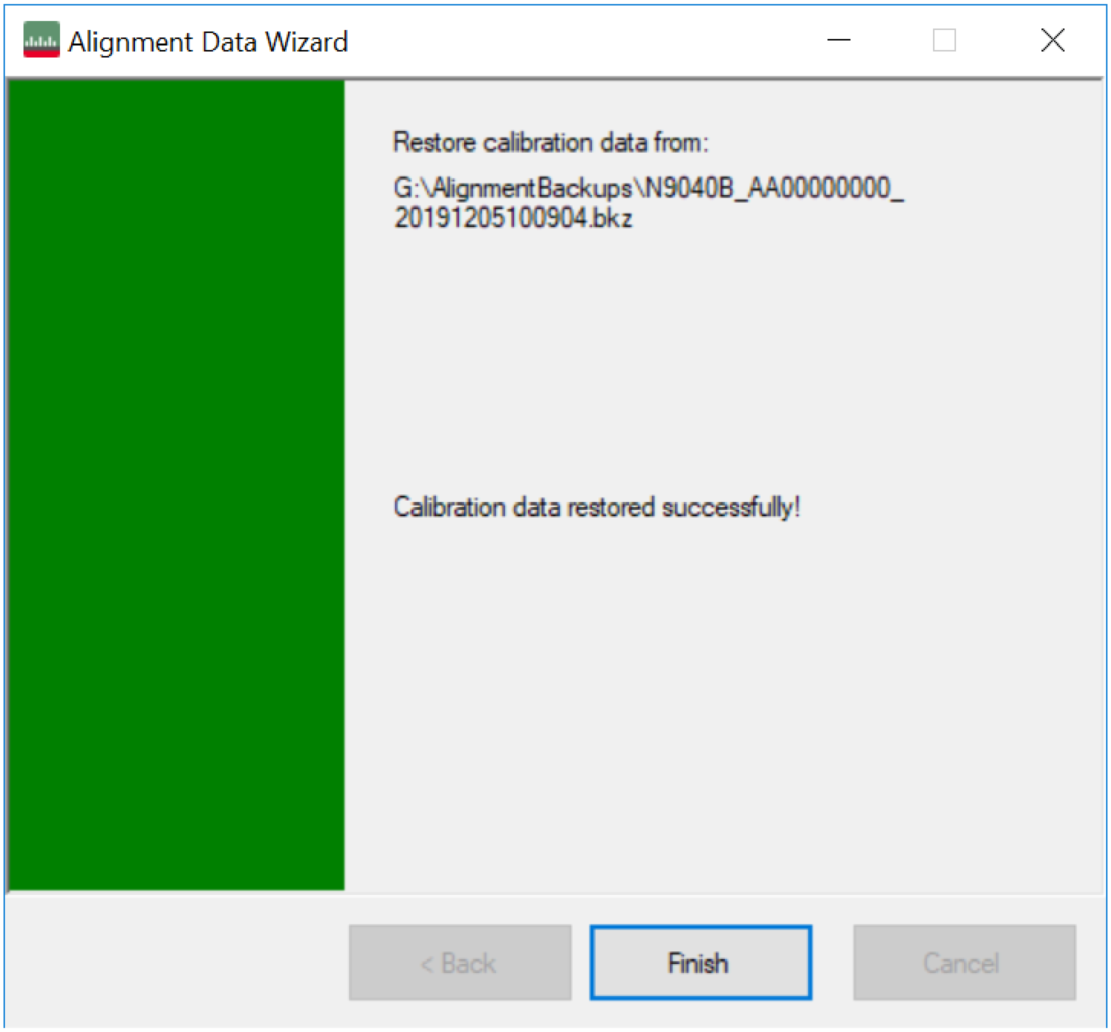
The default restore location for instruments *without* internal flash will be the first drive identified as an external drive (USB or LAN) if such is available; or, if not, the internal D: partition. The default restore file will be the most recent file that matches the default backup file name format: `<model number>_<serial number>_<date>.bkz`



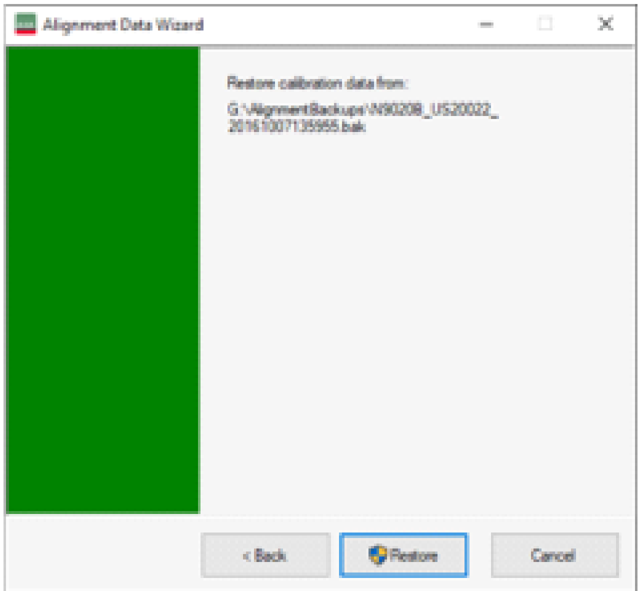
Changing the drive letter also modifies the path displayed in the box below. When this step is first loaded, the drive drop-down menu is populated with connected drives, which provide you with read access.

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).



4.6.6.2 Perform Backup (without Flash) (Remote Command Only)

Invokes an alignment data backup operation to the provided Folder.

NOTE It is recommended that the Folder provided is outside of the instrument (USB or Mapped Network Drive).

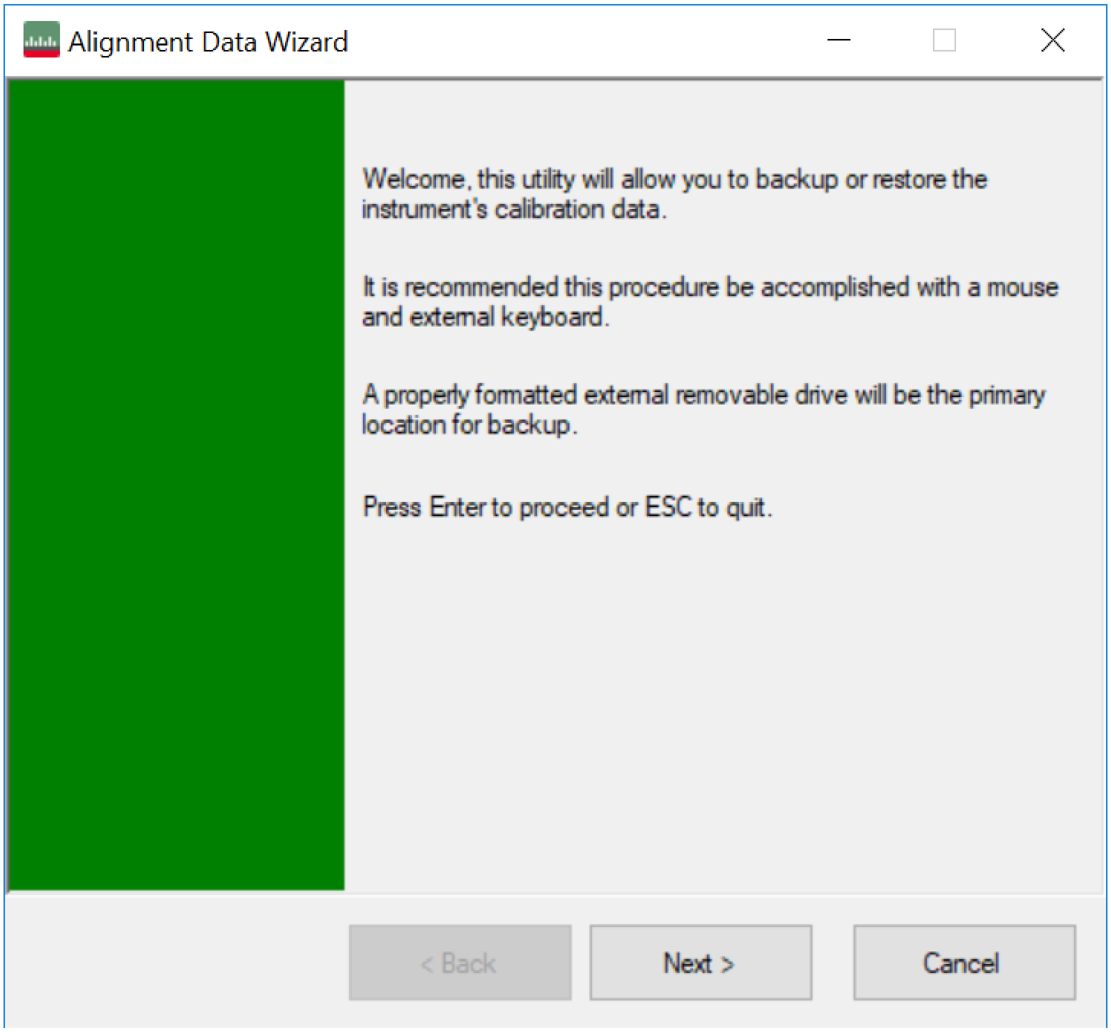
Remote Command	`:CALibration:DATA:BACKup <filename>`
Example	`:CAL:DATA:BACK "F:\AlignDataBackup_N9020A_US00000001_2008140100.bkz"`

4.6.6.3 Perform Restore (With Flash) (Remote Command Only)

Invokes an alignment data restore operation from the internal flash EEPROM.

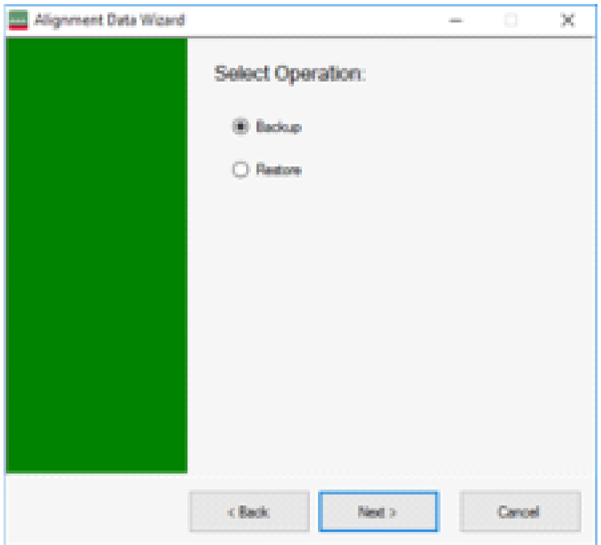
Remote Command	`:CALibration:DATA:INTernal:RESTore`
Example	`:CAL:DATA:INT:REST`

4.6.6.4 Alignment Data Wizard (with Flash)



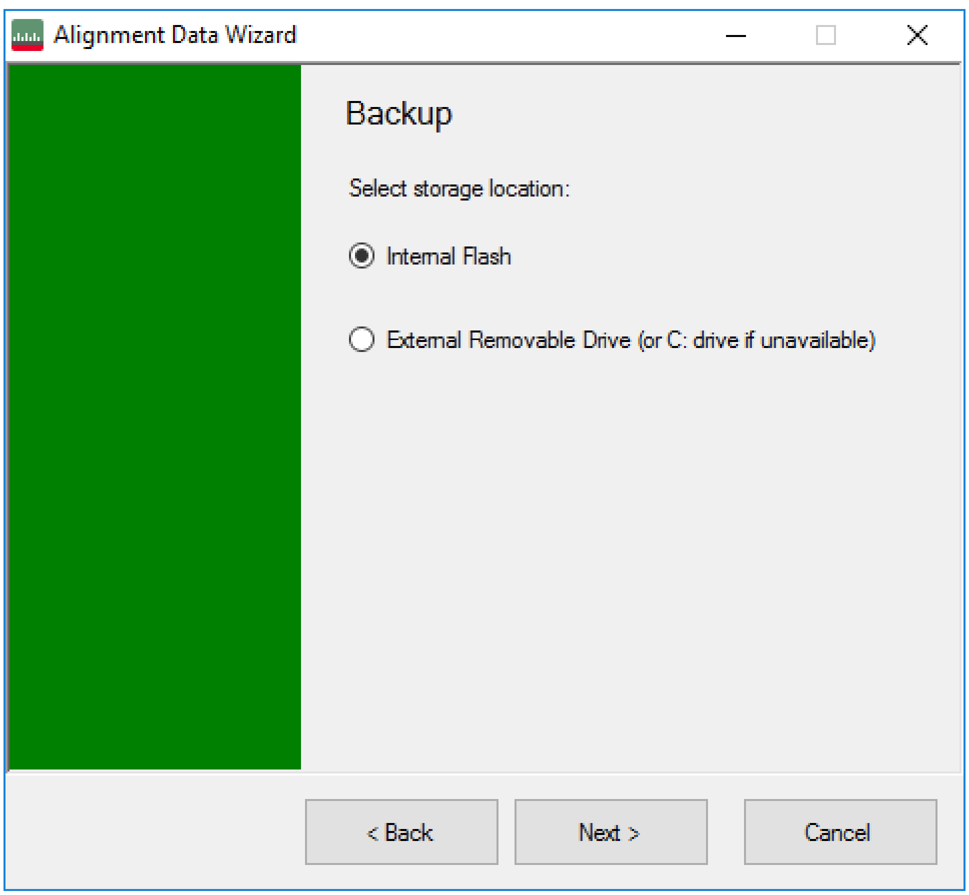
If your instrument has Processor Assembly type PC6S or PC7S (see "Show System" on page 372) the instrument has an internal flash EEPROM that can store a backup of the alignment data. In this case, the interface to the Alignment Data Wizard is enhanced to accommodate this internal storage. This section details the use of this internal flash. For details on using external storage, see the previous section ("Alignment Data Wizard (without Flash)" on page 463).

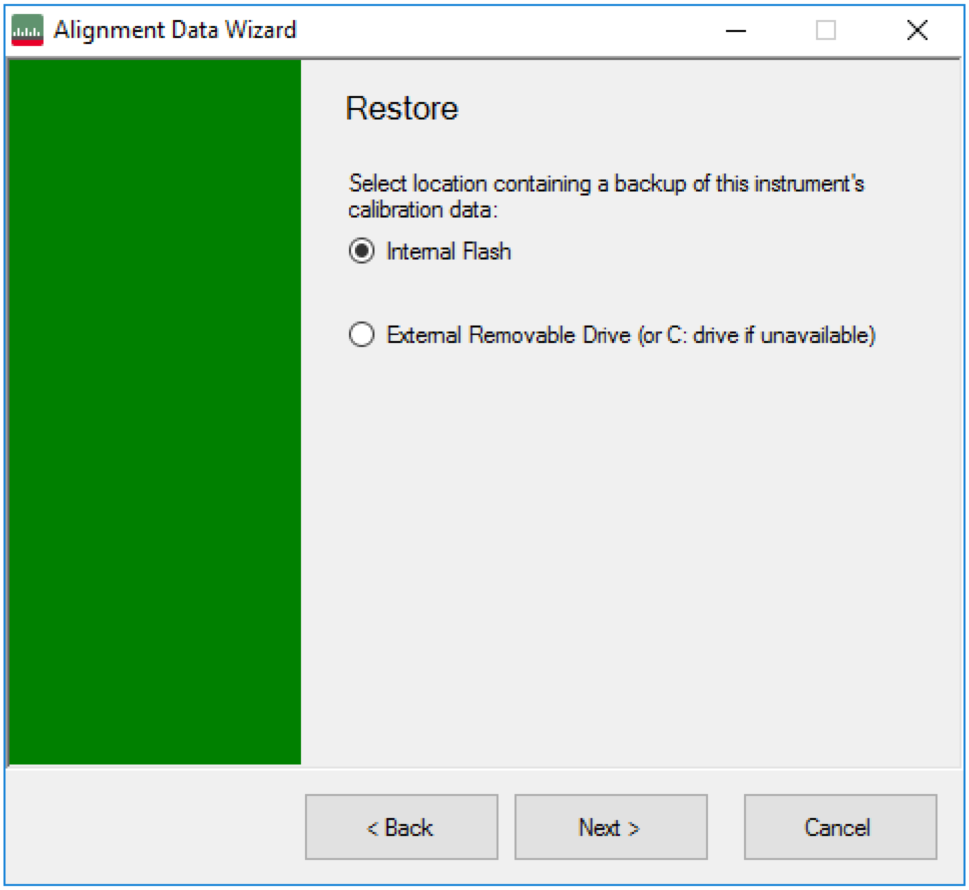
The Alignment Data Wizard guides you through the operations of backing up or restoring alignment data.



Having selected Backup or Restore, you then select the source or destination for the alignment data. As shown below, you can select either:

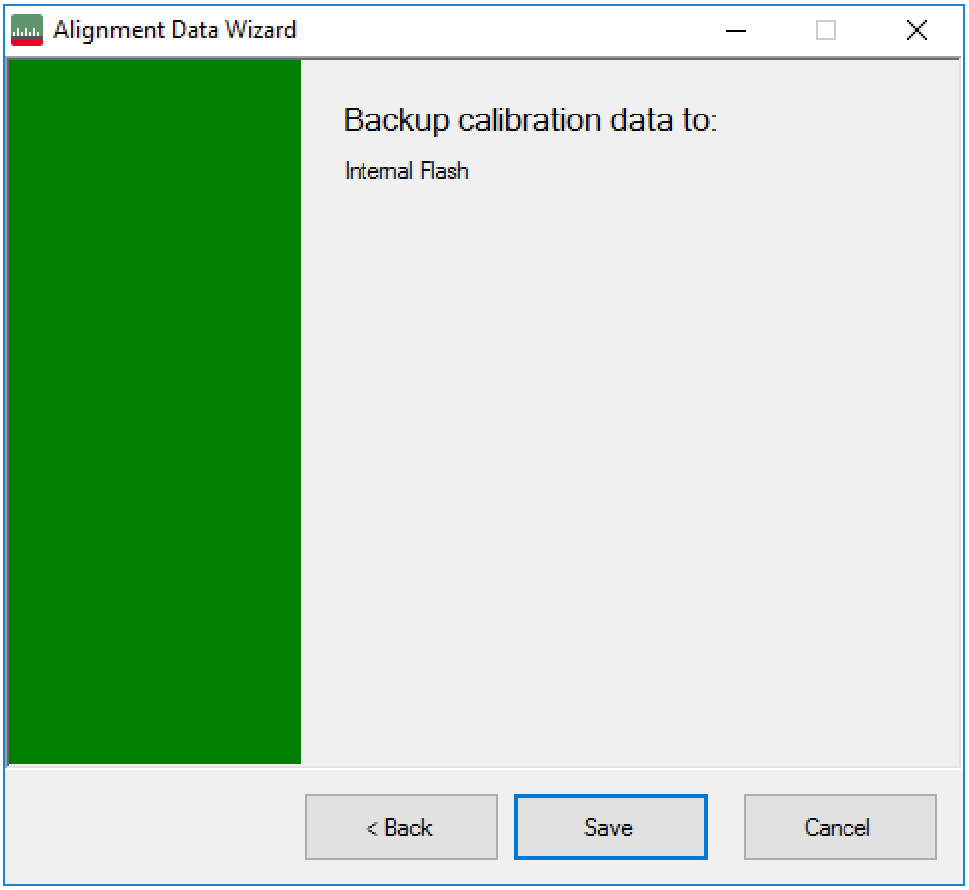
- Internal flash EEPROM, or,
- External Removable Drive (which includes the SD card described in "Backup or Restore Align Data..." on page 462)

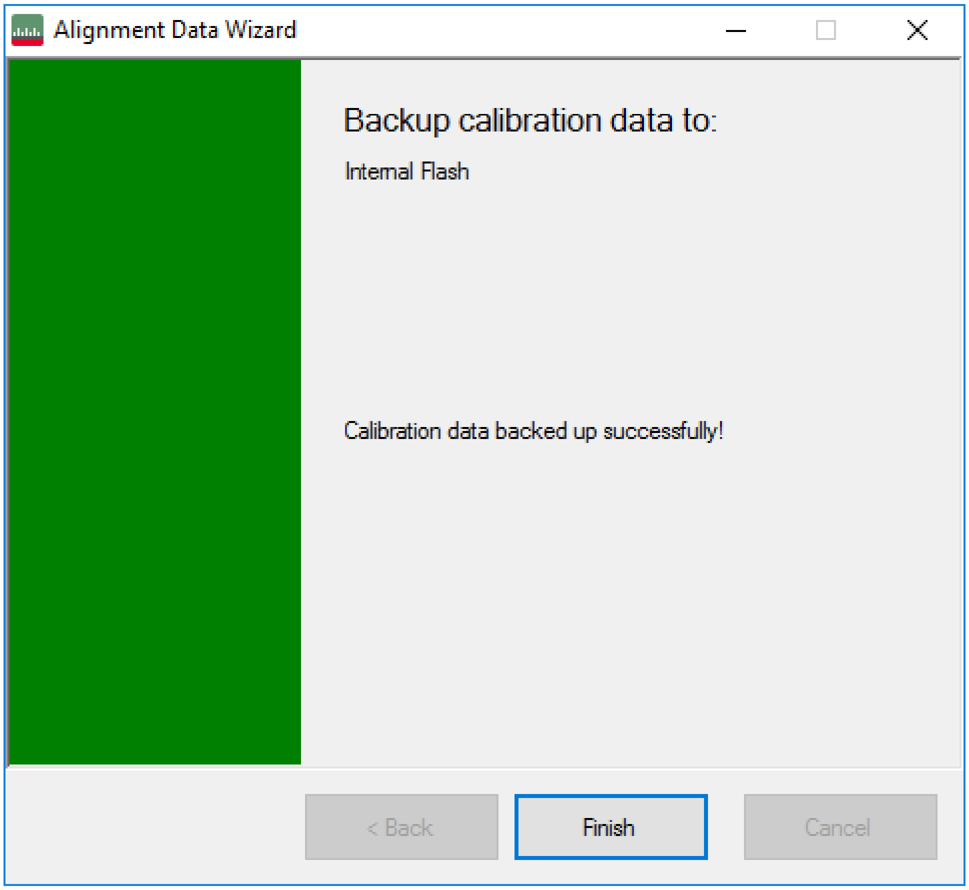




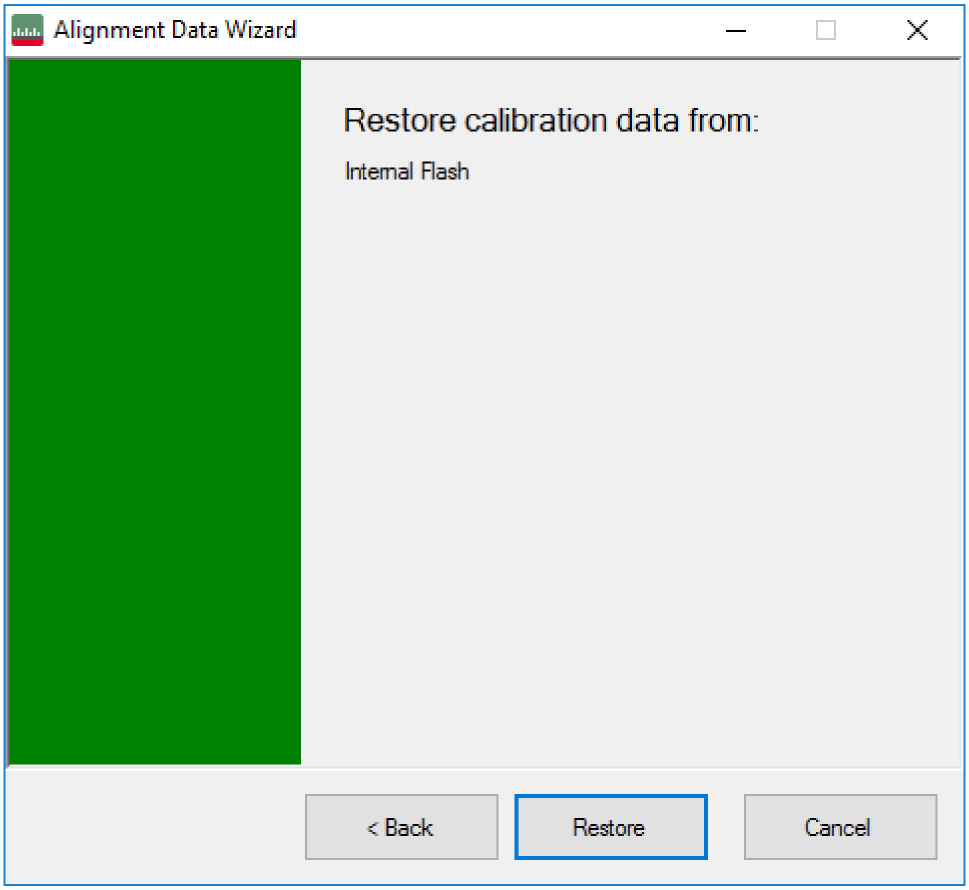
The final page of the wizard asks you to confirm the choices made in the previous pages. When the operation is complete, an indication is displayed on the same page, as below.

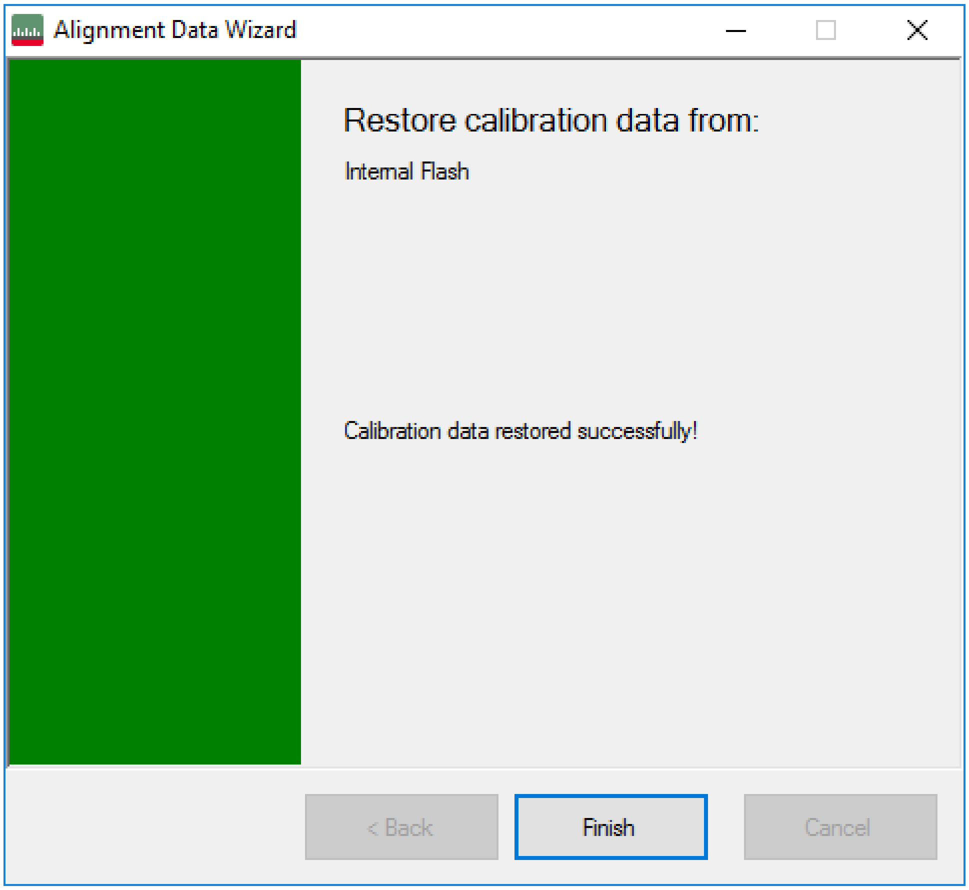
Backup:


Alignment Data Wizard
Backup calibration data to:
Internal Flash
< Back
Save
Cancel

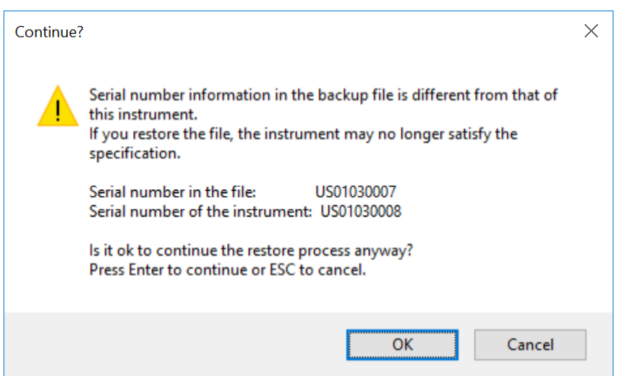

Alignment Data Wizard
Backup calibration data to:
Internal Flash
Calibration data backed up successfully!
< Back
Finish
Cancel

Restore:

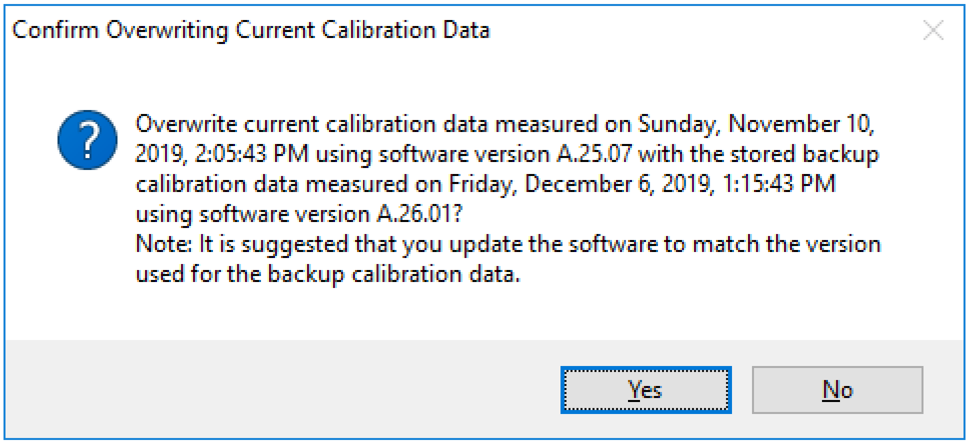

Alignment Data Wizard
Restore calibration data from:
Internal Flash
< Back
Restore
Cancel



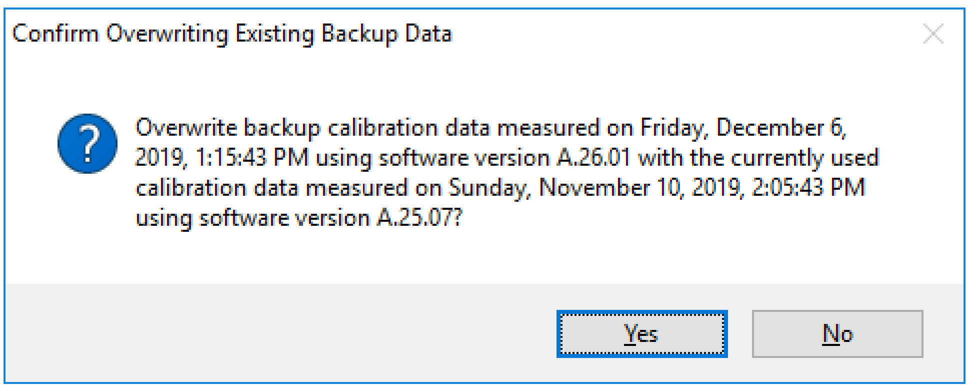
When restoring alignment data, if the serial number information in the backup file being restored is different from that of the instrument, the following message appears (the serial numbers shown are examples):



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):



4.6.6.5 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`

4.6.6.6 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`

4.6.7 Restore Alignment Defaults

This selection 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 message provides an OK and Cancel button 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 Alignment 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

4.7 Security

Accesses capabilities for operating the instrument in a security controlled environment.

The Security page of the System menu has two controls on it, USB Read/Write and Restore Security Defaults.

Dependencies	This menu is not available on the M9391A or M9393A or UXM

4.7.1 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 the customer 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	`:SYST:SEC:USB:WPR ON`
	Sets USB ports to Read-only
	`:SYST:SEC:USB:WPR OFF`
	Sets USB ports to Read-Write

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	This control is grayed-out unless the current user has Administrator privileges
Preset	This is unaffected by Preset or any Restore System Defaults. A Keysight Recovery sets the USB to write protect OFF
State Saved	No
Range	Read-Write|Read only

4.7.2 Restore Security Defaults

Pressing this button sets USB Read/Write to Enable.

NOTE This control is only available to users with Administrator privileges.

4.8 Diagnostics

The Diagnostics page of the System menu has a slider on it that allows you to view Hardware Statistics.

Dependencies	This menu is not available on the M9391A or M9393A or UXM

4.8.1 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)

The display should appear listing the statistics, product number, serial number, and firmware revision.

The CXA models in which the AC/DC Switch field is called Fixed Atten and that omit the mechanical attenuation fields are the N9000A-503/507 models.

Modular HWs only have time and temperature information in Show Hardware Statistics.

The data will be updated only when the Show Hardware Statistics control is pressed, it will not be updated while the screen is displayed.

The tabular data should be directly printable.

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

4.8.2 Query the Mechanical Relay Cycle Count (Remote Command Only)

Return the count of mechanical relay cycles. For N9038A model, there are additional 2 Mechanical Relays which are <N9038A Input2>, <N9038A Bypass>.

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>,<N9038A Input2>, <N9038A Bypass>" Items in the list not pertaining to your particular hardware configuration will return as -999 for those items For the E7760, all items return -999
Dependencies	This SCPI command is *not* supported by the E6607C model

4.8.3 Query the Operating Temperature Extremes (Remote Command 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

4.8.4 Query the Elapsed Time since 1st power on (Remote Command Only)

Returns the elapsed on-time in minutes since 1st power-on.

Remote Command	`:SYSTem:PON:ETIMe?`
Example	`:SYST:PON:ETIM?`
Notes	Query Only

4.9 Licensing

Accesses capabilities for configuring the licenses in your instrument.

4.9.1 License Manager

Pressing 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 five remote commands available for licensing. See:

– "Install License (Remote Command Only)" on page 493
– "Remove License (Remote Command Only)" on page 493
– "List Licenses (Remote Command Only)" on page 494
– "Validate License (Remote Command Only)" on page 495
– "Host ID Query (Remote Command Only)" on page 495
– "List Borrowed Licenses (Remote Command Only)" on page 490
– "Return a Borrowed License (Remote Command Only)" on page 491

Notes	No equivalent remote command for this control
Backwards Compatibility Notes	In ESA the SCPI command for displaying the Show Licenses screen is: `:SYSTem:CONFigure:LKEY:STATe OFF	ON	0	1` `:SYSTem:CONFigure:LKEY:STATe?` There are no equivalent SCPI commands in the X-Series for displaying the License Explorer

4.9.2 System Software Version Date

The software version date is the date of the newest features introduced in this release of the firmware. The date is not the same as the build date of the firmware because the date will only change 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?`

4.9.3 Software Support Expiration Date

The software support expiration date is encoded in each software license's Version field in the YYYY.MMDD format. This gives the end date of the support contract associated with this license. When a support contract is renewed, a new license will be 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 the <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"

4.9.4 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.

4.9.4.1 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 license 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 will post 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.

4.9.4.2 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 will be 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 will automatically check them out at start-up and will only check them in when shutting down.

4.9.4.3 License Checked Out Query (Remote Only)

This query 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 command to see whether the feature is currently checked-out to the instrument. The return 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	The <"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 Return Value Example: 1

4.9.4.4 List Licenses Checked Out (Remote Command Only)

This query 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 command 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`

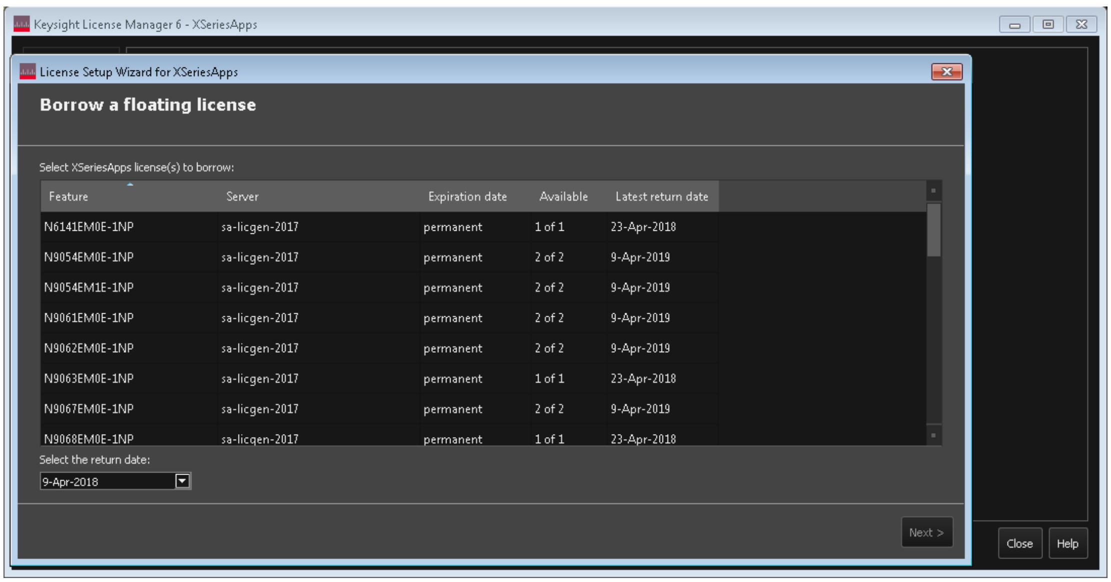
4.9.4.5 Borrowed Network Licenses

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, the user specifies 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 will appear as a local license and can be used even when not connected to the network, and the instrument software will treat 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 the user is done with the license before it automatically returns to the network server, the license can be explicitly returned earlier.

4.9.4.6 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 instrument also implements a remote command for this.

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 the `<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 the `<feature>` is not a valid license or when a license is not currently available for borrowing, one of the following errors will be issued: – -224, "Illegal Parameter Value; License is not installed" – -224, "Illegal Parameter Value; Unknown license feature" – -224, "Illegal Parameter Value; License not available for borrowing"

Additionally, the return date will be evaluated. If it is not a valid date, the following error will be issued:

- -224, “Illegal Parameter Value; 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 will be issued:

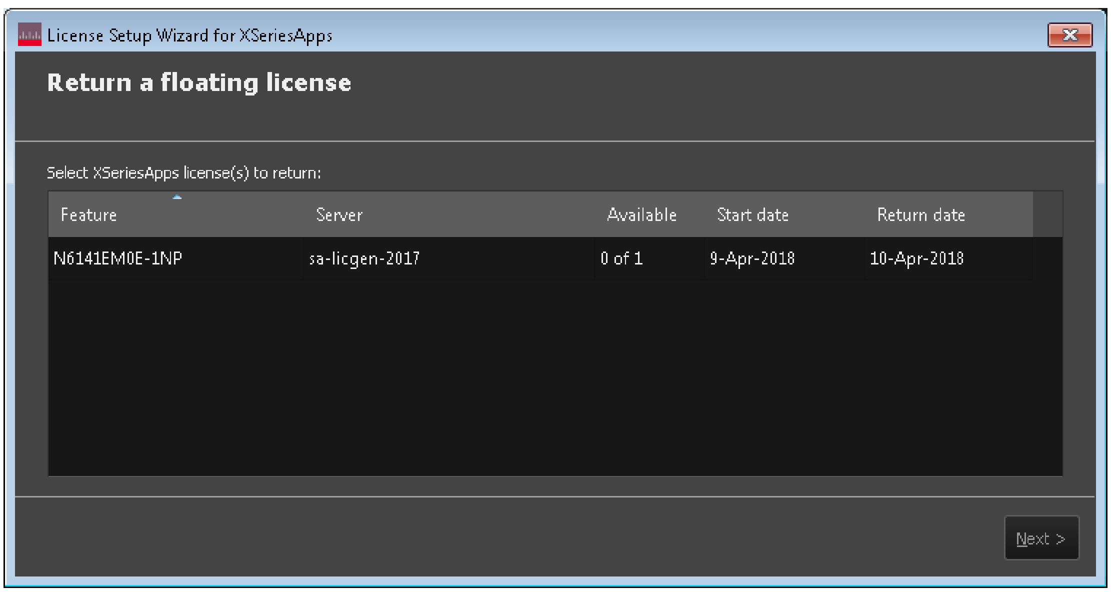
- -221, ”Return date clipped to maximum of <max date>”

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

4.9.4.7 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 Command 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 the `<feature>` is not a valid license or when a license is not borrowed, one of the following errors will be issued: – -224, “Illegal Parameter Value; License is not installed” – -224, “Illegal Parameter Value; Unknown license feature” – -224, “Illegal Parameter Value; License not borrowed”

4.9.4.8 Enabling Network Checkouts While Borrowed

The default for borrowed license use is that the user will be explicitly borrowing all desired network licenses, and that all other available network licenses should be ignored. This allows the user 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 the user does not intend to use RTSA, then by borrowing only the licenses they 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 the user’s intent in borrowing is to ensure access to a particular feature or application, but still wants 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	Control is only visible when licensing is configured to use a network server. SCPI is always available
Preset	This is unaffected by Preset but is set to 0 on a “Restore Misc Defaults” or "Restore System Defaults->All"
State Saved	Power On Persistent (survives shutdown and restart)

4.9.5 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.

4.9.6 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.

4.9.7 Floating License Manager

Pressing 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.

4.9.8 Install License (Remote Command Only)

This command can be 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 will 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

4.9.9 Remove License (Remote Command Only)

Remove 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”,”027253AD27F83CDA5673A9BA5F427FDA5E4F25AEB1017638211AC9F60D9C639FE539735909C551DE0A91”

NOTE	This command will 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 or not 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

4.9.10 List Licenses (Remote Command 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)

4.9.11 Validate License (Remote Command Only)

Allows you to 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"

4.9.12 Host ID Query (Remote Command Only)

Returns the host ID as a string.

Remote Command	:SYSTem:HID?

4.10 Service

Accesses capabilities performed in the factory or under instructions from repair procedures. This menu 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	This menu is not available on the M9391A or M9393A or UXM

4.11 System Remote Commands (Remote Commands Only)

The commands listed below have no front-panel key equivalent.

- "List installed Options (Remote Command Only)" on page 497
- "Lock the Front-panel keys (Remote Command Only)" on page 497
- "Lock Workstation (Remote Command Only)" on page 498
- "List SCPI Commands (Remote Command Only)" on page 500
- "Front Panel activity history (Remote Command only)" on page 500
- "SCPI activity history (Remote Command only)" on page 500
- "Instrument start time (Remote Command only)" on page 501
- "SCPI Version Query (Remote Command Only)" on page 501
- "Date (Remote Command Only)" on page 502
- "Time (Remote Command Only)" on page 502

4.11.1 List installed Options (Remote Command 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

4.11.2 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 with the exception of 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).

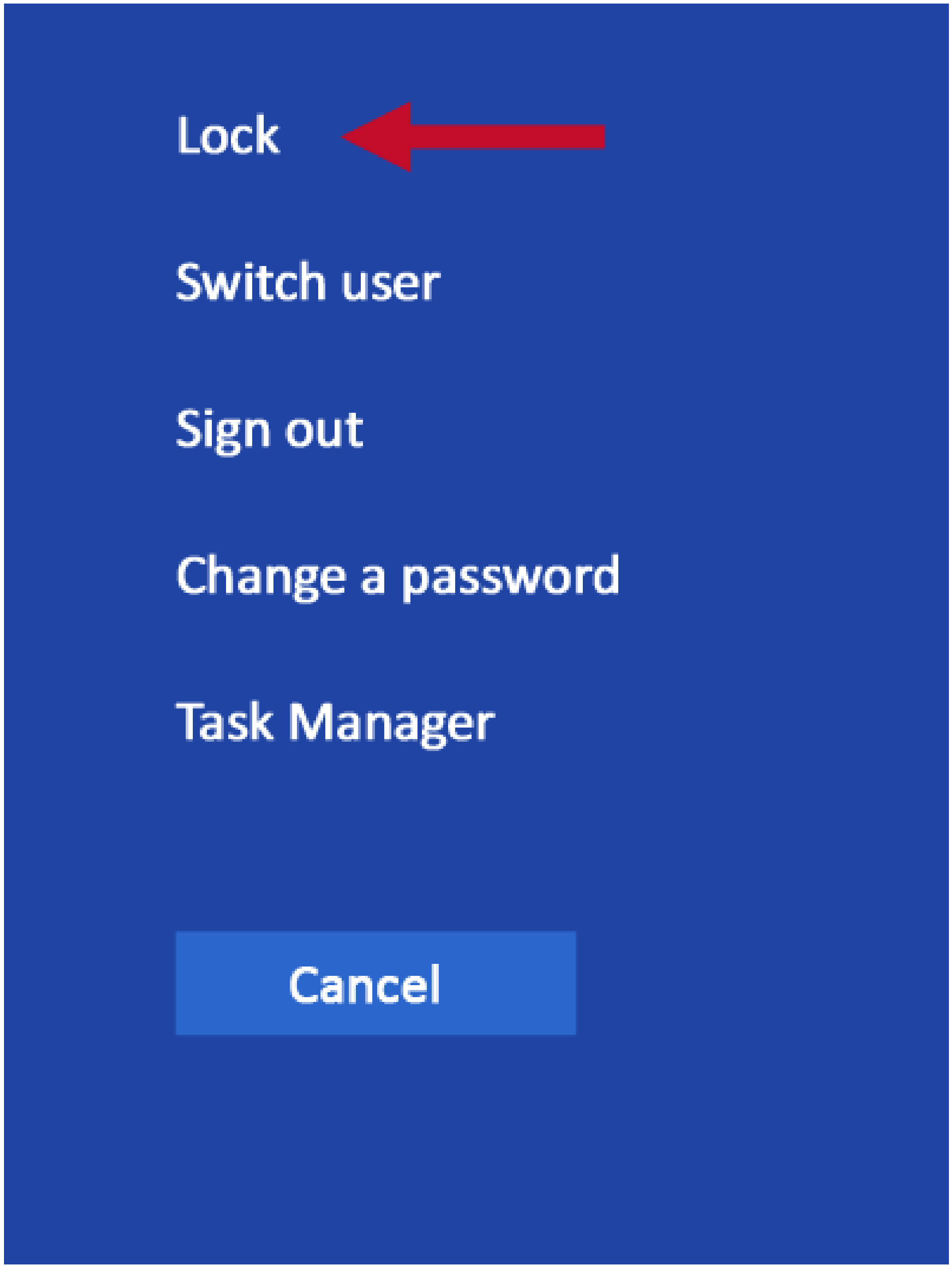
The front panel '**Local**' key (**Cancel**/**Esc**) has no effect if Klock is ON.

See also Local Button@1000.

Remote Command	`:SYSTem:KLOCk OFF | ON | 0 | 1` `:SYSTem:KLOCk?`
Example	`:SYST:KLOC ON`
Notes	Keyboard lock remains in effect until turned-off or the instrument is power-cycled
Preset	Initialized to OFF at startup, unaffected by Preset
State Saved	No

4.11.3 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.

If it fails to initiate it puts an error in the Windows event log for SA;

`"LockWorkStation - Failed to initiate function"`

See also Local Button@1000.

Remote Command	:SYSTem:LWSTation
Example	:SYST:LWST
Notes	The lock remains in effect until someone logs in
State Saved	No

4.11.4 List SCPI Commands (Remote Command 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 (hex 0x0A)

4.11.5 Front Panel activity history (Remote Command only)

Instrument front panel usage can be monitored by using the query :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?

4.11.6 SCPI activity history (Remote Command only)

Instrument remote operation usage via SCPI can be monitored by using the query :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 the query :SYSTem:METRics:STIMe?

4.11.7 Instrument start time (Remote Command only)

To determine if instrument activity has occurred, the SCPI query :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

4.11.8 SCPI Version Query (Remote Command 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?`

4.11.9 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 this command and Time (below).

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, an error will be generated by this command and no action will be taken

4.11.10 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, an error will be generated by this command and no action will be taken

5 Preset

The Preset functions are available in two ways; either by pressing the **Mode Preset** or **User Preset** front panel keys, or from the Preset dropdown menu that 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	`: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	`: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 (green key) and Preset Dropdown
Restore Mode Defaults	`:INSTrument:DEFault`	Local to the current mode, global to 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.	Preset Dropdown
Restore Defaults All Modes	`:SYSTem:DEFault MODes`	Affects all parameters in ALL modes but does not affect Input/Output or	Preset Dropdown

Type Of Preset	SCPI Command	Scope of Preset	Front Panel Access
		System variables Presets the RF Source	
Restore Screen Defaults	`:SYSTem:DEFault SCReen`	Deletes all Screens but one, restores that screen to its default mode and performs a Mode Preset for that mode. Does not affect Input/Output or System variables Presets the RF Source	Preset Dropdown
User Preset	`:SYSTem:PRESet:USER`	Local to the current mode, global to all measurements in the mode, affects all parameters in the mode as well as the Input/Output variables Does not affect System variables	User Preset hardkey and Preset Dropdown
User Preset All Modes	`:SYSTem:PRESet:USER:ALL`	Same as User Preset but affects all Modes in the current Screen	Preset Dropdown
User Preset All Screens		Affects the entire Screen Configuration; global to all Modes and Screens	Preset Dropdown
*RST	`*RST`	Same as Mode Preset - and in addition always sets Single/Cont to Single	Not available from front panel
Input/Output Preset	`:SYSTem:DEFault INPut`	Affects all Input/Output variables	Input/Output menu, Preset dropdown, and

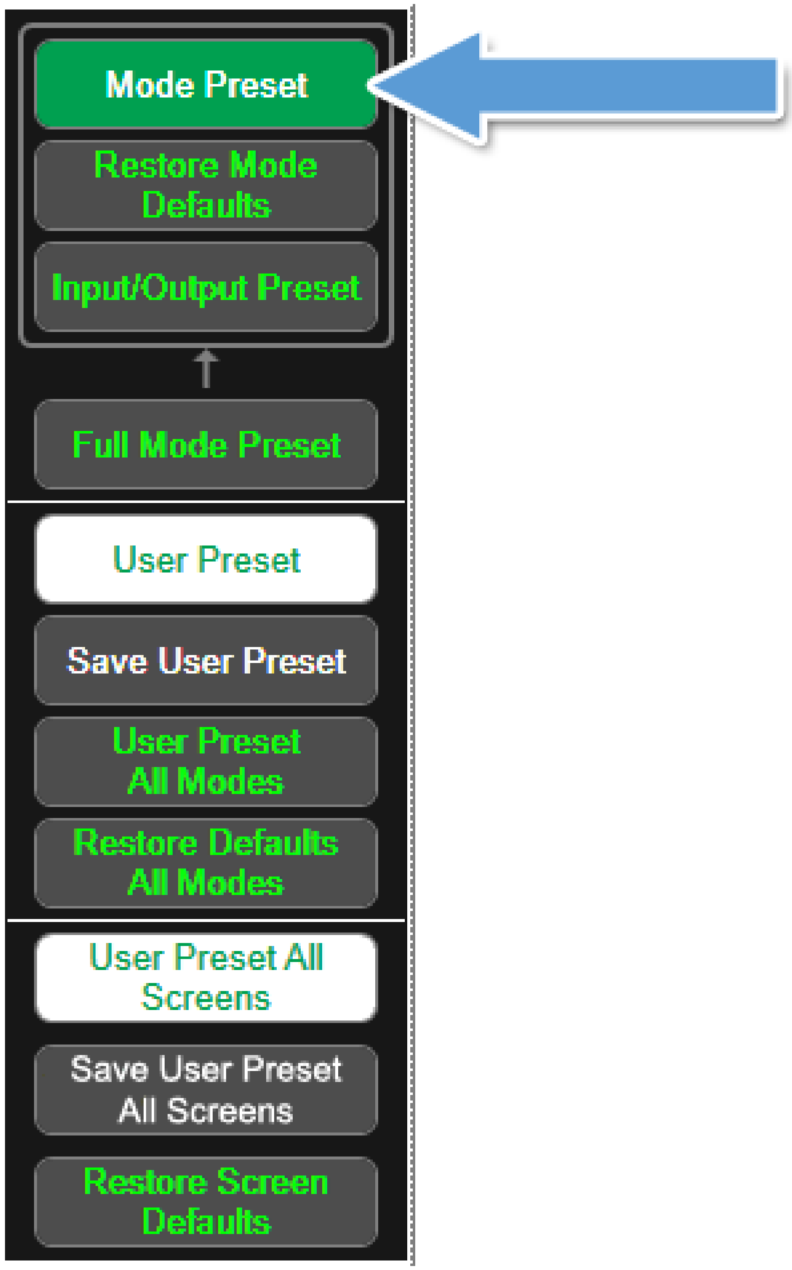
Type Of Preset	SCPI Command	Scope of Preset	Front Panel Access
		Does not preset the RF Source	System Menu, Restore Defaults
Full Mode Preset	:SYSTem:PRESet:FULL	Same as doing Mode Preset, Restore Mode Defaults and Input/Output Preset. Essentially a factory preset of the current Mode Presets the RF Source	Preset Dropdown
Restore User Interface Defaults	:SYSTem:DEFault UINTerface	Affects all variables in the "User Interface" group Does not preset the RF Source	System Menu, Restore Defaults and User Interface tabs
Restore Power On Defaults	:SYSTem:DEFault PON	Affects all variables in the "Power On" group Presets the RF Source	System Menu: Restore Defaults and Power On tabs
Restore Alignment Defaults	:SYSTem:DEFault ALIGn	Affects all variables in the "Alignments" group Presets the RF Source	System Menu, Restore Defaults and Alignments tabs
Restore Miscellaneous Defaults	:SYSTem:DEFault MISC	Affects various variables not reset by other commands Presets the RF Source	System Menu, Restore Defaults
Restore All Defaults	:SYSTem:DEFault [ALL] :SYSTem:PRESet:PERSistent	Affects all variables Presets the RF Source	System Menu, Restore Defaults

5.1 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 or by pressing the **Mode Preset** front panel key.



Mode Preset does the following for the currently active mode:

- Aborts the currently running measurement.
- Switches to the default measurement and brings up the default menu for that measurement.
- Sets most parameters for the Mode and all of 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 or affect any Input/Output or System settings (those set in the System Settings dialog).

Furthermore, there are some Mode settings that are unaffected by a Mode Preset (for example, Noise Floor Extensions, Limit Line data, reference marker numbers, etc.) These are only reset by Restore Mode Defaults, and in each parameter's definition table there is a note that indicates whether it is reset on a Mode Preset or on a Restore Mode Defaults.

See "Types of Preset" on page 504 for more information.

Remote Command	`:SYSTem:PRESet`
Example	`:SYST:PRES`
Notes	`*RST` is preferred over :`SYST:PRES` for remote operation. `*RST` does a Mode Preset, as done by the `:SYST:PRES` command, and it sets the measurement mode to **Single** measurement rather than **Continuous**, for optimal remote control throughput See "*RST - Reset" on page 1034
Status Bits/OPC dependencies	Clears all pending OPC bits. The Status Byte is set to 0
Backwards Compatibility Notes	In the X-Series, the legacy "Factory Preset" has been replaced with Mode Preset, which only presets the currently active mode, not the entire instrument. In the X-Series, the way to preset the entire instrument is by using System, Restore System Defaults All, which behaves essentially the same way as restore System Defaults does on ESA and PSA There is also no "Preset Type" as there is on the PSA. There is a green Mode Preset front-panel key that does a Mode Preset and a white-with-green-letters User Preset front-panel key that does a User Preset. The old PRESet:TYPE command is ignored (without generating an error), and SYST:PRES without a parameter does a Mode Preset, which should cover most backward code compatibility issues 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 will not be preset by a Mode Preset. They are preset using Restore Input/Output Defaults, Restore System Defaults All. Note that because User Preset does a Recall State, and all of these settings are saved in State, they *are* recalled when using User Preset

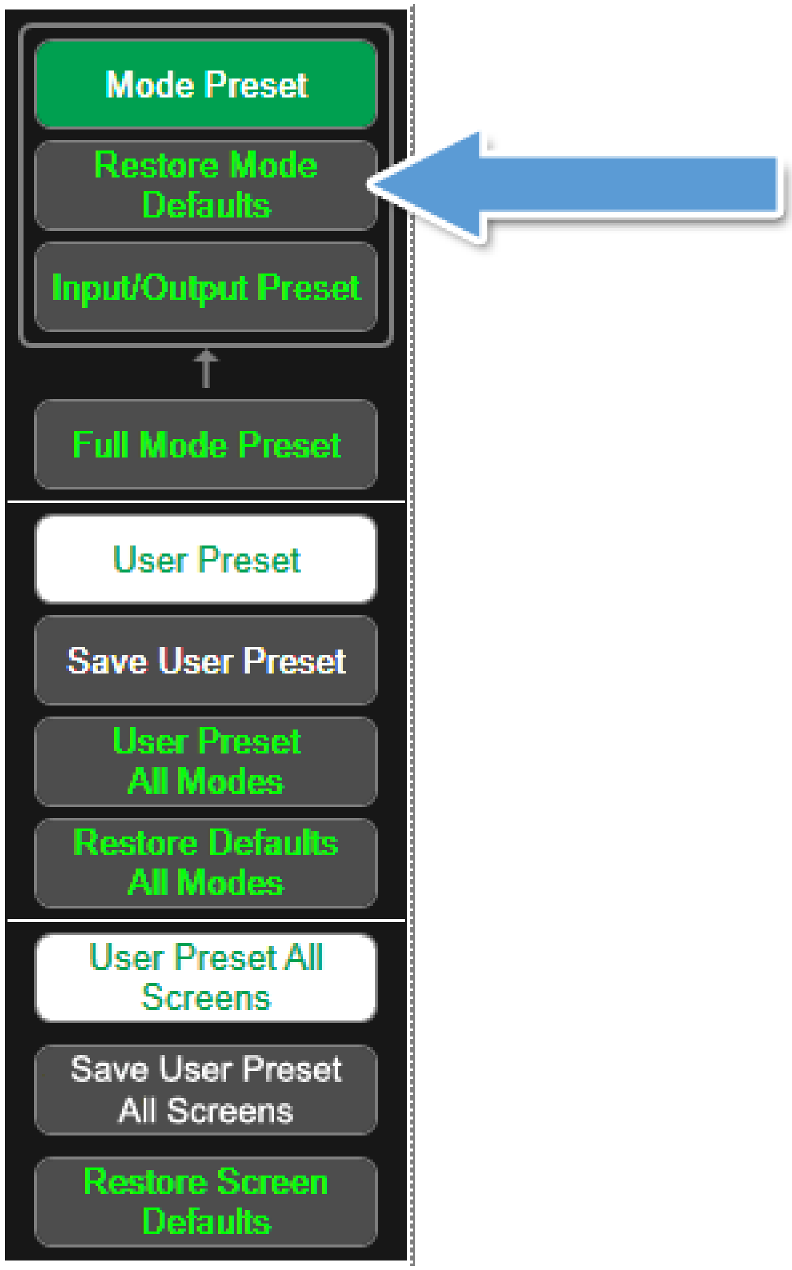
5.2 Restore Mode Defaults

Most settings within a mode are affected by Mode Preset, but there are some Mode settings that are unaffected by a Mode Preset (for example, Noise Floor Extensions, Limit Line data, reference marker numbers, etc.) **Restore Mode Defaults** resets all of these additional settings as well as all of 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 on **Mode Preset** or on **Restore Mode Defaults**.

Note that a Recall State affects all of 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.



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 affirm 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	Restore Mode Defaults causes the currently running measurement to be aborted and causes the default measurement to be active. It gets the mode to a consistent state with all of the default couplings set

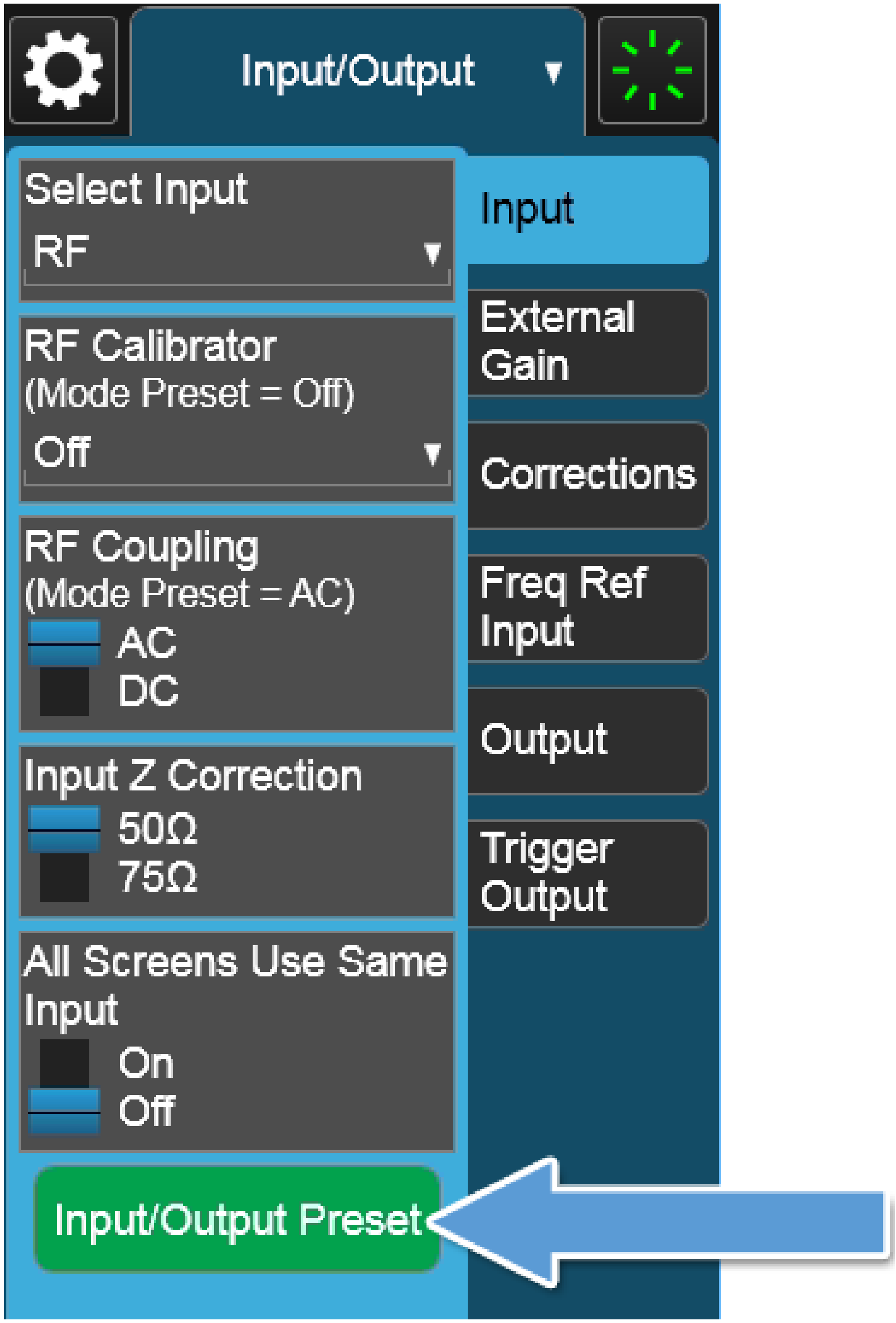
5.3 Input/Output Preset

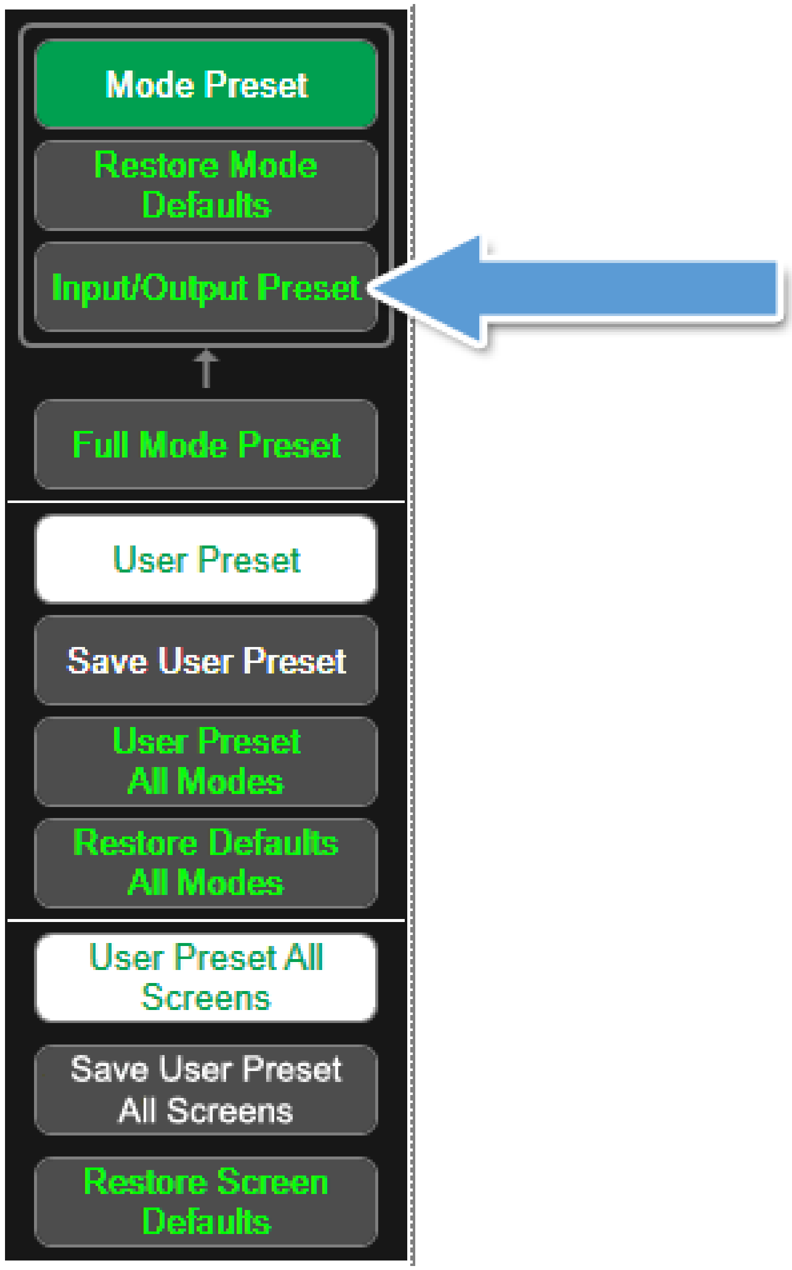
Input/Output Preset resets the group of settings and data associated with the Input/Output front-panel key to their default values. These settings are not affected by a Mode Preset because they are generally associated with connections to the instrument, and most users would not want these resetting every time they pressed the Mode Preset key.

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.

Input/Output Preset can be executed from the Input/Output menu, from the Preset dropdown, or from the Restore Defaults menu under the System key.


Input/Output
Select Input
RF
RF Calibrator
(Mode Preset = Off)
Off
RF Coupling
(Mode Preset = AC)
AC
DC
Input Z Correction
50Ω
75Ω
All Screens Use Same Input
On
Off
Input/Output Preset
Input
External Gain
Corrections
Freq Ref Input
Output
Trigger Output


Mode Preset
Restore Mode Defaults
Input/Output Preset
Full Mode Preset
User Preset
Save User Preset
User Preset All Modes
Restore Defaults All Modes
User Preset All Screens
Save User Preset All Screens
Restore Screen Defaults

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.

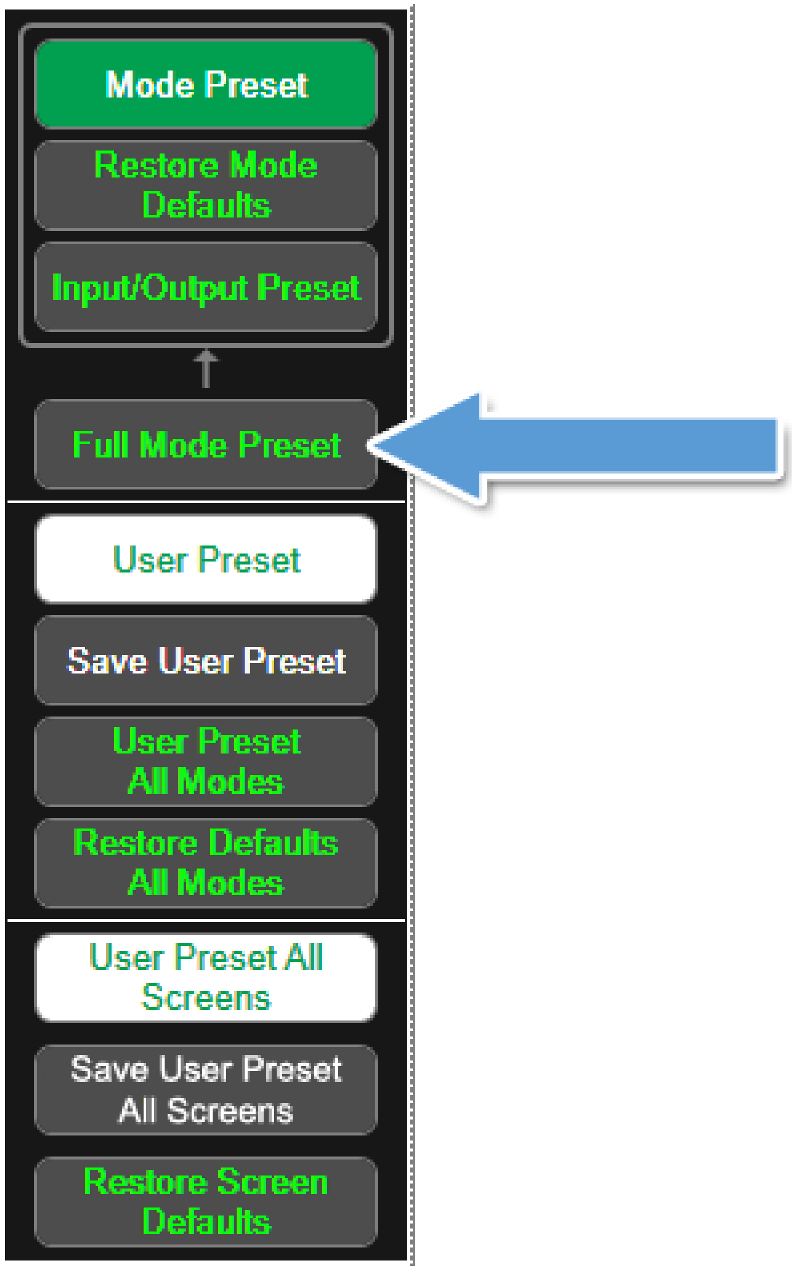
This action cannot be undone. Do you want to proceed?"

The message provides **OK** and **Cancel** buttons, to let you affirm or cancel the operation.

Example	`:SYST:DEF INP` Presets all the Input/Output variables to their factory default values

5.4 Full Mode Preset

Same as doing Mode Preset, Restore Mode Defaults and Input/Output Preset. 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?"

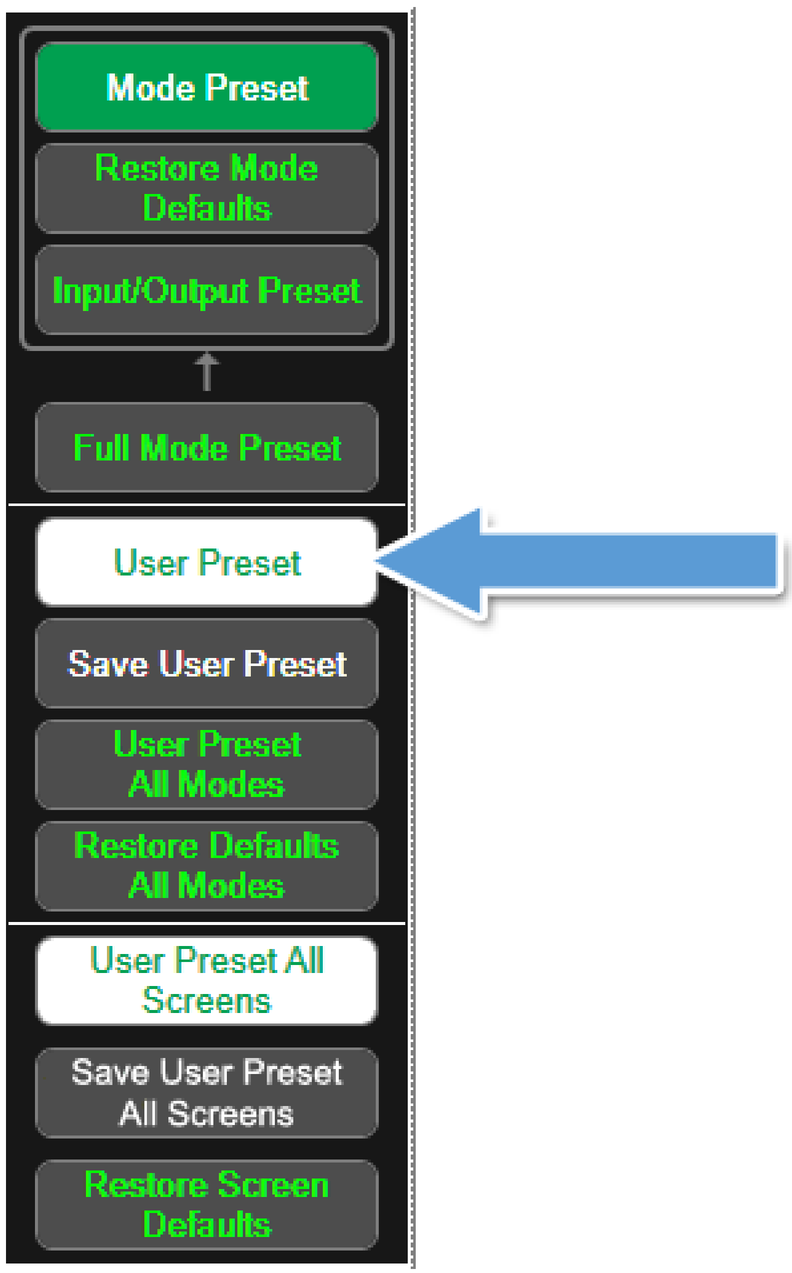
The message provides **OK** and **Cancel** buttons, to let you affirm or cancel the operation.

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

5.5 User Preset

User Preset recalls a state previously saved using the **Save User Preset** function. 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.



Because User Preset is actually a Recall State, rather than a predefined Preset, it works a little differently than Mode Preset, in that it affects all of the variables that normally only reset on Restore Mode Defaults, 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 a Restore Mode Defaults and Input/Output Preset 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 Save User Preset of one instance will overwrite the Save User Preset of another instance.**

Remote Command	`:SYSTem:PRESet:USER`

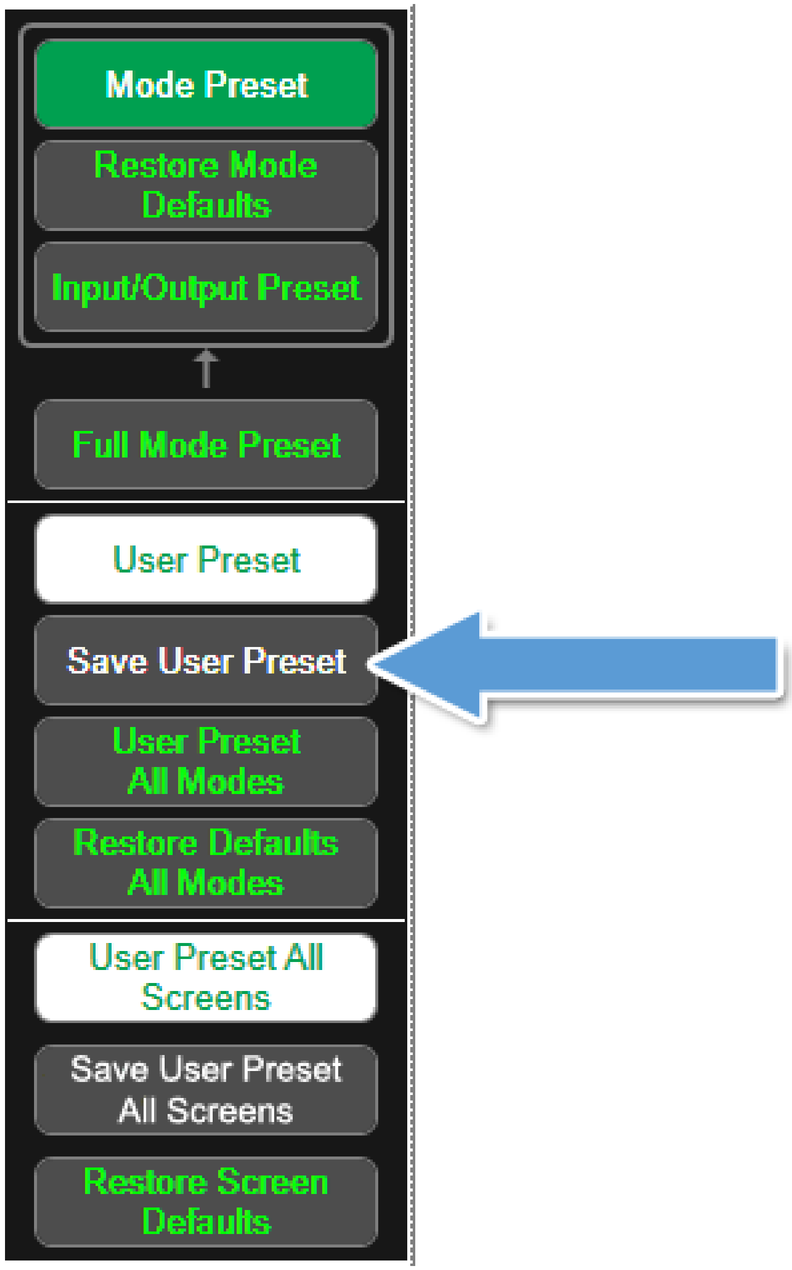
Example	`:SYST:PRES:USER:SAVE`
	Save the User Preset
	`:SYST:PRES:USER`
	Recall the User Preset

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 the X-Series A-models, the **User Preset** hardkey opened a menu that let you select from User Preset, Save User Preset, or User Preset All Modes. In the B-models, the **User Preset** hardkey immediately performs a User Preset, and the aforementioned menu is 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 the X-Series, "state" always includes all of this data; so whenever state is loaded, or User Preset is executed, 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 On ESA and PSA, User Preset affected the entire instrument's state. In the 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 can in legacy analyzers. If you want to recall all modes to their user preset file state, you will need to do a User Preset *after* mode switching into each mode User Preset recalls mode state, which can now include data like traces, whereas on ESA and PSA, User Preset did not affect data

5.6 Save User Preset

Saves the state of the currently active mode in a unique location for recall by the User Preset key. 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.



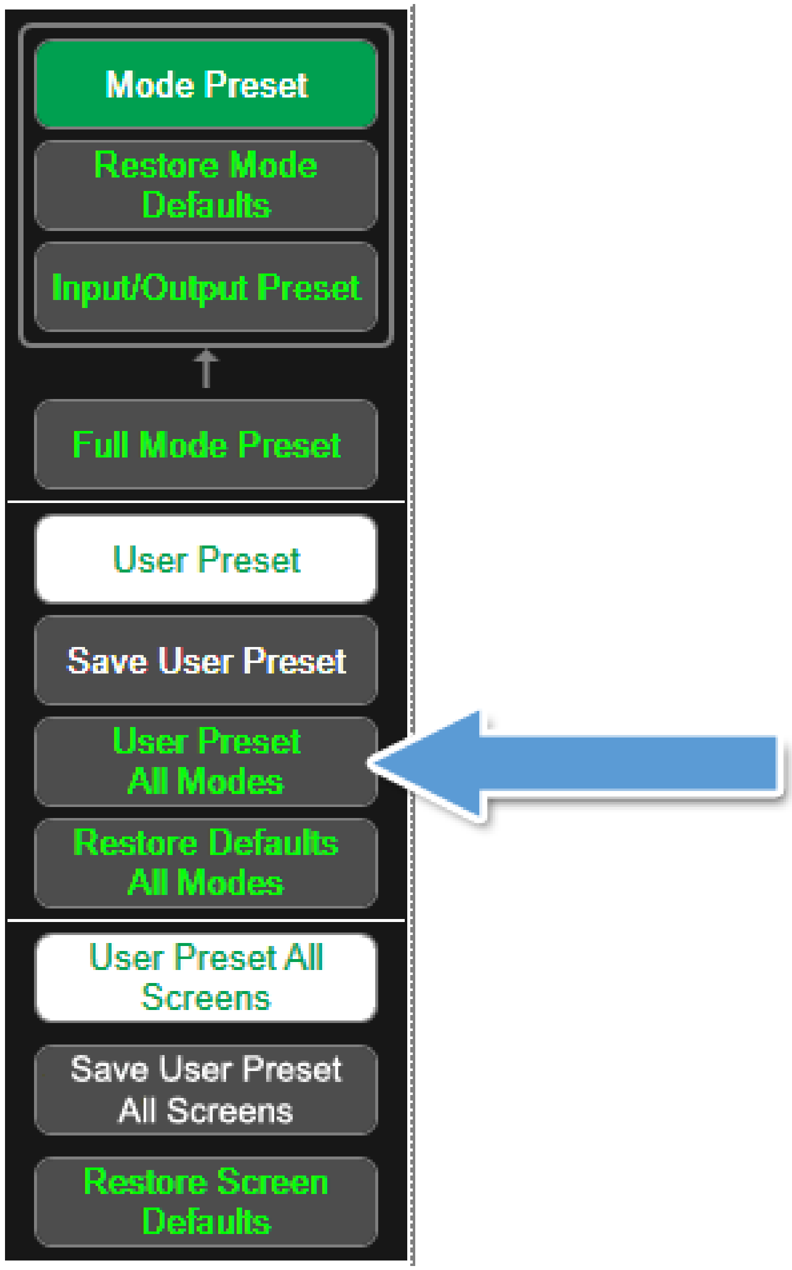
All of the Mode variables are saved, including those reset by Mode Preset and those only reset by Restore Mode Defaults, as well as all of the Input/Output variables, so when you subsequently press the **User Preset** key, the instrument returns to the exact same setup that existed when you pressed the **Save User Preset** control. Thus, User Preset is a preset of larger 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 a `*SAV` or a `:MMEM: STOR:STAT`, except that User Preset Save does not allow you to specify the filename or the location of the file

5.7 User Preset All Modes

User Preset All Modes recalls all of 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.



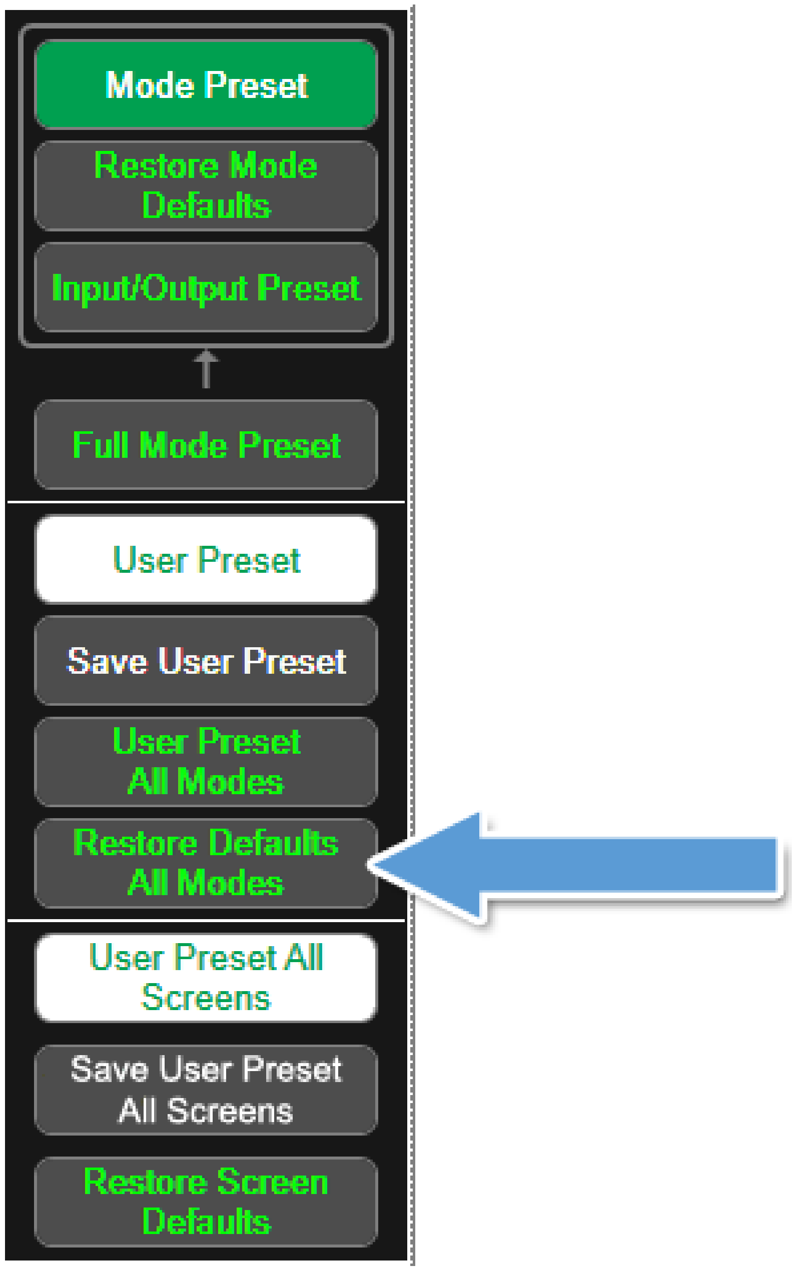
See the "User Preset" on page 520 description for more details on User Preset.

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

5.8 Restore Defaults All Modes

This selection resets all of the Modes in the current Screen back to their default state just as a **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.



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.

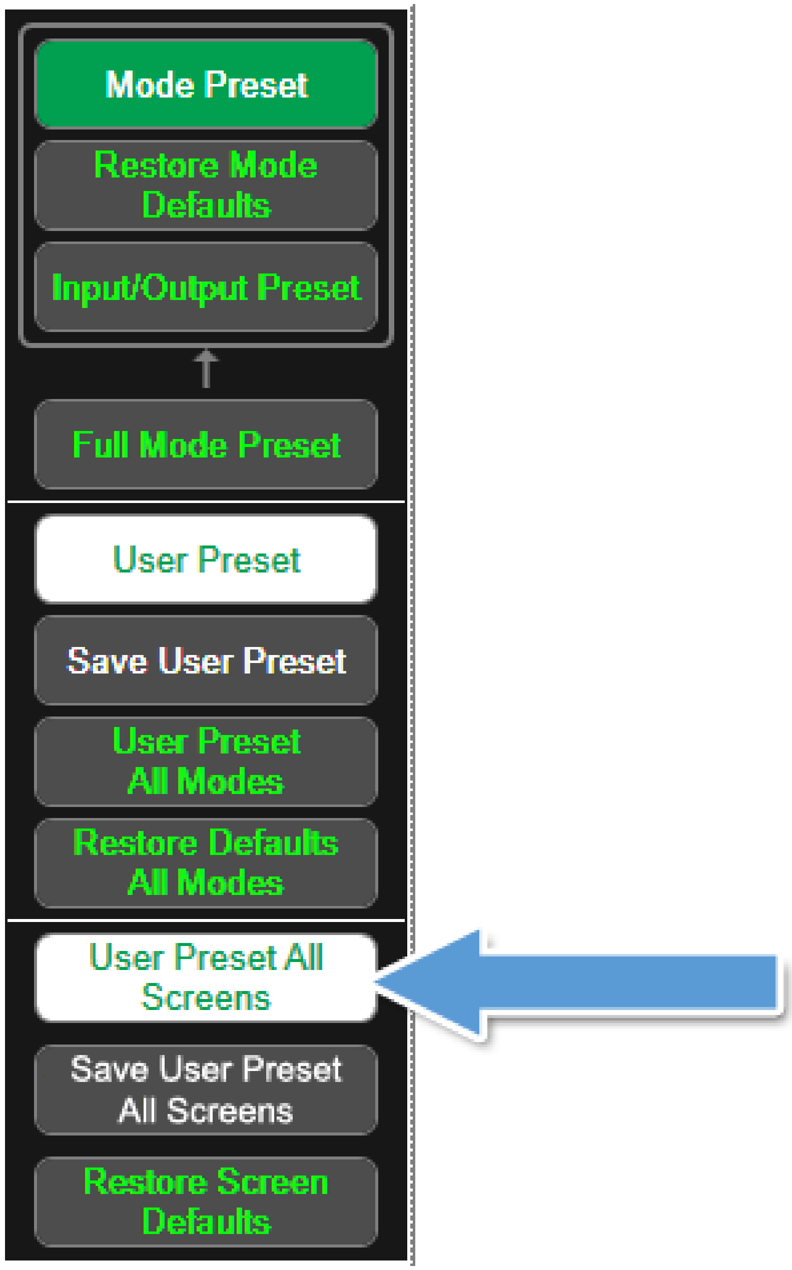
Example	`:SYST:DEF MOD`
Couplings	Causes the currently running measurement to be aborted, a mode switch to the power-on mode, and activates the default measurement for the power-on mode

5.9 User Preset All Screens

User Preset All Screens recalls a screen configuration previously saved using the Save User Preset All Screens function. The complete configuration of all your 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 of the variables that normally only reset on Restore Mode Defaults, and it affects the Input/Output variables, because both of these are included in State files.

Note that recalling a screen configuration in this manner will wipe out your current screen configuration and all states of all Screens.

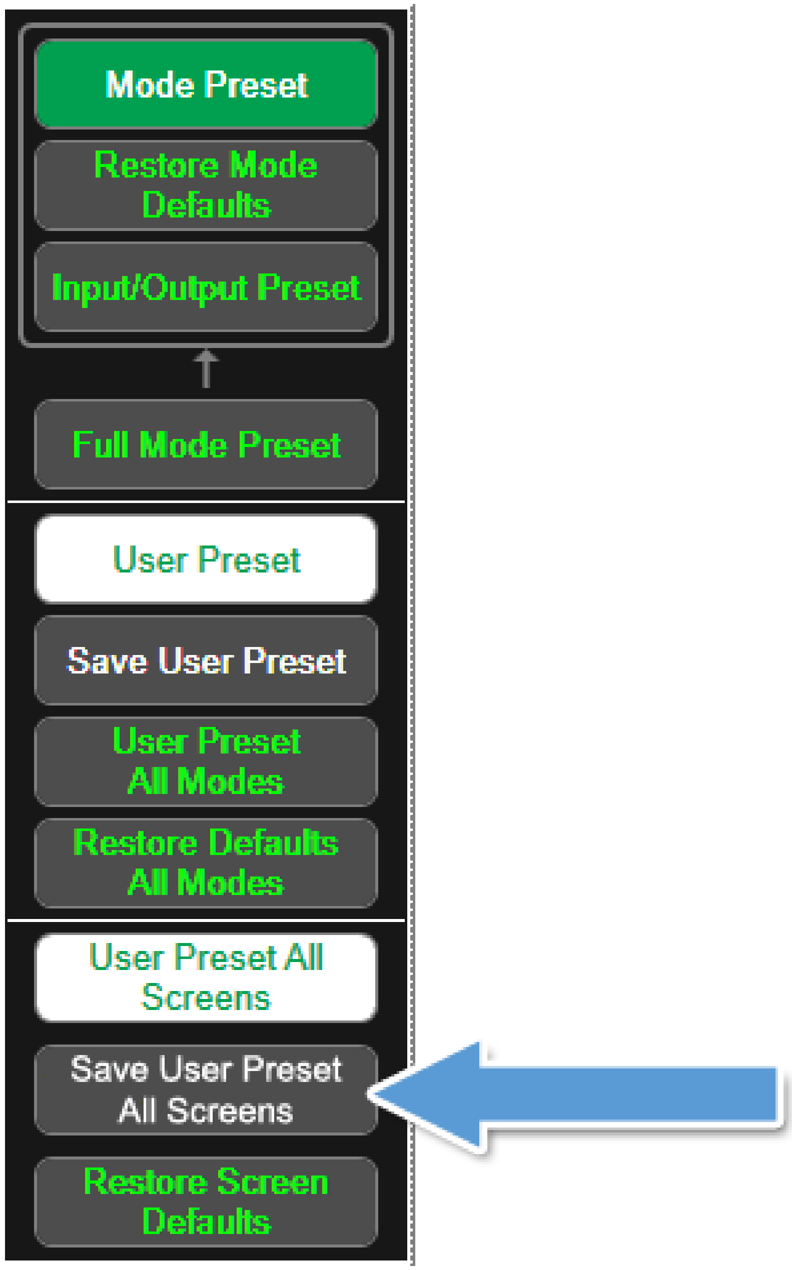


Notes	"Save User Preset All Screens" on page 530 is used to save the current screen configuration as the "user preset all screens" configuration If loading a User Preset All Screens file from a different instrument, some settings may be limited and/or coupled differently, since the capabilities of the 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

5.10 Save User Preset All Screens

Saves the current Screen Configuration in a unique location for recall by the **User Preset All Screens** key.

Save User Preset All Screens can be executed from the Preset dropdown.



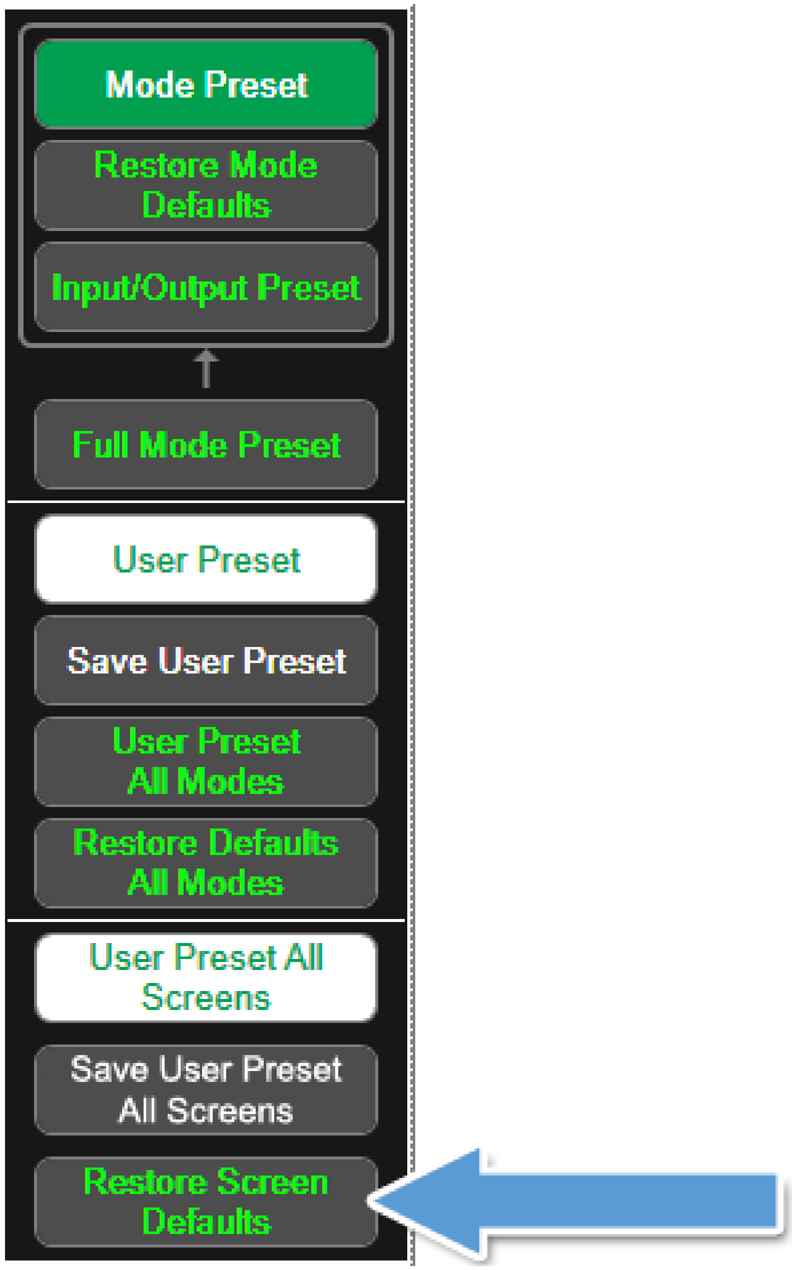
Besides the screen configuration, *all* of the Mode variables of all Screens are saved, including those reset by Mode Preset and those only reset by Restore Mode Defaults, as well as all of the Input/Output variables, so when you subsequently press the User Preset All Screens key, the instrument returns to the exact Screen setup that existed when you pressed the Save User Preset All Screens control.

Notes	Creates the same file as if you requested a Screen Config + State save, except that **Save User Preset All Screens** does not allow you to specify the filename or the location of the file

5.11 Restore Screen Defaults

This selection resets the Screen configuration to the factory default; deleting all screens, all screen names, all screen states, and setting Multi-Screen 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.



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`

5.12 Preset Type (Remote Command Only)

Remote Command	`:SYSTem:PRESet:TYPE FACTory | MODE | USER` `:SYSTem:PRESet:TYPE?`
Example	`:SYST:PRES:TYPE FACT`
Notes	This command is supported for backward compatibility only. It is a no-op, which does not change the behavior of any preset operation
Preset	This is unaffected by Preset but is set to `MODE` on “Restore System Defaults->All”
State Saved	No

5.13 Restart Instrument (Shutdown)

This command shuts down the instrument, then reboots it.

Remote Command	`:SYSTem:PUP`
Example	`:SYST:PUP`

5.14 Restart Application (Application Shutdown)

This command 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, thus the SCPI operation is terminated and restarted. A remote program must use fixed wait time to resume sending commands to the instrument. The wait time will be dependent upon which applications are pre-loaded

5.15 System Log Off (Remote Command Only)

This command 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. This exits the instrument application, thus any unsaved measurement result 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

5.16 Power Standby (Instrument Shutdown)

Pressing the power switch powers down the instrument. You will be notified that shutting down will cause the application to lose unsaved data, and the instrument will wait for you to respond to this prompt before shutting down.

The command below shuts down the instrument in the same way, however you can choose between the normal way (`NORMal`) or the forced way (`FORCe`). In the `NORMal` mode, the system waits until you respond to the warning prompt. In the `FORCe` mode, the system shuts down after 20 seconds, and all data will be lost.

If the instrument is not properly shutdown 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 will be provided 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 do a Mode Preset.

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

The Input/Output key accesses menus that let you control the Input/Output parameters of the instrument. In general, these are functions associated with external connections to the analyzer, either to the inputs or the outputs.

Since the Input/Output connections tend to be based on how you have your hardware set up, in general the input/output settings do not change when you perform a Mode Preset. They can be set to their default value in one of the three ways:

- by using the Restore Input/Output Defaults key on the first page of the input/output menu,
- by using the System->Restore System Defaults->Input/Output Settings or,
- by using the System -> Restore System Defaults->All. Also, they survive a Preset and a Power cycle.

A very few of the Input/Output settings do respond to a Mode Preset; for example, if the Calibrator is on it turns off on a Preset, and if DC coupling is in effect it switches to AC on a Preset. These exceptions are made in the interest of reliability and usability, which overrides the need for absolute consistency. Exceptions are noted in the SCPI table for the excepted functions.

The Input/Output features are common across multiple Modes and Measurements. In general they do not change when you change Modes or Measurements, although some controls appear only in certain measurements.

6.1 RF Source

This tab 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 the E7760 as well as modular products such as EXM and VXT.

External Source Control and built-in Tracking Sources are controlled using the Source tab in Meas Setup of the Swept SA measurement.

Dependencies	Only appears in models that support a built-in independent RF Source, such as E7760, EXM and VXT.

6.1.1 RF Output

This parameter sets the source RF power output state.

Remote Command	`:OUTPut[:EXTernal][:STATe] ON | OFF | 1 | 0` `:OUTPut[:EXTernal][:STATe]?`
Example	`:OUTP OFF` `:OUTP?`
Notes	The EXTernal node is shown in RD text so the SCPI remains the same between internal and external source control. This setting is for the independent mode and has no effect on the "List Sequencer" on page 550. If the "Sequencer" on page 551 is set to ON, the list sequencer controls the source output and this key is grayed-out. When the "Sequencer" on page 551 is set to OFF, makes source leave list sequencer and this setting is blanked out, taking effect immediately.
Dependencies	For the E7760 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. First, set the Output to NONE and then any port can be assigned as an Input.

Each port option for M1750A is available as both an input and output port. They will both default to “NONE”, and if either input or output is selected, the opposite will be disabled at “NONE”

See section Parameters for the M1750A Half Duplex Ports for more details.

When using the VXT M9410A/11A/15A 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

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 labelled 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 section "Parameters for the VXT M9410A/11A/15A and EXM when used with Radio Heads/CIU" on page 660 for more details.

See "More Information" on page 543

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` `[:SENSe]:FEED:RF:PORT:OUTPut?`

Example	`:FEED:RF:PORT:OUTP RFO`
	Set output to RF Output
	`:FEED:RF:PORT:OUTP RRH1RFHD2`
	Set output to Radio Head 1, RF Tx/Rx Port 2

Notes	The `RRHhRFHDp` parameter is used to select a port on a Radio Head (such as the Keysight M1740A mmWave Transceiver) as an output. The SCPI parameter RRHhRFHDp corresponds to **Head h**, port **RF Tx/Rx p**; for example, RRH1RFHD2 = the port labelled **RF Tx/Rx 2** on **Head 1**.
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 and option "FDX" is required to enable RFFD port. For M1750A: RF Input Parameter will be disabled if RF Output Port is not "NONE". If the RF Input Parameter has been selected, then RF Output Port will be disabled. For E7760: 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 will generate the error, -241.04, "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 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 that 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 the 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	This is unaffected by Mode Preset but is set to default on a "Source Preset" or "Restore System Defaults -> All"
State Saved	Saved in State
Annotation	Annotation in the Meas Bar reads as follows: When output is RF Out: Output: RF | When output is RFFD: Output: RFFD When output is RFHD: Output: RFHD When output is A1: Output: A1 When output is A2: Output: A2 When output is A3: Output: A3 When output is B1: Output: B2 When output is B2: Output: B2 When output is B3: Output: B3 When output is IFIO1: Output: IFIO1 When output is IFIO2: Output: IFIO2 When output is None: Output: NONE When output is Gen: Output: Gen| When output is T/R: Output: T/R When output is RFIO1: Output: RFIO1 | When output is RFIO2: Output: RFIO2 | When output is RFIO3: Output: RFIO3 | When output is RFIO4: Output: RFIO4 | When output is (for example) Port 1 on Radio Head 2: Output:Hd 2 RFHD 1

Backwards Compatibility SCPI	`:FEED:RF:PORT:OUTPut IFIO1` IFIO1 is treated as IFO1, and sets the IF output to be the port labelled “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 .

More Information

Here is the detail for the RF Output Port settings:

Value	Example	Notes
RF Output	`:FEED:RF:PORT:OUTP RFO`	On EXM with hardware M9430A, if RF Output is selected as RF Output Port, you need to choose 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	`:FEED:RF:PORT:OUTP 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, an error message is generated : “-221, Settings conflict; RFHD is being used as RF Input Port”. Option “HDX” is required to enable RFHD port
RFFD	`:FEED:RF:PORT:OUTP RFFD`	Option “FDX” is required to enable RFFD port.
Gen	`:FEED:RF:PORT:OUTP GEN`	Selects the Gen port on an M8920A
T/R	`:FEED:RF:PORT:OUTP TR`	Selects the T/R port on an M8920A

6.1.3 Half Duplex Output Port

Specify 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	This control only appears in EXM. If RFIO3 is selected as “Half Duplex Input Port”, then “Half Duplex Output Port” will be set to RFIO4 automatically. And 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

Allows you to control the amplitude of the Source output. Same as the RF Power key on the Amplitude Setup menu.

See "RF Power" on page 544.

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 which provides a 16 dB attenuator and the other which bypasses this attenuator. When this control is On, the path includes the 16 dB attenuator, so the max output level for this path is 0 dBm. When this control is Off, the 16 dB attenuator is bypassed, so the max output level for this path is +5 dBm.

Example	`:FEED:RF:PORT:TR:HPOW:ATT ON`

6.1.6 Amplitude Setup

Allows you to access the Amplitude Setup sub-menu panel.

Notes	The sub-menu under this button is for independent mode and has no effect on the "List Sequencer" on page 550. If the "Sequencer" on page 551 is set to ON, the list sequencer controls the source output and this control will be grayed-out on front panel to indicate out-of-scope. When you set "Sequencer" on page 551 to Off will make source leave list sequencer and this button will be black out.

6.1.6.1 RF Power

Allows you to 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.

Refer to the "RF Power Range " on page 545 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 -130 dBm, 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 -130 dBm on MPA RFIO TX ports, then popup warning message . When the application detects a power setting lower than -130 dBm on MPA GPS ports, then a warning message appears. This is only a warning, and check is performed when RF is ON The Min and Max value here defined UI settable amplitude range. This range is larger than actual amplitude range with level accuracy defined in spec
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 VXT models M9410A/11A, if AWGN State is On and ARB State is On, this setting will be adjusted to the value to maintain the AWGN power relationship defined by Power Control Mode and other noise settings
Preset	-100 dBm
Min/Max	The range of values depends on the current frequency and selected RF output port. Please refer to the "RF Power Range " on page 545 table 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 models M9420A/21A

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: This is the UI power range, which is larger than the actual specification.

Note1: M9421A does not support RFFD port.

Note2: 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 to larger than 20 dBm.

VXT model 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: Min Output Power is the UI power range, which is smaller than the actual specification.

Note1: 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 to larger than 20 dBm.

Note2: Option LFE represents for Low Frequency Extension, which covers frequency from 1 MHz to 380 MHz.

VXT model M9415A

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

Note1: 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 to larger than 20 dBm.

Note2: 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 to larger than 15 dBm.

M8920A

RF Output Port	Frequency Range	Min Output Power	Max Output Power without Option “1EA”	Max Output Power with Option “1EA”
Gen	100 kHz ≤ f ≤ 6 GHz	–150 dBm	3 dBm	15 dBm
T/R	100 kHz ≤ f ≤ 6 GHz	–150 dBm	5 dBm (T/R port high power attenuator Off) -15 dBm (T/R port high power attenuator On)	5 dBm (T/R port high power attenuator Off) -15 dBm (T/R port high power attenuator On)

Note: This is the UI power range, which is larger than the actual specification.

6.1.6.2 Set Reference Power

This key allows you to set the power reference. Pressing this key 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 set to ON with a reference value set, entering a value under Source>Amplitude>RF Power and pressing Set Reference Power will add 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 you must set Power Ref to OFF and then press Set Reference Power.

Dependencies	This key is unavailable, and is grayed out when the "List Sequencer" on page 550 is turned ON.

6.1.6.3 Power Ref

This key allows you to 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 refer to "Set Reference Power" on page 547

Remote Command	`:SOURce:POWer:REFerence <ampl>`
	`:SOURce:POWer:REFerence?`
	`:SOURce:POWer:REFerence:STATe OFF | ON | 0 | 1`
	`:SOURce:POWer:REFerence:STATe?`

Example	`:SOUR:POW:REF 0.00 dBm` `:SOUR:POW:REF:STATe ON`
Dependencies	This setting is unavailable and is grayed out when the "List Sequencer" on page 550 is turned ON.
Couplings	This value is coupled to the "Set Reference Power" on page 547 key such that pressing the Set Reference Power key updates the reference power with the current output power.
Preset	0.00 dBm OFF
Min	-125.00 dBm
Max	10.00 dBm

6.1.6.4 Power Unit

The Generator (Source) Power Unit modifies the units for RF Power and Power Ref. The change is immediate and should not force a restart.

Remote Command	`:SOURce:POWer[:LEVel][:IMMediate][:AMPLitude]:UNIT DBM | W | V | DBUV` `:SOURce:POWer[:LEVel][:IMMediate][:AMPLitude]:UNIT?`
Example	`:SOUR:POW:UNIT V` Sets the RF Power units to volts
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

Allows you to 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 will change as follows and the RF output power will 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 will follow the units set in Power Unit
Dependencies	This setting is unavailable, and is grayed out when the List Sequencer is turned ON.
Preset	0.00 dB
Min	-200.00 dB
Max	200.00 dB

6.1.6.6 Amplitude Increment

Amplitude Increment Sethanges 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 increment 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 will follow 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

Allows you to control the frequency of the Source. Same as the Frequency key on the Frequency Setup menu.

See "Frequency" on page 575

Example	`:SOUR:FREQ 1.00 GHz`

6.1.8 List Sequencer

Allows you access to the sub-menus for configuring the list sequencer.

List sequences allows 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 itself 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 567.

Once the List Sequencer has been configured using the front panel, SCPI, or loading in a tab delimited file, the sequence must be initiated using the front panel Initiate Sequence key or the corresponding SCPI command.

Dependencies	This control is not available in E7760.

6.1.8.1 Sequencer

Allows you to set the state of the list sequencer. When the list sequencer is on, the source is outputting the sequence defined by the sequencer. When the 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 set to ON, the list sequencer controls the output of the source.
Dependencies	This control is not available in E7760.
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, like load or delete will be rejected.
Preset	Off
Range	On | Off

6.1.8.2 Initiate Sequence

Pressing this key arms the sequence for single execution. Once the sequence is armed the source begins the sequence as soon as the trigger is received. If the 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 Yes, the Initiate list sequencer operation is rejected, and the key is grayed out, since source list sequence request is sent to physics via Parallel batch by sequence analyzer. If the file needed by the sequencer is not already in ARB memory, the sequence cannot be initiated and an error will be generated. There is a blocking SCPI query which can be used to query if source list sequence being initiated successfully or not. (see "Remote Software Trigger (Remote command Only)" on page 574 Query Source List Sequence Armed Status)
Dependencies	Under the Sequence Analyzer Mode, if Meas Setup->Include Source is set to YES, Source->List Sequencer->Initiate Sequence is disabled. This control is not available in E7760.

6.1.8.3 Repetition

Allows access to the sub-menu for selecting the repetition type for the list sequencer globally. It cannot be changed between different sequence steps.

In Single, Source list will play one time after initiation. In Continuous, Source list will play 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	This menu is available on EXM. This control is not available in E7760.
Preset	SINGle
Range	SINGle|CONTinuous

6.1.8.4 Trig Out Type

Allows access to the sub-menu for selecting 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	This control is available on EXM, and not available in E7760.
Preset	STEP
Backwards Compatibility SCPI	`:SOURce:LIST:TRIGgerout:TYPe BEGinningofstep | DATamarker`

6.1.8.5 Select Data Marker

When Data Marker is selected for Trig Out Type, sets which marker to route.

Remote Command	`:SOURce:LIST:TRIGger:OUTPut:TYPE:MARKer M1M2|M3|M4` `:SOURce:LIST:TRIGger:OUTPut:TYPE:MARKer?`
Backwards Compatibility SCPI	`:SOURce:LIST:TRIGgerout:TYPe:Marker`

6.1.8.6 Manual Trigger Now

Pressing this key provides a software trigger event to the list sequencer. During execution of sequence, if the sequencer is halted on any step that has been configured with a "Manual" step trigger, then this key press will cause the sequencer to continue and execute the step.

Notes	No remote command, front panel only.

6.1.8.7 List Sequencer Setup

Allows you access to the list sequencer setup menus.

Number of Steps

Allows you to 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. This control is not available in E7760.
Preset	1
Min	1
Max	1000

Go To Step

Allows you to select the step number you wish to view or edit.

Notes	No remote command, front panel only.
Preset	1
Min	1
Max	Step Count

Insert Step Before

Allows you to insert a new step, containing default values, before the currently selected step. Inserting a step will automatically increase the Step Count parameter by 1. If sequence already reaches upper limit of 1000 steps, then insert more step will be rejected and popup error -221, “Setting Conflict; Cannot insert more steps, maximum number of steps reached”

Notes	No remote command, front panel only. If the list already contains the maximum limit of 1000 steps, no operation will be made after pressing this key.

Delete Step

Allows you to delete the current step. Deleting a step will automatically decrease the Step Count parameter by 1. If sequence only has one step left, delete step will be rejected and popup error -221, “Setting conflict; Cannot delete current step, minimum number of steps reached”

Notes	No remote command, Front Panel key only. If the list already contains the minimum limit of 1 step, no operation will be made after pressing this key

Clear List

Allows you to clear the list. Clearing the list sets the number of steps to the default value of 1 and sets the parameters for the only step to their default values.

Step Trigger

This field in the table allows you to select the trigger input for the current step.

See "More Information" on page 555

Remote Command	`:SOURce:LIST:STEP[1]|2|3…1000:SETup:INPut:TRIGger IMMediate	INTernal	EXTernal2	KEY	BUS	EXTernal4` `:SOURce:LIST:STEP[1]|2|3…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	This control is not available in E7760.
Preset	Free Run
Range	Free Run | Internal | Manual (Trigger Key) | Bus | External 2| EXTernal4

More Information

Parameter	SCPI Example	Notes
Free Run	:SOUR:LIST:STEP2:SET:INP:TRIG IMM	Sets the trigger input for the current step to Free Run.
Internal	:SOUR:LIST:STEP2:SET:INP:TRIG INT	Sets the trigger input for the current step to Internal.
Manual (Trigger Key)	:SOUR:LIST:STEP2:SET:INP:TRIG 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	:SOUR:LIST:STEP2:SET:INP:TRIG 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 SCPI 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	:SOUR:LIST:STEP2:SET:INP:TRIG 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

This field in the table allows you to 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|3…1000:SETup:TRANsition:TIME <time>` `:SOURce:LIST:STEP[1]|2|3…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	This control is not available in E7760.
Preset	1.0 ms
Min	0.0 ms
Max	4.0 ks

Band

This field in the table allows you to select the radio band for use in the current step.

Remote Command	`:SOURce:LIST:STEP[1]|2|3…1000:SETup:RADio:BAND 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|3…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	This control is not available in E7760.

Here is the Radio Standard 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
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	Standard	SCPI Example
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 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	Standard	SCPI Example
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 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

Band	Standard	SCPI Example
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
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

This field in the table allows you to 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.

When set to “Uplink”, the source will calculate the uplink frequency according to an uplink formula together with selected channel band and channel number. When set to “Downlink”, the source will calculate the downlink frequency according to a downlink formula together with selected channel band and channel number.

Remote Command	:SOURce:LIST:STEP[1]|2|3…1000:SETup:RADio:BAND:LINK DOWN | UP

	`:SOURce:LIST:STEP[1]|2|3…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	This control is not available in E7760.
Preset	DOWN
Range	DOWN | UP

Freq/Chan

This field in the table allows you to select the frequency or channel value for the current step. If the Band selection for the current row is None, you will enter a Frequency. Otherwise you will enter a Channel, which will cause the frequency to be automatically selected based on the Band selection.

Entering a Frequency

If the Band selection for the current row is None, you will 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|3…1000:SETup:CNFRequency <double>` `:SOURce:LIST:STEP[1]|2|3…1000:SETup:CNFRequency?`
Example	`:SOUR:LIST:STEP2:SET:CNFR 1GHz` `:SOUR:LIST:STEP2:SET:CNFR?`
Notes	SCPI is supported after A.09.40. This SCPI is used to setup channel number or frequency setting, according to current Radio Band setting. If Radio Band is “NONE”, then it’s frequency. If Radio Band is not “NONE”, then it’s channel number.
Dependencies	This control is not available in E7760.
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, you will enter a Channel number. This field in the table allows you to select the channel value for the current step. The frequency will be selected automatically, based on the Band.

Remote Command	`:SOURce:LIST:STEP[1]|2|3…1000:SETup:CNFRequency <double>` `:SOURce:LIST:STEP[1]|2|3…1000:SETup:CNFRequency?`
Example	`:SOUR:LIST:STEP2:SET:CNFR 124` `:SOUR:LIST:STEP2:SET:CNFR?`
Notes	SCPI is supported after A.09.40. This SCPI is used to setup channel number or frequency setting, according to current Radio Band setting. If Radio Band is “NONE”, then it’s frequency. If Radio Band is not “NONE”, then it’s channel number.
Dependencies	This control is not available in E7760.
Couplings	The channel number is coupled to the step frequency value. When the step frequency value is changed, the channel number will increase or decrease 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	0 (Please refer to Section "Channel" on page 577, for valid ranges.)
Max	10838 (Please refer to Section "Channel" on page 577, for valid ranges.)

Power

This field in the table allows you to specify the power value for the current step.

Remote Command	`:SOURce:LIST:STEP[1]|2|3…1000:SETup:AMPLitude <double>` `:SOURce:LIST:STEP[1]|2|3…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. This control is not available in E7760.
Preset	-100 dBm
Min	The range of values depends on the current frequency and selected RF output port. Please refer to "RF Power" on page 544 and the table RF Power Range for the valid ranges.
Max	The range of values depends on the current frequency and selected RF output port. Please refer to "RF Power" on page 544 and the table RF Power Range for the valid ranges.

Waveform

This field in the table allows you to select the waveform to be played back during the current step. Pressing this field lets you choose between CW, a Waveform file, to continue the previous step's waveform, or Off.

See "More Information" on page 563

Remote Command	`:SOURce:LIST:STEP[1]|2|3…1000:SETup:WAVeform <string>` `:SOURce:LIST:STEP[1]|2|3…1000:SETup:WAVeform?`
Example	`:SOUR:LIST:STEP2:SET:WAV "CW"` `:SOUR:LIST:STEP2:SET:WAV?`
Notes	SCPI is supported after A.09.40 String type, takes "Off" | "CW" | "Cont" | "waveform name"
Dependencies	This control is not available in E7760. For VXT models M9410A/11A, if the Waveform is not Continue Previous, there is always a time gap between the current step and the previous step.
Preset	CW
Range	Waveform | Continue Previous | CW | Off

More Information

Parameter	SCPI Example	Notes
CW	`:SOUR:LIST:STEP2:SET:WAV "CW"`	Sets the current step to output a CW tone.
Selected Waveform	`:SOUR:LIST:STEP2:SET:WAV "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	`:SOUR:LIST:STEP2:SET:WAV "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	`:SOUR:LIST:STEP2:SET:WAV "Off"`	Disable RF output of the current step.

Waveform File

Pressing the slide-aside field of this column (>) opens the "Select Waveform" on page 619 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 filename in the table.

Step Duration

The first field under Step Duration in the table allows you to 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|3…1000:SETup:DURation:TYPE TIME | COUNt | CONTinuous | CABort` `:SOURce:LIST:STEP[1]|2|3…1000:SETup:DURation:TYPE?`
Example	`:SOUR:LIST:STEP2:SET:DUR:TYPE TIME` `:SOUR:LIST:STEP2:SET:DUR:TYPE?`
Dependencies	This control is not available in E7760. If the Step Duration is Time or Play Count in VXT models M9410A/11A, only Free Run is the available Step Trigger for the next step. Otherwise an error message will be generated “Parameter error; only Free Run is available as step trigger on step<n>”
Range	Time | Play Count | Continuous | Continuous Abort

More Information

Parameter	SCPI Example	Notes
Time	`:SOUR:LIST:STEP2:SET:DUR:TYPE 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 565 command
Count	`:SOUR:LIST:STEP2:SET:DUR:TYPE COUN`	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

Parameter	SCPI Example	Notes
		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 566 command
Continuous	`:SOUR:LIST:STEP2:SET:DUR:TYPE CONT`	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	`:SOUR:LIST:STEP2:SET:DUR:TYPE 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 565 command

Duration Time

The second field under Step Duration in the table allows you to specify the length of time the current step will play when "Step Duration" on page 564 is Time.

When "Step Duration" on page 564 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|3…1000:SETup:DURation:TCOunt <double>` `:SOURce:LIST:STEP[1]|2|3…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 will continue playing after the sequence is completed. In this extended playing time, ":STAT:OPER:COND? " will return 0 for the Source Sweeping Status Bit (bit 9). SCPI is supported after A.09.40 If current "Duration Type" is "Continuous", then popup error -221,"Settings conflict;Cannot accept time or count input when step duration type is Continuous on step #"
Dependencies	This control is not available in E7760.
Preset	1.00 ms
Min	100 µs
Max	1800 s

Play Count

The second field under Step Duration in the table allows you to specify the number of times the current ARB waveform file will play during a step when "Step Duration" on page 564 is Count.

Remote Command	`:SOURce:LIST:STEP[1]|2|3…1000:SETup:DURation:TCOunt <double>` `:SOURce:LIST:STEP[1]|2|3…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 SCPI is reused by "Play Count" and "Duration Time" according to current Duration Type setting if "Play Count" or "Duration Time". If current "Duration Type" is "Continuous", then popup error -221,"Settings conflict;Cannot accept time or count input when step duration type is Continuous on step #" 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	This control is not available in E7760.
Preset	1
Min	1
Max	65536

Trig Out

This field in the table allows you to specify the trigger output for the current step. The trigger output signal is sent at the start of the step.

When select "On", trigger event will occur on both Internal and External2 paths. Select "Off" will turn off trigger output.

Remote Command	`:SOURce:LIST:STEP[1]|2|3…1000:SETup:OUTPut:TRIGger ON | OFF | 1 | 0` `:SOURce:LIST:STEP[1]|2|3…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	This control is not available in E7760.
Preset	Off
Range	On|Off

Step Configuration (Remote Command Only)

This SCPI command is used to configure the List Sequencer and is 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 setup, the values entered are run through several levels of validation.

Remote Command	`:SOURce:LIST:STEP[1]|2|...|4..1000:SETup IMMediate | INTernal | KEY | BUS | EXTernal2, <time>, 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, DOWN | UP, <freq>, <ampl>, <string>, TIME | COUNt | CONTinuous, <time>, ON | OFF | 1 | 0, [<int>],` `:SOURce:LIST:STEP[1]|2|...|4..1000:SETup?`
Example	`:SOUR:LIST:STEP1:SET INT, 1ms, PGSM, DOWN, 10, -25 dBm, “GSM_Test1.bin”, TIME, 10ms, OFF, 255`
Notes	The parameters are: 1. Step Trigger <**enum**> - specifies the input trigger for the step. For details of the valid types of step trigger see "Step Trigger" on page 554. 2. 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 555. 3. Radio Band <**enum**> - specifies the radio band for the step. 4. Radio Band Link <**enum**> - specifies the radio band link direction for the step. Old “Device” BTS|MS is obsolete but still remain, and acts as alias SCPI of “Link” parameter.

	5. 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 Section "Freq/Chan" on page 561, "Freq/Chan" on page 561 and Section "Freq/Chan" on page 561, "Freq/Chan" on page 561 . 6. Power <**ampl**> - specifies the output power for the step in dBm. For details of the valid ranges see "Power" on page 562. 7. 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 — disable RF output 8. 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 564. 9. Time or Count <time/int> - specifies time duration in seconds or play count of the ARB file associated with the step. 10. Output Trigger <Boolean> - specifies the output trigger for the step.
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 553. If you attempt to remotely set or query a subopcode that is out of range, an error is generated.

Step Configuration of Step Trigger parameter list (Remote Command Only)

This SCPI command is to configure “Step Trigger” parameter array of the whole List Sequencer at one time. The number of array is same as step number defined in "Number of Steps" on page 553 Number of Steps. As a step is setup, the value entered run 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 554. If input parameter number exceeds the step number defined by "Number of Steps" on page 553, 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. IMMediate|INTernal|KEY|BUS|EXTernal2
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 553.

Step Configuration of Transition Time parameter list (Remote Command Only)

This SCPI command is to configure "Transition Time" parameter array of the whole List Sequencer at one time. The number of array is same as step number defined in "Number of Steps" on page 553. As a step is setup, the value entered run 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 555 If input parameter number exceeds the step number defined by "Number of Steps" on page 553, 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 553.

Step Configuration of Radio Band parameter list (Remote Command Only)

This SCPI command configures "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 553. As a step is setup, the value entered run 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 is to setup below parameter array of whole list sequence.

	Radio Band <enum> - specifies the radio band for the step. If input parameter number exceeds the step number defined by "Number of Steps" on page 553, 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 number of steps will be updated. 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
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 553.

Step Configuration of Radio Band Link parameter list (Remote Command Only)

This SCPI command is to configure "Radio Band Link" parameter array of the whole List Sequencer at one time. The number of array is same as step number defined in "Number of Steps" on page 553. As a step is setup, the value entered run 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 is to setup below parameter array of whole list sequence. Radio Band Link <enum> - specifies the radio band link direction for the step. If input parameter number exceeds the step number defined by "Number of Steps" on page 553, 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 number of steps will be updated. DOWN|UP
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 553.

Step Configuration of Frequency/Channel Number parameter list (Remote Command Only)

This SCPI command is to configure "Frequency" or "Channel Number" parameter array of the whole List Sequencer at one time. The number of array is same as step number defined in "Number of Steps" on page 553. As a step is setup, the value entered run 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 is to setup below 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 561 and "Freq/Chan" on page 561 This SCPI 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’s frequency. If Radio Band is not “NONE”, then it’s channel number If input parameter number exceeds the step number defined by "Number of Steps" on page 553, 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 553.

Step Configuration of Power parameter list (Remote Command Only)

This SCPI command is to configure “Power” parameter array of the whole List Sequencer at one time. The number of array is same as step number defined in "Number of Steps" on page 553 Number of Steps. As a step is setup, the value entered run 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 is to setup below 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 562. If input parameter number exceeds the step number defined by "Number of Steps" on page 553, 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 553.

Step Configuration of Waveform parameter list (Remote Command Only)

This SCPI command is to configure “Waveform” parameter array of the whole List Sequencer at one time. The number of array is same as step number defined in "Number of Steps" on page 553. As a step is setup, the value entered run 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	The command is to setup below 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: disable RF output If input parameter number exceeds the step number defined by "Number of Steps" on page 553, 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 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 553.
Range	”filename” | “CW” | “Off” | “CONT”

Step Configuration of Step Duration parameter list (Remote Command Only)

This SCPI command is to configure “Step Duration” parameter array of the whole List Sequencer at one time. The number of array is same as step number defined in "Number of Steps" on page 553. As a step is setup, the value entered run 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	The command is to setup below 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 564. If input parameter number exceeds the step number defined by "Number of Steps" on page 553, 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 number of steps will be updated. TIME | COUNt | CONTinuous
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 553.

Step Configuration of Duration Time or Play Count parameter list (Remote Command Only)

This SCPI command is to configure “Duration Time” or “Play Count” parameter array of the whole List Sequencer at one time. The number of array is same as step number defined in "Number of Steps" on page 553. As a step is setup, the value entered run 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	The command is to setup below 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 553, then generate error, and only those parameters whose index number falls in number of steps will be updated. If current "Step Duration" on page 564 is “Continuous”, then generate error -221,"Settings conflict;Cannot accept time or count input when step duration type is Continuous on step #"
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 553.

Step Configuration of Output Trigger parameter list (Remote Command Only)

This SCPI command is to configure “Output Trigger” parameter array of the whole List Sequencer at one time. The number of array is same as step number defined in "Number of Steps" on page 553. As a step is setup, the value entered run 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	The command is to setup below parameter array of whole list sequence. Output Trigger <Boolean> - specifies the output trigger for the step If input parameter number exceeds the step number defined by "Number of Steps" on page 553, 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. ON|OFF|1|0
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 553.

Clear List (Remote Command Only)

This command is the SCPI equivalent of the Clear List UI featuredescribed in "Clear List" on page 554

Remote Command	`:SOURce:LIST:SETup:CLEar`
Example	`:SOUR:LIST:SETup:CLE`
Dependencies	This control is not available in E7760.

6.1.8.8 Remote Software Trigger (Remote command Only)

During execution of a list sequence, the sequence will halt and wait at any step that has Step Trigger set to “Bus”. Sending this command will trigger the step and continue the sequence.

Remote Command	`:SOURce:LIST:TRIGger:INITiate[:IMMediate]`
Example	`:SOUR:LIST:TRIG:INIT`
Dependencies	This control is not available in E7760.

6.1.8.9 Query List Sequence Initiation Armed Status (Remote Command Only)

This is a blocking SCPI query to determine if source list sequence being initiated successfully or not.

Remote Command	`:SOURce:LIST:INITiation:ARMed?`
Example	`:SOUR:LIST:INIT:ARMed?`
Notes	Query only SCPI. Returning “1” if list sequence has been initiated successfully, returning “0” if not. Once get “0”, you can use :SYST:ERR? to query what error happened.

	Just like “*OPC?”, this command can be blocked until event/status “IsSourceSweeping” happens, and then returns. Doing so can help user’s script query armed status only once during the time interval of the initiation. As an ancillary SCPI of existing SCPI “:SOUR:LIST:TRIGger[:IMMediate]” (see "Initiate Sequence" on page 551 Initiate Sequence), the right usage of this command is to use it after “:SOUR:LIST:TRIG”. If not, this command will return “1” immediately. The return data is in the following format: Integer There is an alias SCPI “:SOURce:LIST:TRIGger:INITiation:ARMed?”
Dependencies	This control is not available in E7760.

6.1.9 Frequency Setup

Allows you to access the Frequency Setup sub-menu panel.

Notes	The sub-menu under this button is for independent mode and has no effect on the "List Sequencer" on page 550. If the "Sequencer" on page 551 is set to ON, the list sequencer controls the source output and this key will be grayed-out. And this button will be grey out on front panel to indicate out-of-scope. When set"Sequencer" on page 551 to Off will make source leave list sequencer and this button will be black out.

6.1.9.1 Frequency

Allows you to 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 brings up the unit terminator.

Remote Command	`:SOURce:FREQuency[:CW] <freq>` `:SOURce:FREQuency[:CW]?`
Example	`:SOUR:FREQ 1.00 GHz`
Notes	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 frequency
Couplings	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 For E7760A, if the Output Port selected is a mmWave port, and option RF4 is not present, the frequency of the source and analyzer must be the same. Thus, changing this source frequency will also update the analyzer frequency. If option RF4 is present, the frequency of the source and receiver are independent
Preset	For E7760: Dependent on port selected For EXM, if license F1A or 5WC is present, the default Center Frequency is 2.412 GHz For VXT Models with Radio Heads/CIU: see "VXT Models with Radio Heads/CIU" on page 577 For all other models: 1.00 GHz
Min	For E7760: Dependent on port selected. VXT models M9420A/21A: 60 MHz VXT models M9410A/11A/15A: 380 MHz

	VXT models M9411A: option LFE = 1 MHz For VXT Models with Radio Heads/CIU: see "VXT Models with Radio Heads/CIU" on page 577 All other models: 10.00 MHz
Max	Hardware Dependent: Option 503 = 3.6 GHz Option 504 = 3.8 GHz Option 506 = 6.00 GHz Option F06 = 6.00 GHz See VXT model M9415A For VXT Models with Radio Heads/CIU: see "VXT Models with Radio Heads/CIU" on page 577 For E7760: Dependent on port selected For EXM, if license 5WC is present, the frequency range should be limited to: 1.1 GHz-1.7 GHz, 2.4 GHz - 2.5 GHz, 4.8 GHz - 6.0 GHz. If the user-defined frequency is outside of range, UI reports the error message “Settings conflict; Frequency is outside available range”

VXT model M9415A

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

Note: Option F06 can be set up to maximum 6.6 GHz on UI, but Spec to customer only ensure up to 6.0 GHz (option F06); Option F06 can be set up to maximum 8.6 GHz on UI, but Spec to customer only ensure up to 8.0 GHz (option F08); Option F12 can be set up to maximum 12.9 GHz on UI, but Spec to customer only ensure up to 12.3 GHz (option F12).

The minimum spec frequency is 380 MHz, but the minimum settable value is 330 MHz.

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

Note: Option F06 can be set up to maximum 6.08 GHz on UI, but Spec to customer only ensure up to 6.0 GHz (option F06). Option F06 and EP6 can be set up to maximum 6.60 GHz on UI, but Spec to customer only ensure up to 6.0 GHz.

The minimum spec frequency is 380 MHz, but the minimum settable value is 330 MHz.

E7760

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 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	28 GHz	24.25 GHz	43.5 GHz

6.1.9.2 Channel

The frequency of the source can be specified by a channel number of a given frequency band. This key allows you to specify the current channel number. For the appropriate range of channel numbers for a given frequency band, refer to the following tables: "GSM/EDGE Channel Number Ranges" on page 578, "W-CDMA Channel Number Ranges" on page 578, "CDMA 2000 / 1xEVDO Channel Number Ranges" on page 580, and "LTE FDD Channel Number Ranges" on page 582.

Channel is not available on E7760.

Remote Command	`:SOURce:FREQuency:CHANnels:NUMBer <int>` `:SOURce:FREQuency:CHANnels:NUMBer?`
Example	`:SOUR:LIST:STEP2:SET:RAD:NUMB 1`
Notes	This key is grayed out when the "Radio Standard/Radio Band" on page 586 is set to NONE.
Couplings	The channel number is coupled to the frequency value when the"Radio Standard/Radio Band" on page 586 is not set to NONE. When the frequency value is changed, the channel number will increase or decrease to match the new frequency. If the 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	Please refer to the tables below for the valid ranges.
Max	Please refer to the tables below for the valid ranges.

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
		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

Band	Link (Device)	Range	Frequency (MHz)
	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
	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

Band	Link (Device)	Range	Frequency (MHz)
	Uplink	312 £ n £ 363	n÷5 + 770
		387 £ n £ 437	n÷5 + 755.1

CDMA 2000 / 1xEVDO Channel Number Ranges

Band	Link (Device)	Range	Frequency (MHz)
US Cellular	Uplink (MS, reverse link)	1 ≤N ≤799	0.030*N+ 825.000
		991 ≤N ≤1023	0.030*(N−1023) + 825.000
		1024 ≤N ≤1323	0.030*(N−1024) + 815.040
	Downlink (BS, forward link)	1 ≤N ≤799	0.030*N+ 870.000
		991 ≤N ≤1023	0.030*(N−1023) + 870.000
		1024 ≤N ≤1323	0.030*(N−1024) + 860.040
US PCS	Uplink (MS, reverse link)	0 ≤N ≤1199	1850.000 + 0.050*N
	Downlink (BS, forward link)	0 ≤N ≤1199	1930.000 + 0.050*N
Japan Cellular Band	Uplink (MS, reverse link)	1 ≤N ≤799	0.0125*N+ 915.000
		801 ≤N ≤1039	0.0125*(N-800)+ 898.000
		1041 ≤N ≤1199	0.0125*(N-1040)+ 887.000
		1201 ≤N ≤1600	0.0125*(N-1200)+ 893.000
	Downlink (BS, forward link)	1 ≤N ≤799	0.0125*N+ 860.000
		801 ≤N ≤1039	0.0125*(N-800)+ 843.000
		1041 ≤N ≤1199	0.0125*(N-1040)+ 832.000
		1201 ≤N ≤1600	0.0125*(N-1200)+ 838.000
Korean PCS Band	Uplink (MS, reverse link)	0 ≤ N ≤ 599	0.050*N+ 1750.000
	Downlink (BS, forward link)	0 ≤ N ≤ 599	0.050*N+ 1840.000
NMT-450 Band	Uplink (MS, reverse link)	1 ≤N ≤400	0.025*(N-1)+ 450.000
		472 ≤N ≤871	0.025*(N-472)+ 410.000
		1039 ≤N ≤1473	0.020*(N-1024)+ 451.010
		1536 ≤N ≤1715	0.025*(N-1536)+ 479.000
		1792 ≤N ≤2016	0.020*(N-1792)+ 479.000

Band	Link (Device)	Range	Frequency (MHz)
	Downlink (BS, forward link)	1 ≤N ≤400	0.025*(N-1)+ 460.000
		472 ≤N ≤871	0.025*(N-472)+ 420.000
		1039 ≤N ≤1473	0.020*(N-1024)+ 461.010
		1536 ≤N ≤1715	0.025*(N-1536)+ 489.000
		1792 ≤N ≤2016	0.020*(N-1792)+ 489.000
IMT-2000 Band	Uplink (MS, reverse link)	0 ≤N ≤1199	1920.000 + 0.050*N
	Downlink (BS, forward link)	0 ≤N ≤1199	2100.000 + 0.050*N
Upper 700 MHz Band	Uplink (MS, reverse link)	0 ≤N ≤240	776.000 + 0.050*N
	Downlink (BS, forward link)	0 ≤N ≤240	746.000 + 0.050*N
Secondary 800 MHz Band	Uplink (MS, reverse link)	0 ≤N ≤719	0.025*N+ 806.000
		720 ≤N ≤919	0.025*(N–720) + 896.000
	Downlink (BS, forward link)	0 ≤N ≤719	0.025*N+ 851.000
		720 ≤N ≤919	0.025*(N–720) + 935.000
2.5 GHz IMT Extension	Uplink (MS, reverse link)	0 ≤N ≤1399	2500.000 + 0.050*N
	Downlink (BS, forward link)	0 ≤N ≤1399	2620.000 + 0.050*N
US PCS 1.9 GHz	Uplink (MS, reverse link)	0 ≤N ≤1299	1850.000 + 0.050*N
	Downlink (BS, forward link)	0 ≤N ≤1299	1930.000 + 0.050*N
AWS	Uplink (MS, reverse link)	0 ≤N ≤899	1710.000 + 0.050*N
	Downlink (BS, forward link)	0 ≤N ≤899	2100.000 + 0.050*N
US 2.5 GHz	Uplink (MS, reverse link)	140 ≤N ≤1459	2495.000 + 0.050*N
	Downlink (BS, forward link)	140 ≤N ≤1459	2617.000 + 0.050*N
700 Public Safety	Uplink (MS, reverse link)	0 ≤N ≤240	787.000 + 0.050*N
	Downlink (BS, forward link)	0 ≤N ≤240	757.000 + 0.050*N
C2K Lower 700	Uplink (MS, reverse link)	0 ≤N ≤360	698.000 + 0.050*N
	Downlink (BS, forward link)	0 ≤N ≤360	728.000 + 0.050*N
400 Euro PAMR	Uplink (MS, reverse link)	1 ≤N ≤400	0.025*(N-1)+ 450.000
	Uplink (MS, reverse link)	472 ≤N ≤871	0.025*(N-472)+ 410.000
	Uplink (MS, reverse link)	1536 ≤N ≤1715	0.025*(N-1536)+ 479.000
	Downlink (BS, forward	1 ≤N ≤400	0.025*(N-1)+ 460.000

Band	Link (Device)	Range	Frequency (MHz)
	link)	472 ≤N ≤871	0.025*(N-472)+ 420.000
	Downlink (BS, forward link)	1536 ≤N ≤1715	0.025*(N-1536)+ 489.000
	Downlink (BS, forward link)		
800 PAMR	Uplink (MS, reverse link)	0 ≤N ≤239	870.0125 + 0.025*N
	Downlink (BS, forward link)	0 ≤N ≤239	915.0125 + 0.025*N

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 $N_{Offs\text{-}UL}$ 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}
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 –	1749.9	21800	21800 –

Band	Downlink			Uplink		
				4149		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.

TDSCDMA Channel Number Ranges

1.28 Mcps TDD Option

No TX-RX frequency separation is required as Time Division Duplex (TDD) is employed. Each subframe consists of 7 main timeslots where all main timeslots (at least the first one) before the single switching point are allocated DL and all main timeslots (at least the last one) after the single switching point are allocated UL.

The nominal channel spacing is 1.6 MHz, but this can be adjusted to optimize performance in a particular deployment scenario.

The carrier frequency is designated by the UTRA absolute radio frequency channel number (UARFCN). The value of the UARFCN in the IMT2000 band is defined in the general case as follows:

Nt = 5*F   0.0 MHz £ F£ 3276.6 MHz

where F is the carrier frequency in MHz

Additional channels applicable to operation in the frequency band defined in sub-clause 5.2(d) are defined via the following UARFCN definition:

Nt = 5 * (F – 2150.1 MHz)   2572.5 MHz £ F£ 2617.5 MHz

UARFCN

1.28 Mcps TDD Option

The following UARFCN range shall be supported for each band:

Frequency Band	Frequency Range	UARFCN Uplink and Downlink transmission
For operation in frequency band as defined in subclause 5.2 (a)	1900-1920 MHz 2010-2025 MHz	9504 to 9596 10054 to 10121
For operation in frequency band as defined in subclause 5.2 (b)	1850-1910 MHz 1930-1990 MHz	9254 to 9546 9654 to 9946
For operation in frequency band as defined in subclause 5.2 (c)	1910-1930 MHz	9554 to 9646
For operation in frequency band as defined in subclause 5.2 (d)	2570-2620 MHz	12854 to 13096
For operation in frequency band as defined in subclause 5.2 (e)	2300-2400 MHz	11504 to 11996
For operation in frequency band as defined in subclause 5.2 (f)	1880-1920 MHz	9404 to 9596

6.1.9.3 Radio Setup

The Radio Standard dialog allows you to select the radio standard and associated radio band. You can also set the Radio Band Link to Uplink or Downlink.

Radio Standard/Radio Band

The Radio Standard/Radio Band dialog allows you to select the radio standard and associated radio band. The first column of the dialog lets you set the Radio Standard; for each standard, the second column of 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 577 control to set Channel numbers, thus setting the "Frequency" on page 575 automatically.

Remote Command	`:SOURce:FREQuency:CHANnels:BAND 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	Set this setting to "NONE" will grey out "Channel" on page 577 in the Frequency Setup menu

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

CDMA2000 - Sets CDMA 2000 / 1XEVDO as the radio standard for use and accesses the CDMA 2000/1xEVDO specific channel band sub-menus.

US Cell	:SOUR:FREQ:CHAN:BAND USCELL
US PCS	:SOUR:FREQ:CHAN:BAND PCS
Japan Cell	:SOUR:FREQ:CHAN:BAND JAPAN
Korean PCS	:SOUR:FREQ:CHAN:BAND KOREAN
NMT 450	:SOUR:FREQ:CHAN:BAND NMT
IMT 2000	:SOUR:FREQ:CHAN:BAND IMT2K
Upper 700	:SOUR:FREQ:CHAN:BAND UPPER
Secondary 800	:SOUR:FREQ:CHAN:BAND SECOND
400 Euro PAMR	:SOUR:FREQ:CHAN:BAND PAMR400
800 PAMR	:SOUR:FREQ:CHAN:BAND PAMR800
2.5 GHz IMT EXT	:SOUR:FREQ:CHAN:BAND IMTEXT
US PCS 1.9 GHz	:SOUR:FREQ:CHAN:BAND PCS1DOT9G
AWS	:SOUR:FREQ:CHAN:BAND AWS
US 2.5 GHz	:SOUR:FREQ:CHAN:BAND US2DOT5G
700 Public Safety	:SOUR:FREQ:CHAN:BAND PUBLIC
C2K Lower 700	:SOUR:FREQ:CHAN:BAND LOWER

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`

TDSCDMA - Sets TDSCDMA as the radio standard for use and accesses the TDSCDMA specific channel band sub-menus.

Band A	`:SOUR:FREQ:CHAN:BAND BANDA`
Band B	`:SOUR:FREQ:CHAN:BAND BANDB`
Band C	`:SOUR:FREQ:CHAN:BAND BANDC`
Band D	`:SOUR:FREQ:CHAN:BAND BANDD`
Band E	`:SOUR:FREQ:CHAN:BAND BANDE`
Band F	`:SOUR:FREQ:CHAN:BAND BANDF`

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

Allows you to 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”, the source will calculate the uplink frequency using an uplink formula together with the selected channel band and channel number . When set to “Downlink”, the source will calculate 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	BTS maps to the Downlink frequency MS maps to the Uplink frequency

6.1.9.4 Set Reference Frequency

This key allows you to set the frequency reference. Pressing this key 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 set to ON with a reference value set, entering a value under Source>Frequency>Frequency and pressing Set Frequency Reference will add 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 you must set Freq Reference to OFF and then press Set Frequency Reference.

Remote Command	:SOURce:FREQuency:REFerence:SET
Example	:SOUR:FREQ:REF:SET
Dependencies	This setting is unavailable, and is grayed out when the List Sequencer is turned ON.

6.1.9.5 Freq Reference

This key allows you to 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 refer to "Set Reference Frequency" on page 591

Remote Command	`:SOURce:FREQuency:REFerence <freq>`
	`:SOURce:FREQuency:REFerence?`
	`:SOURce:FREQuency:REFerence:STATe OFF | ON | 0 | 1`
	`:SOURce:FREQuency:REFerence:STATe?`

Example	`:SOUR:FREQ:REF 0.00 Hz` `:SOUR:FREQ:REF:STATe ON`
Dependencies	This setting is unavailable, and is grayed out when the List Sequencer is turned 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 OFF
Min	0.00 Hz
Max	Hardware Dependent: – Option 503 = 3.6 GHz – Option 504 = 3.8 GHz – Option 506 = 6.00 GHz For E7760: Dependent on port selected

6.1.9.6 Freq Offset

Allows you to 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 to the user.

When the frequency offset is set to zero (0) and you set a new offset value, the displayed frequency value will change as follows and the RF output frequency will 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	This setting is unavailable, and is grayed out when the List Sequencer is turned ON.
Preset	0 Hz
Min	-100.00 GHz
Max	100.00 GHz

6.1.9.7 Freq Increment

Freq Increment Setchanges 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 E7760: 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, UI will report an error message called “Settings conflict; Frequency is outside available range”.

6.1.9.8 Rx/Tx Coupling

Rx/Tx Frequency Coupling allows coupling between the frequency of the Internal Source, RF Output Frequency, and the frequency of the Analyzer, Center Frequency. With all the settings except None, this parameter will couple the Center Frequency of the Analyzer to the RF Output Frequency of the source. Valid setting changes will result in Analyzer CF and RF Output Frequency parameter being set to the same value plus the "Rx/Tx Offset" on page 595.

The four states for coupling are;

1. 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

2. 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.

3. 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.

4. 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`
Notes	Selections are; – NONE: None – BOTH: Analyzer/Source coupled – SFANalyzer: Source follows Analyzer AFSource: Analyzer follows Source
Dependencies	Only appears in the Radio Test Mode
Preset	None (Input/Output Preset)
State Saved	Yes

6.1.9.9 Rx/Tx Offset

Rx/Tx Frequency Coupling Offset allows the user to offset the RF Output Frequency of the source from the Center Frequency of the analyzer. See "Rx/Tx Coupling" on page 594"Rx/Tx Coupling" on page 594 for coupling behavior.

Remote Command	`:SOURce:FREQuency:COUPling:OFFSet <freq>` `:SOURce:FREQuency:COUPling:OFFSet?`
Example	`:SOUR:FREQ:COUP:OFF 100 kHz`
Notes	The offset between Tx and Rx should always be this value. In order to achieve this the following algorithm will be used; RF Output Frequency = Center Frequency + Rx/Tx Frequency Coupling Offset
Dependencies	Coupled to Rx/Tx Coupling. When Rx/Tx Coupling is set to None this parameter is grayed out. If the grayed out control is selected the following message will be shown; “The parameter cannot be changed when Rx/Tx Coupling is Off” Only appears in the 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 E7760: 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 will report an error message called "Settings conflict; Frequency is outside available range".

6.1.10 Modulation

Allows you to toggle the state of the 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 550. If the "Sequencer" on page 551 is set to ON, the list sequencer controls the source output and this key is grayed-out. When the"Sequencer" on page 551 is set to Off, will make source leave list sequencer and this setting will be blanked out, taking effect immediately When the Modulation is ON, the "MOD" annunciator is displayed in the system settings panel. When the Modulation is turned Off, the "MOD" annunciator is cleared. If the"Sequencer" on page 551 is set to 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.

This control is not available on E7760.

AM/FM/PM are not available for VXT model M9415A.

6.1.11.1 AM

Enables or disables the amplitude modulation.

Turning AM on 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:AM:STATe ON | OFF | 1 | 0` `:SOURce:AM:STATe?`
Example	`:SOUR:AM:STAT OFF`
Dependencies	This control is not available in E7760.
Preset	Off
Range	On | Off

6.1.11.2 AM Mod Depth

Allows you to set the amplitude modulation depth in percent.

Remote Command	`:SOURce:AM[:DEPTh][:LINear] <real>` `:SOURce:AM[:DEPTh][:LINear]?`
Example	`:SOUR:AM 0.1`
Dependencies	This control is not available in E7760.
Preset	0.1 %
Min	0.1 %
Max	95.0 %

6.1.11.3 AM Rate

Allows you to 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	This control is not available in E7760.
Preset	400.0 Hz
Min	10 Hz
Max	40 kHz

6.1.11.4 AM Rate Increment

AM Rate Increment changes the step size for the AM Rate function. Once an increment size has been selected and the AM Rate function is active, the step keys (and the UP|DOWN parameters for AM Rate from remote commands) change the 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 the frequency modulation.

Turning FM on 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	This control is not available in E7760.
Preset	Off
Range	On | Off

6.1.11.6 FM Deviation

Allows you to set the frequency modulation deviation.

Remote Command	`:SOURce:FM[:DEViation] <freq>` `:SOURce:FM[:DEViation]?`
Example	`:SOUR:FM 1.00 kHz`
Dependencies	This control is not available in E7760.
Preset	1.00 Hz
Min	1.00 Hz
Max	100.00 kHz

6.1.11.7 FM Rate

Allows you to 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	This control is not available in E7760.
Preset	400.0 Hz
Min	10 Hz
Max	40 kHz

6.1.11.8 FM Rate Increment

FM Rate Increment changes the step size for the FM Rate function. Once an increment size has been selected and the FM Rate function is active, the step keys (and the UP|DOWN parameters for FM Rate from remote commands) change the 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 the phase modulation.

Turning PM on 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	This control is not available in E7760.
Preset	Off
Range	On | Off

6.1.11.10 PM Deviation

Allows you to set the phase modulation deviation in radian.

Remote Command	:SOURce:PM[:DEViation] <real> :SOURce:PM[:DEViation]?
Example	:SOUR:PM 1.00
Dependencies	This control is not available in E7760.
Preset	0.1 rad
Min	0.1 rad
Max	20.0 rad

6.1.11.11 PM Rate

Allows you to 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	This control is not available in E7760.
Preset	400.0 Hz
Min	10 Hz
Max	40 kHz

6.1.11.12 PM Rate Increment

PM Rate Increment changes the step size for the PM Rate function. Once an increment size has been selected and the PM Rate function is active, the step keys (and the UP|DOWN parameters for PM Rate from remote commands) change the 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

Allows access to the menus for setting up the Arbitrary Waveform Generator

Basic Control

The Basic Control index tab lets you set up the basic ARB parameters and select a waveform to play.

ARB State

Allows you to 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 turned 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 the ARB is ON, a user then loads or deletes 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 the "List Sequencer" on page 550. If the "Sequencer" on page 551 is set to 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 set "Sequencer" on page 551 to OFF will make source leave list sequencer and this setting will take 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. “- When 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

Allows you to set the ARB waveform playback sample rate.

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 E7760, the Sample Rate is fixed. If this control is attempted to be set the error -221.1955, “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	125.00 MHz, unless noted below
	– E7760A:
	  – 2.64 GHz
	– Option B40:
	  – 50 MHz
	– VXT models M9420A/21A with Option B85:
	100 MHz

Min	1.00 kHz, except as noted below – E7760A: 2.64 GHz

Max	Hardware Dependent:
	– E7760A:
	  – 2.64 GHz
	– VXT models M9420A/21A:
	  – Option B40: 50 MHz
	  – Option B85: 100 MHz
	  – Option B1X: 200 MHz
	– VXT models M9410A/11A:
	  – Option B40: 50 MHz
	  – Option B3X: 375 MHz
	  – Option B6X: 750 MHz
	  – Option B12: 1.5 GHz

Run-Time Scaling

Allows you to 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	This setting cannot be set in EXM and VXT. Grey out on 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

The Baseband Freq Offset control allows you to 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. This control is not available in E7760.
Preset	0.00 Hz
Min	-50.00 MHz
Max	50.00 MHz

Baseband Power

The Baseband Power control allows you to 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 to 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 will be -14 dBm. This control can be used to change the output level very quickly compared to the RF Power.
Dependencies	This control only appears in VXT models M9410A/11A.
Preset	0 dB
Min	-50 dB
Max	20 dB

Mkr 1 Polarity

Allows you to set the polarity of marker 1.

Remote Command	`:SOURce:RADio:ARB:MPOLarity:MARKer1 POSitive | NEGative` `:SOURce:RADio:ARB:MPOLarity:MARKer1?`
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. This control is not available in E7760.
Preset	Pos
Range	Neg | Pos

Mkr 2 Polarity

Allows you to set the polarity of marker 2.

Remote Command	`:SOURce:RADio:ARB:MPOLarity:MARKer2 POSitive | NEGative` `:SOURce:RADio:ARB:MPOLarity:MARKer2?`
Example	`:SOUR:RAD:ARB:MPOL:MARK2 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. This control is not available in E7760.
Preset	Pos
Range	Neg | Pos

Mkr 3 Polarity

Allows you to set the polarity of marker 3.

Remote Command	`:SOURce:RADio:ARB:MPOLarity:MARKer3 POSitive | NEGative` `:SOURce:RADio:ARB:MPOLarity:MARKer3?`
Example	`:SOUR:RAD:ARB:MPOL:MARK3 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. This control is not available in E7760.
Preset	Pos
Range	Neg | Pos

Mkr 4 Polarity

Allows you to set the polarity of marker 4.

Remote Command	`:SOURce:RADio:ARB:MPOLarity:MARKer4 POSitive | NEGative` `:SOURce:RADio:ARB:MPOLarity:MARKer4?`
Example	`:SOUR:RAD:ARB:MPOL:MARK4 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. This control is not available in E7760.
Preset	Pos
Range	Neg | Pos

Pulse/RF Blank

Allows you to select which marker is used for the pulse/RF blanking function. The pulse/RF blanking 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.

See "More Information" on page 606

Remote Command	`:SOURce:RADio:ARB:MDEStination:PULSe NONE | M1 | M2 | M3 | M4` `: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 blanking 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 blanking setting is updated with the value from the header file. The pulse/RF blanking setting will remain unchanged if the newly selected waveform does not have an associated header file.
Range	None | M1 | M2 | M3 | M4

More Information

Parameter	SCPI Example	Notes
None	:SOUR:RAD:ARB:MDES:PULS NONE	Sets no marker to be used for the pulse/RF blanking function, essentially turning the RF blanking function off.
Marker 1	:SOUR:RAD:ARB:MDES:PULS M1	Sets marker 1 to be used for the pulse/RF blanking function.
Marker 2	:SOUR:RAD:ARB:MDES:PULS M2	Sets marker 2 to be used for the pulse/RF blanking function.
Marker 3	:SOUR:RAD:ARB:MDES:PULS M3	Sets marker 3 to be used for the pulse/RF blanking function.
Marker 4	:SOUR:RAD:ARB:MDES:PULS M4	Sets marker 4 to be used for the pulse/RF blanking function.

ALC Hold

Allows you to specify which marker is routed for use within the ALC hold function. The ALC hold marker function holds the ALC circuitry at the average value of the sample points set by the marker.

The ALC hold function 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.

See "More Information" on page 606

Remote Command	:SOURce:RADio:ARB:MDEStination:ALCHold NONE | M1 | M2 | M3 | M4 :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 will remain unchanged if the newly selected waveform does not have an associated header file. This control is not available in E7760 and VXT models M9410A/11A
Range	None | M1 | M2 | M3 | M4

More Information

None	:SOUR:RAD:ARB:MDES:PULS NONE	Sets no marker to be used for the ALC hold function, essentially turning the ALC hold function off.

Marker 1	`:SOUR:RAD:ARB:MDES:PULS M1`	Sets marker 1 to be used for the ALC hold function.
Marker 2	`:SOUR:RAD:ARB:MDES:PULS M2`	Sets marker 2 to be used for the ALC hold function.
Marker 3	`:SOUR:RAD:ARB:MDES:PULS M3`	Sets marker 3 to be used for the ALC hold function.
Marker 4	`:SOUR:RAD:ARB:MDES:PULS M4`	Sets marker 4 to be used for the ALC hold function.

Trigger Type

The setting for 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?`
Notes	Gated trigger type will be implemented at a later release
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 key allows access to the continuous trigger type setup menu. In Continuous trigger mode, the waveform repeats continuously.

See "More Information" on page 607

Remote Command	`:SOURce:RADio:ARB:TRIGger:TYPE:CONTinuous[:TYPE] FREE | TRIGger | RESet` `:SOURce:RADio:ARB:TRIGger:TYPE:CONTinuous[:TYPE]?`
Example	`:SOUR:RAD:ARB:TRIG:TYPE:CONT FREE`
Preset	FREE
Range	Free Run | Trigger + Run | Reset + Run

More Information

Parameter	SCPI Example	Notes
Free Run	`:SOUR:RAD:ARB:TRIG:TYPE:CONT FREE`	Selects Free Run as the trigger response for the continuous trigger

Parameter	SCPI Example	Notes
		type. Free Run 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	:SOUR:RAD:ARB:TRIG:TYPE:CONT TRIG	Sets Trigger and Run as the trigger response for the continuous trigger type. Trigger and Run 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	:SOUR:RAD:ARB:TRIG:TYPE:CONT RES	Sets Reset and Run as the trigger response for the continuous trigger type. Reset and Run 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 key allows access to the single trigger type setup menu. In Single trigger mode, the waveform plays once.

See "More Information" on page 609

Remote Command	:SOURce:RADio:ARB:RETRigger ON | OFF | IMMediate :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 will return OFF instead of 0, and ON instead of 1.
Preset	ON

More Information

Parameter	SCPI Example	Notes
No Retrigger	:SOUR:RAD:ARB:RETR OFF	Selects No Retrigger as the trigger response for single trigger type. No Retrigger 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	:SOUR:RAD:ARB:RETR ON	Selects Buffered Trigger as the trigger response for single trigger type. Buffered Trigger 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	:SOUR:RAD:ARB:RETR IMM	Selects Restart on Trigger as the trigger response for single trigger type. Restart on Trigger 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 key 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.

See "More Information" on page 610

Remote Command	:SOURce:RADio:ARB:TRIGger:TYPE:SADVance[:TYPE] SINGle | CONTinuous :SOURce:RADio:ARB:TRIGger:TYPE:SADVance[:TYPE]?
Example	:SOUR:RAD:ARB:TRIG:TYPE:SADV SING

Dependencies	This control is not available in E7760.
Preset	CONTinuous
Range	Single | Continuous

More Information

Parameter	SCPI Example	Notes
Single	:SOUR:RAD:ARB:TRIG:TYPE:SADV SING	Selects Single as the trigger response for Segment Advance trigger type. With single selected, 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	:SOUR:RAD:ARB:TRIG:TYPE:SADV CONT	Selects Continuous as the trigger response for Segment Advance trigger type. With continuous selected, 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	No remote command, front panel only.	Used to initiate an immediate trigger event if the trigger source is set to Trigger Key.

Trigger Source

The trigger source setting determines how the source receives the trigger that starts the waveform playing. Therefore, this control is grayed out if the trigger type 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 :SOURce:RADio:ARB:TRIGger[:SOURce]?
Example	:SOUR:RAD:ARB:TRIGger KEY
Notes	For E7760 the available selections are KEY|BUS
Dependencies	This key is grayed out if the current trigger type is Continuous, Free Run.
Preset	EXTernal2 For E7760: BUS
Range	Key | Bus | External1 | External 2 | PXI

More Information

Parameter	SCPI Example	Notes
Key	`:SOUR:RAD:ARB:TRIG KEY`	Sets the current trigger source to the front panel Trigger key. When Trigger Key is selected, the waveform is triggered when you press the front panel Trigger key
Bus	`:SOUR:RAD:ARB:TRIGger BUS`	Sets the current trigger source to Bus. Selecting Bus trigger source enables triggering over GPIB, LAN, or USB using the :SOURce:RADio:ARB:TRIGger:INITiate command
External 1	`:SOUR:RAD:ARB:TRIG EXT1`	Sets the current trigger source to External 1. Selecting External 1 enables triggering a waveform by an externally applied signal
External 2	`:SOUR:RAD:ARB:TRIG EXT2`	Sets the current trigger source to External 2. Selecting External 2 enables triggering a waveform by an externally applied signal 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
PXI	`:SOUR:RAD:ARB:TRIG PXI`	Sets the current trigger source to PXI. Selecting PXI enables triggering a waveform by a PXI backplane Line applied signal

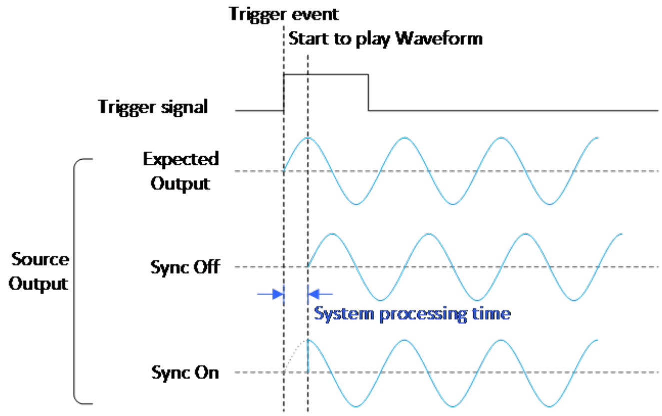
Bus Trigger Command (Remote Command Only)

Used to initiate an immediate trigger event if the trigger source 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 you the behavior of turn on and turn off 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	This control compensates the instrument internal latency. The negative trigger delay compensates the external latency (i.e. heads and cables), refer to External Trigger Delay and PXI Trigger Delay The first PerARB trigger will be cut off when Sync to Trigger Source is On.
Dependencies	Only available when Trigger Source is External or PXI trigger
Preset	Off
Range	On | Off

External Trigger Delay

This key allows you to 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. This key is only active if you select external trigger as trigger source. Negative trigger delay is only supported by VXT models M9410A/11A/15A, see More Information.

Remote Command	`:SOURce:RADio:ARB:TRIGger[:SOURce]:EXTernal:DELay <time>`
	`:SOURce:RADio:ARB:TRIGger[:SOURce]:EXTernal:DELay?`
	`:SOURce:RADio:ARB:TRIGger[:SOURce]:EXTernal:DELay:STATe OFF | ON | 0 | 1`
	`:SOURce:RADio:ARB:TRIGger[:SOURce]:EXTernal:DELay:STATe?`

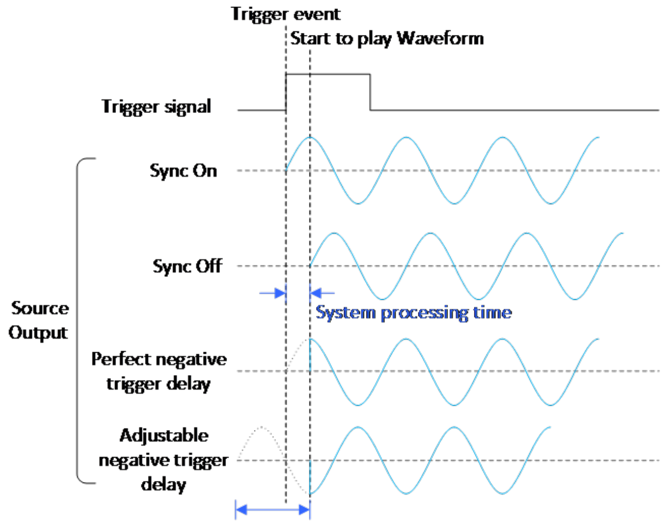
Example	`:SOUR:RAD:ARB:TRIG:EXT:DEL 100ns`

	`:SOUR:RAD:ARB:TRIG:EXT:DEL?`
	`:SOUR:RAD:ARB:TRIG:EXT:DEL:STAT ON`
	`:SOUR:RAD:ARB:TRIG:EXT:DEL:STAT?`

Notes	External trigger delay time set by users will be rounded to the nearest integer multiple of the resolution.
Dependencies	This setting is unavailable and is grayed out when the Trigger Source is not set to external trigger. This control is not available in E7760.
Preset	1 ms OFF
Min	VXT models M9410A/11A/15A: -10 s
Max	8.589934588 s (Note: This value comes from 4ns * (2^31 – 1) = 8589934588 ns) VXT models M9410A/11A: 11.45324612 s, this value comes from 2.666667ns *(2^32-1). For “Continuous – Trigger + Run” trigger : 11.45324612 s, this value comes from 2.666667ns *(2^32-1). Other trigger conditions: 17.17986918 s, this value comes from 4 ns *(2^32-1).

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

This key 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. This key is active only if you select external trigger as trigger source.

Remote Command	`:SOURce:RADio:ARB:TRIGger[:SOURce]:EXTernal:SLOPe POSitive | NEGative` `:SOURce:RADio:ARB:TRIGger[:SOURce]:EXTernal:SLOPe?`
Example	`:SOUR:RAD:ARB:TRIGger:EXT:SLOP POS` `:SOUR:RAD:ARB:TRIGger:EXT:SLOP?`
Dependencies	This setting is unavailable and is grayed out when the Trigger Source is not set to external trigger. This control is not available in E7760.
Preset	Pos
Range	Pos | Neg

Select PXI Line

Controls which PXI_TRIG[0..7] backplane line is used for the trigger source.

This control is only found in the 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:LIN 2`
Dependencies	This setting is unavailable and is grayed out when the "Trigger Source" on page 610 is not set to PXI trigger. This control is not available in E7760.
Preset	0
State Saved	Saved in instrument state
Range	[0,7]

PXI Trigger Delay

This key allows you to 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. This key is only active if you select PXI trigger as trigger source.

Remote Command	`:SOURce:RADio:ARB:TRIGger[:SOURce]:PXI:DELay <time>`
	`:SOURce:RADio:ARB:TRIGger[:SOURce]:PXI:DELay?`
	`: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 100ns`
	`:SOUR:RAD:ARB:TRIG:PXI:DEL?`
	`:SOUR:RAD:ARB:TRIG:PXI:DEL:STAT ON`
	`:SOUR:RAD:ARB:TRIG:PXI:DEL:STAT?`

Notes	PXI trigger delay time set by users will be rounded to the nearest integer multiple of the resolution.
Dependencies	This setting is unavailable and is grayed out when the "Trigger Source" on page 610 is not set to PXI trigger. This control is not available in E7760.
Preset	1 ms OFF
Min	VXT models M9410A/11A/15A: -10 s
Max	8.589934588 s (Note: This value comes from 4ns * (2^31 – 1) = 8589934588 ns) VXT models M9410A/11A: 11.45324612 s, this value comes from 2.666667ns *(2^32-1). For "Continuous – Trigger + Run" trigger : 11.45324612 s, this value comes from 2.666667ns *(2^32-1). Other trigger conditions: 17.17986918 s, this value comes from 4 ns *(2^32-1).

PXI Trigger Polarity

This key 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. This key is active only if you select PXI trigger as trigger source.

Remote Command	`:SOURce:RADio:ARB:TRIGger[:SOURce]:PXI:SLOPe POSitive | NEGative` `:SOURce:RADio:ARB:TRIGger[:SOURce]:PXI:SLOPe?`
Example	`:SOUR:RAD:ARB:TRIGger:PXI:SLOP POS` `:SOUR:RAD:ARB:TRIGger:PXI:SLOP?`
Dependencies	This setting is unavailable and is grayed out when the "Trigger Source" on page 610 is not set to PXI trigger. This control is not available in E7760.
Preset	Pos
Range	Pos | Neg

I/Q Adjustments

This command enables or disables the I/Q adjustments.

Remote Command	`:SOURce:RADio:ARB:IQADjustment:[STATe] OFF | ON | 0 | 1` `:SOURce:RADio:ARB:IQADjustment:[STATe]?`
Example	`:SOURce:RADio:ARB:IQADjustment:[STATe] ON` `:SOURce:RADio:ARB:IQADjustment:[STATe]?`
Dependencies	This control is not available in E7760.
Preset	OFF

I/Q Gain

Allows you to 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	`:SOURce:RADio:ARB:IQADjustment:GAIN 0.5` `:SOURce:RADio:ARB:IQADjustment:GAIN?`
Notes	This command is effective only if the state of the I/Q adjustment function is set to ON.

Dependencies	This setting is unavailable and is grayed out when the ARB state is off. This control is not available in E7760.
Preset	+0.00000000E+000
Min	-1 dB
Max	1 dB

I/Q Delay

This command enables you to 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	`:SOURce:RADio:ARB:IQADjustment:DELay 10ps` `:SOURce:RADio:ARB:IQADjustment:DELay?`
Notes	IQ delay time set by users will be rounded to the nearest integer multiple of the resolution.
Dependencies	This setting is unavailable and is grayed out when the ARB state is off. This control is not available in E7760.
Preset	+0.00000000E+000
Min	-250ns
Max	250ns

RMS

Allows you to directly specify current RMS value used to playback currently selected waveform. Please note incorrect RMS value may cause inaccurate power output in EXM 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 invoking "Save Header" on page 638.

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 will be clipped to the closest boundary.

	Note this value does not affect Source List Sequencer, which will always use the RMS value included in each ARB header. If this setting is to take effect in List Sequencer, use "Save Header" on page 638 "Save Setup to Header" 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 the "Calculate" button will also update this setting.
Preset	0
Range	0 ~ 1.414

RMS Calculation Mode

Allows you to specify the mode to calculate the current RMS. See "More Information" on page 618

Remote Command	`:SOURce:RADio:ARB:RMS:CALCulation:MODE AUTO | M1 | M2 | M3 | M4` `: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 will grey out.
Preset	AUTO
Range	AUTO | M1 | M2 | M3 | M4

More Information

Parameter	SCPI Example	Notes
Auto	`:SOUR:RAD:ARB:RMS:CALC:MODE AUTO`	In Auto, RMS will be calculated based on the whole sample range of the currently selected waveform.
Marker 1	`:SOUR:RAD:ARB:RMS:CALC:MODE M1`	Selects marker 1 to designate sample range used for RMS calculation.
Marker 2	`:SOUR:RAD:ARB:RMS:CALC:MODE M2`	Selects marker 2 to designate sample range used for RMS calculation.
Marker 3	`:SOUR:RAD:ARB:RMS:CALC:MODE M3`	Selects marker 3 to designate sample range used for RMS calculation.
Marker 4	`:SOUR:RAD:ARB:RMS:CALC:MODE M4`	Selects marker 4 to designate sample range used for RMS calculation.

Calculate

Allows you to calculate current RMS based on mode selected. This will update the setting in the "RMS" on page 617 control.

Remote Command	`:SOURce:RADio:ARB:RMS:CALCulate`
Example	`:SOUR:RAD:ARB:RMS:CALC`
Notes	If no waveform is selected, invoking this operation will get error "-221 Setting conflict; No waveform is selected for RMS operation". If no waveform is selected, or selected waveform is waveform sequence, the key will grey out. If selected waveform does not contain marker data, but "RMS Calculation Mode" on page 618 "RMS Calculation Mode" is set to marker, under this circumstance, invoking calculation operation will get 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 618 "RMS Calculation Mode" will be coupled to "Auto" mode automatically. RMS calculation does not suit for waveform sequence. If selected waveform is waveform sequence file, invoking this operation will get error "-221 Setting conflict; RMS calculation does not apply to waveform sequence". But users can still edit current RMS as play parameter, and can save current RMS to waveform sequence header for later use.

Use Header RMS

Allows you to quickly set RMS to value in ARB header. This will update the setting in the "RMS" on page 617 control.

Notes	No remote command, front panel only. If no waveform is selected, the key grays out. If no waveform is selected, invoking this operation generates error "-221 Setting conflict; No waveform is selected for RMS operation".

Select Waveform

The waveform file selection view allows the user to select a waveform segment or sequence to be played by the ARB player. It presents the user 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 E7760.

Waveforms formatted in *.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 intended waveform is not in the memory yet, then issuing this command by SCPI will invoke ARB loading operation first, which involves a delay of unpredictable length. So this command should be followed by the query *OPC?, which holds off subsequent commands until the loading operating is complete. <string> - specifies the name of the waveform segment or waveform sequence to be played by the ARB. When in Sequence Analyzer mode, and Include Source is Yes, if you attempt to play a waveform sequence but not all the required waveform segments are in the ARB playback memory, the application will reject the loading operation and an error is generated . When Include Source is No, if 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 of 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 the 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 over 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 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 will be replayed after the ARB operation is finished.

Segments in ARB Memory

This table shows you which files are loaded into the ARB memory and lets you select a file for playback.

Recall Waveform

Takes you to the Recall Waveform dialog. This is the same as Recall From File in the Recall, "Waveform" on page 897 dialog.

Delete Segment From ARB Mem

Deletes a segment from ARB memory. This is the same as "Delete Segment From ARB Mem" on page 901 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" on page 901 in the Recall, Waveform dialog.

OK

Pressing **OK** inserts the currently highlighted waveform at the end of the waveform sequence, and returns you to the Edit Sequence dialog.

Cancel

Pressing **Cancel** discards any changes, and returns you to the Build New Sequence dialog.

Query ARB Memory File List (Remote Command Only)

Queries the test set for the list of waveform segments in the ARB memory.

NOTE

This command 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 Command Only)" on page 902, "Query ARB Memory Full File List (Remote Command Only)" on page 902.

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

Query ARB Memory Full File List (Remote Command Only)

Queries the test set for the string list of waveform segments in the ARB memory. It 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"

Waveform Sequences

This tab is not available in E7760.

The Waveform Sequences tab 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

This dialog 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

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 625 to insert a waveform.

Repetitions

This field in the table allows you to specify the number of times the currently selected waveform is played within the sequence.

Notes	No remote command, SCPIfront panel only.
Preset	1
Min	1
Max	65535

Marker 1

This field in the table allows you to enable or disable marker 1 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

Marker 2

This field in the table allows you to enable or disable marker 2 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

Marker 3

This field in the table allows you to enable or disable marker 3 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

Marker 4

This field in the table allows you to enable or disable marker 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

Changing this setting to enable/disable the function of saving 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	`:SOURce:RADio:ARB:SEQuence:SYNC Off`
Notes	This setting is just available on primary module. 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 primary module, and primary sequence file name should end with xxx0.seq, so secondary module will be named accordingly following below naming rule. Besides, waveform name in sequence file should also follow the following naming rule. <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. </Naming Rule>
Dependencies	This control is not available in E7760.

Preset	Off
Range	On | Off

Insert Waveform

This dialog page allows you to 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" on page 901 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" on page 901 in the Recall, Waveform dialog.

OK

Pressing **OK** inserts the currently highlighted waveform at the end of the waveform sequence, and returns you to the Edit Sequence dialog.

Cancel

Pressing **Cancel** discards any changes, and returns you to the Build New Sequence dialog.

Delete Segment

Allows you to delete the selected segment from the waveform sequence.

Notes	No remote command, front panel only.

Save Sequence

Allows you to save the newly built Waveform Sequence to HDD.

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.

Notes	No remote command, front panel only.

Build New Sequence (Remote Command Only)

This command is the SCPI equivalent of the waveform sequence creation features described in "Build New Sequence" on page 622.

This command 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 Command	`:SOURce:RADio:ARB:SEQuence[:MWAVeform] <filename>, <waveform1>, <reps>, NONE | 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 Notes below For Setup SCPI“For Setup SCPI”.) `:SOURce:RADio:ARB:SEQuence[:MWAVeform]? <filename>` (For additional description of each item, see Notes For Query SCPI 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 625 to insert a waveform.

Repetitions

This field in the table allows you to specify the number of times the currently selected waveform is played within the sequence.

Notes	No remote command, SCPIfront panel only.
Preset	1
Min	1
Max	TBD

Marker 1

This field in the table allows you to enable or disable marker 1 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

Marker 2

This field in the table allows you to enable or disable marker 2 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

Marker 3

This field in the table allows you to enable or disable marker 3 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

Marker 4

This field in the table allows you to enable or disable marker 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

Changing 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	`:SOURce:RADio:ARB:SEQuence:SYNC On | Off` `:SOURce:RADio:ARB:SEQuence:SYNC?`
Example	`:SOURce:RADio:ARB:SEQuence:SYNC Off`
Notes	This setting is just available on primary module. If this setting is ON, when Sync Config is not NONE, the responding secondary modules' waveform sequence file will be saved accordingly when save sequence... on Primary module, and primary sequence file name should end with xxx0.seq, so secondary module will be named accordingly following below naming rule. Besides, waveform name in sequence file should also follow the below naming rule. <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. </Naming Rule>
Preset	Off
Range	On | Off

Insert Waveform

This dialog page allows you to 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" on page 901 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" on page 901 in the **Recall**, **Waveform** dialog.

OK

Pressing **OK** inserts the currently highlighted waveform at the end of the waveform sequences and returns you to the **Edit Sequence** dialog

Cancel

Pressing **Cancel** discards any changes, and returns you to the **Edit Sequence** dialog.

Delete Segment

Allows you to delete the current segment from the waveform sequence.

Notes	No remote command, front panel only.

Waveform Utilities

This control is not available in E7760.

This tab is only available if there is at least one Multi-pack license installed on the instrument.

On modular instrument like EXM , multi-pack license operations are only allowed on the default module, i.e., “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** 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 SCPI :SYSTem:LICense[:FPACk]:WAVeform:ADD is provided to be consistent with the style of Keysight signal sources. You can use either one of them. 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 will grey 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	This key is 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. If the waveform highlighted is a secure waveform, but is already licensed, this key will be unavailable.

OK

Pressing **OK** adds the currently highlighted waveform to the next available slot, and returns you to the Waveform Utilities dialog.

Cancel

Pressing **Cancel** discards any changes, and returns you to the Waveform Utilities dialog.

Replace Selected Waveform

This dialog allows you to 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 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 SCPI :SYSTem:LICense[:FPACk]:WAVeform:REPLace is provided to be consistent with the style of Keysight signal sources. You can use either one of them. 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 will grey 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.

OK

Pressing **OK** replaces the waveform in the currently selected slot with that currently highlighted, and returns you to the Waveform Utilities dialog.

Cancel

Pressing **Cancel** discards any changes, and returns you to the Waveform Utilities dialog.

Clear Waveform from Slot

Allows you to 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 SCPI :SYSTem:LICense[:FPACk]:WAVeform:CLEar is provided to be consistent with the style of Keysight signal sources. You can use either one of them. 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 will grey 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	This key is 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 second SCPI :SYSTem:LICense[:FPACk]:WAVeform:LOCK is provided to be consistent with the style of Keysight signal sources. You can use either one of them. 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 will grey 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	This key is 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 second SCPI :SYSTem:LICense[:FPACk]:WAVeform:STATus is provided to be consistent with the style of Keysight signal sources. You can use either one of them. Waveform slot number <int> is positive. If you attempt to input a slot number less than or equals 0, an error is generated. Result type is string. If input slot number exceeds total available slot number, "Nonexistent" is returned.
Range	"Locked" | "Available" | "Trail" | "LockRequired" | "Nonexistent"

Slots Free Query (Remote Command 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 SCPI :SYSTem:LICense[:FPACk]:WAVeform:FREE is provided to be consistent with the style of Keysight signal sources. You can use either one of them.

Slot Used Query (Remote Command 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 SCPI :SYSTem:LICense[:FPACk]:WAVeform:USED is provided to be consistent with the style of Keysight signal sources. You can use either one of them.

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 equals 0, an error is generated. Result type is string. If input slot number exceeds total available slot number, “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 equals 0, an error is generated. Result type is string. If input slot number exceeds total available slot number, “Nonexistent” is returned. Only Signal Studio waveform has unique ID, which is a positive number. (User generated waveform has no unique ID). If no waveform stored in the specified slot, then “0” is returned

Locked Waveform Name List Query (Remote Command 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 Command 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. So if the unique ids are same, that means they are same one waveform. So besides SCPI to query locked waveform name list, also provide a SCPI to query locked waveform unique id list

Multi-Pack License multi-module control state (Remote Command Only)

When the state is set to on, multi-pack license operations (like adding/locking/replacinwaveform etc.) from TRXs other than TRX1 are allowed. If the state is set to 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	This command is only effective in modular based OBT, like 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	This key is only available if there is currently a waveform selected for playback. If no waveform is selected, the key is grayed out.

Clear Header

Allows you to 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 will generate an error.

Save Header

Allows you to 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 will generate an error.

Query Waveform Unique ID (Remote Command 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. This is a SCPI only command.

Remote Command	`:MMEMory:HEADer:ID? “<file name>”`

Example	`:MMEM:HEAD:ID? “test.wfm”`
	(query the waveform already loaded into the ARB memory)
	`:MMEM:HEAD:ID? “D:\NVARB\test.wfm”`
	(query the waveform on the hard disk by absolute path)
	`:MMEM:HEAD:ID? “NVWFM:test.wfm”`
	(query the waveform on the hard disk by MSUS)

Notes	SCPI query only. 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 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 Command Only)

This query provides 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	Query only

	After each colon of field title string, related header info string will be 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 related abbreviation description: "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

Used to initiate an immediate trigger event if the trigger source (under ARB Setup) is set to Key.

Notes	No remote command, SCPIfront panel only.
Dependencies	Grayed out unless the Trigger Source is set to Key and an ARB waveform is configured

6.1.13 Source Sync

Allows access to the menu for setting up the Source Synchronization for multiple models.

This control only appears in modular products like VXT and only when the analyzer is configured for MIMO analysis.

6.1.13.1 Sync Config

Allows you to config MIMO type for source.

Sync Config is grayed out when Primary and Secondary modules are in Sync State.

See More Information

Remote Command	`:SOURce:SYNC:CONFig NONE | TWO | THRee | FOUR | SIX | EIGHt | DONE | DTWO | DTHR | DFOU` `:SOURce:SYNC:CONFig?`
Example	`:SOURce:SYNC:CONF TWO`
Notes	For VXT models M9421A, Sync Config is based on the fixed setting.
Dependencies	For 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. For VXT models M9421A: No-Across chassis MIMO is supported when license M9421A-MMO is enabled. Across chassis MIMO is supported when license M9421A-MTS is enabled. For 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.
Range	NONE|TWO|THRee|FOUR|SIX|EIGHt|DONE|DTWO|DTHR|DFOU

More Information

Parameter	SCPI Example	Notes
None	`:SOURce:SYNC:CONF NONE`	Sets MIMO Config type as None.
2x2	`:SOURce:SYNC:CONF TWO`	Sets 2x2 as MIMO Config Type. 2 models are configured to Sync.
3x3	`:SOURce:SYNC:CONF THRee`	Sets 3x3 as MIMO Config Type. 3 models are configured to Sync.
4x4	`:SOURce:SYNC:CONF FOUR`	Sets 4x4 as MIMO Config Type. 4 models are configured to Sync.
6x6	`:SOURce:SYNC:CONF SIX`	Sets 6x6 as MIMO Config Type. 6 models are configured to Sync.
8x8	`:SOURce:SYNC:CONF EIGHt`	Sets 8x8 as MIMO Config Type. 8 models are configured to Sync.
1x1+1x1	`:SOURce:SYNC:CONF 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.

Parameter	SCPI Example	Notes
2x2+2x2	:SOURce:SYNC:CONF 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	:SOURce:SYNC:CONF 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	:SOURce:SYNC:CONF 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

Allows you to set Sync Type.

Sync Type menu is grayed out when models are in Sync State.

See More Information.

Remote Command	:SOURce:SYNC:TYPE PRIMary | SECondary | OFF :SOURce:SYNC:TYPE?
Example	:SOURce:SYNC:TYPE PRIM
Preset	SECondary
Range	Primary|Secondary|OFF

More Information

Parameter	SCPI Example	Notes
OFF	:SOURce:SYNC:TYPE OFF	Sets the Sync Type to OFF. If the Sync Type is set to OFF, this model will not be listed in the Secondary module List.
Secondary	:SOURce:SYNC:TYPE SEC	Sets the Sync Type to Secondary. Use SCPI command ":SOURce:SYNC:CONNected:NAME?" to query the Primary's name in Sync State.
Primary	SOURce:SYNC:TYPE PRIM	Sets the Sync Type to Primary. Sync Setup is only available for Primary.

6.1.13.3 Sync Settings

Opens a menu for setting Sync parameters.

Sync Setup control is grayed out when Primary and Secondary are in Sync State.

Dependencies	This control is grayed out when Sync Type is set to Off or Secondary.

Secondary Module List

This table shows you 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 642

Remote Command	`:SOURce:SYNC:REMote:SECondary <integer> ON | OFF | 1 | 0` `:SOURce:SYNC:REMote:SEC1?`
Example	`:SOURce:SYNC:REMote:SEC1 ON` `:SOURce:SYNC:REMote: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:SEC<integer>:ADDR?` `:SOUR:SYNC:REM:SEC1:ADDR?`	Refer to Remote Chassis to add the IP Address for remote chassis. “Local Host” indicates that the Primary and Secondary modules share the same chassis.
Slot Number	`:SOUR:SYNC:REM:SEC<integer>:SLOT?` `:SOUR:SYNC:REM:SEC2:SLOT?`	Indicates the slot number of available models.

Parameter	SCPI Example	Notes
Socket Port	`:SOUR:SYNC:REM:SEC<integer>:SPOR?` `: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 set to ON, the source settings of Primary will be 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 set to ON, this Toggle will be set to 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

Allows you to 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 set to ON, this control 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 M9421A: 60 MHz VXT models M9410A/11A: 380 MHz
Max	Hardware Dependent: VXT models M9421A: Option 504 = 3.8 GHz Option 506 = 6.0 GHz VXT models M9410A/11A: Option F06 = 6.0 GHz

IP Address

Allows access to set up the controller's IP address of Remote Secondary models.

Remote Command	`:SOURce:SYNC:REMote:ADDRess <string>`
Example	`:SOURce:SYNC:REMote:ADDRess "192.168.1.2"`
Notes	<string> - IP Address

SCPI Socket Port

Allows access to set up the controller's SCPI socket port of Remote Secondary models.

Remote Command	`:SOURce:SYNC:REMote:IPPort <integer>`
Example	`:SOURce:SYNC:REMote:IPPort 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: SOURce:SYNC:REMote:ADDRess "192.168.1.2" SOURce:SYNC:REMote:IPPort 5025 SOUR:SYNC:REM:ADDR:ADD Once a remote chassis is connected, "Secondary Module List" on page 642 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 642.

Remote Command	`:SOURce:SYNC:REMote:ADDRess:DELete`
Example	`:SOUR:SYNC:REM:ADDR:DEL`
Notes	Example of how to delete a remote chassis: SOURce:SYNC:REMote:ADDRess "192.168.1.2" SOUR:SYNC:REM:ADDR:DEL

6.1.13.4 Sync Start

Allows you to 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 will be grayed out when Primary and Secondary modules are in Sync State.

Remote Command	`:SOURce:SYNC:STARt`
Example	`:SOURce:SYNC:STAR`
Notes	If you change the source settings during Sync State, error message will appear in the status bar as “Settings conflict; Sync connection is already established”. And the change will not be applied until Sync Stop.

6.1.13.5 Sync Stop

Allows you to stop the Synchronize.

When Sync Stops, Sync Config menu and Sync Start will be available.

Remote Command	`:SOURce:SYNC:STOP`
Example	`:SOURce:SYNC:STOP`

6.1.14 Source Preset

Allows you to 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

Select Input lets you choose which signal input you want to analyze:

– "RF Input" on page 649

– "External Mixer" on page 649

– "I/Q" on page 652

See also:

– "External Mixer Setup" on page 672

– "I/Q Setup" on page 691

Remote Command	`[:SENSe]:FEED RF | AIQ | EMIXer` `[:SENSe]:FEED?`

Example	`:FEED RF`
	Selects the RF Input
	`:FEED EMIX`
	Selects External Mixing
	`:FEED AIQ`
	Selects BBIQ
	`:FEED?`

Dependencies	I/Q only appears when option BBA present Ext Mix only appears when option EXM present
Couplings	The act of connecting the U7227A USB Preamplifier to one of the analyzer's USB ports will cause 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. The [:SENSe]:FEED RF command turns the calibrator OFF
Preset	This setting is unaffected by a Preset or power cycle. It survives a Mode Preset and mode changes. It is set to RF on a "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 the [:SENSe]:FEED AREFerence command is provided, and is aliased to [SENSe]:FEED:AREF REF50, which causes the input to be switched to the 50 MHz calibrator. The [:SENSe]:FEED RF command 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, the query [:SENSe]:FEED? will 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`
	The query [:SENSe]:FEED? will always returns AIQ whatever the type of legacy parameters 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 in the Input/Output system key are not affected by Mode Preset. Both of these behaviors represent a departure from legacy behavior. In the X-Series. Input/Output settings are reset by using the "Restore Input/Output Defaults" function. They can also be reset to their default values through the System->Restore System Defaults-> In/Out Config key or through the System ->Restore System Defaults -> All key (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 a Mode Preset, but instead by using the "Restore Input/Output Defaults" key/SCPI. Although Input/Output settings are not part of each Mode’s State, they are saved in the Save State files, so that all of the instrument settings can be recalled with Recall State, as in legacy instruments.

Remote Command	`:INPut:MIXer EXTernal | INTernal` `:INPut:MIXer?`
Example	`:INP:MIX INT` `:INP:MIX?`
Notes	In legacy analyzers you choose between the Internal mixer or an External Mixer. In the 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 will be INT if any input other than the external mixer is selected and EXT if the external mixer is selected
Preset	INT
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 analyzer signal input. If RF is already selected, pressing this key accesses the RF input setup functions.

External Mixer

This control allows you to choose an External Mixer through which to apply signal input to the analyzer. When chosen, the LO/IF port becomes the input to the analyzer.

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.**

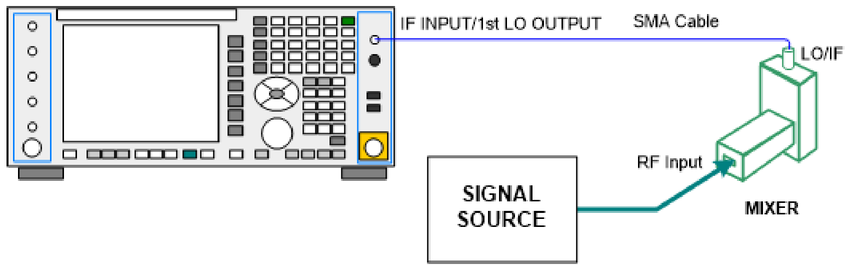
When External Mixer is selected, the **Center Freq** key controls the setting of the Center Freq in external mixing, which is separate from the settings of Center Freq for the RF Input or BBIQ. Each input retains its unique settings for Center Freq. A unique SCPI command is provided solely for the external 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.

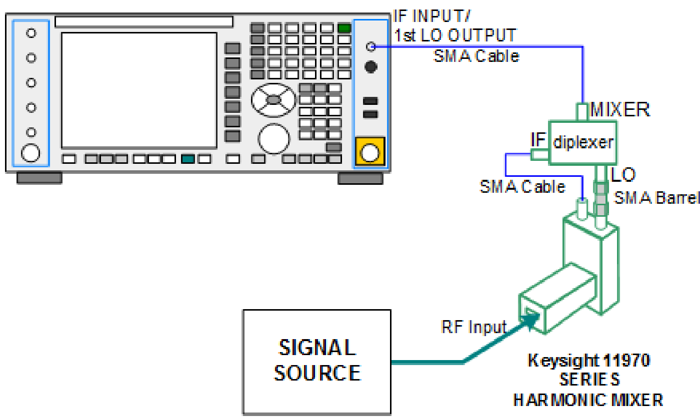
All settings under this key, and all Frequency settings, are remembered when you go out of External Mixer, so that when **External Mixer** is chosen again, all the external mixer functions will retain their previous settings, with the exception of Signal ID which is set to OFF (Signal ID is also set 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 analyzer.

X-series analyzers have a combined LO Out/IF In connection, whereas earlier analyzers used separate ports for the LO Out and the IF in. Internal diplexers in the analyzer and the mixer simplify the connection for the user – only a single SMA cable is required.



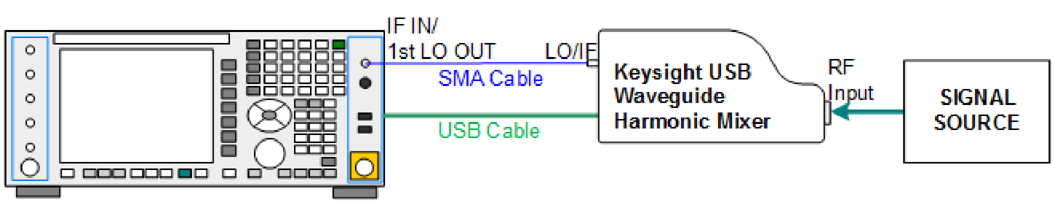
Legacy HP/Agilent and some third party mixers have separate LO In and IF out connections. This requires you to use an external diplexer to connect these mixers. A diplexer can easily be purchased for this purpose (for example, Diplexer Model # DPL.26 or # DPL.313B from OML Inc., Morgan Hill CA)

The connection diagram for such a legacy mixer is:



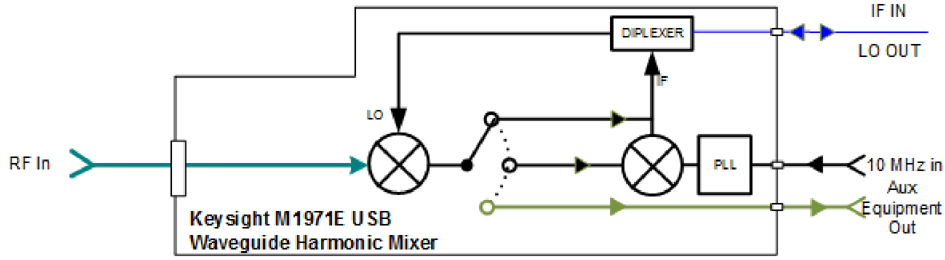
In addition, External Mixing in the X-Series supports the new Keysight M1970 series of Harmonic Mixers, which provide a USB connection for download of calibration data and additional control.

The connection diagram for one of the Keysight USB mixers is:

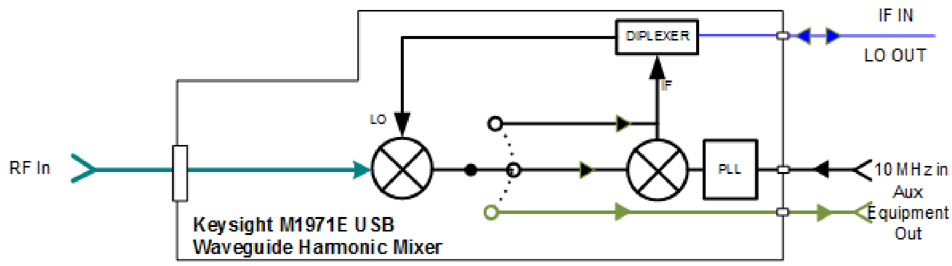


Also available in the M197x series are the M1971 series USB Mixers, which provide additional inputs and outputs for special functionality as described below. These mixers have multiple signal paths which allow them to function in three different states:

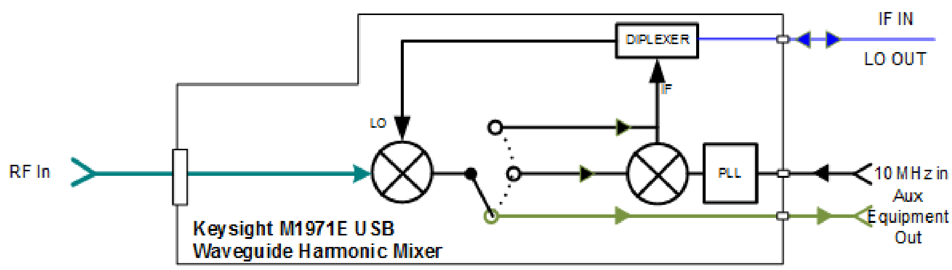
– Normal, in which the mixer functions as a classic external mixer with a single conversion:



– 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 analyzer 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 analyzer 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 the X-Series. The X-Series has hardware differences and additional capabilities (e.g., E4406A does not have independent settings of I & Q nor does it provide for probe calibrations) which make 100% compatibility impossible.

1. The following commands are supported:

   :CALibration:IQ:FLATness

   :INPut:IMPedance:IQ U50|B50|U1M|B1M

   :INPut:IMPedance:REFerence <integer>

2. The [:SENSe]:FEED RF|IQ|IONLy|QONLy|AREFerence|IFALign command supports all parameters except IFALign. The FEED? query will return only RF|AIQ|AREF.

3. 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 the X-Series, however 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:

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. The RF Input Port control 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 and EXM
- M8920A
- E7760
- M9391A and M9393A

NOTE **Switching input ports may change the receiver performance of the instrument.**

Remote Command	`[:SENSe]:FEED[:RF]:PORT[:INPut] <port>` `[:SENSe]:FEED[:RF]:PORT[:INPut]?`

Example	`:FEED:RF:PORT RFIN`
	Uses the port labeled RF Input when the selected input is RF
	`:FEED:RF:PORT RFIN2`
	Uses the port labeled RF Input 2 when the selected input is RF

Notes	<port> is defined as follows: UXA/PXA/MXA/EXA/CXA/MXE/PXE/NFA (see Parameters for UXA/PXA/MXA/EXA/CXA/MXE/PXE/NFA): RFIN: RF Input RFIN2: RF Input 2 ERFIN: External RF EXM (see "Parameters for the EXT, EXF and EXM Wireless Test Sets" on page 663): RFIO1: RFIO 1

	RFIO2: RFIO 2 RFIO3: RF3 I|O RFIO4: RF4 I|O VXT: RFIN: RF Input RFFD: RFIO FD RFHD: RFIO HD, Half Duplex VXT/EXM with Remote Radio Head (e.g., M1740A) and/or CIU (e.g., E7770A) (see "Parameters for the VXT M9410A/11A/15A and EXM when used with Radio Heads/CIU" on page 660): RRHhRFHDp : Head h, RF Tx/Rx p, e.g. RRH1RFHD2 = Head 1, RF Tx/Rx 2 IFINn : DUT IF IN for Channel n, e.g. IFIN1 = DUT IF IN for Channel 1 IFHDn : DUT IF In/Out for Channel n, e.g. IFHD1 = DUT IF In/Out for Channel 1 E7760 (see "Parameters for the E7760 Wideband Transceiver" on page 664): A1|A2|A3|B1|B2|B3|IFIO1|IFIO2 M8920A (see "Parameters for the M8920A Radio Test Set" on page 663): ANT: Ant TR: T/R UXM (see "Parameters for the UXM Wireless Test Set" on page 665): RFIN|RFIO1|RFIO2
Dependencies	This control 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	This is unaffected by Mode Preset but is set to RFIN on a "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 the MXE, the INPUT1 parameter is aliased to RFIN and the INPUT2 parameter is aliased to RFIN2

More Information

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 the Stop Freq is above 1.000025 GHz, it is set to 1.000025 GHz, otherwise it does not change If the 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 the Stop Freq is above 1.58 GHz, it is set to 1.58 GHz, otherwise it does not change If the 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 the UXA/PXA/MXA/EXA/CXA/MXE/PXE/NFA

When using the UXA/PXA/MXA/EXA/CXA/MXE/PXE/NFA analyzers, the following should be noted:

Remote Command	`[:SENSe]:FEED[:RF]:PORT[:INPut] RFIN | RFIN2 | ERFIN`

Example	`:FEED:RF:PORT RFIN`
	sets the RF input to be RF Input
	`:FEED:RF:PORT RFIN2`
	sets the RF input to be RF Input 2 if that port exists

	`:FEED:RF:PORT ERFIN` sets the RF input to be External RF if the V3050A unit is connected
Dependencies	If the SCPI command is sent with RFIN2 or ERFIN and that port does not exist, an error is generated, -221, “Settings conflict; option not installed”
Couplings	Connecting a V3050A will change the Preset to ERFIN and will automatically switch the input to ERFIN. Disconnecting the V3050A will change the Preset back to RFIN and will automatically switch 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

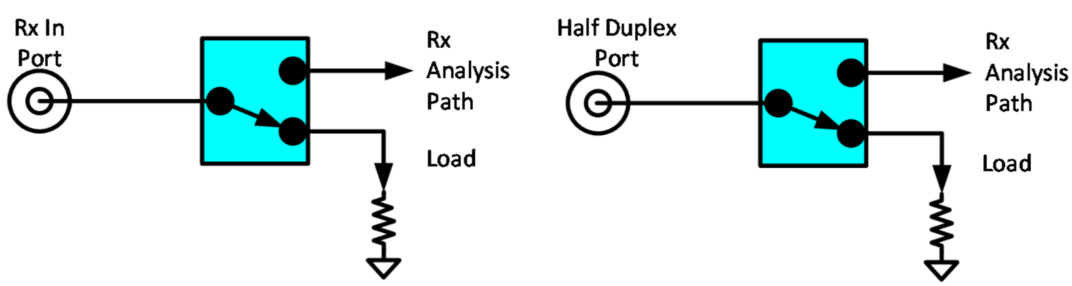
Parameters for the VXT M9410A/11A/15A and M9420/21A Vector Transceivers

When using the VXT models, the following should be noted:

Remote Command	`[:SENSe]:FEED[:RF]:PORT[:INPut] RFIN | RFFD | RFHD | NONE`

Example	`:FEED:RF:PORT RFIN`
	`:FEED:RF:PORT RFFD`
	`:FEED:RF:PORT RFHD`
	`:FEED:RF:PORT NONE`

Notes	The SCPI parameter RFIN sets the RF input to be the RF Input port, labelled RF Input The SCPI parameter RFFD sets the RF input to be the full duplex port, labelled RFIO FD. Note that Option “FDX” is required to enable this port The SCPI parameter RFHD sets the RF input to be the half duplex port, labelled Half Duplex (M9410A/11A) or RFIO HD (M94120A/21A) The SCPI parameter NONE sets the RF In port and Half Duplex port (if HD Port is not set to RF Output) to connect to 50Ω load, see the figure below

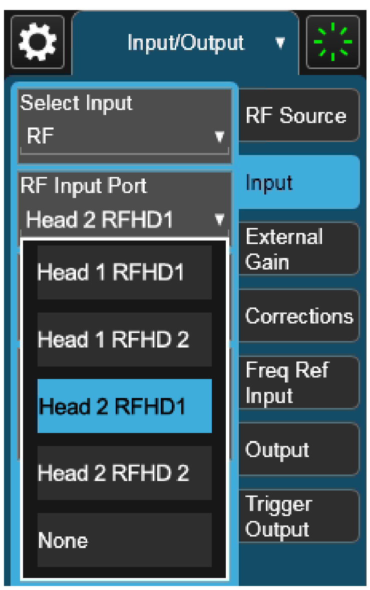


When use Source only, set RF Input to None to provide better isolation. When the input port is set to None, an error appears in the status area:

	
Dependencies	Note that Option “HDX” is required to enable the Half Duplex (RFIO HD) port. Also note that you can’t set this port to be the input if it is already set to be the output. Otherwise, an error message will be generated : “-221, Settings conflict;RF Input cannot be set to RFIO HD when RF Output is RFIO HD” None is not available in VXT models M9420A/21A
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 the VXT M9410A/11A/15A and EXM when used with Radio Heads/CIU

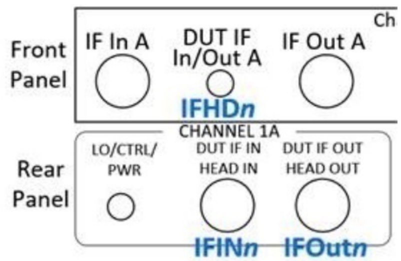
When using a Remote Radio Head (RRH), such as the Keysight M1740A mmWave Transceiver for 5G, with the VXT or EXM, the choices in the dropdown are dependent on which heads are installed. For example, in the case where two M1740A’s are present, each with two ports, the dropdown will look like this:



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 labelled RF Tx/Rx p; for example, RFHD 2 means the port labelled RF Tx/Rx 2 on the M1740A.

When using the E7770A Common Interface Unit, you may make connections to the half-duplex port on the front of the CIU labelled DUT IF In/Out, and/or to ports on the rear of the CIU labelled 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 the user 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:

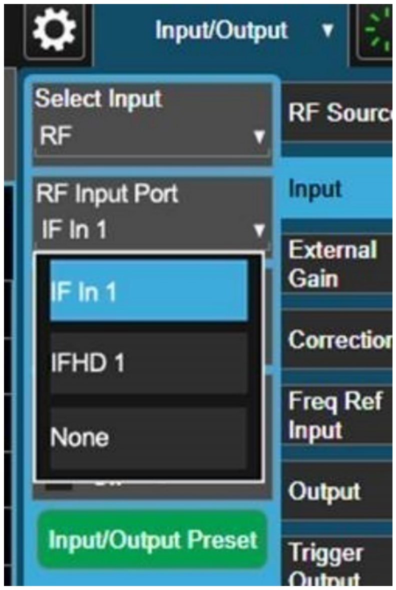


The following table lists the GUI parameter for each input or output on the CIU, and the SCPI parameter for the RF Input Port command (`[:SENSe]:FEED[:RF]:PORT[:INPut]`) and the RF Output Port command (`[:SENSe]:FEED:RF:PORT:OUTPut`):

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, e.g. IFIN1
IF output port	DUT IF OUT	IF Out n	IFOutn, e.g. IFO1
IF port, half duplex	DUT IF In/Out	IFHD n	IFHDn, e.g., 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 particular use case, please consult the Startup Guide for your particular system (e.g. S9100A).

An example of the GUI for the CIU ports appears below:



Remote Command	`[:SENSe]:FEED[:RF]:PORT[:INPut] RRHhRFHDp | NONE` `[:SENSe]:FEED[:RF]:PORT[:INPut] IFIN1 | IFIN2 | IFIN3 | IFIN4`

Example	`:FEED:RF:PORT RRH1RFHD2`
	sets the RF input to be the port labelled RF Tx/Rx 2 on Head 1.
	`:FEED:RF:PORT IFIN1`
	sets the RF input to be the Channel 1 port labelled DUT IF IN on the CIU.

Notes	The SCPI parameter RRHhRFHDp corresponds to **Head h**, port **RF Tx/Rx p**; for example, RRH1RFHD2 = the port labelled **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 analyzer. 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 Compatibility SCPI	`:FEED:RF:PORT A1`

	A1 is treated as RRH1RFHD1 and sets the RF input to be the port labelled 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 labelled 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 labelled “DUT IF In/Out” on the CIU rear panel

Parameters for the EXT, EXF and EXM Wireless Test Sets

(see also "Parameters for the VXT M9410A/11A/15A and EXM when used with Radio Heads/CIU" on page 660)

When using the EXT, EXF and EXM analyzers, the following should be noted:

Remote Command	`[:SENSe]:FEED[:RF]:PORT[:INPut] RFIO1 | RFIO2 | RFIO3 | RFIO4 | NONE`

Example	`:FEED:RF:PORT RFIO1`
	sets the RF input to be RFIO 1
	`:FEED:RF:PORT RFIO2`
	sets the RF input to be RFIO 2
	`:FEED:RF:PORT RFIO3`
	sets the RF input to be RF3 I|O
	`:FEED:RF:PORT RFIO4`
	sets the RF input to be RF4 I|O

Dependencies	On EXF, or on 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 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”
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 the M8920A Radio Test Set

When using the M8920A, the following should be noted:

Remote Command	`[:SENSe]:FEED[:RF]:PORT[:INPut] ANT | TR`

Example	`:FEED:RF:PORT ANT`
	sets the RF input to be the Antenna port on M9470A, labeled Ant
	`:FEED:RF:PORT TR`
	sets the RF input to be the T/R port on M9470A and M8920A, labeled T/R. Note that Option "HDX" is required to enable the T/R port

Dependencies	ANT and TR are only available in modular analyzers and only when the M9470A module is installed, such as in the 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 the E7760 Wideband Transceiver

When using the E7760, the following should be noted:

Remote Command	`[:SENSe]:FEED[:RF]:PORT[:INPut] A1 | A2 | A3 | B1 | B2 | B3 | IFIO1 | IFIO2 | NONE`

Example	`:FEED:RF:PORT A1`
	sets the RF input to be A1
	`:FEED:RF:PORT A2 sets the RF input to be A2`
	`:FEED:RF:PORT A3 sets the RF input to be A3`
	`:FEED:RF:PORT B1 sets the RF input to be B1`
	`:FEED:RF:PORT B2 sets the RF input to be B2`
	`:FEED:RF:PORT B3`
	sets the RF input to be B3
	`:FEED:RF:PORT IFIO1`
	sets the RF input to be IFIO1
	`:FEED:RF:PORT IFIO2 sets the RF input to be IFIO2`

Dependencies	Ports A1,A2,A3,B1,B2,B3 are available if option RF3 is installed. Ports IFIO1 and IFIO2 are available if option RF2 is installed. Note that for the E7760: – attempting to select a port for which the option is not present will generate the error, -241.03, "Hardware missing; Input not available" – A port cannot be selected as an Input while it is occupied as an Output. If the SCPI command is sent while port is occupied an error is generated, -221.1950, "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 that same bank is occupied as an Output; if the SCPI command is sent for this situation an error is generated, -221.1951 "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; if the SCPI command is sent for this situation an error is generated, -221.1956 "Settings conflict; Input Port is not available while occupied by Output of incompatible frequency"
Preset	For E7760 with Option RF2 the Preset value is IFIO1 For E7760 without Option RF2 the Preset value is 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 the UXM Wireless Test Set

For UXM, the following should be noted:

Remote Command	`[:SENSe]:FEED[:RF]:PORT[:INPut] RFIN | RFIO1 | RFIO2`
Preset	RFIN

Parameters for each HD Port on the M1750A mmWave Transceiver

When using each TRX instance for M1750A, the following should be noted:

Remote Command	`[:SENSe]:FEED[:RF]:PORT[:INPut] RFIO1 | RFIO2 | RFIO3 | RFIO4 | NONE`
Example	`:FEED:RF:PORT RFIO1`
Notes	Each SCPI parameter represents 1 of the 4 Input/Output ports connected by a switch to the Half Duplex ports of the M1750A
Dependencies	If the RF Output Parameter is not none, then all of options must be disabled as the Half Duplex ports can only act as either a source or receiver at a given time
Annotation	Annotation in the Meas Bar reads as follows: When input is NONE: NONE When input is RFIOn: Input: RFIOn

6.2.3 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	This control only appears in EXM. If RFIO3 is selected as “Half Duplex Output Port”, then “Half Duplex Input Port” will be set to RFIO4 automatically. And 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

6.2.4 Port Information (Remote Command Only)

Provides information about an instrument port. The return information is two fields separated by a comma.

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 the E7760: 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 will be 0,””
Dependencies	This query is only valid for the E7760.

6.2.5 RF Preselector

In models that support the RF Preselector, such as PXE (N9048B), this key allows you to turn the preselector on and 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 will reset the Stop Freq to 3.6 GHz and get you out of this state, or you can manually set the 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	[:SENSe]:POWer[:RF]:RFPSelector[:STATe] 1|ON. Sets to full compliance measurement. [:SENSe]:POWer[:RF]:RFPSelector[:STATe] 0|OFF. Sets to pre-compliance measurement.
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". This key only appears in Modes that support the RF Preselector, in other Modes, setting or querying the SCPI 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

6.2.6 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 and off.

<table>
<tr><td>Remote Command</td><td><code>[:SENSe]:POWer[:RF]:RFPSelector:NFILter[:STATe] OFF | ON | 0 | 1</code>
<code>[:SENSe]:POWer[:RF]:RFPSelector:NFILter[:STATe]?</code></td></tr>
<tr><td>Example</td><td><code>:POW:RFPS:NFIL 1</code>
<code>:POW:RFPS:NFIL?</code></td></tr>
<tr><td>Dependencies</td><td>Only appears when RF Input is selected as the Input
This control only appears in models which support the notch filter, such as PXE. Attempting to turn it on or off via SCPI in models that do not support it generates an error message: -241 Hardware missing; Not available for this model number.
This control only appears in measurements which 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 an error message: -221, Settings conflict; Feature not supported for this measurement.
In Frequency Scan measurement, this key is grayed out when final measurement is running, aligned with the <code>RF Preselector</code> key. The warning message “Function not available while measurement is running” appears if the grayed out key is pressed.</td></tr>
<tr><td>Preset</td><td>Off</td></tr>
<tr><td>State Saved</td><td>Saved in instrument state</td></tr>
<tr><td>Range</td><td>On|Off</td></tr>
<tr><td>Annotation</td><td>Due to limited space in the Measurement Bar, Notch Filter annotation is shown as part of the RF Presel state.
– <code>RF Presel: On, NF</code>, when both RF Presel and Notch Filter are turned on.
– <code>RF Presel: On</code>, when RF Presel = on and Notch Filter= off.
– <code>RF Presel: Off</code>, when RF Presel = off.</td></tr>
<tr><td>Backwards Compatibility SCPI</td><td><code>:INPut<1|2>:PRESelection:FILTer:NOTCh[:STATe] ON | OFF</code>
<code>:INPut<1|2>:PRESelection:FILTer:NOTCh[:STATe]?</code></td></tr>
</table>

6.2.7 RF Calibrator

Lets you choose a calibrator signal to look at or turns the calibrator off.

<table>
<tr><td>Remote Command</td><td><code>[:SENSe]:FEED:AREFerence REF50 | REF4800 | OFF</code>
<code>[:SENSe]:FEED:AREFerence?</code></td></tr>
<tr><td>Example</td><td><code>:FEED:AREF REF50</code>
selects the 50 MHz amplitude reference as the signal input.
<code>:FEED:AREF REF4800</code></td></tr>
</table>

	selects the 4.8 GHz amplitude reference as the signal input `:FEED:AREF OFF` turns the calibrator "off" (switches back to the selected input - RF or I/Q)
Dependencies	Only appears when RF Input is selected as the Input Selecting an input (RFExt Mix or I/Q) turns the Calibrator OFF. This is true whether the input is selected using the menu panel or with the [:SENSe]:FEED command. 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 will not show, and if the REF4800 parameter is sent, the analyzer will generate an error.
Couplings	When one of the calibrator signals is selected, the analyzer routes that signal (an internal amplitude reference) to the analyzer, 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.

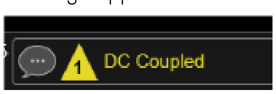
Remote Command	`:CALibration:SOURce:STATe OFF | ON | 0 | 1` `:CALibration:SOURce:STATe?`
Notes	For ESA backwards compatibility. In the ESA the calibrator was a separate output which you connected to the input and switched on with this command. In the X-Series, the ON parameter is aliased to the [SENSe]:FEED:AREF REF50 command and the OFF parameter is aliased to [SENSe]:FEED:AREF OFF. When CALibration:SOURce:STATe? is received, 1 will be returned if any of the references is selected and 0 if the Calibrator is "Off"
Preset	OFF

6.2.8 RF Coupling

Specifies alternating current (AC) or direct current (DC) coupling at the analyzer RF input port. Selecting AC coupling switches in a blocking capacitor that blocks any DC voltage present at the analyzer input. This decreases the input frequency range of the analyzer, but prevents damage to the input circuitry of the analyzer if there is a DC voltage present at the RF input.

NOTE **When operating in DC coupled mode, ensure protection of the analyzer 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 This control does not appear in models that are always AC coupled. When the SCPI command to set DC coupling is sent to these models, it results in the error “Illegal parameter value; This model is always AC coupled” In these models, the SCPI query INP:COUP? always returns AC. This control does not appear in models that are always DC coupled.When the SCPI command to set AC coupling is sent to these models, it results in the error “Illegal parameter value; This instrument is always DC coupled” In these models, the SCPI query 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
CXA-C75 Input 2	1 MHz	n/a

X-Series Model	Lowest Freq for meeting specs when AC coupled	Lowest Freq for meeting specs when DC coupled
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 analyzer.

6.2.9 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 analyzer with a 50 ohm input impedance.

There are a variety ways 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	`:CORR:IMP 75`
	sets the input impedance correction to 75 ohms.
	`:CORR:IMP?`

Couplings	In CXA option C75, when RF Input 2 is selected, the Input Z Correction will automatically change to 75 ohms. You may then change it to whatever is desired. When the main RF Input is selected, the Input Z Correction will automatically change to 50 ohms. You may then change it to whatever is desired.
Preset	This is unaffected by a Preset but is set to 50 ohms on a "Restore Input/Output Defaults" or "Restore System Defaults->All" Some instruments/options may have 75 ohms available.
State Saved	Saved in instrument state

6.2.10 All Screens Use Same Input

If "All Screens Use Same Input" is On then all Screens share the same Input settings. This is the default state.

If "All Screens Use Same Input" is 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 which 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 on boxes with multiple RF ports like 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)

6.2.11 External Mixer Setup

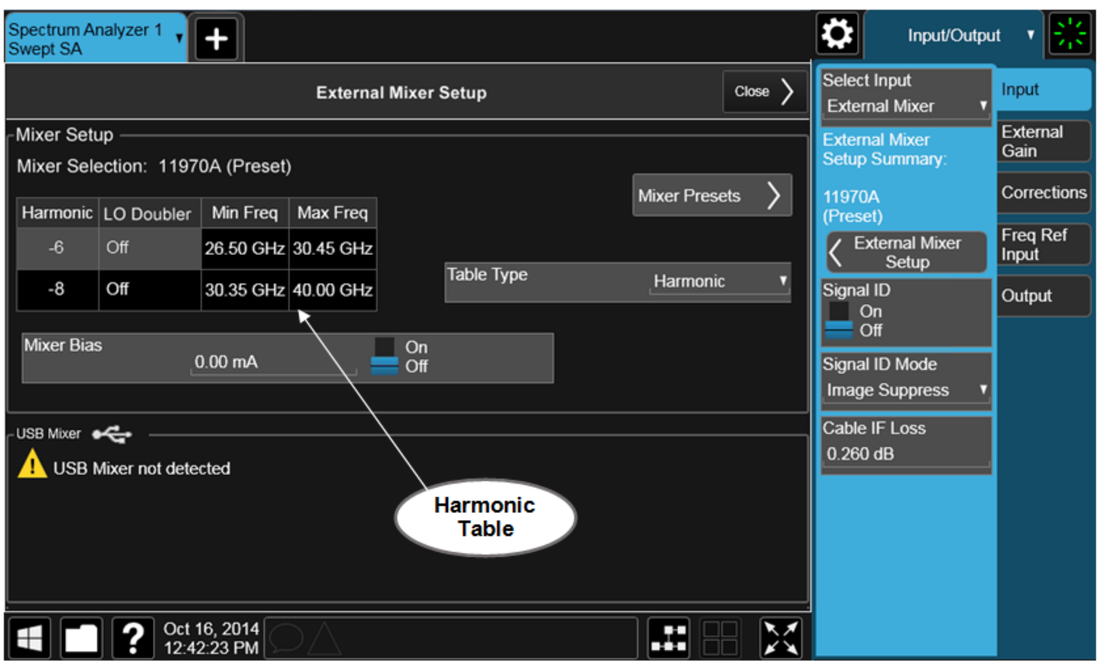
This dialog lets you select the mixer type, and lets you configure your mixer (if necessary). The first page of the dialog shows you the current settings for the selected mixer. These settings may be dependent on which IF path is currently in use, whether a + or – harmonic is currently selected, etc.

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 analyzer; therefore you should make sure to turn off the External Mixer corrections when you are not using the External Mixer input.

NOTE **The Keysight USB Mixers automatically give their flatness data to the analyzer, and the correction is applied internally. No correction needs to be entered by the user, and the correction does not appear in the user-accessible Corrections tables. The user is 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 the user has 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 analyzer 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 analyzer uses the maximum Span the measurement allows, and sets the Center Freq 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. See for more detail on editing the table.

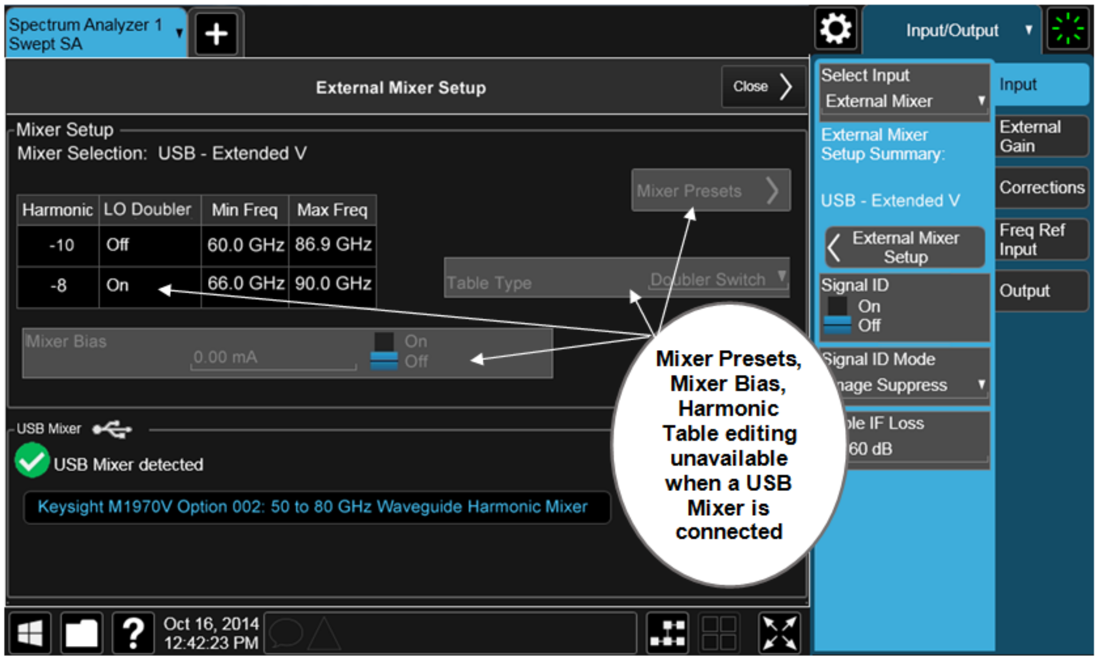
When you edit the Harmonic Table, the nominal Min Freq and Max Freq that are available will usually be different than the Preset you were using; and the absolute frequency limits will change as well. This may result in a change to your Start and/or Stop Freq, if the current values fall outside the new range, requiring you to retune your Center Freq to get your signal back in the center.

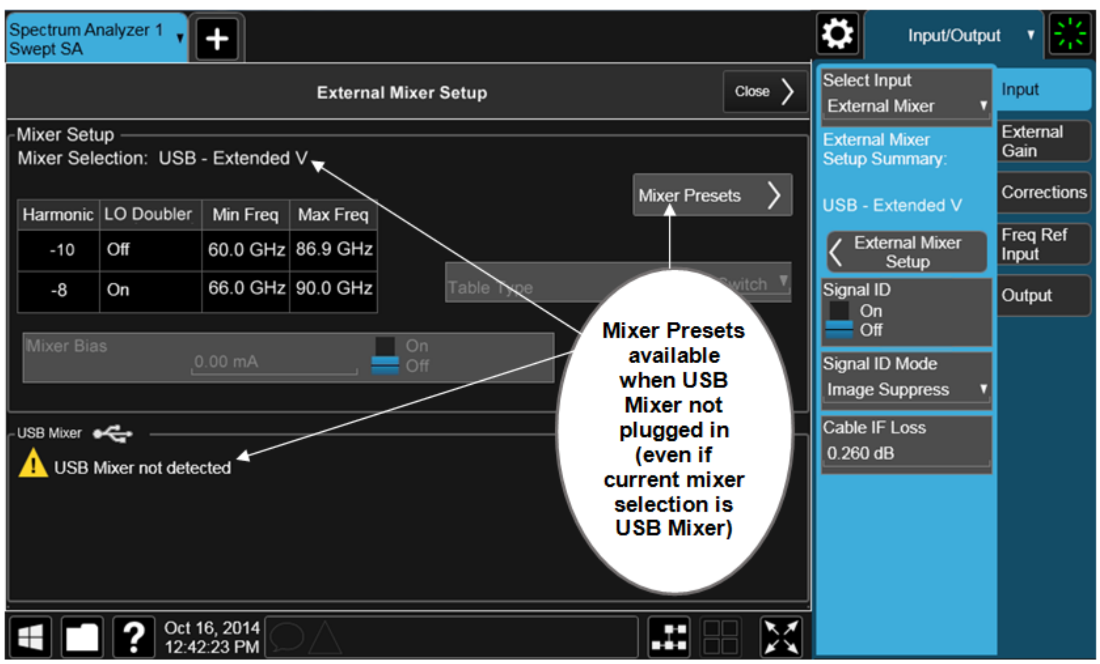
The analyzer supports the Keysight M1970 Series Harmonic Mixers with USB connection. While in External Mixing, if one of these mixers is plugged in to a USB port, it is automatically detected and displayed in the "USB Mixer" area of the setup screen, including its model number and serial number.

The analyzer assumes that if you plug a mixer into the USB you want to use that mixer, so:

7. 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 analyzer 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 will stop being grayed out, allowing you to preset to a different mixer.
8. When Restore Input/Output Defaults is performed, if a Keysight USB Mixer is plugged into the analyzer's USB port, the Mixer Selection remains unchanged.
9. When recalling an instrument state, if a Keysight USB Mixer is plugged into the analyzer'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 analyzer 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 GHz Waveguide Harmonic Mixer	USB - M1971E-003 Extended E-Band	USB 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 analyzer using a lossy and uncalibrated cable or waveguide connection.

Connecting the mixer to the USB port on the analyzer 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.

6.2.11.1 Mixer Presets

This dialog lets you preset 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` `[: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 All of these presets are detailed in their respective control descriptions The query form of this command returns the most recent preset, UNLESS the harmonic table has been edited after the preset was executed. If the harmonic table has been edited it returns CUSTOM The command USB will refresh the USB mixer connection and automatically detect the mixer band. The query form of this command returns the following if an Keysight USB Mixer is plugged into the analyzer'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 analyzer. 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 analyzer’s USB port, in which case the Mixer Selection remains unchanged. When using Keysight USB Mixers, if a Restore All Defaults (SCPI command SYSTem:DEFault) has been perform, either remove and reinsert the USB cable or press the Refresh USB Mixer Connection control.
Backwards Compatibility Notes	The [:SENSe]:MIXer:BAND command was used in PSA and ESA to select the mixer band. In the X-Series, only the legacy parameters A, Q, U, V, and W are honored, and they preset the analyzer to match the corresponding Agilent 11970 legacy mixer. Parameters D, E, F, G ,J , K, Y, which were accepted in ESA and PSA, return an error if sent. If you are using a mixer in one of these bands, you should study the tables of presets and choose the appropriate preset to match your application. Also the USER parameter is no longer accepted, as the control model for mixer customization is very different in the X-Series.

11970

This column allows you to preset for one of the models 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 choose 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	-30	170	260	215

Mixer	Readout on setup dialog and menu panel	Harm #	RF start	RF stop	RF center
	doubler				
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 choose 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 choose 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

6.2.11.2 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 the user switches to another input (e.g., the RF Input).

Remote Command	`[:SENSe]:MIXer:BIAS <real>`
	`[:SENSe]:MIXer:BIAS?`
	`[:SENSe]:MIXer:BIAS:STATe OFF | ON | 0 | 1`
	`[:SENSe]:MIXer:BIAS:STATe?`

Example	`:MIX:BIAS 0`
	`:MIX:BIAS?`
	`:MIX:BIAS:STAT 0`
	`:MIX:BIAS:STAT?`

Preset	This is unaffected by Preset but is set to OFF and 0 on a "Restore Input/Output Defaults" OFF
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"

6.2.11.3 Table Type

This parameter determines which type of configuration you want the Custom Mixer to be. You can choose Single Row, Harmonic Switching, or Doubler Switching. See detail under each of these keys.

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),

– as two rows where the harmonic number switches between the first row and the second, or

– as two rows where the LO Doubler state switches between the first row and the second

In the Single Row type, 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.

In the Harmonic Switching type, the External Mixer switches the Harmonic Number in the middle of the sweep. The Lo Doubler may be on 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.

In the Doubler Switching type, 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.

The fields you can edit vary with the Table Type:

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. This is unaffected by Mode Preset, but on a "Restore Input/Output Defaults" the Mixer is preset to 11970A, for which the Table Type is Harmonic Switching
State Saved	Saved in instrument state

6.2.11.4 Harmonic

Touching the Harmonic field in the Harmonic Table 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 the Table Type, the Mixer Selection changes to “Custom”.

In Custom mode, your 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 LO’s that support doubling) the doubled range is approximately 8.0 – 14.0 GHz. That range times the harmonic you have selected will determine your tuning range. If your frequency is currently outside that range when you edit the Harmonic Table, your frequency will be changed to fall at the edge of the range. To change it back you must go into the Mixer Presets menu and select a Preset.

The harmonic number is a signed integer, where the sign has the meaning of choosing between positive and negative mixing products. Desired mixing products occur at an IF frequency which 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 analyzer 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 analyzer 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 the Harmonic via SCPI, the Mixer Selection changes to “Custom”
Preset	This is unaffected by Mode Preset, but on a "Restore Input/Output Defaults" editing is turned 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

6.2.11.5 LO Doubler

Touching the LO Doubler field in the Harmonic Table lets you enter 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 LO’s 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	This control is grayed out and set to Off when Table Type is set to Doubler Switching. Grayout message “-221 Settings conflict; Function unavailable while Table Type=Doubler Switching”
Couplings	When you set a value for the doubler setting via SCPI, the Mixer Selection changes to “Custom”
Preset	This is unaffected by Mode Preset, but on a "Restore Input/Output Defaults" editing is turned off, 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

6.2.11.6 Refresh USB Mixer Connection

This operation 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 a Restore All Defaults (SCPI command SYSTem:DEFault) has been perform, either remove and reinsert the USB cable or press the Refresh USB Mixer Connection control.

6.2.12 Mixer Path

This parameter 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 analyzer 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	This control 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 analyzer displays a “No Result; Meas invalid with Aux Equip” error condition message. This is error 135. Dual Conversion is grayed out unless in the Swept SA measurement. If grayed out and the SCPI for Dual Conversion is sent, an error is generated:”-221,Settings Conflict;Dual Conversion mixer path is only available in Swept SA.” If in Dual Conversion and Swept SA is exited, reverts to Normal setting. If 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 will be generated, “Ref missing or out of range;M1971” (error 521). This also lights the Error LED on the mixer itself.
Couplings	When the Aux Equipment path is chosen, the analyzer 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

6.2.13 User IF Freq

Specifies the user's desired IF frequency when using the Aux Equipment path. This setting will determine the LO frequency the instrument will drive into the mixer to correspond to the center frequency specified by the user. 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:UIFFfreq <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

6.2.14 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 color to alert the user to the fact that Signal ID is on, as it can cause unexpected behavior if the user is 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 analyzer 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, the user 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 Signal ID is not available in some measurements. If the Signal ID control 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. Signal ID is not available with Signal Track so Signal ID is grayed out if in Signal Track. Signal ID will be 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, the Signal ID control 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	This is unaffected by Preset but is set to OFF on a "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 the user to the fact that Signal ID is on, as it can cause unexpected behavior if the user is not aware that it is on.

6.2.15 Signal ID Mode

Lets you set which Signal ID mode you will use, either Image Suppress or Image Shift.

Image Suppress

The Image Suppress mode of Signal ID 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 the user will 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	This is unaffected by Preset but is set to ISUPpress on a "Restore Input/Output Defaults"
State Saved	Saved in instrument state

6.2.16 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

6.2.17 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.

See "More Information" on page 690

Remote Command	`[:SENSe]:FEED:IQ:TYPE IQ | IONLy | QONLy` `[:SENSe]:FEED:IQ:TYPE?`

Example	`:FEED:IQ:TYPE IQ`
	Set the input to be both the I and Q channels, combined as I + j * Q.
	`:FEED:IQ:TYPE IONL`
	Set the input to be only the I channel.
	`:FEED:IQ:TYPE QONL`
	Set the input to be only the Q channel.
	`:FEED:IQ:TYPE IND`
	Turn on both I and Q channels and treat I as channel 1 and Q as channel 2.

Dependencies	Only appears when I/Q is the selected input
Preset	IQ
State Saved	Yes This is unaffected by a Preset but is set to the default value on a "Restore Input/Output Defaults" or "Restore System Defaults->All"

Remote Command	`:INPut[1]:IQ:TYPE IQ | I | Q` `:INPut[1]:IQ:TYPE?`
Notes	For R&S FSQ-B71 compatibility
Preset	IQ

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.

6.2.18 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 692).

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 This is unaffected by a Preset but is set to the default value on a "Restore Input/Output Defaults" or "Restore System Defaults->All"
Min/Max	1 Ω - 1 MΩ

6.2.19 I/Q Setup

This dialog allows you to set up and calibrate various parameters for the I/Q inputs.

Dependencies	Only appears when I/Q is the selected input

6.2.19.1 I Setup

Access 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 analyzer uses both main and complementary ports. When differential input is off (also called single-ended or unbalanced input), the analyzer uses only the main port.

Remote Command	`:INPut:IQ[:I]:DIFFerential OFF | ON | 0 | 1` `:INPut:IQ[:I]:DIFFerential?`

Example	`:INP:IQ:DIFF ON`
	Put the I channel in Differential mode
	`:INP:IQ:DIFF OFF`
	Put the I channel in Single Ended mode

Notes	When I Differential Input = On, the analyzer will check 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 will be 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 Analyzer will use only the main port and the key will show that the Analyzer'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) !This is unaffected by Mode Preset but is set to the default value on a "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.

Remote Command	`:INPut[1]:IQ:BALanced[:STATe] OFF | ON | 0 | 1` `:INPut[1]:IQ:BALanced[:STATe]?`
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 set to On.
Preset	OFF

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	`:INP:IQ:IMP HIGH`
	Set the I channel input impedance to 1 MΩ
	`:INP:IQ:IMP LOW`
	Set the I channel input impedance to 50 Ω

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 ! This is unaffected by Mode Preset but is set to the default value on a "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 This is unaffected by Preset but is set to the default value on a "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)

This is Remote Command only (no front panel) and is for backwards compatibility only. It combines the Differential Input and Input Z selections into a single SCPI command.

Remote Command	`:INPut:IMPedance:IQ U50 | B50 | U1M | B1M` `:INPut:IMPedance:IQ?`

Example	`:INPut:IMPedance:IQ U50`
	This is equivalent to the following two SCPI commands:
	`:INP:IQ:DIFF OFF`
	`:INP:IQ:IMP 50`

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 This command is for backwards compatibility. It 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 SCPI 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. Also, note the subtle difference between this SCPI 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	This command 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

6.2.19.2 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. It survives a power cycle and is not affected by a Preset or Restore.
Min/Max	0.001/10000

This is an alternate form of the SCPI that allows input as a power instead of a ratio.

Remote Command	`[:SENSe]:CORRection:IQ:I|Q:ATTenuation <rel_ampl>` `[:SENSe]:CORRection:IQ:I|Q: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 analyzer's port. This allows for removal of a DC offset before reaching the analyzer's input port voltage limits. For example, a signal that varies 1 V peak-to-peak with a DC offset equal to the analyzer's max input voltage would exceed the input limits of the analyzer for half its cycle. Removing the DC offset allows the analyzer 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 the Offset affects only the current probe type's setting and leaves all others unchanged.
Preset	0 V
State Saved	Saved with probe calibration data. It 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 will filter 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	`:INP:COUP:I DC`
	Turn off low frequency rejection on the I channel, allowing signals down to DC
	`:INP:COUP:I LFR1`
	Turn on low frequency rejection on the I channel for frequencies lower than 1.7 Hz
	`:INP:COUP:I LFR2`
	Turn on low frequency rejection on the I channel for frequencies lower than 0.14 Hz

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 the Coupling affects only the current probe type's setting and leaves all others unchanged.
Preset	DC
State Saved	Saved with probe calibration data. It 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	`:CAL:IQ:PROBe:I:CLE` Clear the calibration data for the I channel and the current probe (with EEPROM identification) or probe type (without EEPROM identification)

6.2.19.3 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 the user 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. The user 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.

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

The 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 not be connected to anything.
State Saved	No.

I/Q Isolation Calibration Time (Remote Command Only)

Returns the last date and time that the I/Q Isolation Calibration was performed. This is a remote query command only.

Remote Command	`:CALibration:IQ:ISOLation:TIME?`
Example	`:CAL:IQ:ISOL:TIME?`
Notes	This returns 6 integer values: year, month, day, hour, minute, second. When no calibration has been performed, all values will be 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 SCPI 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 Command Only)

Return the last date and time that the I/Q Probe Calibration was performed for a specific port. This is a remote query command only.

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 will be 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 SCPI 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 Command Only)

Return the last date and time that the I/Q Probe Calibration was performed for a specific port. This is a remote query command only.

Remote Command	`:CALibration:IQ:PROBe:IBAR:TIME?`
Example	`:CAL:IQ:PROB:IBAR:TIME?`
Notes	This returns 6 integer values: year, month, day, hour, minute, second. When no calibration has been performed, all values will be 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

6.2.19.4 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	This is unaffected by a Preset but is set to the default value (Q Same as I set to "On") on a "Restore Input/Output Defaults" or "Restore System Defaults->All"
State Saved	Saved in instrument state
Range	On | Off

Differential

Selects differential input on or off for the Q channel. For differential input (also called balanced input), the analyzer uses both the Q and Q-bar ports. When differential input is off (also called single-ended or unbalanced input), the analyzer uses only the Q port.

Remote Command	`:INPut:IQ:Q:DIFFerential OFF | ON | 0 | 1` `:INPut:IQ:Q:DIFFerential?`

Example	`:INP:IQ:Q:DIFF ON`
	Put the Q channel in Differential mode
	`:INP:IQ:Q:DIFF OFF`
	Put the Q channel in Single Ended mode

Notes	When Differential Input = On, the analyzer will check 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 Analyzer will use only the main port and the key will show that the Analyzer'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 This is unaffected by a Preset but is set to the default value on a "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	`:INP:IQ:Q:IMP HIGH`
	Set the Q channel input impedance to 1 MΩ
	`:INP:IQ:Q:IMP LOW`
	Set the Q channel input impedance to 50 Ω

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. (159.0005).
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 This is unaffected by Preset but is set to the default value on a "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 This is unaffected by a Preset but is set to the default value on a "Restore Input/Output Defaults" or "Restore System Defaults->All"
Min/Max	0 s/ 100 ns

6.2.19.5 Q Probe

Accesses the probe setup parameters for the Q channel. See "Combined Differential/Input Z (Remote Command Only)" on page 693

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. It survives a power cycle and is not affected by a Preset or Restore.
Min/Max	0.001/10000

This is an alternate form of the SCPI that allows input as a power instead of a ratio.

Remote Command	`[:SENSe]:CORRection:IQ:I|Q:ATTenuation <rel_ampl>` `[:SENSe]:CORRection:IQ:I|Q: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 analyzer's port. This allows for removal of a DC offset before reaching the analyzer's input port voltage limits. For example, a signal that varies 1 V peak-to-peak with a DC offset equal to the analyzer's max input voltage would exceed the input limits of the analyzer for half its cycle. Removing the DC offset allows the analyzer 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 the Offset affects only the current probe type's setting and leaves all others unchanged.
Preset	0 V
State Saved	Saved with probe calibration data. It 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 will filter 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	`:INP:COUP:Q DC`
	Turn off low frequency rejection on the Q channel, allowing signals down to DC
	`:INP:COUP:Q LFR1`
	Turn on low frequency rejection on the Q channel for frequencies lower than 1.7 Hz
	`:INP:COUP:Q LFR2`
	Turn on low frequency rejection on the Q channel for frequencies lower than 0.14 Hz

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 the Coupling affects only the current probe type's setting and leaves all others unchanged.
Preset	DC
State Saved	Saved with probe calibration data. It 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	`:CAL:IQ:PROBe:I:CLE` Clear the calibration data for the Q channel and the current probe (with EEPROM identification) or probe type (without EEPROM identification)

6.2.19.6 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 698

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 SCPI 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 Port Probe Calibration Time (Remote Command Only)

Return the last date and time that the I/Q Probe Calibration was performed for a specific port. This is a remote query command only.

Remote Command	`:CALibration:IQ:PROBe:Q:TIME?`

Example	:CAL:IQ:PROB:Q:TIME?
Notes	This returns 6 integer values: year, month, day, hour, minute, second. When no calibration has been performed, all values will be 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 SCPI 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 Command Only)

Return the last date and time that the I/Q Probe Calibration was performed for a specific port. This is a remote query command only.

Remote Command	:CALibration:IQ:PROBe:QBAR:TIME?
Example	:CAL:IQ:PROB:QBAR:TIME?
Notes	This returns 6 integer values: year, month, day, hour, minute, second. When no calibration has been performed, all values will be 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

6.2.20 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 698

Dependencies	Only appears when I/Q is the selected input

6.2.20.1 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 SCPI command.
State Saved	No.

6.2.20.2 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 SCPI command.
State Saved	No

6.2.20.3 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 SCPI command.
State Saved	No

6.2.20.4 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	`:CALibration:IQ:FLATness:QBAR`

Command	
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 SCPI command.
State Saved	No

6.2.20.5 I/Q Cable Calibration Time (Remote Command Only)

Returns the last date and time that the I/Q Cable Calibration was performed for a specific port. This is a remote query command only.

Remote Command	`:CALibration:IQ:FLATness:I|IBAR|Q|QBAR:TIME?`
Example	`:CAL:IQ:FLAT:I:TIME?`
Notes	This returns 6 integer values: year, month, day, hour, minute, second. When no calibration has been performed, all values will be 0.
Annunciation	Guided Calibration, Cable Calibration, Last Calibration

6.2.21 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 the Radio Test Mode. Only appears in modular products and only if the M9260A Audio Analyzer module is installed.
Preset	Unaffected by Mode Preset, but set to Channel 1 by Input/Output Preset.

6.2.22 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 and Option 107 is present.
Preset	OFF

6.2.23 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, only appear in Audio Measurements and only if Option 107 is present. In Radio Test, only appears in modular products and only if the M9260A Audio Analyzer module is installed.
Preset	AC

6.2.24 Audio Input Ground

This control 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 the Radio Test Mode. Only appears in modular products and only if the M9260A Audio Analyzer module is installed.
Preset	Unaffected by Mode Preset, but set to Ground by Input/Output Preset.

6.2.25 Audio In Impedance

This control lets you set the Impedance of the currently selected audio input channel.

The value entered by the user rounds 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 the Radio Test Mode. Only appears in modular products and only if the M9260A Audio Analyzer module is installed.
Preset	Unaffected by Mode Preset, but set to 600 by Input/Output Preset.

6.2.26 Input/Output Preset

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 generally associated with connections to the instrument, and most users would not want these resetting every time they pressed the Mode Preset key.

This is the same as the button found in the Preset dropdown, and also the same as the Input/Output button in the Restore Defaults menu under the System key.

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?”

The message provides an **OK** and **Cancel** button for the user to affirm or cancel the operation.

Example	`:SYST:DEF INP` presets all the Input/Output variables to their factory default values.

6.3 External Gain

This tab contains controls which 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, will immediately change all of the above, without new data needing to be taken.

NOTE **Changing the External Gain causes the analyzer 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 the 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 analyzer 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 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 713

Remote Command	`[:SENSe]:CORRection:SA[:RF]:GAIN <rel_ampl>` `[:SENSe]:CORRection:SA[:RF]:GAIN?`

Example	`:CORR:SA:GAIN 10`
	sets the Ext Gain value to 10 dB
	`:CORR:SA:GAIN -10`
	sets the Ext Gain value to -10 dB (that is, an attenuation of 10 dB)

Notes	Does not auto return
Dependencies	The reference level limits are determined in part by the External Gain/Atten, Max Mixer Level, and RF Atten This key is grayed out in Modes that do not support External Gain
Preset	This is unaffected by Preset but is set to 0 dB on a "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

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 analyzer over USB whenever it is connected to one of the analyzer’s USB ports.

While the USB Preamplifier is plugged into one of the analyzer’s USB ports, the analyzer 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 analyzer 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 analyzer 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	`:CORR:MS:GAIN 10`
	sets the Ext Gain value to 10 dB
	`:CORR:MS:GAIN -10`
	sets the Ext Gain value to -10 dB (that is, a loss of 10 dB)

Notes	Does not auto return
Dependencies	The reference level limits are determined in part by the External Gain, Max Mixer Level, RF Atten This key is grayed out in modes that do not support MS
Preset	This is unaffected by a Preset but is set to 0 dB on a "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

Remote Command	`[:SENSe]:CORRection:MS[:RF]:LOSS <rel_ampl>` `[:SENSe]:CORRection:MS[:RF]:LOSS?`

Example	`:CORR:MS:LOSS 10`
	sets the Ext Gain value to -10 dB, and subsequently querying :LOSS will give 10 dB
	`:CORR:MS:LOSS -10`

	sets the Ext Gain value to 10 dB, and subsequently querying :LOSS will give -10 dB
Notes	A positive value of <rel_ampl> in the above command means a loss and a negative value indicates a gain Anytime :LOSS is set it sets :GAIN to the negative value of the parameter sent Anytime :LOSS is queried it gives the negative of :GAIN
Preset	This is unaffected by a Preset but is set to 0 dB on a "Restore Input/Output Defaults" or "Restore System Defaults->All"
Min	100 dB
Max	-100 dB

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	`:CORR:BTS:GAIN 10`
	sets the Ext Gain value to 10 dB
	`:CORR:BTS:GAIN -10`
	sets the Ext Gain value to -10 dB (that is, a loss of 10 dB)

Notes	Does not auto return
Dependencies	The reference level limits are determined in part by the External Gain, Max Mixer Level, RF Atten This key is grayed out in modes that do not support BTS
Preset	This is unaffected by a Preset but is set to 0 dB on a "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

Remote Command	`[:SENSe]:CORRection:BTS[:RF]:LOSS <rel_ampl>` `[:SENSe]:CORRection:BTS[:RF]:LOSS?`

Example	`:CORR:BTS:LOSS 10`
	sets the Ext Gain value to -10 dB, and subsequently querying :LOSS will give 10 dB
	`:CORR:BTS:LOSS -10`
	sets the Ext Gain value to 10 dB, and subsequently querying :LOSS will give -10 dB

Notes	A positive value of <rel_ampl> in the above command means a loss and a negative value indicates a gain Anytime :LOSS is set it sets :GAIN to the negative value of the parameter sent

	Anytime :LOSS is queried it gives the negative of :GAIN
Preset	This is unaffected by a Preset but is set to 0 dB on a "Restore Input/Output Defaults" or "Restore System Defaults->All"
Min	100 dB
Max	-100 dB

6.3.4 I Ext Gain

This function 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 This is unaffected by a Preset but is set to 0 dB on a "Restore Input/Output Defaults" or "Restore System Defaults->All"
State Saved	Yes
Min	-100 dB
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

This function 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 This is unaffected by a Preset but is set to 0 dB on a "Restore Input/Output Defaults" or "Restore System Defaults->All"
State Saved	Saved in instrument state
Min	-100 dB
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 is selected, I Ext Gain value is applied to both I and Q channel input if the Input Path is I+jQ. When Independent 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

This tab contains controls which let you pick 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 are how you switch back and forth from actual data at the analyzer 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 analyzer 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 the :FEED:DATA SCPI is sent an Undefined Header error is generated.

The available choices depend on what measurement you are running. All measurements support Input; Capture Buffer and File are only available in certain measurements, shown in the table below. The choice of the internal Recorded data area is only available in the Pulse application.

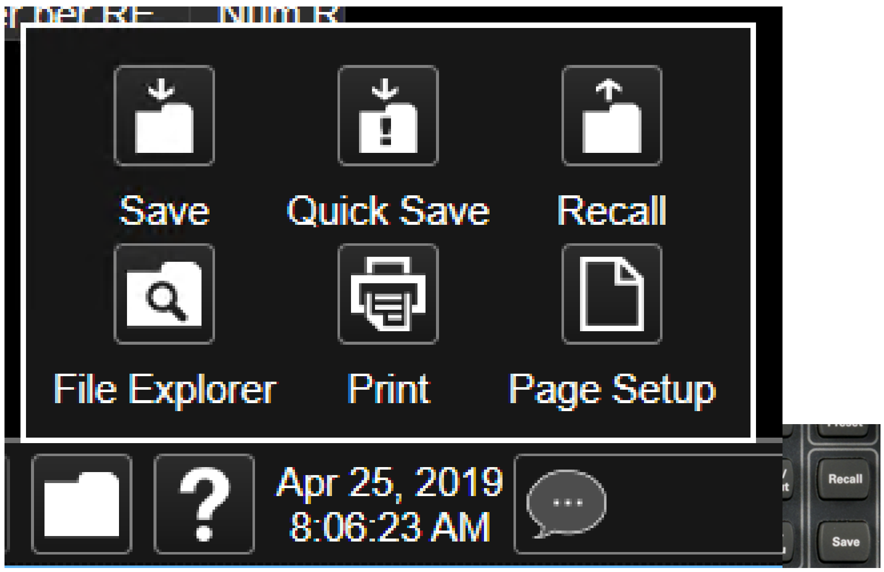
Measurement	Capture Buffer	File
WCDMA Code Domain	x	
WCDMA Mod Accuracy	x	
VMA Digital Demod		x
VMA Custom OFDM		x
5G NR Modulation Analysis		x
FDD LTE-A Modulation Analysis		x
TDD LTE-A Modulation Analysis		x
WLAN Modulation Analysis	x	x
WLAN Spectral Flatness		x
WLAN MIMO Modulation Analysis		x
Analog 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 [Mode: VMA, 5GNR, LTEAFDD, LTEATDD, WLAN, BT, ADEMOD, SRCOMMS] (under the Save hardkey or the Save icon in the File panel)

Recall, Recording [Mode: VMA, 5GNR, LTEAFDD, LTEATDD, WLAN, BT, ADEMOD, SRCOMMS] (under the Recall hardkey or the Recall icon in the File panel)

Sweep, Recording tab

Sweep, Playback tab

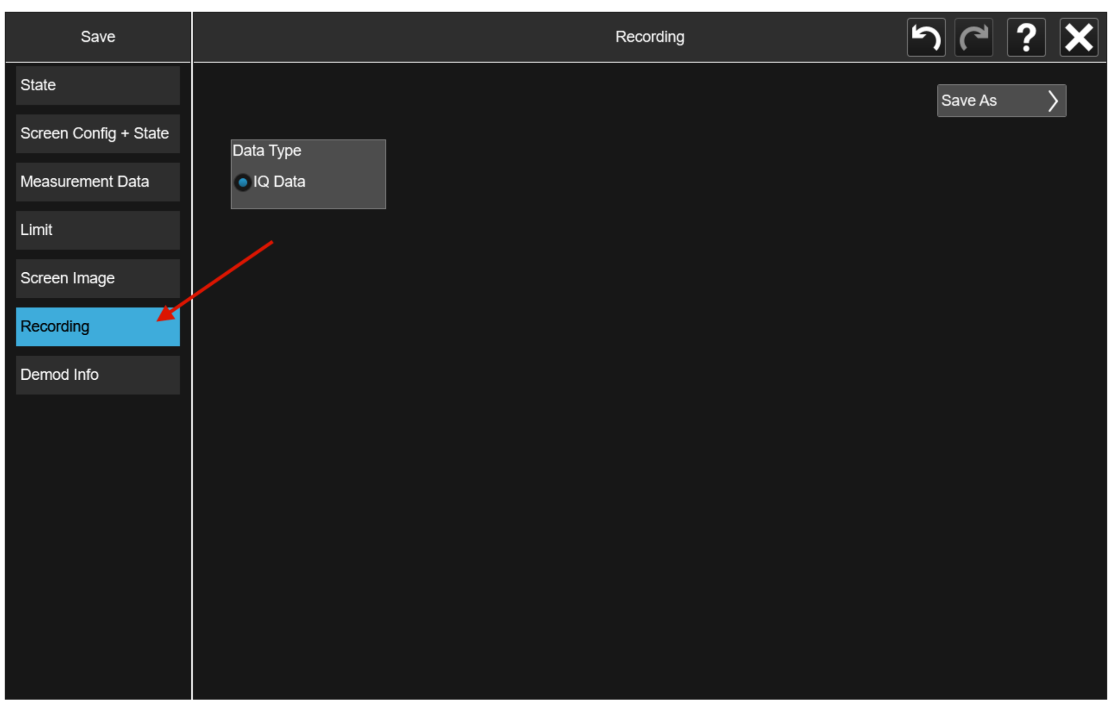
Input/Output, Data Source tab (this tab)

Saving a Recording

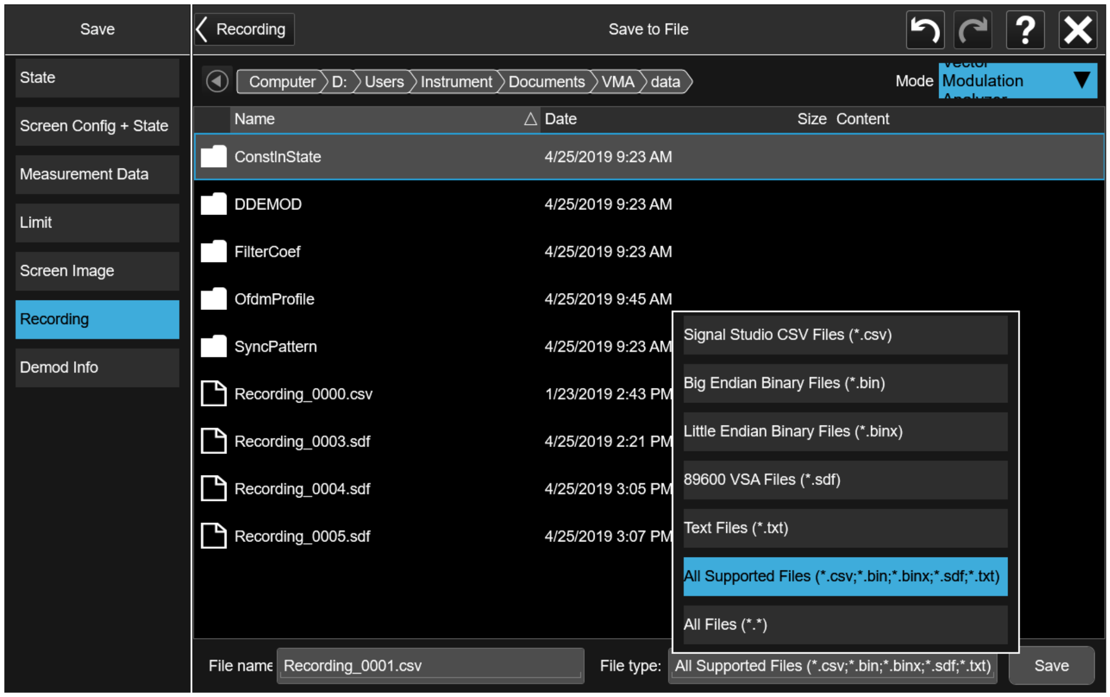
When you save a recording, a certain number of measurement records get saved to a Recording file. The amount of data which gets saved varies depending on the measurement and measurement settings. We will use VMA Digital Demod to illustrate the process.

If you go to the Sweep menu and press the Recording tab, 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:

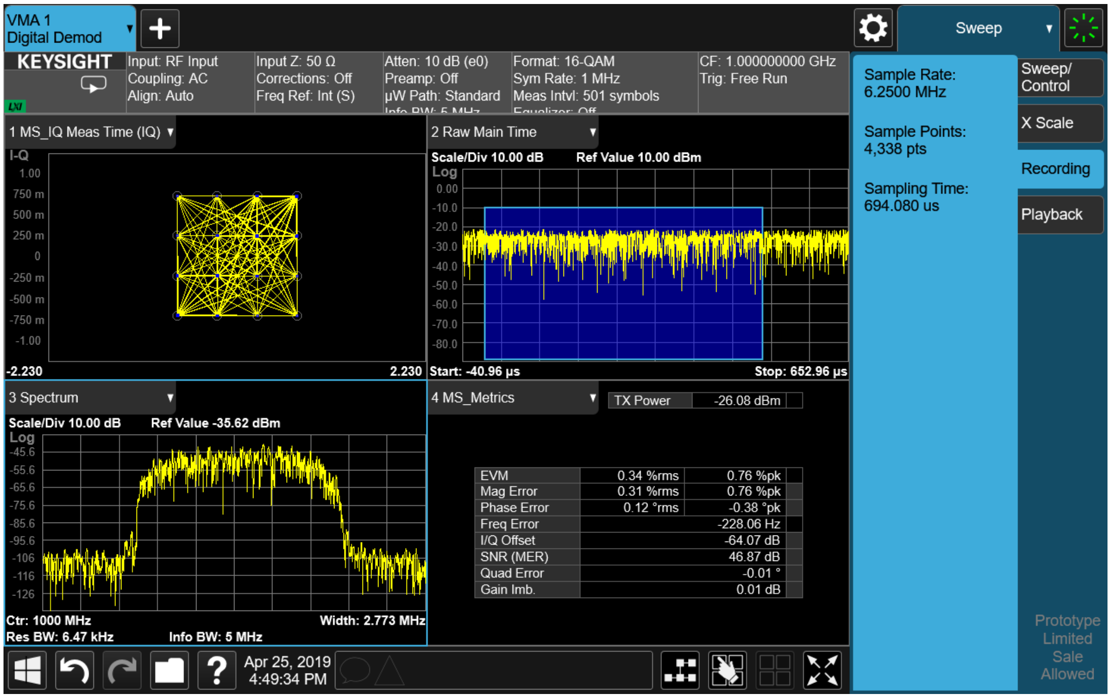


Then press Save As and choose the file type you would like to use for the Save (CSV, SDF, TXT, BIN, BINX). You can find details about the various file formats in the Recording [Mode: VMA, 5GNR, LTEAFDD, LTEATDD, WLAN, BT, ADEMOD, SRCOMMS] section.



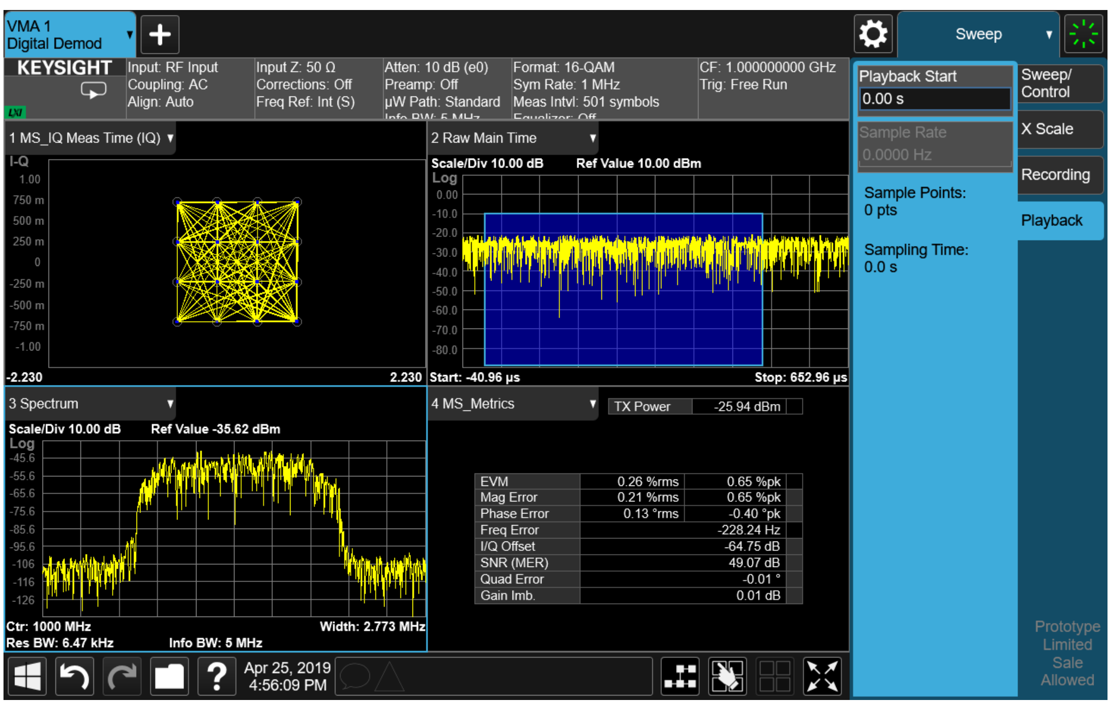
Then press “Save” to save the raw I/Q data of the current measurement.

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 go to the Sweep menu and press the Playback tab, 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:

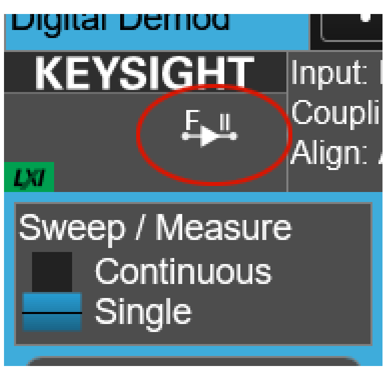
Note that the Sample Rate key is grayed out if the file type you loaded contains Sample Rate information. BIN and BINX files do not include sampling rate information inside the file, so after recalling one of these file types, you will need to set the Sample Rate. You should have noted the Sample Rate which 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 analyzer:

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 analyzer 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.

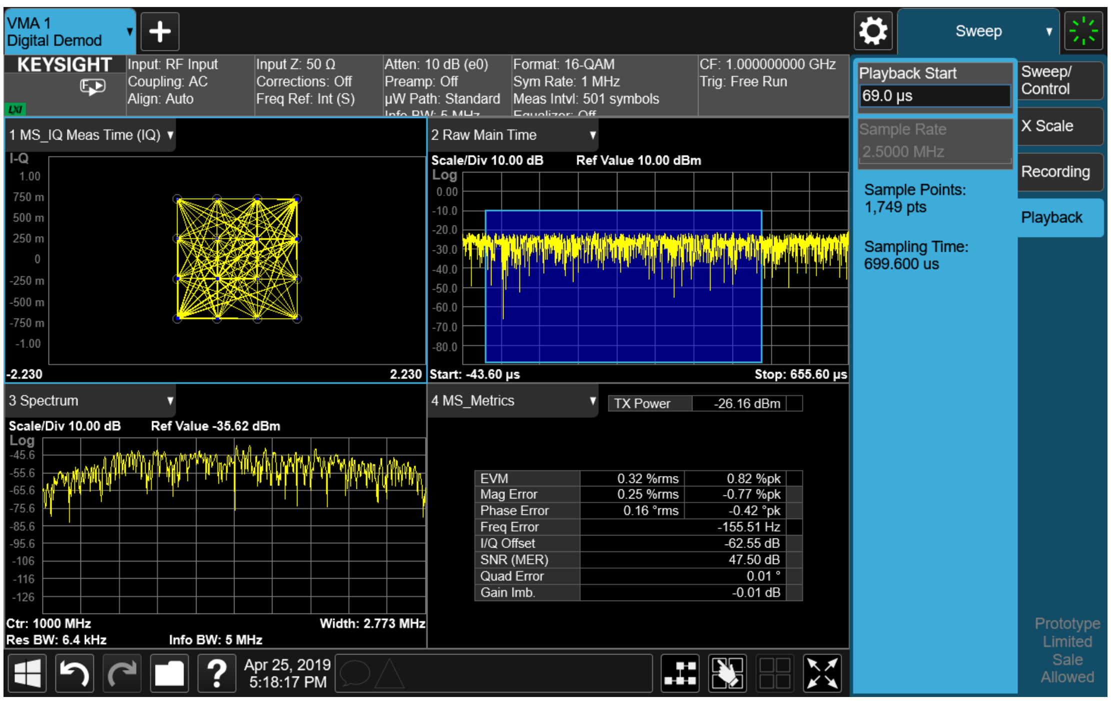
If you wish to return to looking at data at the analyzer input, simply change the **Data Source** control from File back to Input.

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

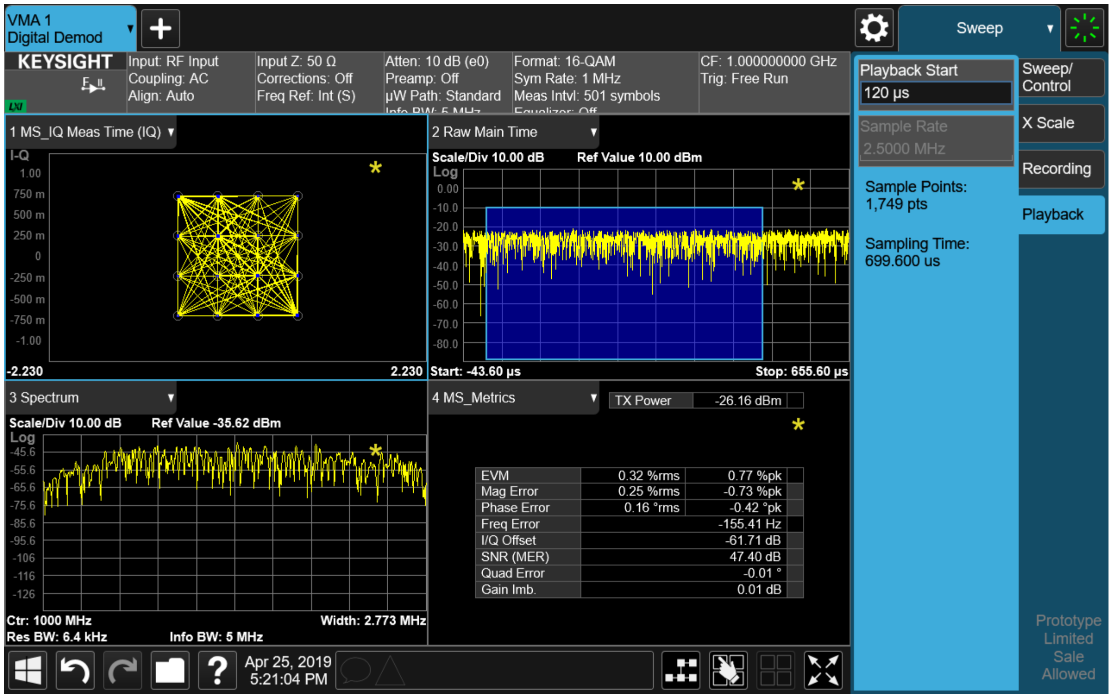
In this mode, turn the knob clockwise or use the Up key on the front panel to move through successive records in the recording. You will see the Playback Start control change from 0 to successively higher values as you move through the records.



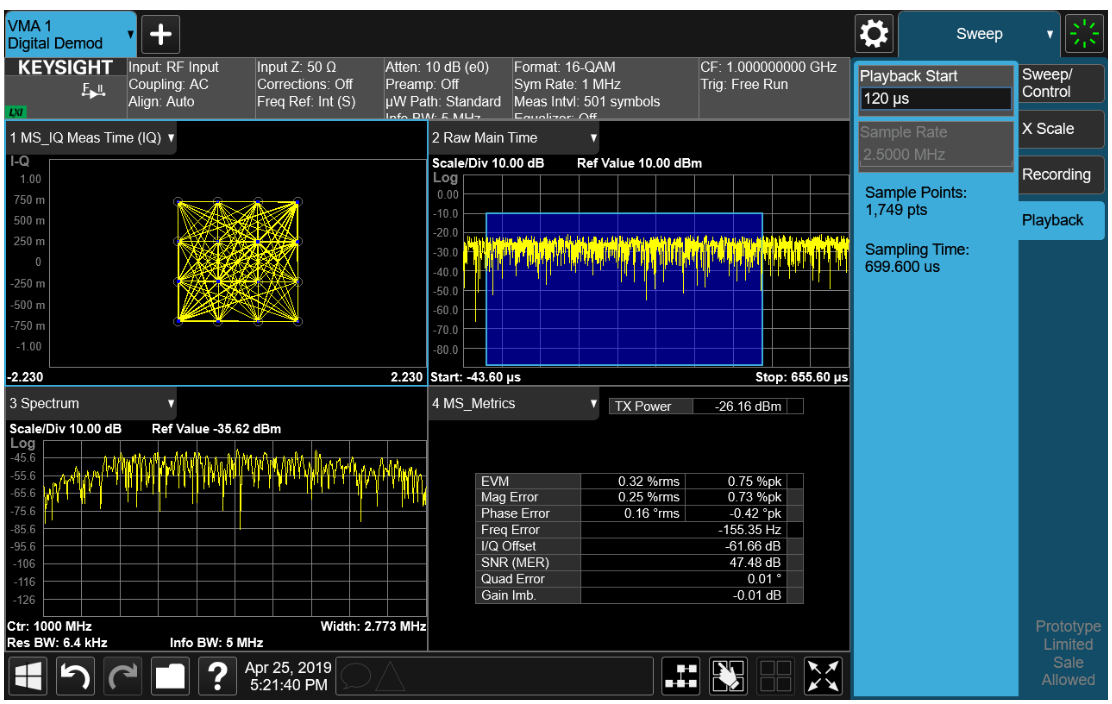
Single Pause mode

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 hit Restart, the invalid data indicator will disappear, as below:



6.4.1 Data Source

Gives you the choice of what you want to use as the input to the analysis engine:

– 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,orEXTMixer) currently selected on the Input tab under Input/Output.

– Capture Buffer: 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: 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: 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 for a table of available choices on a per-measurement basis.

Remote Command	`[:SENSe]:FEED:DATA INPut | STORed | RECorded | FILE` `[:SENSe]:FEED:DATA?`

Example	`:FEED:DATA INP`
	causes the measurement to look at the input selection
	`:FEED:DATA STOR`
	causes stored measurement data to be used with a different measurement that supports this
	`:FEED:DATA?`

Notes	INPut = Input STORed = Capture Buffer RECorded = Recorded FILE = File
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. In cdma2000, Capture Data is available only for Code Domain and Modulation Accuracy measurements. For all other measurements, the ‘Capture Buffer’ key is grayed-out.
Preset	This is unaffected by Preset but is set to INPut on a "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

Pressing this control 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 by a user. There is no save/recall function to save the raw data in an external media. However 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	This is command only, there is no query
Dependencies	Grayed out in the SA measurement.
Backwards Compatibility SCPI	[:SENSe]:FEED:SOURce:STORe

6.5 Corrections

This tab 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 enteredby the user, sent over SCPI, or loaded from a file. They allow you to correct the response of the analyzer for various use cases. The 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 analyzer, 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 which 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 analyzer 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 the EMI Measurement, 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 the OFF state to the ON state 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 the OFF state to the ON state automatically turns on "Apply Corrections". Note that if any Correction is turned on which has a transducer unit set (other than “None”), the Y Axis Unit of the analyzer is forced to that Transducer Unit. All other Y Axis Unit choices are grayed out. This command will generate an “Option not available” error unless you have the proper option installed in your instrument.
Preset	Not affected by a 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 will display as amber to indicate Corrections are in use.
Backwards Compatibility Notes	Unlike legacy analyzers, 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 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

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` `[:SENSe]:CORRection:CSET[1]|2|...|16:RF:PORT?`

Example	`:CORR:CSET:RF:PORT CINP`
	Set Correction Port for Correction 1 to apply to the currently selected input.
	`:CORR:CSET4:RF:PORT RRH1RFHD2`
	Set Correction Port for Correction 4 to apply to Radio Head 1, RF Tx/Rx Port 2

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 as well.
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, RFFD is not available on M9421A. 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

Parameters, notes and examples. Note that the presence of these ports is highly hardware dependent.

Correction Port	Example	Note
Current Input	`:CORR:CSET:RF:PORT CINP`	The correction will be applied to whichever input is currently selected in the Input menu
RF Input	`:CORR:CSET:RF:PORT`	Main RF Port

Correction Port	Example	Note
	RFIN	Not available on EXM with hardware M9431A
RF Input 2	:CORR:CSET:RF:PORT RFIN2	Second RF Port, labeled RF Input 2 Only available on certain instruments. Not available on modular analyzers.
BBIQ input	:CORR:CSET:RF:PORT AIQ	Requires option BBA Not available on modular analyzers.
External Mixer	:CORR:CSET:RF:PORT EMIX	Requires option EXM Not available on modular analyzers.
Antenna	:CORR:CSET:RF:PORT ANT	Antenna input port on M9470A, labeled Ant
Generator	:CORR:CSET:RF:PORT ANT	Generator output port on M9470A, labeled Gen
T/R	:CORR:CSET:RF:PORT TR	T/R port on M9470A, labeled T/R
RF Full Duplex	:CORR:CSET:RF:PORT RFFD	On modular analyzers, labeled RFFD. Option “FDX” is required to enable RFFD port.
RF Half Duplex	:CORR:CSET:RF:PORT RFHD	On modular analyzers, labeled RFHD. Option “HDX” is required to enable RFHD port.
A1	:CORR:CSET:RF:PORT A1	On E7760
A2	:CORR:CSET:RF:PORT A2	On E7760
A3	:CORR:CSET:RF:PORT A3	On E7760
B1	:CORR:CSET:RF:PORT B1	On E7760
B2	:CORR:CSET:RF:PORT B2	On E7760
B3	:CORR:CSET:RF:PORT B3	On E7760
IFIO1	:CORR:CSET:RF:PORT IFIO1	On E7760
IFIO2	:CORR:CSET:RF:PORT IFIO2	On E7760
RF Output	:CORR:CSET:RF:PORT RFO	Appears on some modular analyzers. Not available on EXM with hardware M9431A
RFIO1	:CORR:CSET:RF:PORT RFIO1	Appears on some modular analyzers.
RFIO2	:CORR:CSET:RF:PORT RFIO2	Appears on some modular analyzers.
RFIO3	:CORR:CSET:RF:PORT RFIO3	Only available in EXM with hardware M9431A
RFIO4	:CORR:CSET:RF:PORT RFIO4	Only available in EXM with hardware M9431A
GPS out	:CORR:CSET:RF:PORT GPS	Appears on some modular analyzers.
GNSS out	:CORR:CSET:RF:PORT GNSS	Appears on some modular analyzers.

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 which is only an Output is always corrected as an output if the Correction is On. A port which is only an Input is always corrected as an Input if the Correction is On. For a port which 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 which 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. RFIO1 | RFIO2 | RFIO3 | RFIO4 | RFFD | TR | A1 | A2 | A3 | B1 | B2 | B3 | IFIO1 | IFIO2
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 will result 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 analyzer 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 will only operate properly if the analyzer 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.

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 analyzer 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 is placed on the screen that says "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.

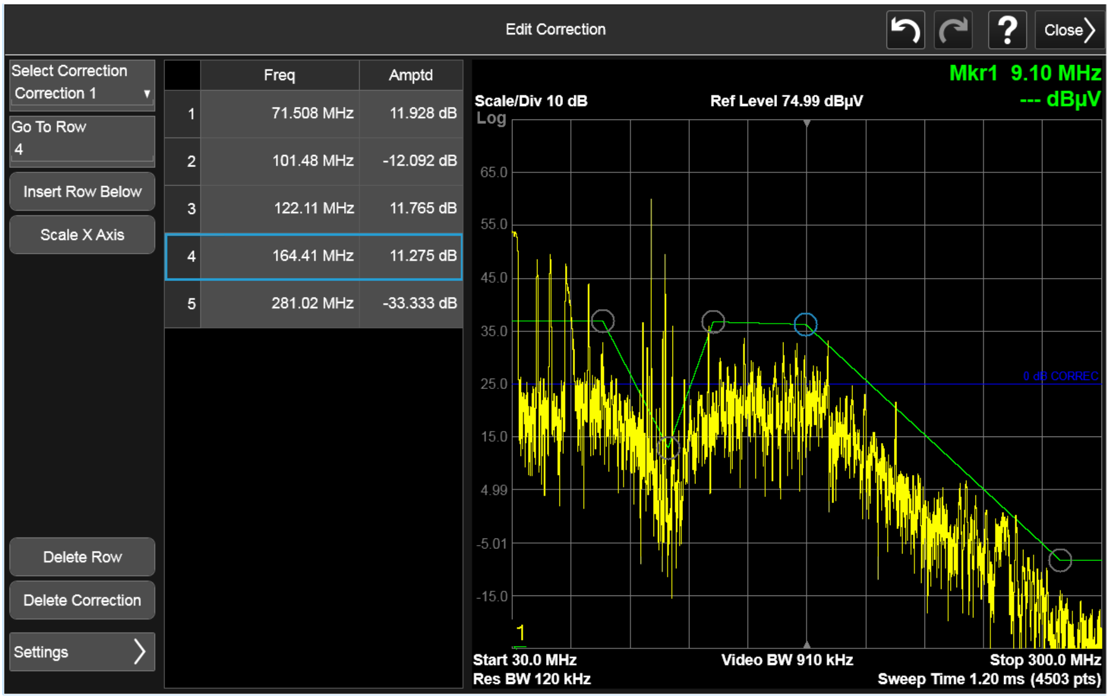
Remote Command	`[:SENSe]:CORRection:CSET[1]|2|...|16:DELete`

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

The Settings control on the Edit Corrections menu opens up another menu page which 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

This setting 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 only support Linear Interpolation.

See "Interpolation" on page 739

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 a Preset. Set to Linear by Restore Input/Output Defaults.
State Saved	Saved in instrument state.

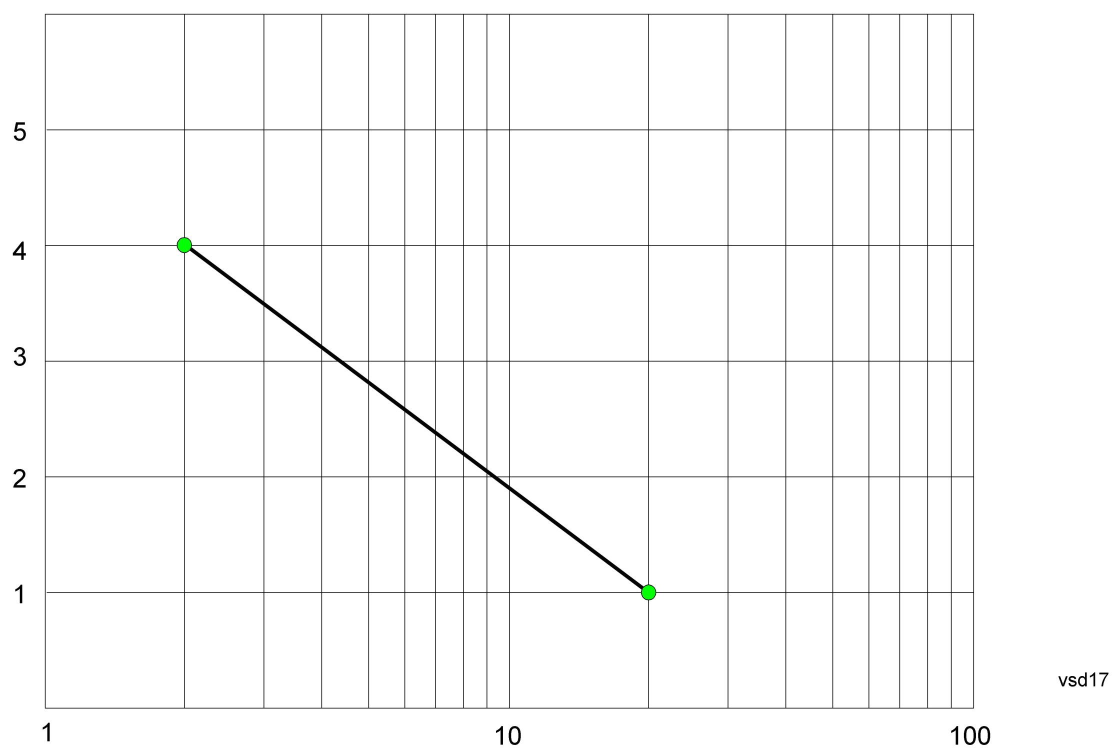
Interpolation

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.

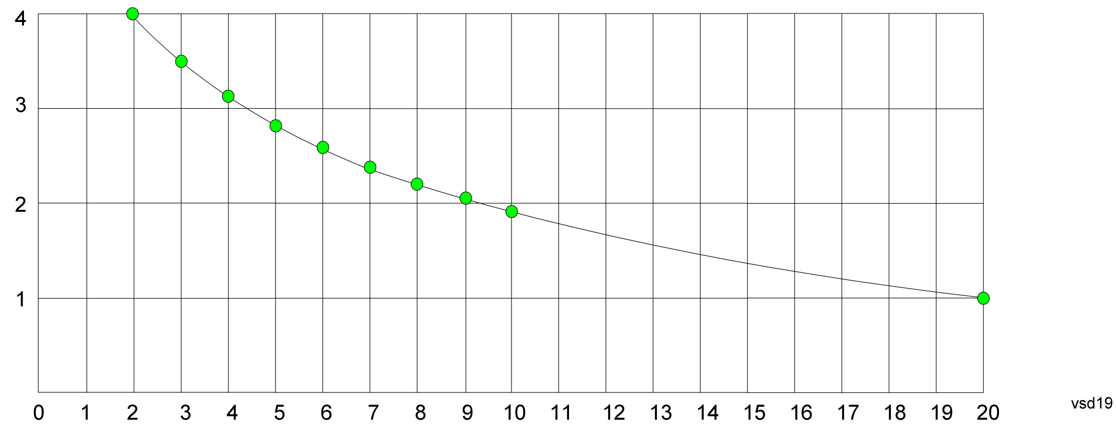
To effect this correction, the goal, for any particular start and stop frequency, is to build a correction trace, whose number of points matches the current Sweep Points setting of the instrument, which will be used to apply corrections on a bucket by bucket basis to the data traces.

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.

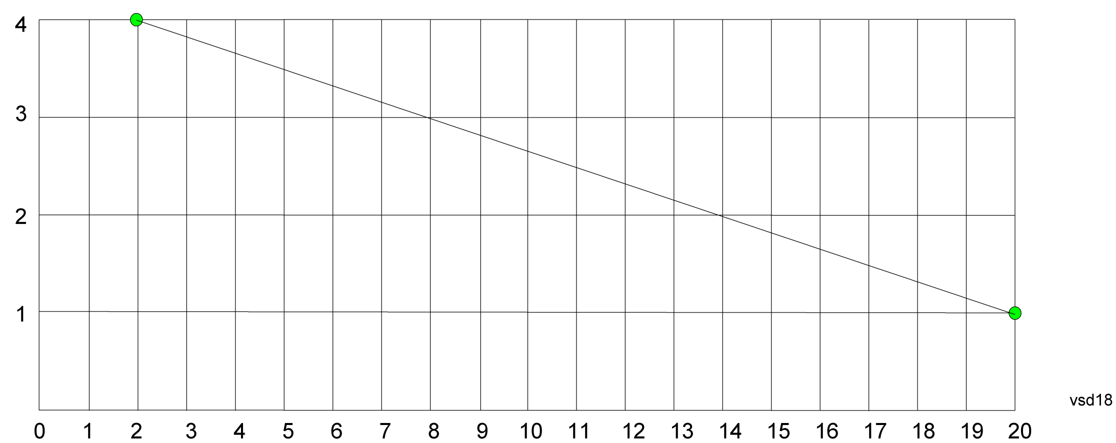
If we interpolate on a log scale, we assume that the line between the two points is a straight line on the log scale. For example, let's say the two points are (2,4) and (20,1). A straight line between them on a log scale looks like:



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 analyzer 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 analyzer 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 analyzer 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 741

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 will be 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.

For M1750A only Magnitude will be applied with Complex Corrections. Some measurements, like Swept SA, have no phase component to the measurement, but nonetheless support Complex Corrections. For such measurement, 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	`:CCOR:CSET:SEL 3`
	Select correction 3
	`:CCOR:CSET:DEL`

	Delete correction 3

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	`:CCOR:CSET:SEL 3`
	Select correction 3
	`:CCOR:CSET ON`
	Turn correction 3 on

Dependencies	Changing this from `OFF` to `ON` automatically turns on "Apply Corrections" Key is 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 a 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 displays in amber color 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 731.

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	`:CCOR:CSET:SEL 2`
	Select correction 2
	`:CCOR:CSET:PORT RFIN`
	Set correction 2 to RFIN
	`:CCOR:CSET:PORT RRH1RFHD2`
	Set Correction 2 to Radio Head 1, RF Tx/Rx Port 2

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, RFFD is not available on M9421A. 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 a 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	`:CCOR:CSET:SEL 4`
	Select correction 4
	`:CCOR:CSET:DIR INP`
	Set correction 4 to Input

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 which can be either an Input or an Output (or both), such as RFHD, RFFD or T/R, all three choices are available. RFIO1 | RFIO2 | RFIO3 | RFIO4 | RFFD | TR | A1 | A2 | A3 | B1 | B2 | B3 | IFIO1 | IFIO2
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 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: if line 2 begins with a !, the ! is not displayed in the Description field.)

Remote Command	`[:SENSe]:CCORrection:CSET:DESCription "text"` `[:SENSe]:CCORrection:CSET:DESCription?`
Example	`:CCOR:CSET:SEL 4` Select correction 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 a 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: if line 3 begins with a !, the ! is not displayed in the Comment field.)

Remote Command	`[:SENSe]:CCORection:CSET:COMMent "text"` `[:SENSe]:CCORection:CSET:COMMent?`

Example	`:CCOR:CSET:SEL 4`
	Select correction 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 748) it says “(SCPI)”. If no correction is loaded, it says “(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)

This setting 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 only support Linear Interpolation.

See "Interpolation" on page 739 under Corrections.

Remote Command	`[:SENSe]:CCORrection:CSET:X:SPACing LINear | LOGarithmic` `[:SENSe]:CCORrection:CSET:X:SPACing?`
Example	`:CCOR:CSET:SEL 4`

	Select correction 4 `:CCOR:CSET:X:SPAC LIN` Set linear interpolation
Preset	Unaffected by a Preset. Set to Linear by Restore Input/Output Defaults.
State Saved	Saved in instrument state.

6.5.7.11 Set Data (Remote Command Only)

This command allows you to 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	`:CCOR:CSET:SEL 4`
	Select correction 4
	`:CCOR:CSET: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 4.

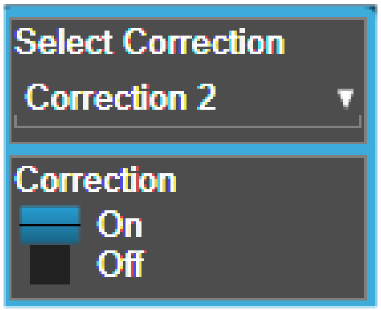
Preset	Empty after Restore Input/Output Defaults. Survives a shutdown or restart of analyzer application (including a power cycle).
State Saved	Saved in instrument state.
Min	Freq: 0 Hz Amptd: -1000 dBm
Max	Freq: 1 THz Amptd: +1000 dBm

6.5.8 Apply Corrections

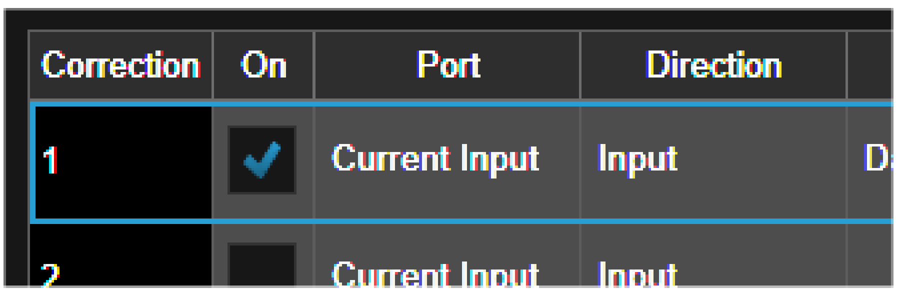
When you turn on Apply Corrections, all of the Corrections which are turned On are applied to the measured data. When you turn off Apply Corrections, no Corrections are applied, even if they are turned On.

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 731) and "Complex Corrections" on page 742.

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

This function 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.

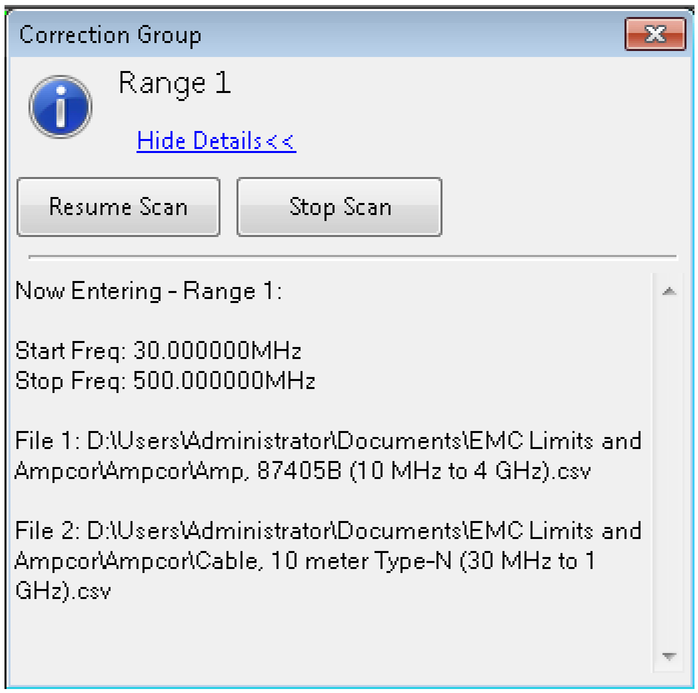
Note that the Corrections in the Correction Group, although they are loaded into memory, are independent of the main Correction registers at the top of the Corrections menu, and will not display under the Select Correction, Correction On/Off or Edit Correction functions.

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 will be set to OFF and the correction on/off state keys will be 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 a Preset. Set to OFF by **Restore Input/Output Defaults**
State Saved	Saved in instrument state.

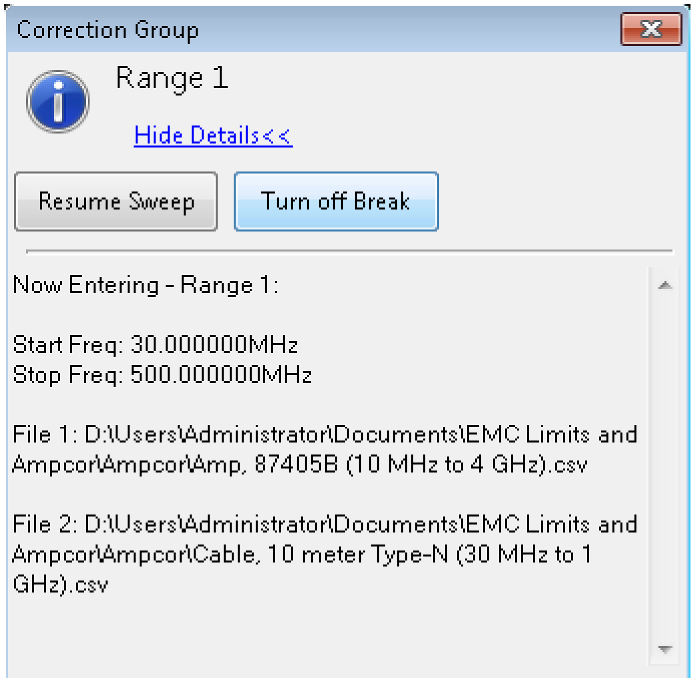
6.5.11 Break

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 Swept SA measurement of Spectrum Analyzer application, the message prompt is like below. You are given the option to resume the sweep or turn off the break. If it is 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 Frequency Scan measurement of Emi Receiver application, if break is turned on when a SCPI is sent to start the scan, the scan will be paused when it reaches the boundary of correction group ranges. Bit 8 (Paused) of status operation register will set to true. To resume, send “INITiate2:RESume” command. To stop the scan, send “ABORt” command. When running Swept SA measurement of Spectrum Analyzer application, the break state is not affecting the operation of sweep when SCPI controlling sweep is sent. Instead, the SCPI commands close the message prompt if it is showing up 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 a 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 there is invalid data 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	When reload is failed, error icons appear at the status column of correction group editor for range that has 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 a Preset, it survives power cycle. You can set it to empty by 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.

Notes	No SCPI. Front panel only.
Preset	Unaffected by a Preset. Set to empty by **Restore Input/Output Defaults**

6.5.13.5 Specify File

Pressing this key brings up the file browsing menu. When a file is selected, correction data will be loaded from the file. The correction data will be there 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 which contains a different antenna unit, a Mass Storage error is generated. If you try to add a correction file which contains data that does not cover the range frequency, the file cannot be added, an Execution error is generated.

6.5.13.6 Remove File

Pressing this key 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 which 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.

Notes	No SCPI. Front panel only.
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 a 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 a 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 a 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 a Preset. Set to empty by **Restore Input/Output Defaults**
Min	0
Max	1 THz

6.5.14 Merge Correction Data (Remote Command Only)

The command takes 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.

Any new point with the same frequency as an existing correction point will replace the existing point's amplitude with 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 analyzer application (including power cycle)
Min	Freq: 0 Hz Amptd: -1000 dBm
Max	Freq: 1 THz Amptd: +1000 dBm

6.5.15 Set (Replace) Data (Remote Command Only)

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.

An Ampcor array can contain 2000 points maximum.

<table>
<tr><td>Remote Command</td><td>[:SENSe]:CORRection:CSET[1]|2|...|16:DATA <freq>, <ampl>, ...
[:SENSe]:CORRection:CSET[1]|2|...|16:DATA?</td></tr>
<tr><td>Example</td><td>: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.</td></tr>
<tr><td>Preset</td><td>Empty after Restore Input/Output Defaults. Survives a shutdown or restart of analyzer application (including a power cycle).</td></tr>
<tr><td>State Saved</td><td>Saved in instrument state.</td></tr>
<tr><td>Min</td><td>Freq: 0 Hz
Amptd: -1000 dBm</td></tr>
<tr><td>Max</td><td>Freq: 1 THz
Amptd: +1000 dBm</td></tr>
</table>

6.5.16 Correction Group Range Data (Remote Command Only)

The command takes an ASCII series of alternating start frequency, stop frequency and file names, each value separated by commas.

The values sent in the command will replace the content of correction group.

The default path for CSV files is:

D:\My Documents\amplitudeCorrections\

<table>
<tr><td>Remote Command</td><td>[: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?</td></tr>
<tr><td>Example</td><td>: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.</td></tr>
<tr><td>Notes</td><td><filename> is the string containing the path of the correction files.
<filename2>, <filename3>, <filename4>, <filename5>, <filename6>, <filename7>, <filename8> are optional. User 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.</td></tr>
</table>

	Data for ranges 1 to 10 must be set in ascending order. If you try to set the data for a correction group range which 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 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 which 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 analyzer 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 defined in table is accepted without error.

6.6 Freq Ref Input

This tab 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 761

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 model numbers. If not available, the choice will not appear, and sending the PULSe parameter via SCPI will generate an error. For VXT models M9420A/21A/10A/11A/15A the only available selection is EXTernal, unless M9420A/21A/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 E7760 and M8920A the only available selections are INTernal|EXTernal This control is not available in UXM
Preset	This is unaffected by a Preset but is set to EXTernal for VXT models M9420A/21A/10A/11A/15A, INTernal for E7760, and SENSe for other models, on a "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 the 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 a part of state in the X-Series.

Remote Command	`[:SENSe]:ROSCillator:SOURce?`
Notes	The query [SENSe]:ROSCillator:SOURce? returns the current switch setting. This means: 10. 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 and not SENSe. 11. If it was set to SENSe and there is an external reference present, the query returns EXTernal and not SENSe. 12. If it was set to SENSe and there is a 1 pps signal present, the query returns PULSe and not SENSe. 13. If it was set to EXTernal, then the query returns "EXTernal" 14. If it was set to INTernal, then the query returns “INTernal”. 15. If it was set to PULSe, then the query returns “PULSe” Note: In the EXM, the SCPI query always returns “INTernal” for non-controlling instances.
Preset	For VXT models M9420A/21A/10A/11A/15A: EXTernal For E7760, M8920A: INTernal All other models: SENSe
Backwards Compatibility Notes	The query [:SENSe]:ROSCillator:SOURce? was a query-only command in ESA which always returned whichever reference the instrument was using. The instrument automatically switched to the ext ref if it was present. In PSA (which had no sensing) the command [:SENSe]:ROSCillator:SOURce set the reference (INT or EXT), so again its query returned the actual routing. Thus the query form of this command is 100% backwards compatible with both instruments.

Remote Command	`[:SENSe]:ROSCillator:SOURce INTernal | EXTernal`
Notes	For PSA compatibility the command form is provided and is directly mapped to [:SENSe]:ROSCillator:SOURce:TYPE Note: In the EXM, the SCPI command does nothing for non-controlling instances.

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/21A/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 model M9415A, External Freq Ref Input controls the “REF In” port on the front panel.

NOTE In the 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 under 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 on the **External Ref Freq** control), it will use this signal as an External Reference. If it senses a 1 pulse per second signal, it will use 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 analyzer 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” on a System, Restore Defaults, Align or a 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, will cause 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 analyzer 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 analyzer 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 analyzer 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 analyzer’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 analyzer 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 analyzer 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.

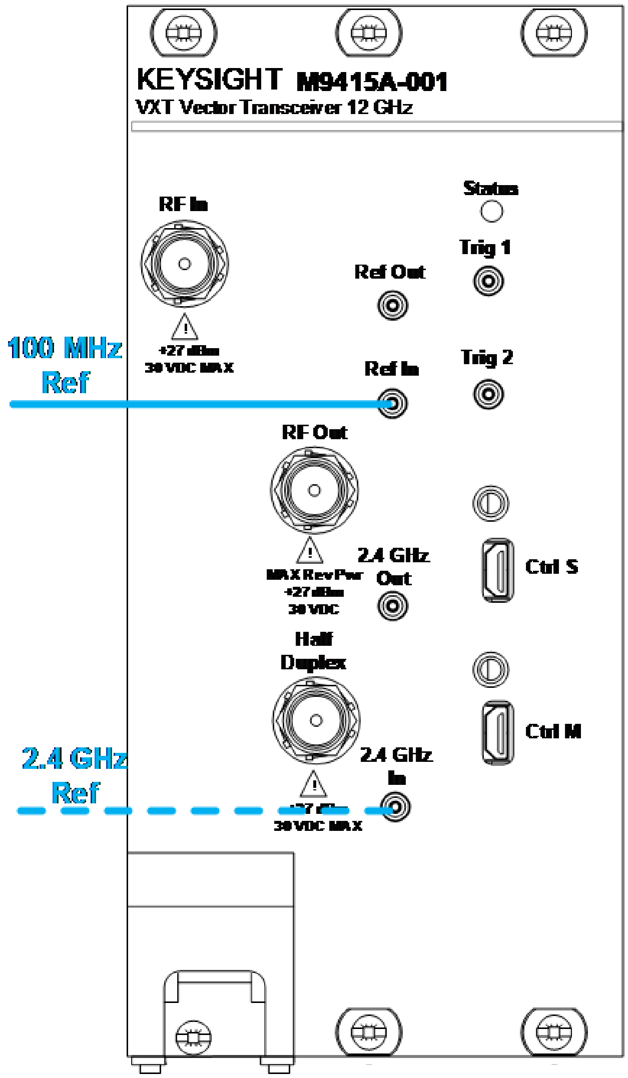
Note that this value only affects the instrument’s ability to lock. It does not affect any calculations or measurement results. See "Freq Offset" in the Frequency section for information on how to offset frequency values.

Remote Command	`[:SENSe]:ROSCillator:EXTernal:FREQuency <freq>` `[:SENSe]:ROSCillator:EXTernal:FREQuency?`
Example	`:ROSC:EXT:FREQ 20 MHz`

	sets the external reference frequency to 20 MHz, but does not select the external reference. `:ROSC:SOUR:TYPE EXT` selects the external reference.
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). This control is not available in UXM. For VXT models M9420A/21A/10A/11A: only 100 MHz is available For VXT model M9415A: only 100 MHz and 2.4 GHz are available. See More Information about VXT model M9415A.
Preset	This is unaffected by a Mode Preset or an "Input/Output Preset" or "Restore Defaults,Input/Output" but is set to 100 MHz for VXT models and 10 MHz for other models, on a "Restore Defaults, Misc" or "Restore Defaults,All" or by pressing the “Default External Ref Freq” button.
State Saved	Power On Persistent (survives power cycle)
Min	CXA, EXA, N897xB, E7760, M8920A, CXA-m: 10 MHz VXT models: 100 MHz All other models: 1 MHz
Max	CXA, EXA, N897xB, M8920A, CXA-m: 10 MHz EXA with option R13: 20 MHz MXA, PXA, EXM: 50 MHz VXT models M9420A/21A/10A/11A: 100 MHz VXT model M9415A: 2.4 GHz

More Information about VXT model M9415A

The following figure shows the front panel of VXT model M9415A:


KEYSIGHT M9415A-001
VXT Vector Transceiver 12 GHz
RF In
Status
Trig 1
Ref Out
100 MHz Ref
+27 dBm
30 VDC MAX
Ref In
Trig 2
RF Out
2.4 GHz Out
MAX Rev Pwr
+27 dBm
30 VDC
Ctrl S
Half Duplex
Ctrl M
2.4 GHz Ref
2.4 GHz In
30 VDC MAX

To use 100 MHz reference signal, connect it to the REF In port. To use 2.4 GHz reference signal, connect it to the 2.4 GHz In port. 2.4 GHz reference provides better performance.

Invalid External Ref Freq will be clipped to the previous or the correct one. If neither 100 MHz nor 2.4 GHz reference were connected, a Reference Unlocked error will be reported. When reference unlocked happens, connect a valid reference signal to recover the system.

6.6.3 Default External Ref Freq

This button 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	This is command only, there is no query
Dependencies	Grayed out if the Ext Ref Freq is already set to the default This control does not appear in EXM, UXM, VXT models or M8920A.

6.6.4 LO Input

This parameter sets the LO Input to External or Internal.

See More Information.

Remote Command	`[:SENSe]:ROSCillator:LO:INPut INTernal | EXTernal` `[:SENSe]:ROSCillator:LO:INPut?`
Example	`:ROSC:LO:INP EXT` `:ROSC:LO:INP?`
Dependencies	Only available in VXT models M9410A/11A/15A For VXT model M9415A, this parameter is read-only. LO Input depends on Ext Ref Freq. when Ext Ref Freq is 100 MHz, LO Input will be set to Internal. when Ext Ref Freq is 2.4 GHz, LO Input will be set to

	External
Preset	`INTernal`
State Saved	Saved in instrument state

More Information

Parameter	SCPI Example	Notes
Internal	`:ROSC:LO:INP EXT`	When Internal is selected, internal reference signal will be used to synchronize the LO board
External	`:ROSC:LO:INP INT`	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 Input to External: For VXT model M9415A, a 2.4 GHz reference signal is required to rout to the 2.4 GHz In port 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

This control 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 analyzer by several dB, even tens of dB, by using an external reference with excellent phase noise. When an external reference is used the analyzer'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. This key only appears in analyzers equipped with the required hardware. This control does not appear in EXM, UXM, VXT models or the E7760.
Preset	This is unaffected by a Preset but is set to Narrow on a "Restore Input/Output Defaults" or "Restore System Defaults -> All"
State Saved	Saved in Input/Output state.

6.6.6 Reference Oscillator On/Off (SCPI Command Only)

This command is 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.

Remote Command	`[:SENSe]:ROSCillator:OUTPut[:STATe] ON | OFF | 1 | 0 [:SENSe]:ROSCillator:OUTPut[:STATe]?`
Example	`:ROSCillator:OUTP ON`
Notes	The query 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.
Preset	This is unaffected by a Preset but is set to On on a "Restore Input/Output Defaults" or "Restore System Defaults -> All"

6.7 Output

This tab 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 display, 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 models M9420A/21A.

This Tab does not appear in the M9393A or M9391A.

Backwards Compatibility Notes	In ESA there was not a user interface to enable the Video Output (Analog Output), Trigger Output, or Gate Output. In the X-Series each of these physical connectors requires configuration, thus the user interface has been added for X-Series, along with the potential for an output you think is always on to be switched off.

6.7.1 Analog Out

This menu lets you control which signal is fed to the “Analog Out” connector on the analyzer 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 go to a mode or measurement for which the selected output does not apply.

See "More Information" on page 770

Remote Command	`:OUTPut:ANALog OFF | SVIDeo | LOGVideo | LINVideo | DAUDio`
	`:OUTPut:ANALog?`
	`:OUTPut:ANALog:AUTO OFF | ON | 0 | 1`
	`:OUTPut:ANALog:AUTO?`

Example	`:OUTP:ANAL SVIDeo`
	causes the analog output type to be Screen Video
	`:OUTP:ANAL:AUTO ON`

Preset	This is unaffected by Preset but is set to DAUDio on a "Restore Input/Output Defaults" or "Restore System Defaults->All

	ON
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. So for backwards compatibility with earlier X-Series firmware versions, Auto (:OUTP:ANAL:AUTO ON) will duplicate 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.

More Information

Here is information about the various Analog Outputs:

Source	Example	Notes
Off	`OUTP:ANAL OFF`	The Analog Output is off.
Screen Video	`OUTP:ANAL SVID`	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 analyzer'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	`OUTP:ANAL LOGV`	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	`OUTP:ANAL LINV`	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	`OUTP:ANAL DAUD`	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 gives 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.
Demod Audio	(varies with analyzer 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 analyzer is in zero-span, there is no retrace, as the analyzer 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

This lets you control the amplitude of the Analog Output when Screen Video is selected.

The 1V (Normal) setting provides a nominal output of 1V peak-to-peak into an open circuit. This matches the traditional behavior of the X-series analyzers.

The 2V (Compatibility) setting provides a nominal output of 2V peak-to-peak into an open circuit. This matches the legacy behavior of the 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 2V
Dependencies	Only appears if Screen Video is the selected Analog Output
Preset	This is unaffected by Preset but is set to NORM on a "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 Bus Out is 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 Bus Out is 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 and Wideband Digital Bus cannot be on at the same time, so: – When Wideband Bus is turned on, if Digital Bus is already on, an advisory message is displayed, “Wideband Digital Bus On, Digital Bus (narrow band) forced to Off.” – When Digital Bus 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

The Wideband Digital Bus control turns on the LVDS port on the Wideband IF, which causes the I/Q pairs from the current measurement to get sent to this port. The control is grayed out unless in the RTSA measurement application, which is the only measurement that supports wideband streaming.

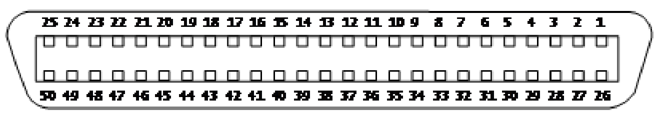
When Wideband Digital Bus is on, the internal processing and routing of acquisitions continues as usual and the display of measurement data is unaffected.

When Wideband Digital Bus is 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 and Wideband Digital Bus cannot be on at the same time, so: – When Wideband Bus is turned on, if Digital Bus is already on, an advisory message is displayed, “Wideband Digital Bus On, Digital Bus (narrow band) forced to Off.” – When Digital Bus 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 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
Stream_I[10]	15	40
Stream_I[11]	16	41
GND	17	42

Connection	“-“ pin #	“+” pin #
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
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

The Data Stream control 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. A Preset will reset 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

This menu 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..

See:

– "More Information" on page 778

– "Notes on the Aux IF Outputs" on page 779

Remote Command	`:OUTPut:AUX SIF | AIF | LOGVideo | OFF` `:OUTPut:AUX?`
Dependencies	The control does not appear in models that do not support the Aux IF Out.
Preset	This is unaffected by a Preset but is set to OFF on a "Restore Input/Output Defaults" or "Restore System Defaults->All”
State Saved	Saved in Input/Output state
Backwards Compatibility Notes	In the PSA, the IF output has functionality equivalent to the "Second IF" function in the X-Series’ Aux IF Out menu. In the X-Series, it is necessary to switch the Aux IF Out to “Second IF” to get this functionality, whereas in PSA it is always on, since there are no other choices. Hence a command to switch this function to “Second IF” will have to be added by customers migrating from PSA who use the IF Output in PSA.

More Information

Here is information about the various Aux IF Outputs:

Source	Example	Notes
Off	`OUTP:AUX OFF`	In this mode nothing comes out of 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	`OUTP:AUX SIF`	In this mode 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 analyzer.
Arbitrary IF	`OUTP:AUX AIF`	In this mode 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

Source	Example	Notes
		which appears on the menu panel, from 10 MHz to 75 MHz with 500 kHz resolution. 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.
Fast Log Video	`OUTP:AUX LOGV`	In this mode 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 needs as Option E4440A-H7L Fast Rise Time Video Output on the Keysight 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

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.

The Second IF choice does not appear unless Option CR3 is installed.

Arbitrary IF

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.

The Arbitrary IF choice does not appear unless Option CRP is installed.

Fast Log Video

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).

The Fast Log Video choice does not appear unless Option ALV is installed.

6.7.8 Arbitrary IF Freq

Sets the frequency of the Arbitrary IF when Aux IF Out is set to Arbitrary IF.

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 Arbitrary IF is the selected Aux IF Output.
Preset	This is unaffected by a Preset but is set to 70 MHz on a "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

The Ext/Wide IF Out switch causes the signal which 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 the N9041B when RF Input 2 is the selected input port and in the 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 will change IF2 Out and Aux IF Out to Off, and setting Aux IF Out to something other than Off or IF2 Out to On will force 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 Note that we could display a measurement if the sweep is entirely below 50 GHz for N9041B or below 18 GHz for N9032B/N9042B, but instead we choose to disable the measurement completely when the switch is on. This is simpler for the user and there is no use case for allowing the user to make a low band measurement while the high band IF is routed externally.
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 shows as an error because no valid data is on the screen or available via SCPI. However, the signal out the Ext/Wide IF Out port is still valid given the other settings.

6.7.10 IF2 Out

The IF2 Out switch causes the signal which 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 will change 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 will force 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 will result in an error.

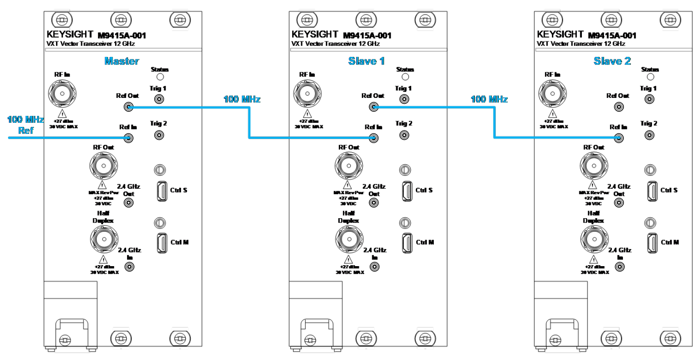
- Direct selection of the 1 GHz path: Measurements that directly support the 1 GHz path have a 1 GHz selection in the IF Path menu in Meas Setup.
- Indirect selection of the 1 GHz path: certain measurements, like CCDF, always choose the widest available path, and so will choose the 1 GHz path if it is 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 HIG is installed. When this switch is On, no measurement is displayed, and the error "No result; meas invalid with IF2 Out set to On" appears in the Status bar.

	Note that we COULD display a measurement if any path but the 1 GHz path is used, but instead we choose to disable the measurement completely when the switch is on. This is simpler for the user and it is not clear there is a use case for allowing the user to make a measurement in a different IF path while the 1 GHz IF path is routed externally.
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 shows as an error because no valid data is on the screen or available via SCPI. However, the signal out the IF2 Out port is still valid given the other settings.

6.7.11 REF Out

Allows you to toggle the state of the REF Out. The REF Out port is designed for MIMO, which provides the reference daisy chain for the Primary and Secondary modules.



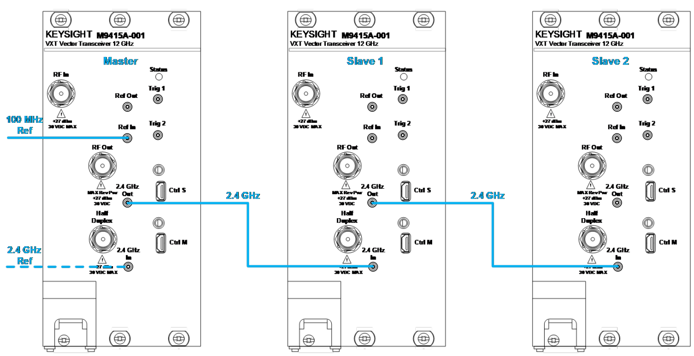
Parameter Name	REF Out
Control Path	**Input/Output, Output**
Control Type	Auto Dropdown
SCPI Command	`:OUTPut:EREFerence:OUTPut ON | OFF | 1 | 0` `:OUTPut:EREFerence:OUTPut?`
SCPI Example	`:OUTP:EREF:OUTP ON` `:OUTP:EREF:OUTP?`
Preset	OFF
Notes	This control is used to rout the 100 MHz reference signal on the REF In port to the REF Out port.
Dependencies	Only available in VXT model M9415A when the Freq Ref Input is External and the

	Ext Ref Freq is 100 MHz
Range	ON|OFF
Initial S/W Revision	A.27.00
Help Map ID	

6.7.12 LO Out

Allows you to turn LO Out on or off. LO Out is used to provide reference daisy chain in MIMO.

- For VXT models M9410A/11A, controls the "4.8 GHz Out" port on the front panel. Set to **ON** to output a 4.8 GHz reference signal.
- For VXT model M9415A, controls the "2.4 GHz Out" port on the front panel. Set to **ON** to output a 2.4 GHz reference signal.



SCPI Command	`:OUTPut:LO:OUTPut ON | OFF | 1 | 0` `:OUTPut:LO:OUTPut?`
SCPI Example	`:OUTP:LO:OUTP ON` `:OUTP:LO:OUTP?`
Dependencies	Only available in VXT models M9410A/11A/15A With Option PHC, clock alignment of LO board will be executed before MIMO Sync starts
Preset	OFF

6.8 Trigger Output

This tab accesses controls that configure the Trigger output settings.

6.8.1 Trig 1 Out

This control selects the type of output signal that will be output from the Trig 1 Out connector.

Although the Trig 1 Out control applies only to the Trig 1 output, the SCPI command (detailed in the table below) can be used for any of the Trig Out connectors by using the appropriate TRIGGER parameter (e.g. TRIG1, TRIG2, etc.).

See "More Information" on page 784

Remote Command	`:TRIGger|TRIGger1|TRIGger2|TRIGger3|TRIGger4[:SEQuence]:OUTPut HSWP | MEASuring | MAIN | GATE | GTRigger | OEVen | SPOint | SSWeep | SSETtled | S1Marker | S2Marker | S3Marker | S4Marker | PARB | FSYNc | OFF` `:TRIGger|TRIGger1|TRIGger2|TRIGger3|TRIGger4[:SEQuence]:OUTPut?`
Example	`:TRIG:OUTP HSWP` `:TRIG2:OUTP GATE`
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 SCPI command for an output you do not have generates an error, “Hardware missing; Not available for this model number” . Querying a nonexistent output returns OFF. For VXT models M9410A/11A: – When the Trig Out Device is `Analyzer`, only `MEASuring`, `MAIN` and `OFF` are available – When the Trig Out Device is `Source`, only `S1Marker`, `S2Marker`, `S3Marker`, `S4Marker`, `PARB`, `FSYNc` and `OFF` are available
Preset	Trigger 1: Sweeping (HSWP) Trigger 2: Gate Trigger 3: Sweeping (HSWP) (on models that support Trigger 3) Trigger 4: Gate (on models that support Trigger 4) This is unaffected by a Preset but is preset to the above values on a “Restore Input/Output Defaults” or “Restore System Defaults->All”
State Saved	Saved in instrument state

More Information

Here is information about the various Trigger Outputs:

Source	Example	Notes
Off	TRIG1:OUTP OFF TRIG2:OUTP OFF	Selects no signal to be output to the Trig 1 or Trig 2 Out connector.
Sweeping (HSWP)	TRIG1:OUTP HSWP	Selects the Sweeping Trigger signal to be output to the Trig 1 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 ohm output impedance.
Measuring	TRIG1:OUTP MEAS	Selects the Measuring trigger signal to be output to the Trig 1 Out connector. This signal is true while the Measuring status bit is true.
Main Trigger	TRIG1:OUTP MAIN	Selects the current instrument trigger signal to be output to the Trig 1 Out connector.
Gate Trigger	TRIG1:OUTP GTR	Selects the gate trigger signal to be output to the Trig 1 Out connector. This is the source of the gate timing, not the actual gate signal.
Gate	TRIG1:OUTP GATE	Selects the gate signal to be output to the Trig 1 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 Out connector represents the time the gate is configured to pass the signal.
Odd/Even Trace Point	TRIG1:OUTP OEV	Selects either the odd or even trace points as the signal to be output to the Trig 1 Out connector when performing swept spectrum analysis. When the polarity is positive, this output goes high during the time the analyzer is sweeping past the first point (Point 0) and every other following trace point. The opposite is true if the polarity is negative.
Source Point Trigger	TRIG1:OUTP SPO	Selects the gate signal to be output to the Trig 1 Out connector for use as the Point Trigger when operating an external source in Tracking mode. When Ext Trigger 1 is selected as the Point Trigger under Source, the Source Point Trigger under Trig1 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	TRIG2:OUTP S1M	Selects the Trigger Output at Marker 1 in the Waveform file which is currently playing. Only available in VXT: for M9420/21A only for Trigger Output 2, for M9410A/11A available for both Trigger Output 1/2.
Source Marker 2	TRIG2:OUTP S2M	Selects the Trigger Output at Marker 2 in the Waveform file which is currently playing. Only available in VXT: for M9420/21A only for Trigger

Source	Example	Notes
		Output 2, for M9410A/11A available for both Trigger Output 1/2.
Source Marker 3	`TRIG2:OUTP S3M`	Selects the Trigger Output at Marker 3 in the Waveform file which is currently playing. Only available in VXT: for M9420/21A only for Trigger Output 2, for M9410A/11A available for both Trigger Output 1/2.
Source Marker 4	`TRIG2:OUTP S4M`	Selects the Trigger Output at Marker 4 in the Waveform file which is currently playing. Only available in VXT: for M9420/21A only for Trigger Output 2, for M9410A/11A available for both Trigger Output 1/2.
PerArb	`TRIG2:OUTP PARB`	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. Only available in VXT Models M9410A/11A.
FSYNc	`:TRIG:FRAM:SYNC EXT1` `TRIG2:OUTP FSYNc`	Selects the Trigger Output as FSYNc. The FSYNc parameter means route the Periodic Timer Sync Source signal to the specified Trigger output. That is, the signal selected with the :TRIGger [:SEQuence]:FRAMe:SYNC EXTernal1|EXTernal2|RFBurst|PXI|OFF command will be routed to the specified trigger output. The example code means that the External 1 trigger will be used as the Periodic Timer Sync Source, and this signal will then be routed to the Trigger 2 output. Only available in VXT Models M9410A/11A.

6.8.2 Trig 1 Out Polarity

This control sets the output to the Trig 1 Out connector to trigger on either the positive or negative polarity.

Although the Trig 1 Polarity control applies only to the Trig 1 output, the SCPI command (detailed in the table below) can be used for any of the Trig Out connectors by using the appropriate TRIGGER parameter (e.g. TRIG1, TRIG2, etc.).

Remote Command	`:TRIGger|TRIGger1|TRIGger2|TRIGger3|TRIGger4[:SEQuence]:OUTPut:POLarity POSitive	NEGative` `:TRIGger|TRIGger1|TRIGger2|TRIGger3|TRIGger4[: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 SCPI command for an output you do not have generates an error, “Hardware missing; Not available for this model number” Note that a query of a nonexistent output returns OFF.

Preset	This is unaffected by a Preset but is set to POSitive on a "Restore Input/Output Defaults" or "Restore System Defaults->All"
State Saved	Saved in instrument state

6.8.3 Trig 1 Out Device

This control sets the output to the Trig 1 Out connector to trigger on either the Analyzer or Source.

Although the Trig 1 Direction control applies only to the Trig 1 output, the SCPI command (detailed in the table below) can be used for any of the Trig Out connectors by using the appropriate TRIGGER parameter (e.g. TRIG1, TRIG2, etc.).

Remote Command	`:TRIGger|TRIGger1|TRIGger2|TRIGger3|TRIGger4[:SEQuence]:OUTPut:DIRection ANALyzer | SOURce` `:TRIGger|TRIGger1|TRIGger2|TRIGger3|TRIGger4 [:SEQuence]:OUTPut:DIRection?`
Example	`:TRIG1:OUTP:DIR ANAL`
Dependencies	Only available on VXT models M9410A/11A.
Preset	This is unaffected by a Preset but is set to ANALyzer on a "Restore Input/Output Defaults" or "Restore System Defaults->All"
State Saved	Saved in instrument state

6.8.4 Trig 2 Out

This control selects the type of output signal that will be output from the Trig 2 Out connector.

Although the Trig 2 Out control applies only to the Trig 2 output, the SCPI command (detailed in the table under Trig 1 Out) can be used for any of the Trig Out connectors by using the appropriate TRIGGER parameter (e.g. TRIG1, TRIG2, etc.).

Example	`:TRIG2:OUTP HSWP` `:TRIG2:OUTP GATE`
Notes	Trig 2 Out is used as the source trigger out in EXM and VXT, the available choices in EXM and VXT are S1Marker, S2Marker, S3Marker, S4Marker and OFF.
Dependencies	The second Trigger output (Trig 2 Out) does not appear in all models; in models that do not support it, the Trig 2 Out control is blanked, and sending the SCPI command for this output generates an error, “Hardware missing; Not available for this model number” In models that do not support the Trigger 2 output, this error is returned if trying to set Trig 2 Out and a query of Trig 2 Out returns OFF.

6.8.5 Trig 2 Out Polarity

This control sets the output to the Trig 2 Out connector to trigger on either the positive or negative polarity.

Although the Trig 2 Out Polarity control applies only to the Trig 2 output, the SCPI command (detailed in the table under Trig 1 Out Polarity) can be used for any of the Trig Out connectors by using the appropriate TRIGGER parameter (e.g. TRIG1, TRIG2, etc.).

Example	`:TRIG2:OUTP:POL POS`
Dependencies	This control does not appear in EXM or VXT.
Preset	This is unaffected by a Preset but is set to POSitive on a "Restore Input/Output Defaults" or "Restore System Defaults->All"

6.8.6 Trig 2 Out Device

This control sets the output to the Trig 2 Out connector to trigger on either the Analyzer or Source.

Although the Trig 2 Direction control applies only to the Trig 2 output, the SCPI command (detailed in the table under Trig 1 Direction) can be used for any of the Trig Out connectors by using the appropriate TRIGGER parameter (e.g. TRIG1, TRIG2, etc.).

Example	`:TRIG2:OUTP:DIR SOUR`
Dependencies	Only available on VXT models M9410A/11A.
Preset	This is unaffected by a Preset but is set to Source on a "Restore Input/Output Defaults" or "Restore System Defaults->All"
State Saved	Saved in instrument state

6.8.7 Src PXI Trig Out

Selects which signal will be routed to the backplane Source PXI Trigger Output Line.

See "More Information" on page 789

Remote Command	`:TRIGger:PXIE:SOURce[:SEQuence]:OUTPut S1Marker | S2Marker | S3Marker | S4Marker | PARB | OFF` `:TRIGger:PXIE:SOURce[:SEQuence]:OUTPut?`
Example	`:TRIG:PXIE:SOUR:OUTP S1M` `:TRIG:PXIE:SOUR:OUTP?`
Dependencies	This control only appears in EXM and VXT.

Preset	Off
State Saved	Saved in instrument state

More Information

Here is information about the various Source PXI Trigger Outputs:

Source	Example	Notes
Off	TRIG:PXIE:SOUR:OUTP OFF	Selects no signal to be output to the Source PXI backplane line.
Source Marker 1	TRIG:PXIE:SOUR:OUTP S1M	Selects the Trigger Output at Marker 1 in the Waveform file which is currently playing to be output to the Source PXI backplane line.
Source Marker 2	TRIG:PXIE:SOUR:OUTP S2M	Selects the Trigger Output at Marker 2 in the Waveform file which is currently playing to be output to the Source PXI backplane line.
Source Marker 3	TRIG:PXIE:SOUR:OUTP S3M	Selects the Trigger Output at Marker 3 in the Waveform file which is currently playing to be output to the Source PXI backplane line.
Source Marker 4	TRIG:PXIE:SOUR:OUTP S4M	Selects the Trigger Output at Marker 4 in the Waveform file which is currently playing to be output to the Source PXI backplane line.
PerArb	TRIG:PXIE:SOUR:OUTP PARB	PerArb is a synchronization trigger which is generated by the ARB at the beginning of each repetition of playing the signal. This selection causes the PerArb. Trigger Output which is currently playing to be output to the Source PXI backplane line. Only available in VXT Models M9410A/11A.

6.8.8 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	This control only appears in EXM and VXT
Preset	This is unaffected by a Preset but is set to POSitive on a "Restore Input/Output Defaults" or "Restore System Defaults->All" POSitive

State Saved	Saved in instrument state

6.8.9 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	This control only appears in EXM and VXT.
Preset	4
State Saved	Saved in instrument state
Range	[0,7]

6.8.10 Analyzer PXI Trig Out

Select the signal which will be output from Analyzer PXI Trigger Line (Backplane Trigger Line 0~3).

See "More Information" on page 790

Remote Command	`:TRIGger:PXIE:ANALyzer[:SEQuence]:OUTPut HSWP | MEASuring | MAIN | GATE | GTRigger | OEVen | OFF` `:TRIGger:PXIE:ANALyzer[:SEQuence]:OUTPut?`
Example	`:TRIG:PXIE:ANAL:OUTP HSWP`
Dependencies	This is only available on certain modular analyzers, such as CXA-m and VXT models M9410A/11A. Only Off, Measuring and Main are available for VXT models M9410A/11A.
Preset	This is unaffected by a Preset but is preset to OFF on a "Restore Input/Output Defaults" or "Restore System Defaults->All"
State Saved	Saved in instrument state

More Information

Here is information about the various Analyzer PXI Trigger Outputs:

Source	Example	Notes
Off	`TRIG:PXIE:ANAL:OUTP OFF` `TRIG:PXIE:ANAL:OUTP OFF`	Selects no signal to be output to the Analyzer PXI backplane trigger line.

Source	Example	Notes
Sweeping (HSWP)	`TRIG:PXIE:ANAL:OUTP 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	`TRIG:PXIE:ANAL:OUTP 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	`TRIG:PXIE:ANAL:OUTP MAIN`	Selects the current instrument trigger signal to be output to the Analyzer PXI backplane trigger line.
Gate Trigger	`TRIG:PXIE:ANAL:OUTP 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	`TRIG:PXIE:ANAL:OUTP 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 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	`TRIG:PXIE:ANAL:OUTP 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 analyzer is sweeping past the first point (Point 0) and every other following trace point. The opposite is true if the polarity is negative.

6.8.11 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	This is only available on certain modular analyzers, such as CXA-m and VXT models M9410A/11A
Preset	This is unaffected by a Preset but is set to POSitive on a "Restore Input/Output Defaults" or "Restore System Defaults->All" `POSitive`

State Saved	Saved in instrument state

6.8.12 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	This is only available on certain modular analyzers, such as CXA-m and VXT models M9410A/11A.
Preset	0
State Saved	Saved in instrument state
Range	[0,3]

6.8.13 Source Internal Trig Out

Select 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 - PerArb is a synchronization trigger, which is generated by the ARB at the beginning of each repetition of playing the signal.
Dependencies	This is only available on VXT models M9420A, M9410A and M9411A.
Preset	This is unaffected by a Preset but is preset to OFF on a "Restore Input/Output Defaults" or "Restore System Defaults->All"
State Saved	Saved in instrument state

6.8.14 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 that 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	This is only available on VXT models
Preset	This is unaffected by a **Preset** but is set to `POSitive` by "Restore Input/Output Defaults" or "Restore System Defaults->All" `POSitive`
State Saved	Saved in instrument state

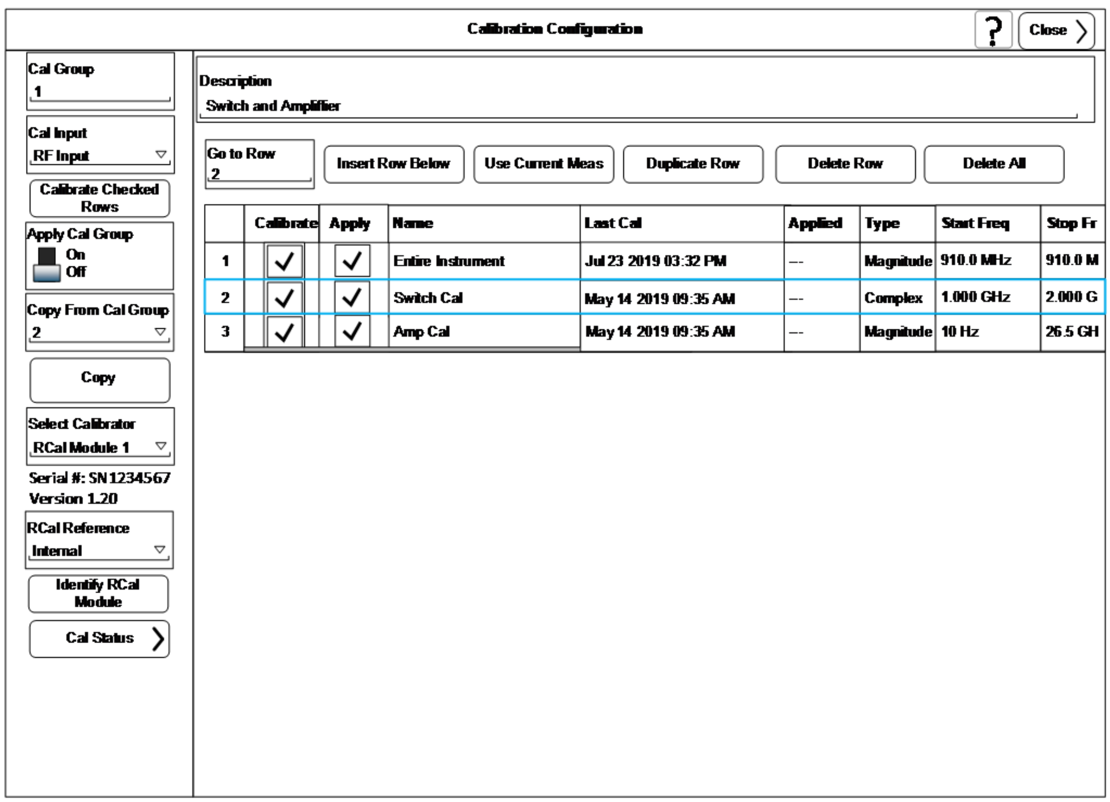
6.9 Calibration

This tab allows you to 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

Selecting the Configuration key 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. Users can scroll or swipe vertically or horizontally to view Cal's 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

IF Gain	Preamp	LNA	uW Path Ctrl	Coupling	Ph Noise Opt	Mixer Mode	Match State
All	Off	On	On	AC	Best Wide Offset	Normal	True
High Gain	Off	On	On	AC	Best Close-In Ø	Normal	True
Low Gain	Low Band	Off	Off	DC	Best Spurs	Alternative	True
Low Gain	Full Range	Off	Off	AC	Best Close-In Ø	Normal	True
All	Off	On	On	DC	Fast Tuning	Alternative	False
High Gain	Off	On	On	DC	Best Wide Offset	Normal	True

High Gain
Low Gain
All

Off
Low Band
Full Range

AC
DC

Best Close-In Ø Noise [offset < 600 kHz]
Balance Noise and Spurs [offset < 600 kHz]
Best Spurs [offset < 600 kHz]
Best Wide-Offset Ø Noise [offset > 800 kHz]
Fast Tuning

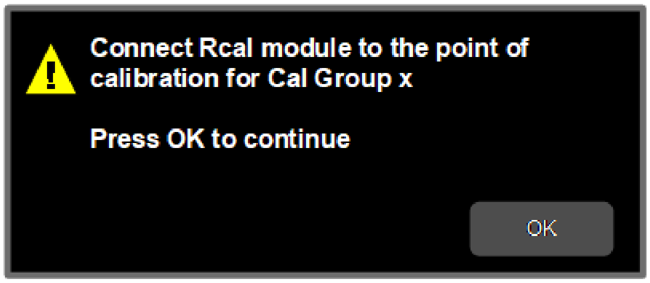
6.9.1.1 Cal Group

This is the same as Cal Group from the Calibration tab.

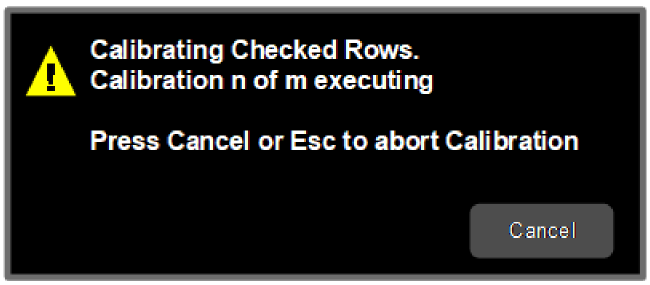
6.9.1.2 Calibrate Checked Rows

This key executes the Cal's 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 Cal's 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, Cal's that have completed use the new Cal data and update the Last Cal field. Cal's that have not completed retain the existing Cal data and Last Cal timestamp, or show "---" if the Cal had never been executed.

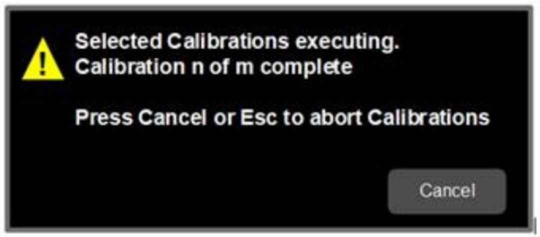
Remote Command	`:SYSTem:CALibration:INITiate:SELected`
Example	`:SYST:CAL:INIT:SEL`
Notes	Cals cannot be applied until they have been calibrated. Once a Cal has been calibrated, the Last Cal field in the table displays the date and time the Cal was last calibrated.
Dependencies	This command is applied to the currently selected Cal Group.
Couplings	Calibrate Selected control 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 from 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	This command aborts the currently running calibration. The previously ran 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 pops up, and the abort can be executed by selecting Cancel button. 

6.9.1.5 Copy From Cal Group

Determines the Cal Group from which existing rows are copied when using the Copy 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

Allows the user to 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	This command is applied to the currently selected Cal Group
Couplings	Copy control is 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 user attempts 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` `: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 the V3050A unit is connected.
State Saved	Saved in State

Parameters, notes and examples. Note that the presence of these ports is highly hardware dependent.

Cal Input	Example	Note
RF Input	:SYST:CAL:INPut RFIN	Main RF Port Not available on EXM with hardware M9431A
RF Input 2	:SYST:CAL:INPut RFIN2	Second RF Port, labeled RF Input 2 Only available on certain instruments.
External Mixer	:SYST:CAL:INPut EMIX	Requires option EXM
External RF	:SYST:CAL:INPut ERFIN	Only available if the 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	For SCPI, this 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 analyzer, the message “Selected RCal module not connected” is generated.
Dependencies	For SCPI, this 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

Remote Command	`:SYSTem:CALibration:IDENtify`
Example	`:SYST:CAL:IDEN`
Dependencies	For SCPI, this command is applied to the currently selected Cal Group. Requires the user to select an RCal module using Select RCal Module

6.9.1.11 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	For SCPI, this command is applied to the currently selected Cal Group.
Preset	External

State Saved	Saved in instrument state.
Range	Internal | External

6.9.1.12 RCal Status

RCal status button 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.

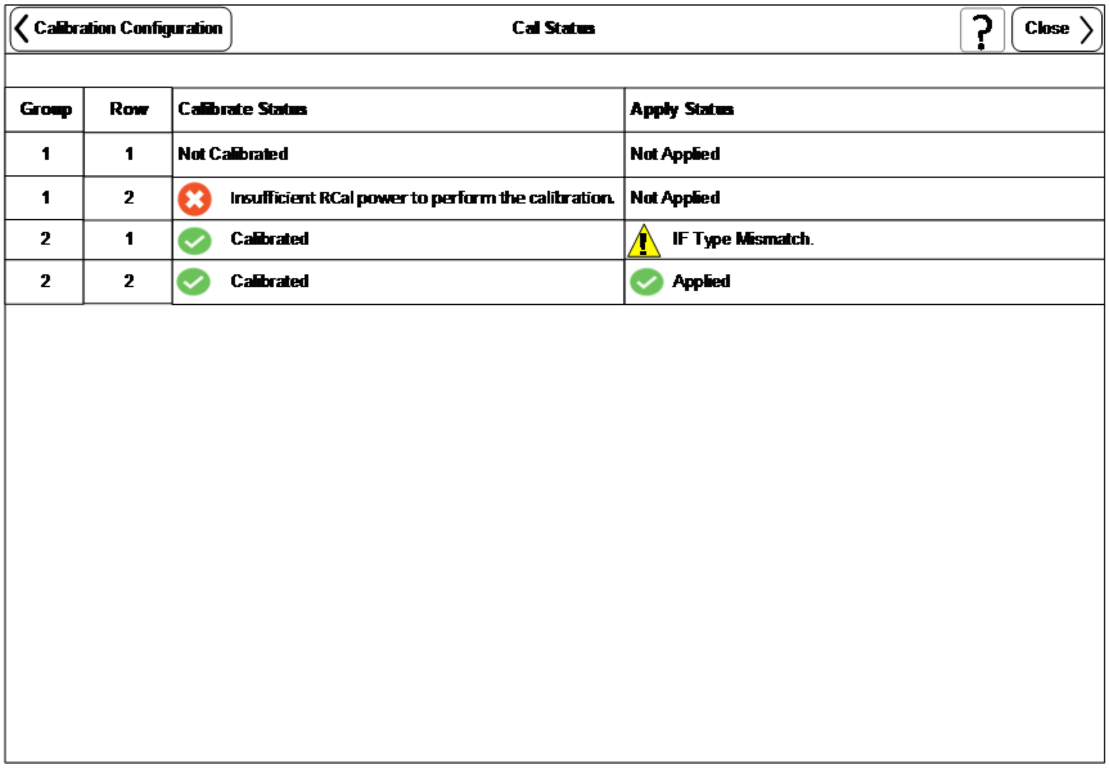
If a Calibration Fails, an error icon will be shown in the Calibrate column of the row(s) that failed with a message indicating the nature of the failure. If the failure cannot be addressed by the user, the error message “Calibration Failed. See Error Log” will be shown and details of the failure will 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
- Extermal 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 the user with the group and row of a Calibration and its current state and any error details if the status is not ok. Table format shown below:



RCal Status

This query only SCPI commands 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	`:SYST:CAL:ROW2:STAT?` Returns a comma separated list of the status of an individual row status in the format “Group”, “Row”, ‘Status’, “Details”
Dependencies	For SCPI, this 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

This query only SCPI commands returns a comma separate 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, the empty string is returned.

Remote	`:SYSTem:CALibration:STATus:ALL?`

Command	
Example	`:SYST:CAL:STAT:ALL?` Returns a comma separate list of all entries in the Cal Status table in the format "Group", "Row", 'Status', "Details" which are repeated for each row in the table

6.9.1.13 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

6.9.1.14 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	For SCPI, this 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.

6.9.1.15 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	The Cal Group Description is also shown on the Calibration menu panel, but is limited to the first 18 characters
Dependencies	For SCPI, this command is applied to the currently selected Cal Group
State Saved	Saved in instrument state.

6.9.1.16 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	For SCPI, this 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. -221, Settings conflict; Feature not supported for this measurement.

6.9.1.17 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	For SCPI, this 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.

6.9.1.18 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	This control is disabled if the Cal Group contains no Cal rows
Dependencies	For SCPI, this 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 All

Deletes all the Cals in the currently selected Cal Group

Remote Command	`:SYSTem:CALibration:DELete:ALL`
Example	`:SYST:CAL:DEL:ALL`
Notes	This control is disabled if the Cal Group contains no Cal rows
Dependencies	For SCPI, this command is applied to the currently selected Cal Group

6.9.1.20 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	For SCPI, this 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

6.9.1.21 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	For SCPI, this 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 turned on, RCal in the Meas Bar will display as amber to indicate Calibrations are in use.

6.9.1.22 Name

Sets an ASCII field allowing the user 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	For SCPI, this 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

6.9.1.23 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	`:SYST:CAL:ROW2:LAST?` Returns data and time Cal 2 was last executed
Notes	SCPI query 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	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

6.9.1.24 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	`:SYST:CAL:ROW2:CAPP?` Returns Cal Stats of Cal 2
Notes	SCPI query 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	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

6.9.1.25 Cal Type

Specifies how the calibration is to be performed on the selected Cal. Choices 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	Cal Type is only available if the selected RCal module has a license for complex calibrations. If it does not this control is disabled 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
Preset	MAGNitude
State Saved	Saved in instrument state
Range	Magnitude | Complex

6.9.1.26 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	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. By direct entry: You cannot set the Start Frequency > Stop Frequency. You can set the Start frequency = Stop frequency. If you set Start Frequency = Stop Frequency, Frequency Step is adjusted to 0, and Frequency Points is adjusted to 1. With the knob or step keys: If you set Start Frequency = Stop Frequency, Frequency Step is adjusted to 0, and Frequency 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. The 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 analyzer 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. The 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 is changed to -80 MHz
Max	Depends on the instrument maximum frequency – 10 Hz minimum span.

6.9.1.27 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 (503, 507, 508, 513, 526)
Dependencies	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 By direct entry: You cannot set the Stop frequency < the Start frequency. You cannot set the Start frequency = the Stop frequency. You can set the Start frequency = Stop frequency. If you set Start Frequency = Stop Frequency, Frequency Step is adjusted to 0, and Frequency Points is adjusted to 1 With the knob or step keys: If you set Start Frequency = Stop Frequency, Frequency Step is adjusted to 0, and Frequency 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. The 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 the 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. The 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 Stop Frequency is changed to -79.999990 MHz
Max	Depends on the instrument maximum frequency

6.9.1.28 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 (503, 507, 508, 513, 526)
Dependencies	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. You cannot set the 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	This parameter is coupled to Freq Points. Changing the Freq Step adjusts the Freq Points using (((Stop Freq – Start Freq) / Freq Step) + 1) and clips to the next integer value, which may result in the Freq Step being clipped too. If the Freq Step is set to a value > Stop Freq – Start Freq the Stop Freq is increased and Freq Points are set to 1.
Preset	All 10 kHz
State Saved	Saved in instrument state.
Min	1 Hz
Max	Depends on the instrument maximum frequency

6.9.1.29 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	This parameter is coupled to Freq Step. Changing the Freq Points adjusts the Freq Step using (Stop Freq – Start Freq) / (Freq Points – 1) and clips to the next integer value, which may result in the Freq Step being clipped.
Preset	1
Min	1
Max	100000

6.9.1.30 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	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.
Preset	STEP
State Saved	Saved in instrument state.
Range	Step | All | Bypass

6.9.1.31 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	The Mech Atten Start control is disabled unless Mech Atten Type is Step. 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	This parameter is coupled to Mech Atten Stop. Mech Atten Start must be <= Mech Atten Stop. If Mech

	Atten Start > Mech Atten Stop, 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

6.9.1.32 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	The Mech Atten Stop control is disabled unless Mech Atten Type is Step 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	This parameter is coupled to Mech Atten Start. Mech Atten Stop must be >= Mech Atten Start. If Mech Atten Stop < Mech Atten Start, Mech Atten Start = Mech Atten Stop
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 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	The Mech Atten Step control is disabled unless Mech Atten Type is Step. 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.
Preset	2 dB
State Saved	Saved in instrument state
Min	2 dB
Max	70 dB

6.9.1.34 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	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
Preset	STEP
State Saved	Saved in instrument state
Range	Step | All | Bypass

6.9.1.35 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	This control 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) The Elec Atten Start control is disabled unless Elec Atten Type 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 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	This parameter is 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

6.9.1.36 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	This control 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) The Elec Atten Stop control is be disabled unless Elec Atten Type 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	This parameter is 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

6.9.1.37 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	The Elec Atten Step control is disabled unless Elec Atten Type is Step 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
Preset	1 dB
State Saved	Saved in instrument state
Min	1 dB
Max	24 dB

6.9.1.38 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	This control only appears if input RF is selected and RF Input Port 2 is selected and the Full Range Attenuator exists 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
Preset	STEP
State Saved	Saved in instrument state.
Range	Step | All |

6.9.1.39 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	The Full Range Atten Start control only appear in the 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. The Full Range Atten Start control is disabled unless Full Range Atten Type is Step. 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	This parameter is 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

6.9.1.40 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	The Full Range Atten Stop control only appears in the 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

	The Full Range Atten Stop control is disabled unless Full Range Atten Type is Step. 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	This parameter is 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

6.9.1.41 Frequency Extender Attentuation 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	This control only applies, and is only visible, when the External RF (ERFIN) input is selected. 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.
Preset	STEP
State Saved	No
Range	Step | All | Reference

6.9.1.42 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	This control only applies, and is only visible, when the External RF (ERFIN) input is selected

	The Frequency Extender Attenuation Start control is disabled unless Frequency Extender Attenuation Type is Step. 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	This parameter is 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

6.9.1.43 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	This control only applies, and is only visible, when the External RF (ERFIN) input is selected The Frequency Extender Attenuation Stop control is disabled unless Frequency Extender Attenuation Type is Step. 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	This parameter is 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

6.9.1.44 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	This control only applies, and is only visible, when the External RF (ERFIN) input is selected 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
Preset	1 dB
State Saved	No
Min	1 dB
Max	V3050A: 26 dB

6.9.1.45 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	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 from SCPI, it generates an error -241,"Hardware missing; Option not installed."
Dependencies	The 25 MHz path is available only when 25 MHz or wider IF Bandwidth option is installed. The 40 MHz path is available only when 40 MHz or wider IF Bandwidth option is installed. The 85 MHz path is available only when 85 MHz or wider IF Bandwidth option is installed. The 125 MHz path is available only when 125 MHz or wider IF Bandwidth option is installed. The 140 MHz path is available only when Option B1X is installed.

	The 160 MHz path is available only when Option B1Y is installed. There cannot be a B1Y option without a B1X option. The 255 MHz path is available only when Option B2X or wider IF Bandwidth option is installed. The 510 MHz path is available only when Option B5Y or wider IF Bandwidth option is installed. The 1 GHz path is available only when Option H1G/B1G or wider IF Bandwidth option is installed. The 2 GHz path is available only when Option B2G(R20) or wider IF Bandwidth option is installed. The 4 GHz path is available only when Option B4G(R40) or wider IF Bandwidth option is installed. The 1.5 GHz path is available only when license R15 option is installed. If Option B85 is installed, and also B1A or B1X is installed, the 85 MHz key does not show up and the B85M SCPI selection is disabled. When the B85M SCPI is selected in this case, the instrument generates an error -221, “Settings Conflict; Use wider bandwidth selection”. If Option B1A is installed, and also B1X is installed, the 125 MHz key does not show up and the B125M SCPI selection is disabled. When the B125M SCPI is selected in this case, the instrument generates an error -221, “Settings Conflict; Use wider bandwidth selection”. In cases where the path is not available, but is selected from 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, it presets to 10 MHz
State Saved	No
Range	B10M | B25M | B40M | B85M | B125M | B140M | B160M | B255M | B510M | B1G | B1500M | B2G | B4G | EXT

6.9.1.46 IF Gain

Determines the IF Gain to be used in the Calibration

Remote Command	`:SYSTem:CALibration:ROW[1]|2|…|100:IF:GAIN[:STATe]HIGH|LOW|ALL` `:SYSTem:CALibration:ROW[1]|2|…|100:IF:GAIN[:STATe]?`
Example	`:SYST:CAL:ROW3:IF:GAIN ALL`
Dependencies	For SCPI, this query 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	DEF
State Saved	Saved in instrument state.
Range	High Gain | Low Gain | All

6.9.1.47 Preamp

Determines if the Preamp is to be used in the Calibration

Remote Command	`:SYSTem:CALibration:ROW[1]|2|…|100:POWer:GAIN:BAND OFF | LOW | FULL` `:SYSTem:CALibration:ROW[1]|2|…|100:POWer:GAIN:BAND?`

Example	`:SYST:CAL:ROW2:POWer:GAIN:BAND OFF`
Dependencies	For SCPI, this query 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

6.9.1.48 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	For SCPI, this 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

6.9.1.49 µW Path Control

Determines the µW Path Control to be used in the Calibration.

Remote Command	`:SYSTem:CALibration:ROW[1]|2|…|100POWer[: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	For SCPI, this query 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 option MPB is present and licensed or option LNB is present and licensed The Low Noise Path selection does not show unless option LNP is present and licensed The uW Presel Bypass selection does not show unless option MPB is present and licensed. The Full Bypass selection does not show 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	Standard Path|Low Noise Path| µW Presel Bypass| Full Bypass

6.9.1.50 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	For SCPI, this query 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

6.9.1.51 Phase Noise Optimization

Selects the LO (local oscillator) phase noise behavior for various desired operating conditions.

See "More Information" on page 823

Remote Command	`:SYSTem:CALibration:ROW[1]|2|…|100:FREQuency:SYNThesis[:STATe] 1 | ... | 5` `:SYSTem:CALibration:ROW[1]|2|…|100:FREQuency:SYNThesis[:STATe]?`
Example	`:SYST:CAL:ROW1:FREQ:SYNT 2` selects optimization for best wide offset phase noise
Notes	Parameter: 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. 2: optimizes phase noise for wide frequency offsets from the carrier. 3: optimizes LO for tuning speed 4: 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 taken. 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.

	The actual behavior varies somewhat depending on model number and option; you always get fast tuning by choosing #3, but in some models, the “Fast Tuning” choice is identical to the “Best Close-In” choice. Specifically: – Models with option EP0 (for example UXA), have a two stage local oscillator, which switches to a single loop for fast tuning – Models with option EP1 (for example PXA), have a two-loop local oscillator, which switches to a single loop for fast tuning – Models with option EP2 (available, for example, for MXA), 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 Close-In; this is useful when you have to look across a wide range of spans – In all other cases, Fast Tuning is the same as Best Close-In.
Dependencies	For SCPI, this query 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	This parameter is coupled with Phase Noise Optimization All. When Phase Noise Optimization All is set to ON, it will select all available LO mappings, and Phase Noise Optimization parameter will display All in the Configuration table. SCPI Query is still available to see which parameter will be displayed when Phase Noise Optimization All is set to OFF.
Preset	2
State Saved	Yes
Range	All but EP0: Best Close-In|Best Wide-Offset|Fast Tuning EP0: Balanced|Best Wide-Offset|Fast Tuning|Best Close-In|Best Spurs No EPx option: Best Close-In Φ Noise [offset < 20 kHz] | Best Wide-Offset Φ Noise [offset > 30 kHz] | Fast Tuning [same as Close-in] EP0: Best Close-In Φ Noise [offset < 600 kHz] | Best Wide-Offset Φ Noise [offset > 800 kHz] | Fast Tuning | Balance Noise & Spurs [offset < 600 kHz] | Best Spurs [offset < 600 kHz] |

	EP1: Best Close-In Φ Noise [offset < 140 kHz] | Best Wide-Offset Φ Noise [offset > 160 kHz] | Fast Tuning [single loop] EP2 & EP3: Best Close-In Φ Noise [offset < 70 kHz] | Best Wide-Offset Φ Noise [offset > 100 kHz] | Fast Tuning [medium loop bw] EP4: Best Close-In Φ Noise [offset < 90 kHz] | Best Wide-Offset Φ Noise [offset > 130 kHz] | Fast Tuning [same as Close-in]
Min	1
Max	5
Annunciation	EP0: Balanced | Best Wide | Fast | Best Close-In | Best Spurs Other than EP0: Best Close-In | Best Wide | Fast

More Information

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.

Here are details of the various settings you can choose:

Best Close-in Φ Noise

Instruments without option EP0:

Example	`:SYST:CAL:ROW1: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 analyzers this annotation appears as [offset <20 kHz]

Instruments with option EP0:

Example	`:SYST:CAL:ROW1: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 **Balance Noise and Spurs** setting, parameter 1 selects **Balance Noise and Spurs** in EP0 instruments, in the interests of optimizing code compatibility across the family. Parameter 4 selects **Best Close-in Noise**, which is usually not as good a choice as **Balance Noise and Spurs.**

Balance Noise and Spurs

Example	`:SYST:CAL:ROW1: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 Wide-offset Φ Noise

Example	`:SYST:CAL:ROW1: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 analyzers 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. If there is 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 are always be below –70 dBc.

Fast Tuning

Example	`:SYST:CAL:ROW1: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” 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 the Best Spurs configuration. It is available with this “Fast Tuning” label to inform the user, and to make the user interface more consistent with other X-Series analyzer family members.

(In models whose hardware does not provide for a fast tuning option, the settings for Best Close-in Φ Noise are used if Fast Tuning is selected. This gives the fastest possible tuning for that hardware set.)

Best Spurs

Example	`:SYST:CAL:ROW1:FREQ:SYNT 5`

In instruments with EP0, the LO is configured for better phase noise than the “Wide-Offset” case close to the carrier, but the configuration has 11 dB worse phase noise than the “Best Close-In” case mostly within ±1 octave around 300 kHz offset. Spurs are even lower than in the “Balance Noise and Spurs” case at better than –90 dBc, whether or not the carrier is on-screen.

6.9.1.52 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[:STATe]?`
Example	`:SYST:CAL:ROW1:FREQ:SYNT:ALL ON`
Notes	When this parameter is set to ON, it will override the Phase Noise Optimization parameter, and will select all available LO settings
Dependencies	For SCPI, this query 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	This parameter is coupled with Phase Noise Optimization. When this parameter is set to ON, it will select all available LO mappings, and Phase Noise Optimization parameter will display All in the Configuration table. When this parameter is set to OFF, the Phase Noise Optimization parameter will display it's previously set value in the Configuration table
Preset	OFF
State Saved	Saved in instrument state.
Range	On|Off

6.9.1.53 Mixing Mode

Determines the LO Mixing Mode to be used.

Remote Command	`:SYSTem:CALibration:ROW[1]|2|…|100:LO:MMODe NORMal	ALTernate` `:SYSTem:CALibration:ROW[1]|2|…|100:LO:MMODe?`
Example	`:SYST:CAL:ROW3:LO:MMOD NORM`
Dependencies	For SCPI, this query 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 | Alternative

6.9.1.54 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	For SCPI, this 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 the checked Apply rows of the currently selected Cal Group are applied or not.

Remote Command	`:SYSTem:CALibration:CGRoup:APPLy <bool>` `:SYSTem:CALibration:CGRoup:APPLy?`
Example	`:SYST:CAL:CGR:APPL ON` `:SYST:CAL:CGR:APPL?`
Dependencies	This 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 the Apply Cal Group before any Cal's 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 turned on, RCal in the Meas Bar will display as amber to indicate Calibrations are in use.

6.9.4 All Apply Cal Group Off

Turns Apply Cal Group off in all groups.

Remote Command	`:SYSTem:CALibration:CGRoup:APPLy:AOFF`
Example	`:SYST:CAL:CGR:APPL:AOFF`

6.9.5 Connection

Opens the Connection Dialog, which provides step-by-step instructions.

6.10 Calibrator Control

This tab allows you to select a calibrator and control the calibrator settings.

6.10.1 Select Cal Source

Allows you to 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	The values translate as follows: 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 will not appear in the dropdown. If sending SCPI to select a calibrator that is not available, the analyzer will generate an error.
Couplings	Selecting REF50 will set the RF Calibrator to REF50. Selecting REF4800 will set the RF Calibrator to REF4800. Selecting a calibrator source other than REF50 or REF4800 will set RF Calibrator to OFF.
Preset	This setting is unaffected by a Mode Preset. It is set to None on a "Restore Input/Output Defaults" or "Restore System Defaults->All"

6.10.2 Cal Output

Allows you to 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	This setting is unaffected by a Mode Preset. It is set to Off on a "Restore Input/Output Defaults" or "Restore System Defaults->All"

6.10.3 Cal Frequency

Allows you to set the selected calibrator’s frequency.

Remote Command	`:SYSTem:CALibration:TUNE:FREQuency <freq>` `:SYSTem:CALibration:TUNE:FREQuency?`

Example	`:SYST:CAL:TUNE:FREQ 150000000`
	Sets source frequency to 150 MHz
	`:SYST:CAL:TUNE:FREQ?`

Preset	This setting is unaffected by a Mode Preset. It is set to 1 GHz on a "Restore Input/Output Defaults" or "Restore System Defaults->All"
Min	Dependent on the selected calibrator.
Max	Dependent on the selected calibrator.

6.10.4 Cal Signal Type

Allows you to 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 it will be disabled in the dropdown. Changing the signal type to a disabled option will generate an error.
Preset	This setting is unaffected by a Mode Preset. It is set to CW on a "Restore Input/Output Defaults" or "Restore System Defaults->All"

6.10.5 Cal Comb Spacing

Allows you to set the calibrator’s comb spacing, when the signal type is Comb.

Remote Command	`:SYSTem:CALibration:TUNE:SPACing <freq>` `:SYSTem:CALibration:TUNE:SPACing?`

Example	`:SYST:CAL:TUNE:SPAC 1000000`
	Sets comb spacing to 1 MHz
	`:SYST:CAL:TUNE:SPAC?`

Dependencies	Only appears when Comb is selected as Cal Signal Type. If the selected calibrator does not support the Comb signal, attempting to set the spacing will generate an error.

Preset	This setting is unaffected by a Mode Preset. It is set to 0 Hz on a "Restore Input/Output Defaults" or "Restore System Defaults->All"
Min	Dependent on the selected calibrator.
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

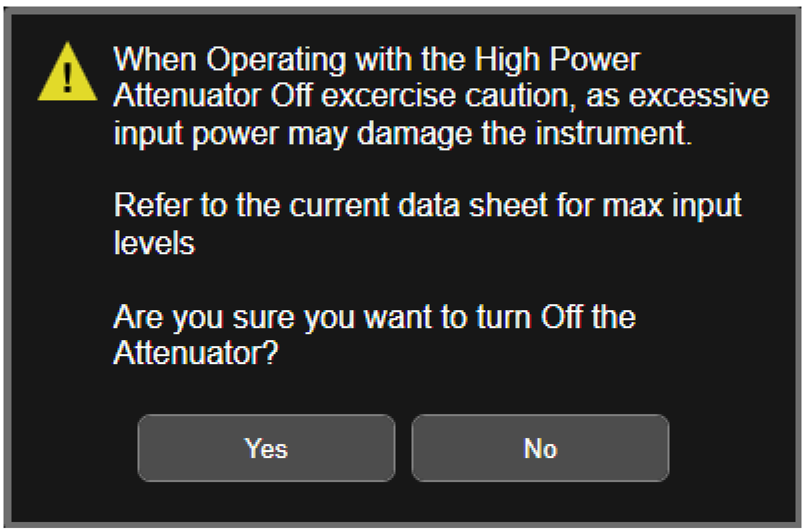
Remote Command	`:SYSTem:CALibration:TUNE:REFerence INTernal | EXTernal` `:SYSTem:CALibration:TUNE:REFerence?`
Example	`:SYSTem:CALibration:TUNE:REFerence INTERNAL` Sets the calibrator frequency reference to Internal
Dependencies	Only displayed when a RCal module is the selected calibrator.
Preset	This setting is unaffected by a Mode Preset. It is set to preset value on a "Restore Input/Output Defaults" or "Restore System Defaults->All"
Range	Internal | External

6.11 Advanced

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 this control is ON, the path includes the 16 dB attenuator, so the max input level for this path is +47 dBm (50 W).
- When this control is 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 the 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

The Aux I/O Control 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 the user changes 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, will not affect the LISN Control (Mode Setup) setting.

Notes	No SCPI. Front panel only.

6.12.1 Data 0

Sets the value for Data 0.

Remote Command	`:OUTPut:AUX:IO:DATA0 OFF | ON | 0 | 1`
Example	`:OUTPut:AUX:IO:DATA0 OFF`
Notes	The current value is persistent upon a Mode Preset, only an Input/Output Preset presets the value to On
Preset	On
Range	On|Off

6.12.2 Data 1

Sets the value for Data 1.

Remote Command	`:OUTPut:AUX:IO:DATA1 OFF | ON | 0 | 1`
Example	`:OUTPut:AUX:IO:DATA1 OFF`
Notes	The current value is persistent upon a Mode Preset, only an Input/Output Preset presets the value to On
Preset	On
Range	On|Off

6.12.3 Data 2

Sets the value for Data 2.

Remote Command	`:OUTPut:AUX:IO:DATA2 OFF | ON | 0 | 1`
Example	`:OUTPut:AUX:IO:DATA2 OFF`

Notes	The current value is persistent upon a Mode Preset, only an Input/Output Preset presets the value to On
Preset	On
Range	On|Off

6.12.4 Data 3

Sets the value for Data 3.

Remote Command	`:OUTPut:AUX:IO:DATA3 OFF	ON	0	1`
Example	`:OUTP:AUX:IO:DATA3 OFF`
Notes	The current value is persistent upon a Mode Preset, only an Input/Output Preset presets the value to On
Preset	On
Range	On|Off

6.12.5 Data 4

Sets the value for Data 4.

Remote Command	`:OUTPut:AUX:IO:DATA4 OFF	ON	0	1`
Example	`:OUTPut:AUX:IO:DATA4 OFF`
Notes	The current value is persistent upon a Mode Preset, only an Input/Output Preset presets the value to On
Preset	On
Range	On|Off

6.12.6 Data 5

Sets the value for Data 5.

Remote Command	`:OUTPut:AUX:IO:DATA5 OFF	ON	0	1`
Example	`:OUTPut:AUX:IO:DATA5 ON`
Notes	The current value is persistent upon a Mode Preset, only an Input/Output Preset presets the value to On
Preset	Off
Range	On|Off

6.12.7 Data 6

Sets the value for Data 6.

Remote Command	`:OUTPut:AUX:IO:DATA6 OFF | ON | 0 | 1`
Example	`:OUTPut:AUX:IO:DATA6 ON`
Notes	The current value is persistent upon a Mode Preset, only an Input/Output Preset presets the value to On
Preset	Off
Range	On|Off

6.12.8 Data 7

Sets the value for Data 7.

Remote Command	`:OUTPut:AUX:IO:DATA7 OFF | ON | 0 | 1`
Example	`:OUTPut:AUX:IO:DATA7 ON`
Notes	The current value is persistent upon a Mode Preset, only an Input/Output Preset presets the value to On
Preset	Off
Range	On|Off

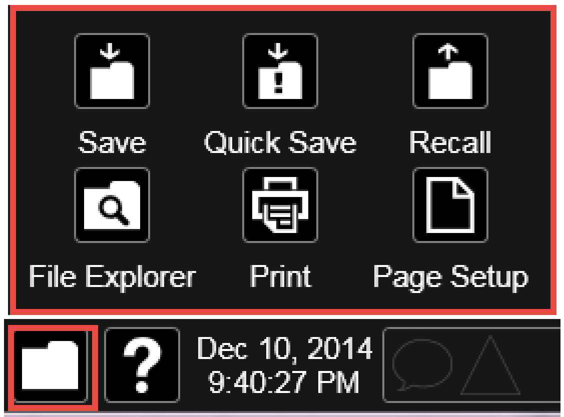
6.12.9 Aux IO Control (Remote Command Only)

Sets/Queries the value for all 8 data lines.

Remote Command	`:OUTPut:AUX:IO <Value>` `:OUTPut:AUX:IO?`
Example	`:OUTPut:AUX:IO 31`
Notes	The current value is persistent upon a Mode Preset, only an Input/Output Preset presets the value to On
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>`

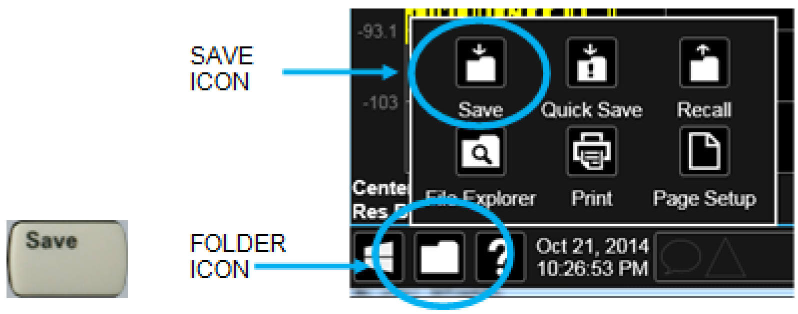
7 Save/Recall/Print

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.

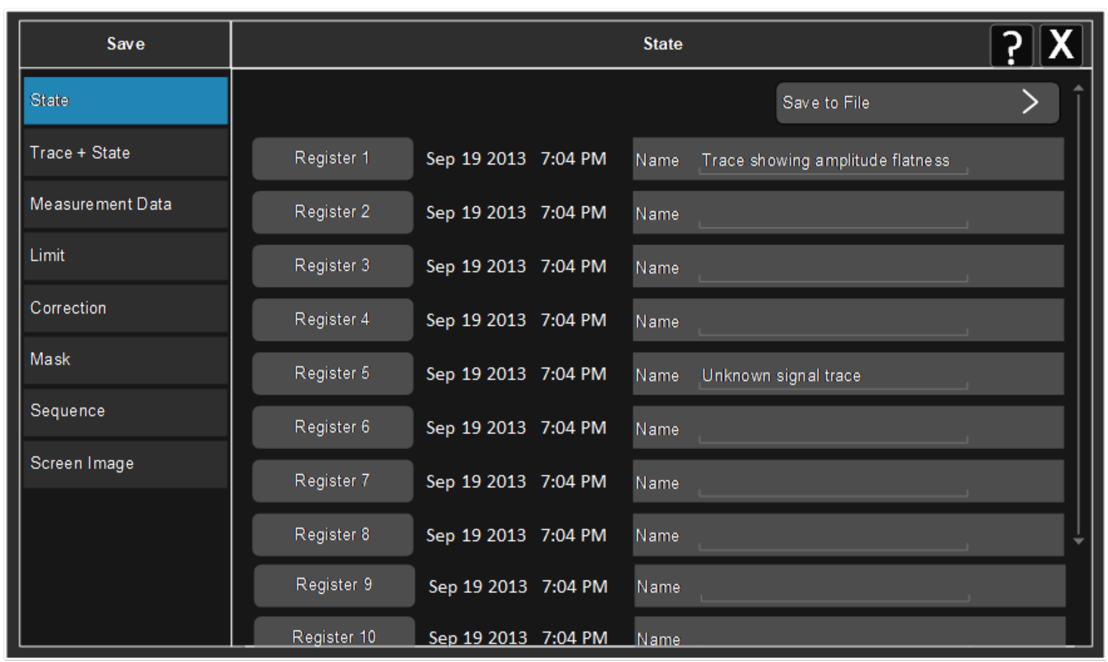


7.1 Save

The Save dialog lets you save states, traces, screen images and other items from the analyzer to files on the analyzer's internal storage, to removable devices, and to directories on the network. You access the Save 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 Save dialog has section tabs running down the left side, which you use to specify what you want to save.



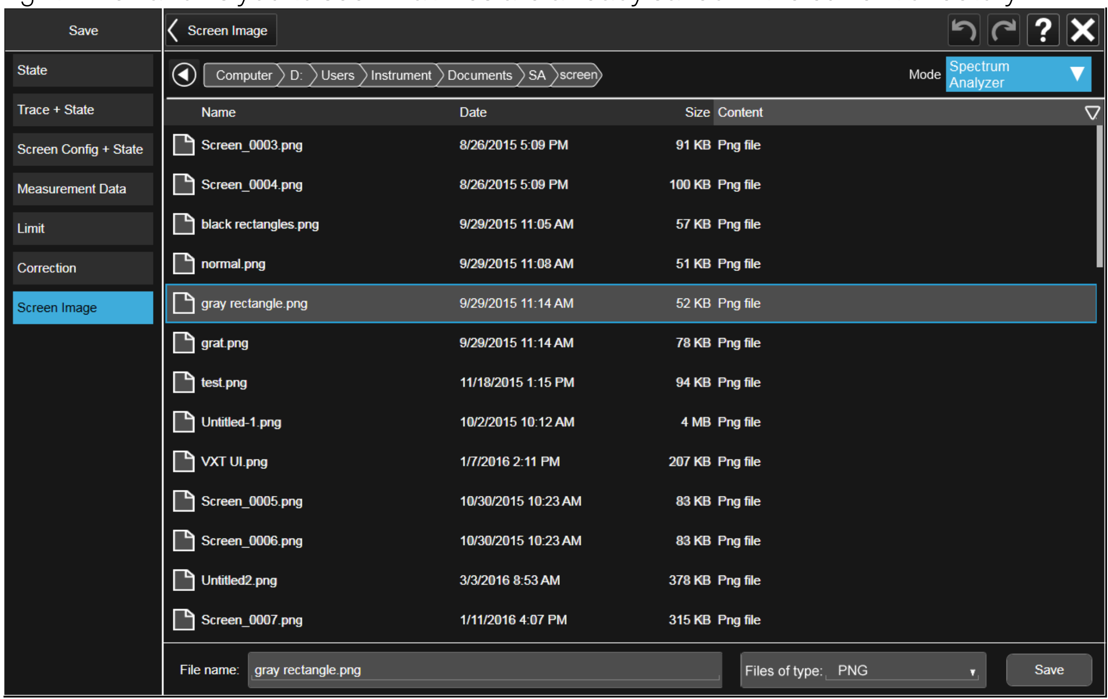
You choose the save item and then complete the save by choosing a register or file location to which to save the item.

Notes	No remote command for this key specifically, but the :MMEM:STORe command is available for specific file types. An example is :MMEM:STOR:STATe <filename>.

7.1.1 Save to File / Save As

For every Save type, a button appears called "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 push the "Save to File" or "Save As" button, a dialog slides in from the right which 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 (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 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, since it runs the risk of being overwritten during an instrument software upgrade.

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 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 analyzer (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 the Quick Save documentation for more on the automatic file naming algorithm.

7.1.2 State

Save **State** lets you choose a register or file for saving the state.

State files contain essentially all the information required to return the analyzer 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 analyzer to restore the state.

State files contain all of 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 or 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 the INST:SEL command (for example, SA for the Spectrum Analyzer).

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 which were saved by another instance.

Remote Command	`:MMEMory:STORe:STATe <filename>`
Example	`:MMEM:STOR:STATe "MyStateFile.state"` This stores the current instrument state data in the file MyStateFile.state in the default directory.
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 analyzer automatically returns to the previous menu and any Save As dialog goes away.
Backwards Compatibility SCPI	`:MMEMory:STORe:STATe 1,<filename>` For backwards compatibility, the above syntax is supported. The "1" is simply ignored. The command is sequential.

7.1.2.1 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 which 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

7.1.2.2 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 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).

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 analyzer, it will bring its custom name along with it.

If you try to edit the name of an empty register, the analyzer will first save the state to have a file to put the name in. If you load a named state file into an analyzer with older firmware it will ignore the metadata.

The *SAV and *RCL commands will not be affected by the custom register names, nor will 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 length 0 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 a "Restore System Defaults->Misc"

7.1.3 Trace+State

Save **Trace+State** lets you choose a register or file for saving selected traces and the state.

Trace+State files contain essentially all the information required to return the analyzer 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 analyzer to restore the state and trace(s).

Trace+State files contain all of 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 or 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 the INST:SEL command (for example, Basic for the IQ Analyzer).

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 which 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 845.

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	`:MMEM:STOR:TRAC TRACE1,“myState.trace”`
	
	saves 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 ALL,“myState.trace”`
	
	saves the file myState.trace on the default path and flags it as an “all traces” file
	`:MMEM:STOR:TRAC:REG TRACE1,2`
	
	stores trace 1 data in trace register 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 analyzer 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 will come back 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 will load 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 will 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.

7.1.3.1 Save From Trace

This control enables you to select 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.

7.1.3.2 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 which 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

7.1.3.3 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 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).

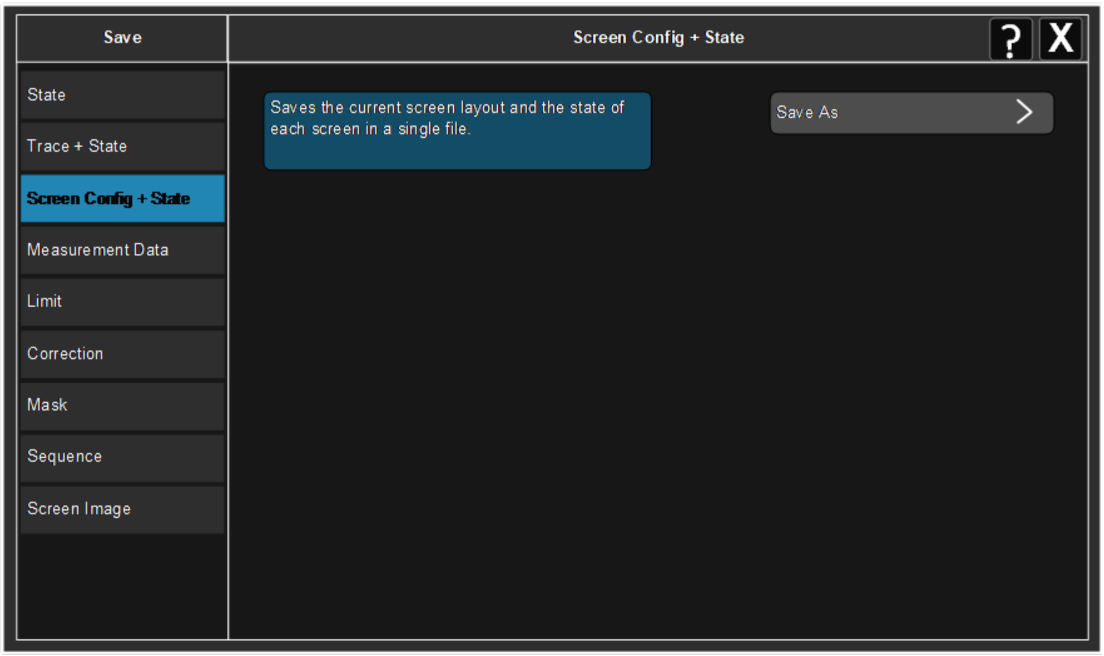
The register names are stored within the trace+state files, but they are not part of the instrument state; that is, once you have edited a register name, loading a new state will not change that register name.Another consequence of this is that the names will be persistent through a power cycle. Also, if a named state file is transferred to another analyzer, it will bring its custom name along with it.

If you try to edit the name of an empty register, the analyzer will first save the trace+state to have a file to put the name in. If you load a named state file into an analyzer with older firmware it will ignore 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 length 0 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 a “Restore System Defaults->Misc”

7.1.4 Screen Config + State

SaveScreen Config + State lets you save 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	`:MMEM:STOR:SCON "myScreenConfig.screen"` This stores the current screen configuration in the file MyScreenConfig.screen in the default directory.

7.1.5 Measurement Data

Save Measurement Data lets you specify 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 other 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 the INST:SEL command (for example, SA for the Spectrum Analyzer) and <measurement name> is the parameter used to select the measurement with the CONF: command (for example, SAN for the Swept SA). So a Peak Table file from the Swept SA would be stored in

`My Documents\SA\data\SAN\results`

Measurement Data files have the 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`

7.1.5.1 Save From

This control enables you to select 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 which are in View or Blank may have different x-axis data than the current measurement settings; but this different x-axis data will not be output to the file.

Preset	Not part of Preset, but is reset to by Restore Mode Defaults; survives shutdown

7.1.5.2 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.

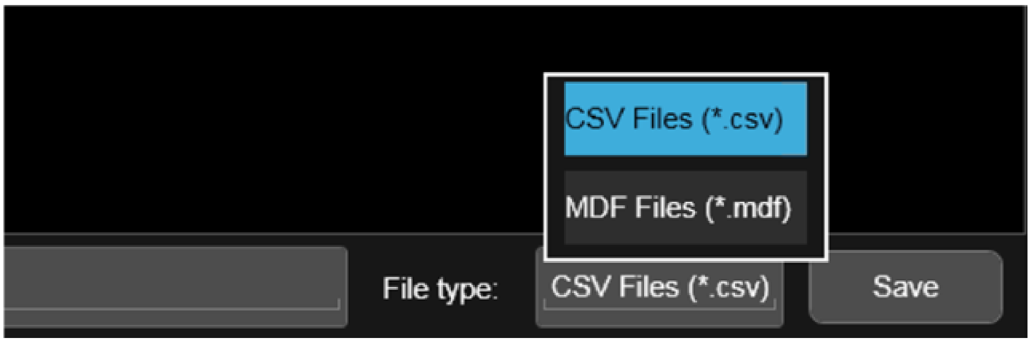
Trace

Selecting **Trace** allows you to export 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.

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 when in the Swept SA measurement):



The default path for **Trace** data files is:

My Documents\RTSA\data\traces

The trace file contains a "meta" data header which describes the current state of the analyzer.

Remote Command	`:MMEMory:STORe:TRACe:DATA TRACE1 | TRACE2 | TRACE3 | TRACE4 | TRACE5 | TRACE6 | TRACE7 | TRACE8 | TRACE9 | TRACE10 | TRACE11 | TRACE12 | ALL,<filename>`

Example	`:MMEM:STOR:TRAC:DATA TRACE2,"myTrace2.csv"`
	Exports Spectrum Trace 2 to the file myTrace2.csv in the current path. For the SA mode, the default path is My Documents\SA\data\traces
	`:MMEM:STOR:TRAC:DATA TRACE9,"myTrace9.mdf"`
	Exports PVT Trace 3 to the file myTrace9.mdf in the current path in MDIF format.

Notes	In RTSA Mode, the parameters and traces are mapped as follows: – TRACE1 = Spectrum Trace 1 – TRACE2 = Spectrum Trace 2 – TRACE3 = Spectrum Trace 3 – TRACE4 = Spectrum Trace 4 – TRACE5 = Spectrum Trace 5 – TRACE6 = Spectrum Trace 6 – TRACE7 = PVT Trace 1

	– TRACE8 = PVT Trace 2 – TRACE9 = PVT Trace 3 – TRACE10 = PVT Trace 4 – TRACE11 = PVT Trace 5 – TRACE12 = PVT Trace 6 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. The Recall dialog has only CSV as the file type. You can't load MDF files back into the analyzer.
Dependencies	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 of 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

Peak Table

Available in SA and RTSA only.

Selecting **Peak Table** allows you to export 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) and <measurement name> is the parameter used to select the measurement with the CONF: command (for example, SAN for the Swept SA).

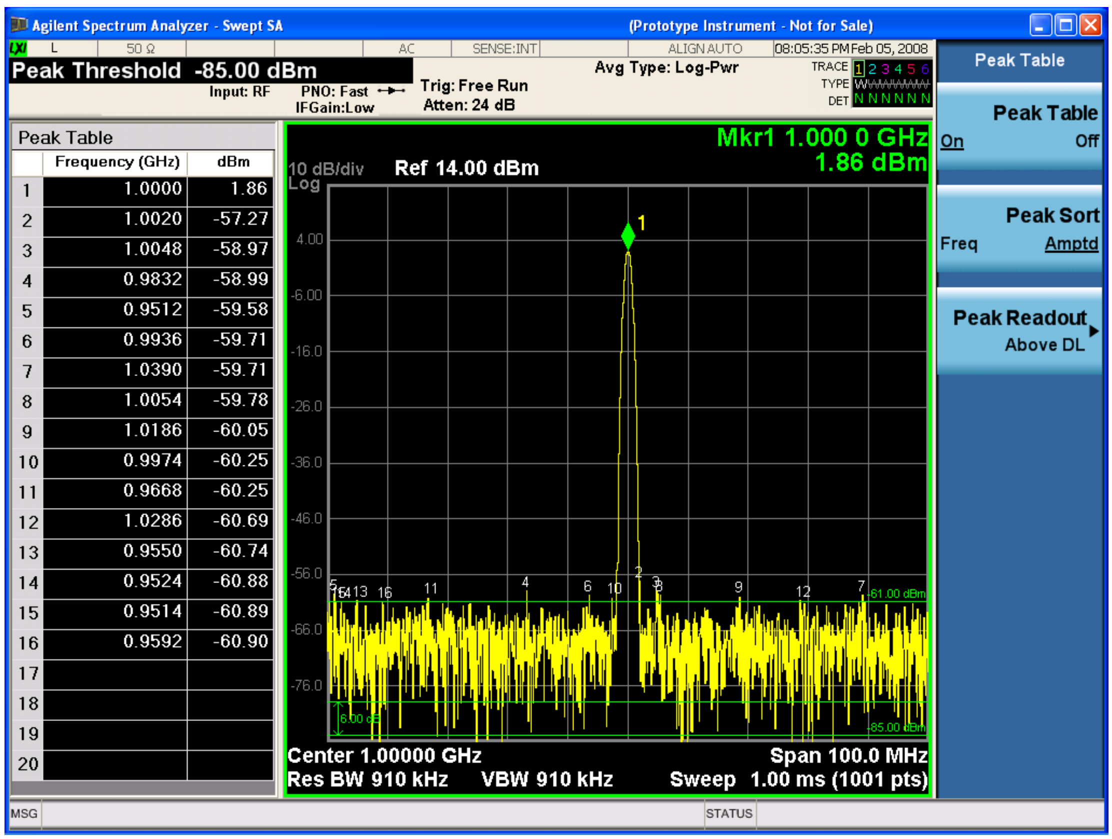
The Peak Table file contains a "meta" data header which describes the current state of the analyzer. The metadata is detailed below.

Remote Command	`:MMEMory:STORe:RESults:PTABle <filename>`
Example	`:MMEM:STOR:RES:PTAB "myResults.csv"` Saves the results from the current peak table to the file myResults.csv in the current path.
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 the Peak Table is not on, no file is saved and a message is generated

Peak Table File Contents

Imagine 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 only.

Selecting **Marker Table** allows you to export 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) and <measurement name> is the parameter used to select the measurement with the CONF: command (for example, SAN for the Swept SA).

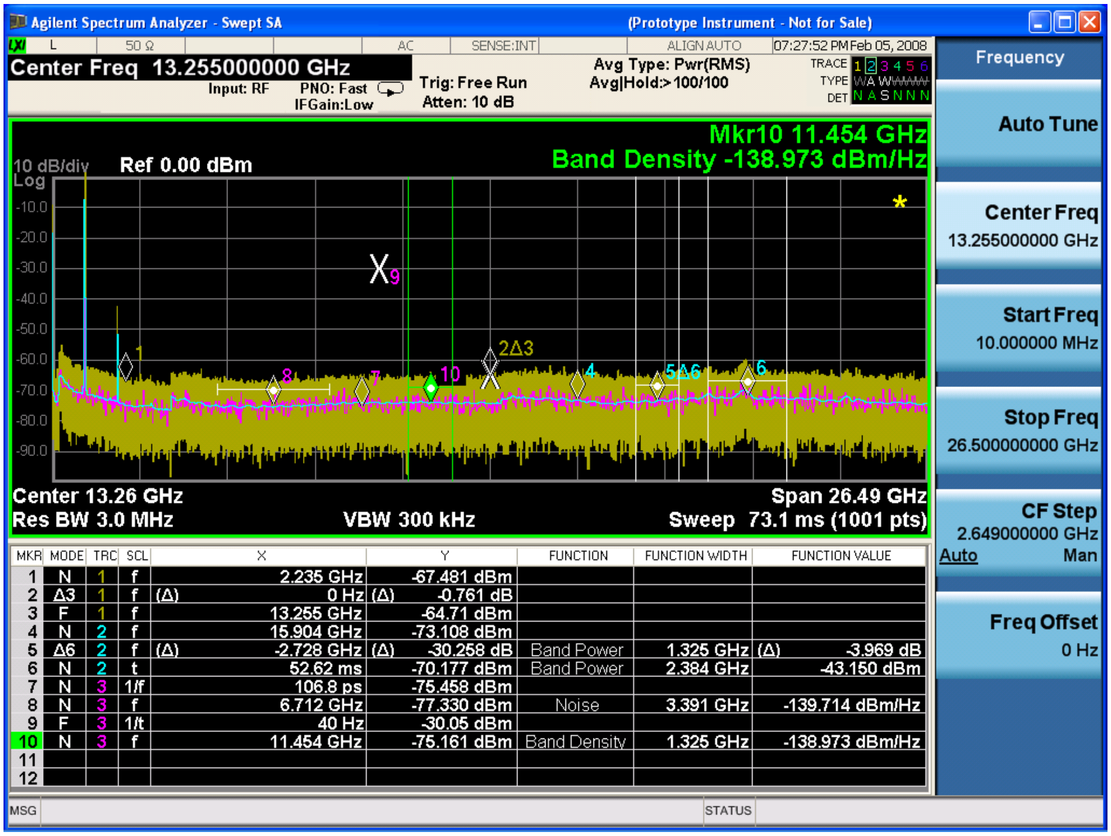
The Marker Table file contains a "meta" data header which describes the current state of the analyzer. The metadata is detailed below.

Remote Command	`:MMEMory:STORe:RESults:MTABle <filename>`
Example	`:MMEM:STOR:RES:MTAB "myResults.csv"` Saves the results from the current marker table to the file myResults.csv in the current path.
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 the 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.

Imagine that, at the point where a Marker Table Meas Result is requested, the following screen is showing:



MKR	MODE	TRC	SCL	X	Y	FUNCTION	FUNCTION WIDTH	FUNCTION VALUE
1	N	1	f	2.235 GHz	-67.481 dBm			
2	Δ3	1	f	(Δ) 0 Hz	(Δ) -0.761 dB			
3	F	1	f	13.255 GHz	-64.71 dBm			
4	N	2	f	15.904 GHz	-73.108 dBm			
5	Δ6	2	f	(Δ) -2.728 GHz	(Δ) -30.258 dB	Band Power	1.325 GHz	(Δ) -3.969 dB
6	N	2	t	52.62 ms	-70.177 dBm	Band Power	2.384 GHz	-43.150 dBm
7	N	3	1/f	106.8 ps	-75.458 dBm			
8	N	3	f	6.712 GHz	-77.330 dBm	Noise	3.391 GHz	-139.714 dBm/Hz
9	F	3	1/t	40 Hz	-30.05 dBm			
10	N	3	f	11.454 GHz	-75.161 dBm	Band Density	1.325 GHz	-138.973 dBm/Hz
11								
12								

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" on page 848. 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

Only available in SA mode, RTSA mode, and EMI mode RTSC (Real Time Scan) measurement.

Selecting **Spectrogram** 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.

The **Spectrogram** file contains a "meta" data header which describes the current state of the analyzer. The metadata is detailed below.

Remote Command	`:MMEMory:LOAD:RESults:SPECtrogram <filename>`

Example	`:MMEM:LOAD:RES:SPEC "MeasResult_0001.csv"` Imports the results from the file MeasResult_0001.csv in the default path in the current path.
Dependencies	Requires spectrogram view and single mode when recalling spectrogram. Else, error message "Spectrogram view and Single mode must be on to recall Spectrogram Meas Results file" will be 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.

Density

Available in RTSA only.

Remote Command	`:MMEMory:STORe:RESults:DENSity <filename>`

Example	`:MMEM:STOR:RES:DENS "myResults.csv"`
	saves the results from the current Density display to the file myResults.csv in the current path.
	The default path is:
	`My Documents\RTSA\data\results`

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 Density results is requested and the Density view is not on, no file is saved and a message is generated.
Preset	Not part of Preset, but is reset to Peak Table by Restore Mode Defaults. Survives a shutdown.

Meas Results

The Meas Results file contains information which describes the current state of the analyzer. It is detailed in the Meas Result File Contents below.

This command is only available in certain measurements, such as:

- Power Suite: 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".

For example, for the Complex Spectrum measurement, go to the Help heading called "Complex Spectrum Measurement" and you will see a section called "Remote Command Results for Complex Spectrum". This section has an arrow on the left which means if you click on the section title, it will dropdown a detail section showing the Remote Command Results.

The table that is revealed gives you a number of return values for the FETCh command (in this case, the FETCh:SPECtrum command), which depend on the subopcode (N) you use to query the 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 you get when you send FETCh:SPECtrum1? matches the data in the column labelled "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+07,3.921568627E+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 the Spectrum Analyzer) and <measurement name> is the parameter used to select the measurement with the CONF: command (for example, CHP for the Channel Power) 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.

7.1.6 Limit

Save > **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 other 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 the Spectrum Analyzer). Hence a Limit file from any measurement in the Spectrum Analyzer mode would be stored in:

`\My Documents\SA\data\limits`

The default path for Limit files from the Log Plot measurement in the 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 analyzer, but you can only save limits as `.csv` files.

Remote Command	`:MMEMory:STORe:LIMit LLINE1 | LLINE2 | LLINE3 | LLINE4 | LLINE5 | LLINE6,<filename>`

Example	`:MMEM:STOR:LIM LLINE2,"myLimitLine2.csv"` Saves the 2nd Limit Line to the file myLimitLine2.csv in the current path.
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	This key will only appear if you have the proper option installed in your instrument. In the Log Plot measurement in the Phase Noise Mode, there are only three Limit Lines, so the valid parameters are LLINE1|LLINE2| LLINE3
Preset	1; not part of Preset, but is reset by Restore Mode Defaults and 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 analyzers 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 "=" will be ignored. If a field is not present or the data is invalid, the value will not be 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	

7.1.6.1 Select Limit

This control enables you to select the specific Limit to be saved, e.g., Limit 1.

Preset	Not part of Preset, but is reset to LLINE1 by Restore Mode Defaults; survives shutdown

7.1.7 Correction

Selecting **Correction** allows you to export Amplitude Corrections files in the PC-readable .csv format.

Amplitude Correction files are Comma-Separated-Value (CSV) files, and contain the correction data in a form that can be imported into Excel or other 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 extension .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 864

Remote Command	`:MMEMory:STORe:CORRection 1 | ... | 8, <filename>`
Example	`:MMEM:STOR:CORR 2 "myAmpcor.csv"` saves Correction 2 to the file `myAmpcor.csv` on the current path
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 will be grayed out in measurements that do not. The key will not show at all if no measurements in the Mode support it This key 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 Corrections Data File contains a copy of one of the analyzer correction tables. Corrections provide a way to adjust the trace display for predetermined gain curves (such as for cable loss).

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 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)

Line #	Type of field	Example	Notes
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 analyzer. 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 analyzer 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 unit 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

7.1.7.1 Select Correction

This control enables you to select the specific Correction to be saved, e.g., Correction 1.

Preset	Not part of a Preset, but is reset to Correction 1 by Restore Input/Output Defaults. Survives a shutdown.

7.1.8 Correction Group

Pressing this key 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	`:MMEM:STOR:CORR:GRO "D:\myAmpcorGroup.csv"`

	saves Correction Group to the file 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 mode and in Spectrum Analyzer mode if option EMC or EMI Receiver mode is present. None
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 (i.e., Antenna unit, break, description and comment) range table and correction files data. Corrections files are text files in .csv (comma separated values) form, to make them importable into Excel or other spreadsheet programs.

7.1.9 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.

7.1.9.1 FMT Mask

Save FMT Mask allows you to export a Frequency Mask Trigger mask to a file.

Remote Command	`:MMEMory:STORe:FMT <filename>`
Example	`:MMEM:STOR:FMT "MYFMT.CSV"` saves the FMT mask data to the file myFmt.csv in the current directory.
Notes	The default path is: `My Documents\”Mode”\data\FMT` 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 there is a risk that files on this drive will be overwritten during an instrument software upgrade. Both single and double quotes are supported for any filename parameter over SCPI.
Annotation	After save is complete, an advisory is displayed in the message bar confirming which file was saved.

FMT Data File

An FMT data file contains a copy of the parameters used to configure a Frequency Mask.

FMT data files are text files in .csv (comma separated values) form, to make them importable into Excel or other spreadsheet programs. The format for the FMT data files is as follows.

Line #	Type of field	Example	Notes
1	File type, must be "FMT"	FMT	May not be omitted
2	Mask Name (in quotes)	"GSM Interference Mask"	60 characters max; may be empty but may not be omitted. If exceeds 60 characters, error -233 Too much data reported
3	Instrument Version, Model #	A.12.00, N9030A	May be empty but may not be omitted
4	List of options	526 ALV B1X B1Y B25 B40 B85 BBA CR3 CRP DCF DDA DP2 EA3 EDP EMC EP1 ERC ESC EXM FS1 FSA FT2 LFE LNP MAT MPB NF2 NFE NUL P26 PFR RT2 RTL RTS	
5	Trigger Criteria	TriggerCriteria, Enter	May be empty but may not be omitted. If empty default value of Enter will be used.
6	Trigger Mask	TriggerMask, Upper	May be empty but may not be omitted. If empty default value of Upper will be used.
7	Trigger Delay	TrigDelay, 1.0ms	May be empty but may not be omitted. If empty default value of 1.0µs will be used.
8	Trigger Delay State	TrigDelayState, Off	May be empty but may not be omitted. If empty default value of Off will be used.
9	X Relative to Center Freq	XRelative, True	May be empty but may not be omitted. If empty default value True will be used.
10	Y Relative to Ref Level	YRelative, True	May be empty but may not be omitted. If empty

Line #	Type of field	Example	Notes
			default value True will be used.
11	X Offset	XOffset, 0	May be empty but may not be omitted. If empty default value 0 will be used.
12	Y Offset	YOffset, 0	May be empty but may not be omitted. If empty default value 0 will be used.
13	Mask Hue	Mask Hue, 170	
14	Mask Opacity	Mask Opacity, 15	
15	Opacity Preview	Opacity Preview, False	
16	Upper Mask Data	UpperMaskData	Upper Mask data begins on the next line. This will be in the format Freq,Ampl pairs for each mask point.
		995000000, -30.3141372680664	
		998333333.333333, -20.9380844116211	
		999913793.103448, -8.05	
		1000109195.4023, .05	
		1000109195.4023, -64.05	
		1000270114.94253, -64.05	
		1002580459.77011, -87.4942291259766	
		1005000000, -86.5962646484375	
Dependent on amount of Upper Mask Data	Lower Mask Data	LowerMaskData	Lower Mask data begins on the next line. This will be in the format Freq,Ampl pairs for each mask point.

The data follows the DATA row, as comma separated X, Y pairs; one pair per line.

Example:

FMT

"MASK NAME"

A.01.12, N9030A

526 ALV B1X B1Y B25 B40 B85 BBA CR3 CRP DCF DDA DP2 EA3 EDP EMC EP1 ERC ESC EXM FS1 FSA FT2 LFE LNP MAT MPB NF2 NFE NUL P26 PFR RT2 RTL RTS

Trigger Criteria, Leave

Trigger Type, Upper

Trigger Delay, 1E-06

Trigger Delay State, True

X Relative, False

Y Relative, False

X Offset, 0

Y Offset, 0

Mask Hue, 170

Mask Opacity, 15

Opacity Preview, False

Upper Mask Data

995000000, -30.3141372680664

998333333.333333, -20.9380844116211

999913793.103448, -8.05

1000109195.4023, .05

1000109195.4023, -64.05

1000270114.94253, -64.05

1002580459.77011, -87.4942291259766

1005000000, -86.5962646484375

In table format:

FMT	
"GSM Interference Mask"	
A.02.06	N9030A
526 ALV B1X B1Y B25 B40 B85 BBA CR3 CRP DCF DDA DP2 EA3 EDP EMC EP1 ERC ESC EXM FS1 FSA FT2 LFE LNP MAT MPB NF2 NFE NUL P26 PFR RT2 RTL RTS	
TriggerCriteria	Enter
TriggerMask	Upper
TrigDelay	1.0ms
TrigDelayState	Off
XRelative	TRUE
YRelative	TRUE

XOffset	0
YOffset	0
Mask Hue	170
Mask Opacity	15
Opacity Preview	False
Upper Mask Data	
-1500000.00	-80.00
-1000000.00	-60.00
-21000.00	-25.00
-20000.00	-20.00
20000.00	-15.00
21000.00	-30.00
1000000.00	-60.00
1500000.00	-75.00
Lower Mask Data	
-1200000.00	-95.00
-800000.00	-90.00
100000.00	-87.00
1000000.00	-86.50
1500000.00	-75.50

7.1.10 Waveform Sequence

The Save Waveform Sequence function lets you save 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.

7.1.11 Screen Image

Save **Screen Image** lets you choose a file for saving the contents of the display.

Screen Image files are PNG files with the same resolution as the data display. They contain the picture that was on the screen before going into the Save dialog. When the Screen Image key is pressed, a "thumbnail" of the captured image is displayed, as shown below, with the note “This is the image that will be saved” below it, as shown below.

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 a *CLS (clear status) command will remove any message displayed on the screen. So if you do not want to see the “File saved” message after sending the MMEM:STOR:SCR command (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 will remove 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 will still be 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 a 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 the INST:SEL command (for example, SA for the Spectrum Analyzer).

Screen Image files have the 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	`:MMEM:STOR:SCR "myScreen.png"` This stores the current screen image in the file MyScreenFile.png in the default directory.
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.

7.1.11.1 Theme

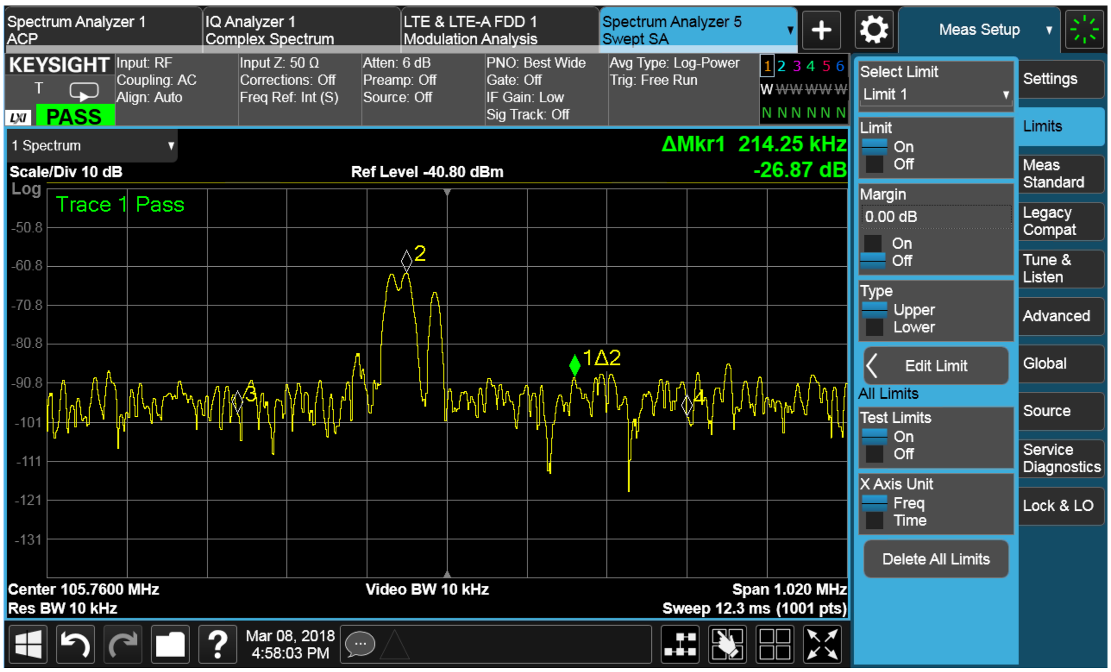
Accesses a menu of functions that enable you to choose the theme to be used when saving the screen image. It allows you to choose between themes to be used when saving the screen image.

See "More Information" on page 874 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 is 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 will be 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-models so the A-models monochrome commands will yield color. The query of :MMEM:STOR:SCR:THEM? will always return FILLed or OUTLine, it will not return FCOLor, FMONochrome, TDColor, or TDMonochrome. In ESA and PSA we offer the choice of "Reverse Bitmap" or "Reverse Metafile" when saving screen images. This is much like the "Outline" theme available in the X-Series Touch UI. There is no monochrome theme in the X-Series Touch UI.

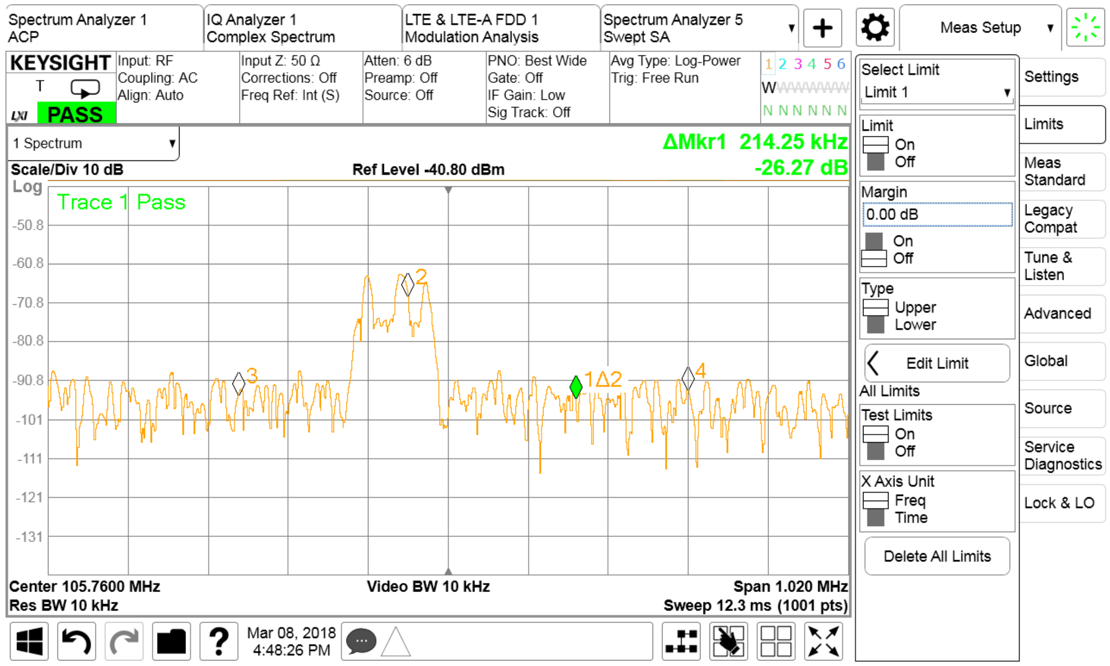
More Information

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:



7.1.12 Remote Only Commands

The following commands execute file system operations such as move, copy and transfer data from a file.

7.1.12.1 Mass Storage Catalog (Remote Command Only)

Remote Command	:MMEMory:CATalog? [<directory_name>]
Example	:MMEM:CAT? "C:\"
Notes	The string <directory_name> must be a valid logical path. If no string then it uses the current directory. 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. The <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

7.1.12.2 Mass Storage Change Directory (Remote Command Only)

Remote Command	`:MMEMory:CDIRectory [<directory_name>]` `:MMEMory:CDIRectory?`
Example	`:MMEM:CDIR “C:\Program Files”`
Notes	The string must be a valid logical path. 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.

7.1.12.3 Mass Storage Copy (Remote Command Only)

Remote Command	`:MMEMory:COPY <string>,<string>[,<string>,<string>]`
Example	`:MMEM:COPY "C:\TEMP\Screen_0000.png","C:\"`
Notes	The string must be a valid logical path. 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 (e.g., C:\Windows) and the current user does not have Power User or Administrator privileges.

7.1.12.4 Mass Storage Device Copy (Remote Command Only)

This command transfers data to/from a file and a peripheral device.

Remote Command	`:MMEMory:COPY:DEVice <source_string>,<dest_string>`
Notes	The strings must be a valid logical path or a valid device keyword. If the dest_string is a device keyword, the data is copied from the source file to the device. If the 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.

7.1.12.5 Mass Storage Delete (Remote Command Only)

Remote Command	`:MMEMory:DELete <file_name>[,<directory_name>]`
Example	`:MMEM:DEL “Screen_0000.png”`
Notes	The string must be a valid logical path. If no directory is specified, uses the current directory. Removes a file from the specified directory. The <file_name> parameter specifies the file name to be removed. This command will generate an “access denied” error if the file is in a restricted folder (e.g., C:\Windows) and the current user does not have Power User or Administrator privileges.

7.1.12.6 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>` `:MMEMory:DATA? <file_name>`
Example	`:MMEM:DATA? “MyFile.txt”`
Notes	The string must be a valid logical path. If no directory is specified, uses the current directory. The command form is MMEMory:DATA <file_name>,<data>. It loads <data> into the file <file_name>. <data> is in 488.2 block format. <file_name> is string data. The query form is MMEMory:DATA? <file_name> with the response being the associated <data> in block format.

7.1.12.7 Mass Storage Make Directory (Remote Command Only)

Remote Command	`:MMEMory:MDIRectory <directory_name>`
Example	`:MMEM:MDIR “C:\TEMP\NewDir”`
Notes	The string must be a valid logical path. Creates a new directory. The <directory_name> parameter specifies the name to be created. This command will generate an “access denied” error if the new directory would be in a restricted folder (e.g., C:\Windows) and the current user does not have Power User or Administrator privileges.

7.1.12.8 Mass Storage Move (Remote Command Only)

Remote Command	`:MMEMory:MOVE <string>,<string>[,<string>,<string>]`
Example	`:MMEM:MOVE "C:\TEMP\Screen_0000.png","C:\"`

Notes	The string must be a valid logical path. 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 will generate an "access denied" error if the destination is a restricted folder (e.g., C:\Windows) and the current user does not have Power User or Administrator privileges.

7.1.12.9 Mass Storage Remove Directory (Remote Command Only)

Remote Command	`:MMEMory:RDIRectory <directory_name>`
Example	`:MMEM:RDIR "C:\TEMP\NewDir"`
Notes	The string must be a valid logical path. Removes a directory. The <directory_name> parameter specifies the directory name to be removed. All files and directories under the specified directory shall also be removed. This command will generate an "access denied" error if the folder is a restricted folder (e.g., C:\Windows) or is in a restricted folder and the current user does not have Power User or Administrator privileges.

7.1.12.10 Mass Storage Determine Removable Media (Remote Command Only)

This command is used to determine if 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 CPU's, 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 will be 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 will be returned. Examples: – One removable device present will result in a return string of "F:". – Two removable devices present will result in a return string of "F:,G:". – No removable devices present will result in a return string of "".

7.1.12.11 Mass Storage Determine Removable Media Label (Remote Command Only)

This command is 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" will be generated. Setting the removable media label requires Administrative privileges. If the currently logged in use does not have appropriate privileges the error "-221.9900,Settings conflict;Administrator privileges required" is generated.

7.1.12.12 Mass Storage Determine Removable Media Write-protect status (Remote Command Only)

This command is 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" will be generated.
Preset	The return value will be depending on SD card installed.

7.1.12.13 Mass Storage Determine Removable Media size (Remote Command Only)

This command is used to query 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 which is less than 1 GB will return 0 GB. If the <partition> specified does not exist or is not a removable media device the error -252,"Missing Media" will be generated.

7.1.12.14 :SYSTem:SET (Remote Command Only)

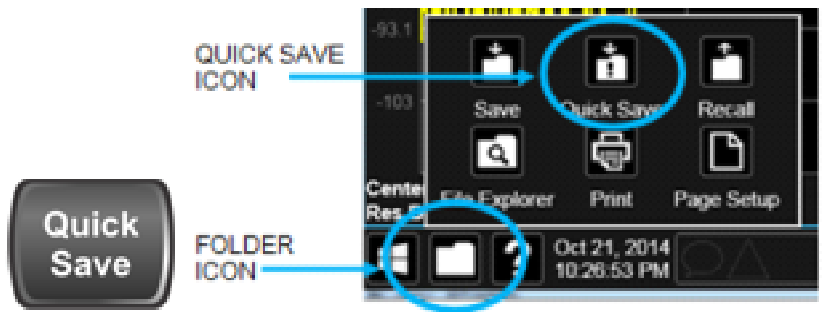
Remote command that allows the user to obtain the state of the currently active mode in a form that can then be loaded back into the instrument quickly.

Remote Command	`:SYSTem:SET <instrument state in IEEE Block>` `:SYSTem:SET?`
Notes	SYST:SET? returns current instrument state of the active mode in IEEE Block data format. The state is in a machine readable format only. Sending the query returns the following format: <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>

7.2 Quick Save

The Quick Save function 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 a 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 number, 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

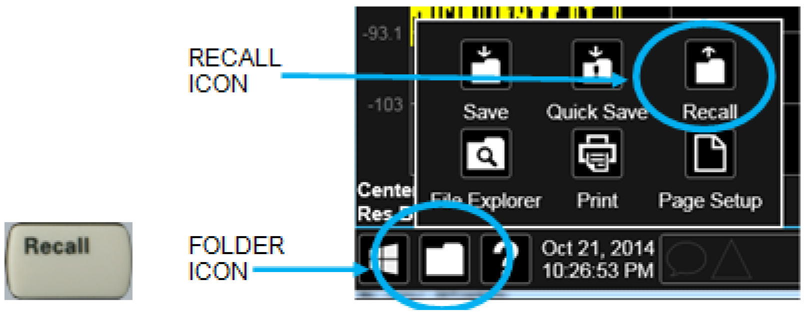
Quick Save can be operated in the Normal mode and in a special “Prompt” mode. There is a switch on the User Interface page of the System menus that lets you control this.

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.

7.3 Recall

The Recall dialog lets you recall previously saved states, traces and other items to the analyzer from files on the analyzer'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 Recall 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 the :MMEM:LOAD command is available for specific file types. An example is :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. It may be appropriate to issue a warning if the state is limited on the recall; warnings do not go out to

SCPI so this would only affect the manual user.

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.

7.3.1 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.

Files of Type

This 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)

7.3.2 State

Recall **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	`:MMEM:LOAD:STAT "MyStateFile.state"` This loads the state file data (on the default file directory path) into the instrument state.
Notes	When you pick a file to recall, the analyzer 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 functiontries 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 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 a *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 analyzer exits the Recall menu and returns to the previous menu.
Backwards Compatibility SCPI	`:MMEMory:LOAD:STATe 1,<filename>` For backwards compatibility, the above syntax is supported. The "1" is simply ignored.

7.3.2.1 Recall Type

If you have a built-in Source in your Analyzer, you may wish, when recalling State, to recall only the part of the State file which applies to the Analyzer, and leave the Source unaffected. Or you may wish to recall only the part of the State file which applies to the Source, and leave the Analyzer unaffected.

This control 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	`:MMEMory:LOAD:RTYPe: ALL`
Dependencies	– This control is only available in models with a built-in source, such as VXT models.
Preset	– ALL
Range	– ALL|ANALyzer|SOURce

7.3.2.2 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 under 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

7.3.2.3 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 under the **Save, State** function.

7.3.3 Trace+State

Recall **Trace+State** lets you choose a register or file for recalling 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 Trace+State menu lists 16 registers from which you can recall trace+state files. Pressing a Register button 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 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 | TRACE2 | TRACE3 | TRACE4 | TRACE5 | TRACE6,<filename>` `:MMEMory:LOAD:TRACe:REGister TRACE1 | TRACE2 | TRACE3 | TRACE4 | TRACE5 | TRACE6,<integer>`

Example	`:MMEM:LOAD:TRAC TRACE2,"MyTraceFile.trace"`
	This 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, andis set to be not updating.
	`:MMEM:LOAD:TRAC:REG TRACE1,2`
	restores the trace data in register 2 to Trace 1

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 the Recall the analyzer exits the Recall menu and returns to the previous menu.

Some modes and measurements do not have available all 6 traces. Phase Noise mode command, for example, is: MMEMory:LOAD:TRACe TRACE1|TRACE2|TRACE3,<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>

7.3.3.1 Recall To Trace

These menu selections let you choose the Trace where the recalled trace will go. Not all modes have the same number of traces available. The default is the currently selected trace, selected in 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.

If the .trace file is an "all trace" file, "To Trace" is ignored and the traces each go back to the trace from which they were saved.

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 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

7.3.3.3 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 under the **Save, State** function.

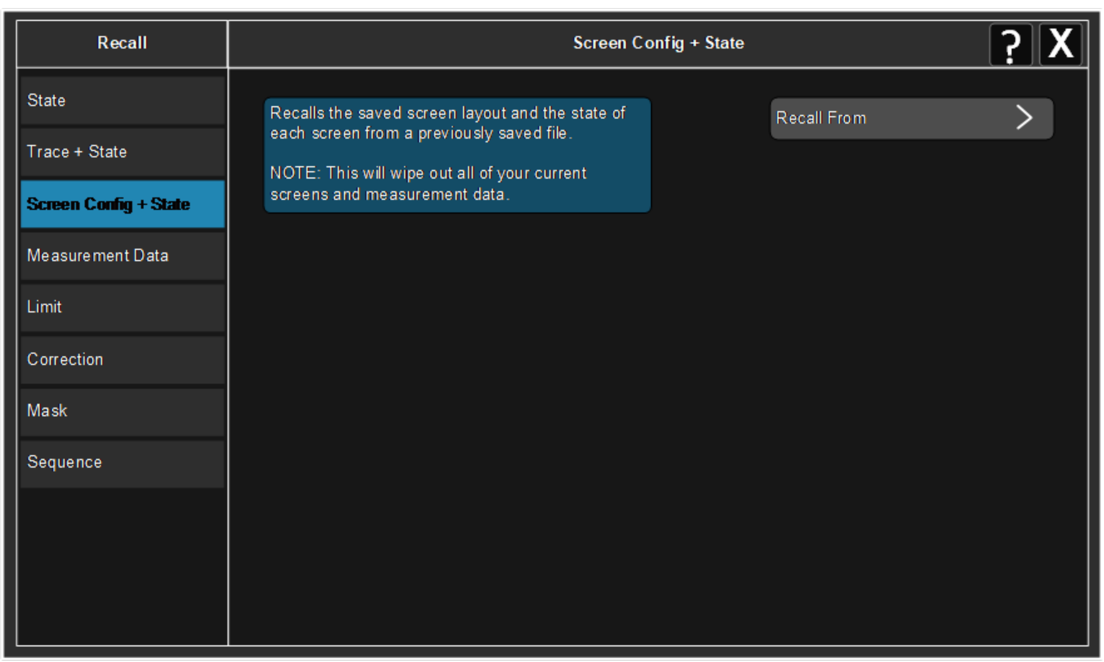
7.3.4 Screen Config + State

RecallScreen 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 will wipe out your current screen configuration; you don’t get 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



Since we already used the "SCReen" parameter for Screen Image, the SCPI commands are:

Remote Command	`:MMEMory:LOAD:SCONfig <filename>`
Example	`:MMEM:LOAD:SCON "myScreenConfig.screen"` This loads the screen configuration from the file MyScreenConfig.screen in the default directory.

7.3.5 Measurement Data

Recall 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 the "Measurement Data" on page 847 description under **Save**.

Since the commonly exported data files are in .csv format, you can edit the data prior to importing it. This allows youto export a data file, manipulate the data in Excel (for example) and then import it.

7.3.5.1 Data Type

You choose the data type to recall 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. Data Types which are not importable will not appear, even if they do appear in the corresponding **Save** menu.

Trace

Selecting **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 analyzer when the file was saved. This metadata is compared to the current state of the analyzer when the file is recalled; if it doesn't match the current state, the "invalid data indicator" (*) is displayed.

The metadata is detailed in Trace File Contents in the Save section.

Remote Command	`:MMEMory:LOAD:TRACe:DATA TRACE1 | TRACE2 | TRACE3 | TRACE4 | TRACE5 | TRACE6,<filename>`

Example	`:MMEM:LOAD:TRAC DATA TRACE2,"myTrace2.csv"` Imports the 2nd trace from the file myTrace2.csv in the current path. For SA mode, the default path is My Documents\SA\data\traces
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.

Selecting **Spectrogram** 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.

The **Spectrogram** file contains a "meta" data header which describes the current state of the analyzer. The metadata is detailed below.

Remote Command	`:MMEMory:LOAD:RESults:SPECtrogram <filename>`
Example	`:MMEM:LOAD:RES:SPEC "MeasResult_0001.csv"` Imports the results from the file MeasResult_0001.csv in the default path in the current path.
Dependencies	Requires spectrogram view and single mode when recalling spectrogram. Else, error message "Spectrogram view and Single mode must be on to recall Spectrogram Meas Results file" will be 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.

7.3.6 Limit

RecallLimit lets you choose 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 other spreadsheets, as well as header data that gives information on the limit.

See the Save Limit description ("Limit" on page 859) 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 analyzer, 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	`:MMEM:LOAD:LIM LLINE2,"myLimitLine2.csv"` Imports the 2nd Limit Line from the file myLimitLine2.csv in the current path.
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 the Phase Noise Mode, there are only three Limit Lines, so the valid parameters are LLINE1|LLINE2| LLINE3 This key will only appear 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 analyzer will set 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 will be erased before the data loads. If this operation is over the remote interface there will be 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

7.3.6.1 Select Limit

This control enables you to select the Limit register where the recalled Limit will be placed, e.g., Limit 1.

Preset	Not part of Preset, but is reset to LLINE1 by Restore Mode Defaults; survives shutdown

7.3.7 Correction

Selecting **Correction** allows you to import Amplitude Corrections files in the PC-readable .csv format.

Amplitude Correction files are CSV files, and contain the correction data in a form that can be imported into Excel or other spreadsheets, as well as header data that gives information on the correction.

For backwards compatibility, older limit files with the extension .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 the 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 will change to match the Antenna (Transducer) Unit in the file.

Remote Command	`:MMEMory:LOAD:CORRection 1 | ... | 8, <filename>`
Example	`:MMEM:LOAD:CORR 2, "myAmpcor.csv"` recalls the Amplitude Correction data from the file myAmpcor.csv in the current directory to the 2nd Amplitude Correction table, and turns on Correction 2
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 will be grayed out in measurements that do not. The key will 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 **ApplyCorrections is** set to 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

7.3.7.1 Select Correction

This control enables you to select the register where the recalled Correction will be placed, e.g. Correction 1.

Preset	Not part of a Preset, but is reset to Correction 1 by Restore Input/Output Defaults. Survives a shutdown.

7.3.8 Complex Correction

Selecting **Complex Correction** allows you to import 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 other 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	`:MMEM:LOAD:CCOR 2, "mycor.s2p"` recalls 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.
Dependencies	Complex Corrections are not supported by all Measurements. The tab will 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.
Couplings	When a complex correction file is loaded from mass storage, it is automatically turned on (**Correction** ON) and **ApplyCorrections is** set to 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.

7.3.8.1 Select Complex Correction

This control enables you to select the register where the recalled Complex Correction will be placed e.g., Complex Correction 1.

Preset	Not part of a Preset, but is reset to Correction 1 by Restore Input/Output Defaults. Survives a shutdown.

7.3.9 Correction Group

Selects the correction group as the data type to be imported. The next step is to press the Recall From control 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 as the values will be overwritten during the recall.

Remote Command	`:MMEMory:LOAD:CORRection:GROup <filename>`
Example	`:MMEM:LOAD:CORR:GRO “D:\myCorrGroup.csv”`

	Imports the Correction Group and the corresponding correction tables from the file 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	This file type is supported in EMI Receiver mode and in Spectrum Analyzer mode if option EMC or EMI Receiver mode is present. None
Annotation	After recall is complete, display an advisory in the message bar.
Status Bits/OPC dependencies	Sequential - aborts the current measurement

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.

7.3.10.1 FMT Mask

Recall FMT Mask allows you to import a Frequency Mask Trigger mask from a file.

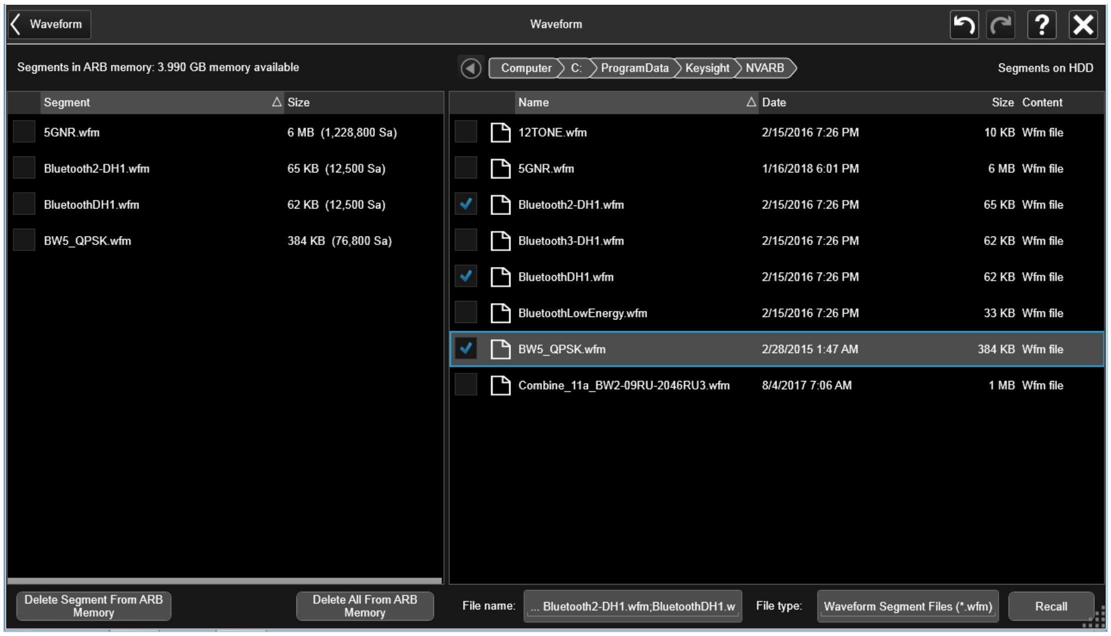
Remote Command	`:MMEMory:LOAD:FMT <filename>` The file name must have extension ".csv"
Example	`:MMEM:LOAD:FMT "myFmt.csv"` recalls the FMT mask data from the file myFmt.csv in the current directory and sets the Trigger Type to FMT.
Notes	The default path is: My Documents\"Mode"\data\FMT
Dependencies	Only appears in Pulse and RTSA Modes
Couplings	All the FMT setup parameters will be updated with the values from the imported file. Trigger Type will change to FMT is not already selected. This will only be the case when the command is executed remotely.
Annotation	After recall is complete, an advisory is displayed in the message bar confirming which file was recalled.

7.3.11 Waveform

The Recall Waveform function lets you recall waveforms into the ARB memory of an Internal Source.

When you select the Waveform tab in the Save dialog, It puts up a hint 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" and it takes you to 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 the :MMEMory:COPY command.

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:

- Waveform Files - *.wfm. These are Keysight Signal Studio files.
- Binary Files - *.bin. These are interleaved IQ data files. They could be single precision or double precision customer created files. One-byte marker may be added.
- CSV Files - *csv. This comma separated value file could be generated by Microsoft Excel.
- Text Files - *txt.
- Matlab Files - *.mat. A *.mat waveform should be Level 4, Level 5 or HDF5 MAT-files (only Level 5 Matlab file is supported in X24).

Waveforms formatted in *.csv, *.txt and *.mat 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 on the right column represents the amplitude of real(I) points, Data on 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 comma or tabs will be 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.

7.3.11.1 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>`

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 the query *OPC?, which holds off subsequent commands until the loading operating is complete. <string> - specifies the path name of the file to load from the HDD into ARB memory. It could be a <full path + filename>, or <“NVWFM” MSUS + colon + filename>. If you specify a file over SCPI, but the file is not at the specified location, an error is generated. If 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: 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” which 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 will be 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”. User can install required licenses according to <required licenses> string to license it, or multi-pack license it. Sequence Analyzer Mode: When in Sequence Analyzer mode, and Include Source is Yes, an attempt to load a file to ARB memory will be 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>`
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, you can either use Windows File Explorer, or the :MEMory:COPY command. <string> - specifies the directory on the HDD to load the files into ARB memory from. If you specify a directory over SCPI, but the directory does not exist, an error is generated. If the ARB is ON, a user then loads or deletes 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.

Sequence Analyzer Mode:

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.

7.3.11.2 Delete Segment From ARB Mem

Deletes a segment from ARB memory.

Remote Command	`:SOURce:RADio:ARB:DELete <string>`
Example	`:SOUR:RAD:ARB:DEL “testwaveform.bin”`
Notes	<string> - specifies the waveform to be deleted from the ARB playback memory. 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 which 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 will be replayed after the ARB operation is finished. Sequence Analyzer Mode: 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.

7.3.11.3 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 will be replayed after the ARB operation is finished.

	Sequence Analyzer mode: 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.

7.3.11.4 Set Default Directory (Remote Command Only)

Allows you to change 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

7.3.11.5 Query ARB Memory File List (Remote Command Only)

Queries the test set for the list of waveform segments in the ARB memory.

NOTE

This command 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 Command Only)" on page 902.

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

7.3.11.6 Query ARB Memory Full File List (Remote Command Only)

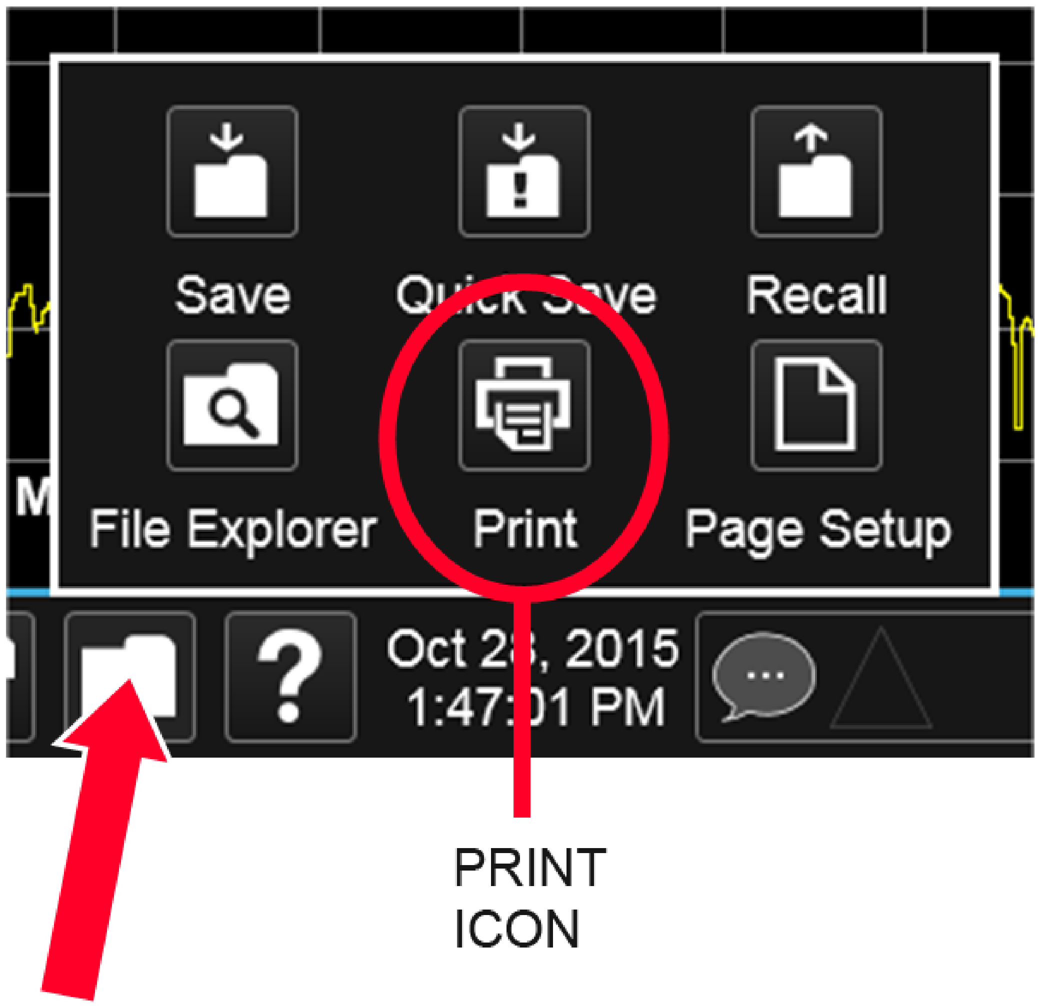
Queries the test set for the string list of waveform segments in the ARB memory. It returns a string list for waveform segment names in the ARB memory.

Remote	`:SOURce:RADio:ARB:FCATalog?`

Command	
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”

7.4 Print

The Print icon is found under the File Functions icon.



The Print icon opens a Print dialog for configured printing (for example, to the printer of your choice).

The :HCOPy command is equivalent to pressing the PRINT key.

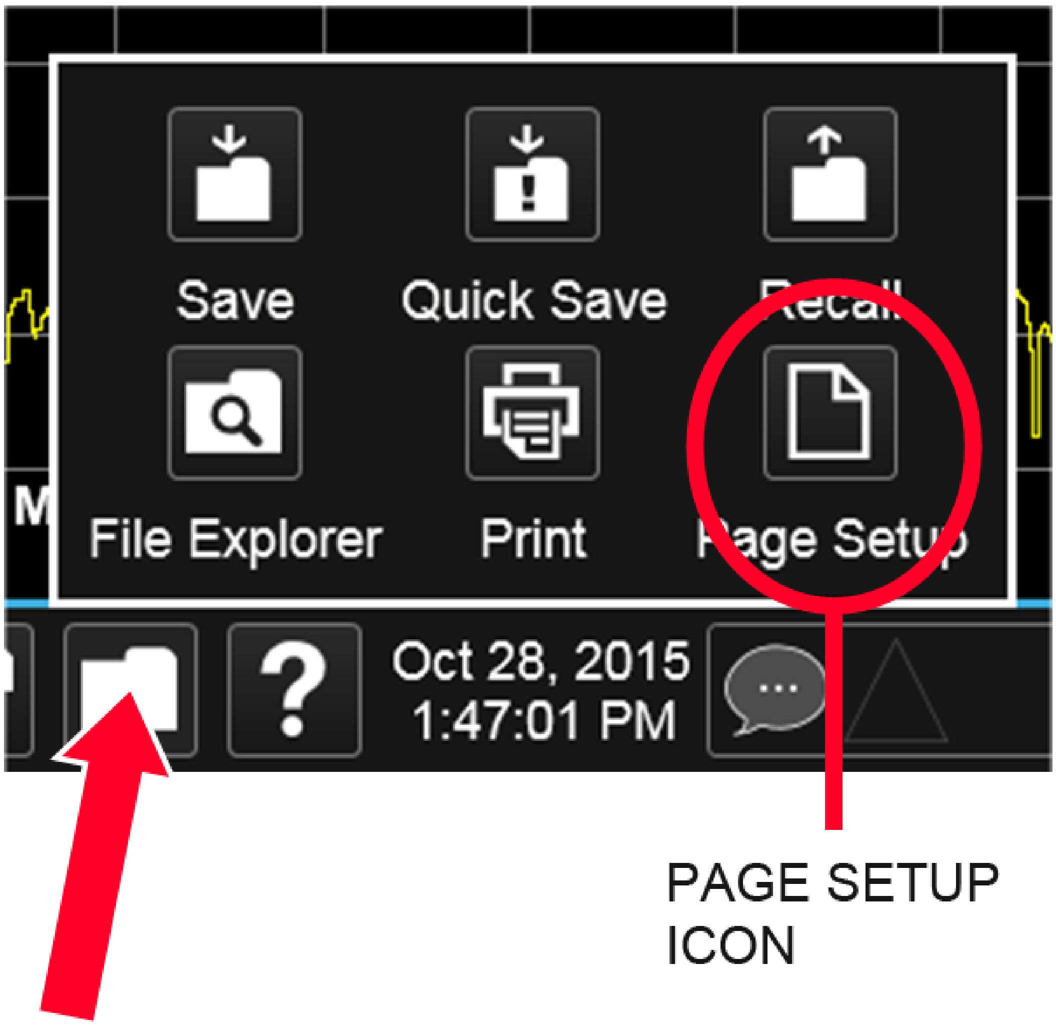
Remote Command	`:HCOPy[:IMMediate]`

The HCOPy:ABORt command can be used to abort a print which is already in progress. Sending HCOPy:ABORt will cause the analyzer 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 the user sent the ABORt command.

Remote Command	`:HCOPy:ABORt`

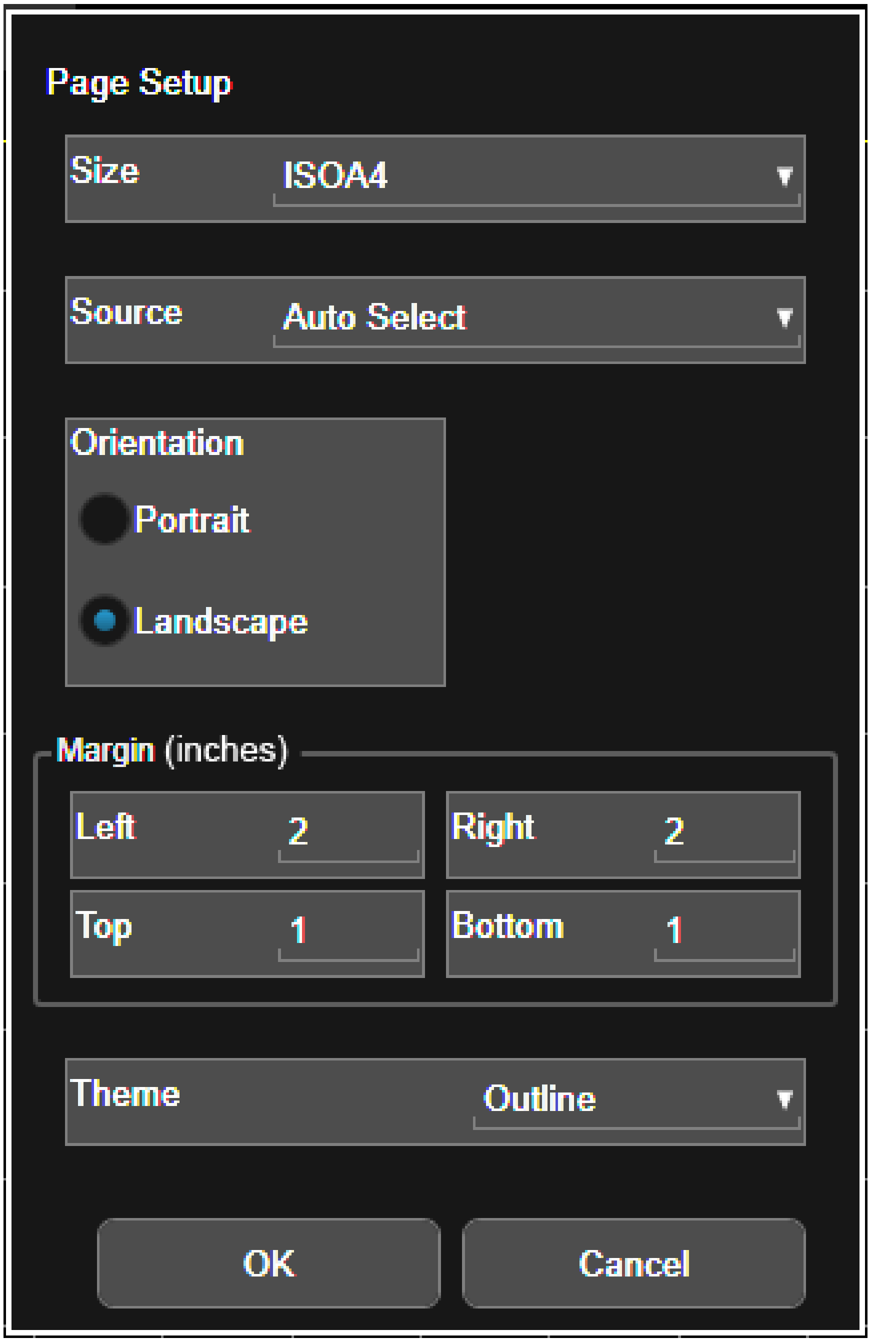
7.5 Page Setup

The Page Setup icon is found under the File Functions icon.



The Page Setup icon brings up a Windows Page Setup dialog that allows you to control aspects of the pages sent to the printer when the PRINT hardkey is pressed.

Paper size, the printer paper source, the page orientation and the margins are all settable. There are no SCPI commands for controlling these parameters.



Also contained in this dialog is a drop-down control that lets you select the display Theme to use when printing. The Page Setup themes are the same as those available for the Screen Image "Theme" on page 873.

The Theme control has a corresponding SCPI command:

Remote Command	`:SYSTem:PRINt:THEMe FILLed | OUTLine` `:SYSTem:PRINt:THEMe?`
Example	`:SYST:PRIN:THEM OUTL`

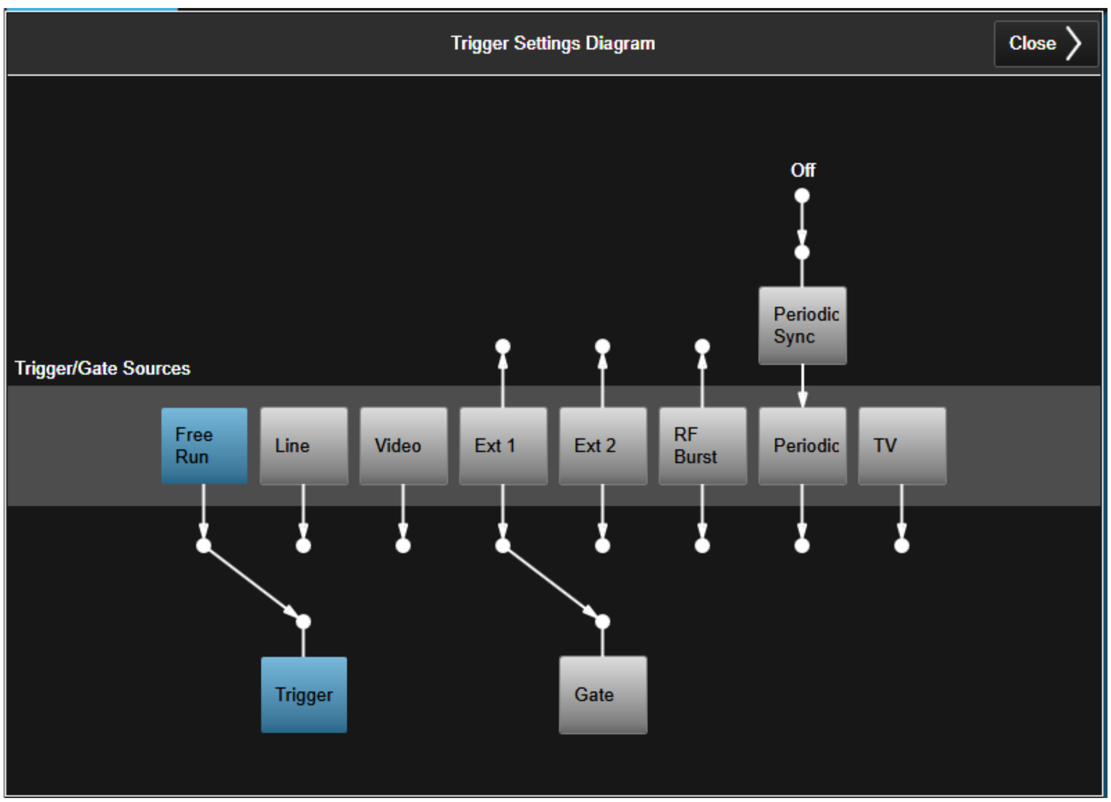
Preset	OUTL; not part of Preset, but is reset by Restore Misc Defaults or Restore System Defaults All and survives subsequent running of the modes.
State Saved	No
Backwards Compatibility SCPI	`:SYSTem:PRINt:THEMe TDColor | TDMonochrome | FCOLor | FMONochrome`
Backwards Compatibility Notes	To permit code compatibility with A-model X-Series Signal Analyzer instruments, the command parameters from the A-models will be 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-models so the A-models monochrome commands will yield color. The query of :SYST:PRINT:THEM? will always return FILLed or OUTLine, it will not return FCOLor, FMONochrome, TDColor, or TDMonochrome.

8 Trigger

The **Trigger** key accesses menus that let you control the Trigger system of the instrument. In general, these are functions associated with internal triggers or trigger inputs. Trigger Output functions are configured under the **Input/Output** key.

The 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 Settings Diagram" on page 961.



In general, each Measurement can have a different Trigger and each Measurement remembers its previously-set Trigger.

8.1 Trigger

The Trigger tab contains controls which let you select the trigger source and setup of each of the trigger sources. The analyzer is designed to allow triggering from a number of different sources, for example, Free Run, Video, External, RF Burst, and so forth.

In general, each Measurement can have a different Trigger Source, and each Measurement remembers its previously-set Trigger Source.

8.1.1 Select Trig Source

Specifies the trigger source for the currently selected analyzer 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 analyzer 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 918 and "I/Q Trigger Source (Remote Command Only)" on page 922.

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.

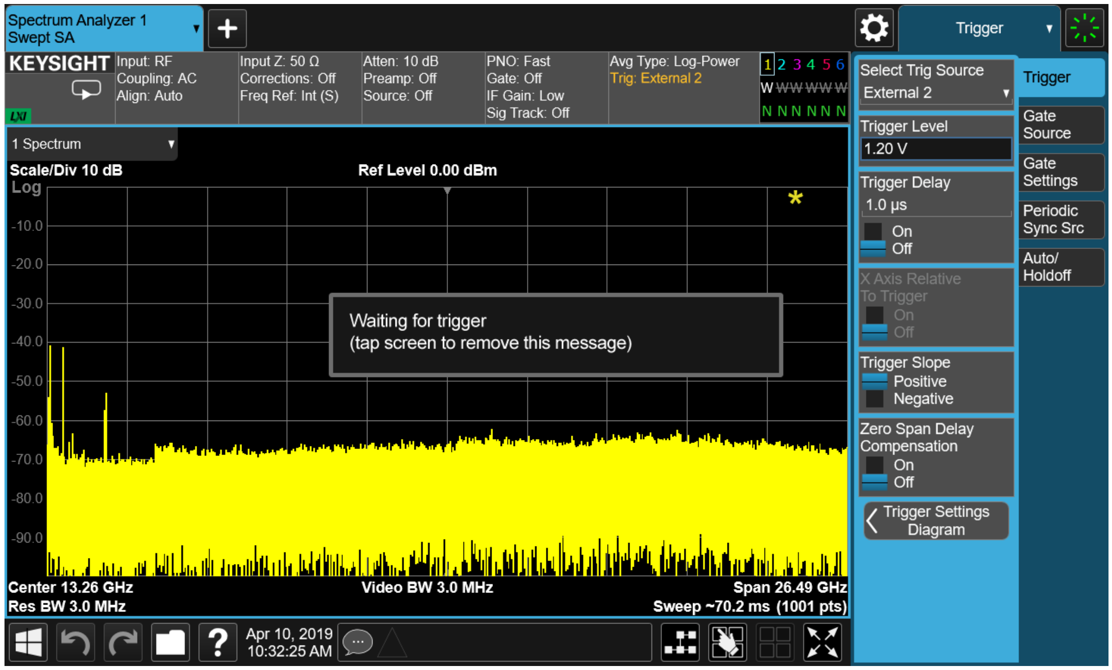
Note that the controls available on the Trigger Tab change depending on which trigger source is selected. Tap each trigger source in the table in the “List of Available Trigger sources” dropdown to see what parameters are available for that trigger source.

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 analyzer 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 which says “Waiting for trigger”. The trigger annotation in the Meas Bar will also turn amber, as shown below:



You may 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

This table shows 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 922	All Modes and measurements except those measurements that support no triggers at all
Video/ADC	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	All Modes and measurements supporting Video, except Spectrum Analyzer

	mode (Only supported in certain model's IF Paths)
"Line" on page 925	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" on page 924	RTSA and Pulse Modes only
"FMT" on page 931	RTSA and Pulse Modes only
"External 1" on page 926	All Modes and measurements
"External 2" on page 926	All Modes and measurements
"External 3" on page 927	All Modes except EMI, Avionics, GSM, Phase Noise, Bluetooth and Analog Demod In Spectrum Analyzer, LTE, Short Range Comms, VMA, WLAN and WCDMA, only in the Power Stat CCDF measurement
"RF Burst" on page 928	All Modes except EMI In Spectrum Analyzer, all measurements except List Sweep
"Periodic" on page 929	All Modes except EMI In Spectrum Analyzer, all measurements except List Sweep
TV [Mode: SA]	Spectrum Analyzer Mode only, and only in the Swept SA measurement
I/Q Triggers: "I/Q Mag" on page 931 "Input I" on page 932 "Input Q" on page 932 "I (Demodulated)" on page 933 "Q (Demodulated)" on page 933 "Aux I/Q Mag" on page 934	All Modes except EMI, Avionics, RTSA, Analog Demod and Pulse In Spectrum Analyzer, only in Power Stat CCDF and Burst Power In WCDMA, only in Power Stat CCDF and IQ Waveform In GSM/EDGE, only in EVM, GMSK Phase & Freq Error, Transmit Power and IQ Waveform In Phase Noise, only in IQ Waveform In Bluetooth, only in Transmit Analysis In LTE, only in Power Stat CCDF, Modulation Analysis, Conformance EVM, and IQ Waveform 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 In VMA, only in Power Stat CCDF, Digital Demod and IQ Waveform
"PXI" on page 934	All Modes and measurements (only found in modular analyzers)
"Internal" on page 935	All Modes and measurements (only found in modular analyzers)

Backwards Compatibility SCPI

The following table contains information about SCPI commands 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

Backwards Compatibility Notes	In analyzers prior to the X-Series, the Average detector was not available when Video triggering was on, and consequently, functions that set the detector to average (such as Marker Noise or Band/Intvl Power) were not available when the video trigger was on. Similarly, Video triggering was not available when the detector was Average. In the X-Series, these restrictions are removed

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 analyzer 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.

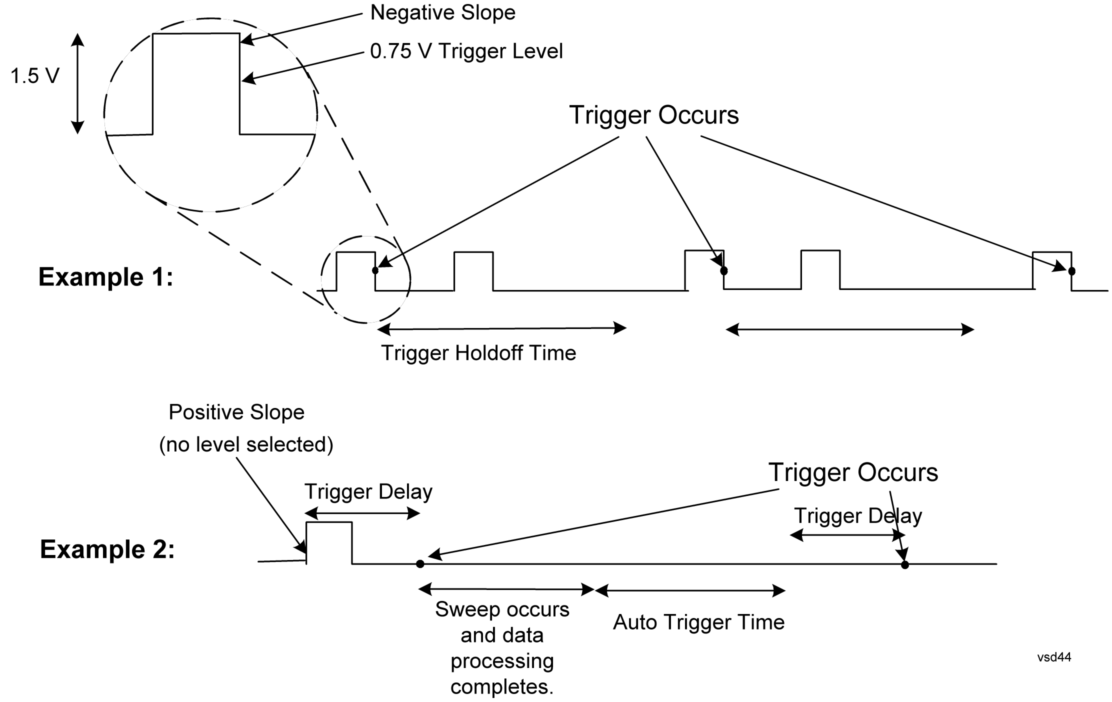
Once you have established the settings for a given trigger source, they generally will remain unchanged for that trigger source as you go from measurement to measurement within a Mode (although the settings can change as you go from Mode to Mode). Furthermore, the trigger settings within a Mode are the 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 | 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:
	`:TRIG:HARM:SOUR EXT1`
	Harmonics
	`:TRIG:TOI:SOUR EXT1`
	TOI
	`:TRIG:LIST:SOUR EXT1`
	List Sweep
	`:TRIG:BPOW:SOUR EXT1`
	Burst Power
	Power Suite measurements (appear in many Modes):
	`:TRIG:CHP:SOUR EXT1`
	Channel Power
	`:TRIG:OBW:SOUR EXT1`
	Occupied BW, Output Spectrum BW
	`:TRIG:ACP:SOUR EXT1`
	ACP, Adjacent Channel Power
	`:TRIG:PST:SOUR EXT1`
	Power Stat CCDF
	`:TRIG:SEM:SOUR EXT1`
	SEM
	`:TRIG:SPUR:SOUR EXT1`
	Spurious Emission
	`:TRIG:MON:SOUR EXT1`
	Monitor Spectrum
	`:TRIG:WAV:SOUR EXT1`
	IQ Waveform
	EMI Receiver Mode:
	`:TRIG:APD:SOUR EXT1`
	APD
	`:TRIG:DAN:SOUR EXT1`
	Disturbance Analyzer
	`:TRIG:FSC:SOUR EXT1`

Frequency Scan

`:TRIG:SCH:SOUR EXT1`

Strip Chart

`:TRIG:MON:SOUR EXT1`

Monitor Spectrum

IQ Analyzer Mode:

`:TRIG:SPEC:SOUR EXT1`

Complex Spectrum

WCDMA Mode:

`:TRIG:RHO:SOUR EXT1`

Mod Accuracy

`:TRIG:CWCD:SOUR EXT1`

Combined WCDMA

`:TRIG:LPST:SOUR EXT1`

List Power Step

`:TRIG:CDP:SOUR EXT1`

Code Domain

`:TRIG:PCON:SOUR EXT1`

Power Control

`:TRIG:EVMQ:SOUR EXT1`

QPSK EVM

GSM/EDGE Mode:

`:TRIG:EEVM:SOUR EXT1`

EVM

`:TRIG:PFER:SOUR EXT1`

GMSK Phase & Freq Error

`:TRIG:EORF:SOUR EXT1`

Output RF Spectrum

`:TRIG:ETSP:SOUR EXT1`

Tx Band Spur

`:TRIG:TXP:SOUR EXT1`

Transmit Power

`:TRIG:CGSM:SOUR EXT1`

Combined GSM

`:TRIG:EPVT:SOUR EXT1`

Power vs Time

Phase Noise Mode:

`:TRIG:LPL:SOUR EXT1`

Log Plot

`:TRIG:SFR:SOUR EXT1`

Spot Frequency

Analog Demod Mode:

`:TRIG:AM:SOUR EXT1`

AM

`:TRIG:FM:SOUR EXT1`

FM

`:TRIG:FMS:SOUR EXT1`

FM Stereo

`:TRIG:PM:SOUR EXT1`

PM

Bluetooth Mode:

`:TRIG:IBSP:SOUR EXT1`

EDR In-band Spurious Emissions

`:TRIG:TX:SOUR EXT1`

Transmit Analysis

`:TRIG:IBEM:SOUR EXT1`

LE In-band Emissions

5G NR Mode:

`:TRIG:PVT:SOUR EXT1`

Power vs Time

`:TRIG:EVM:SOUR EXT1`

Modulation Analysis

`:TRIG:PAVT:SOUR EXT1`

Phase and Amplitude vs Time

LTE and LTE-A FDD/TDD Modes:

`:TRIG:CEVM:SOUR EXT1`

Conformance EVM

`:TRIG:PVT:SOUR EXT1`

Transmit On/Off Power

`:TRIG:EVM:SOUR EXT1`

Modulation Analysis

WLAN Mode:

`:TRIG:PVT:SOUR EXT1`

Power vs Time

	`:TRIG:EVM:SOUR EXT1`
	Modulation Analysis
	`:TRIG:FLAT:SOUR EXT1`
	Spectral Flatness
	Short Range Comms Mode:
	`:TRIG:EVM:SOUR EXT1`
	Modulation Analysis
	VMA Mode:
	`:TRIG:DDEM:SOUR EXT1`
	Digital Demod
	Pulse Mode:
	`:TRIG:PULS:SOUR EXT1`
	Pulse

Notes	For some of the trigger parameters the tie-in to the parameter is not obvious. These are: IMMediate, which selects Free Run FRAMe , which selects Periodic Trigger FMT, which selects Frequency Mask Trigger AEXTernal, which 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, do not use the <measurement> keyword. Using the wrong 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. **For 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 920 and "I/Q Trigger Source (Remote Command Only)" on page 922 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.
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

Here are the Trigger Source Presets for the various measurements. These are the Trigger Sources that will be 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, 5G NR	IMM	IQ not supported
OBW	SA, WCDMA, LTEAFDD, LTEATDD, BT, 5G NR	1xEVDO: EXT1 Others: IMM	IQ not supported
Transmit Analysis	BT	RFB	IQMag
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, 5G NR	LTEATDD: - BTS: External 1 - MS: Periodic Timer	LTEATDD: - BTS: External 1 - MS: Periodic Timer

Meas	Mode	Preset for RF	Preset for IQ
		Others: IMM	Others: IMM
ACP	SA, WCDMA, LTEAFDD, LTEATDD, MSR,SRCOMMS, 5G NR	IMM	IQ not supported
Tx Power	SA, GSM	RFBurst	IMM
SPUR	SA, WCDMA, MSR, LTEAFDD, LTEATDD, 5G NR	IMM	IQ not supported
SEM	SA, WCDMA, MSR, LTEAFDD, LTEATDD, SRCOMMS, 5G NR	IMM	IQ not supported
CDP	WCDMA	IMM	IMM
RHO	WCDMA	IMM	IMM
PCON	WCDMA	IMM	IMM
QPSK	WCDMA	EXT1	IMM
MON	All except SA and BASIC	IMM	IQ not supported
WAV	All except SA	LTEATDD: - BTS: External 1 - MS: Periodic Timer GSM/EDGE: RFBurst All others: IMM	LTEATDD: - BTS: External 1 - MS: Periodic Timer GSM/EDGE: IQMag All others: IMM
EVM	LTEAFDD, LTEATDD, SRCOMMS, 5G NR	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	IQMag
GMSK ORFS	EDGE/GSM	RF Burst	IQ not supported
EDGE PVT	EDGE/GSM	RFB	IMM
EDGE EVM	EDGE/GSM	RFB	IQMag
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, 5G NR	BTS: External 1 MS: Periodic Timer	BTS: External 1 MS: Periodic Timer

Meas	Mode	Preset for RF	Preset for IQ
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	Analog Demod	IMM	IQ not supported
PAvT	SA, 5G NR, VMA	IMM	IMM

RF Trigger Source (Remote Command Only)

The **RF Trigger Source** command 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	`:TRIG:ACP:RF:SOUR EXT1`
	Selects the external 1 trigger input for the ACP measurement and the RF input
	`:TRIG:RF:SOUR VID`
	Selects video triggering for the `SANalyzer` measurement and the RF input. For `SAN`, do not use the <measurement> keyword.

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 models M9420A/21A, and "Trigger 1" on the front panel of VXT models M9410A/11A 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 models M9420A/21A, and "Trigger 2" on the front panel of VXT models M9410A/11A. 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, 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 sec. This message goes away when a trigger signal appears

I/Q Trigger Source (Remote Command Only)

This command 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	`:TRIG:SOUR IMM`

	Swept SA measurement `:TRIG:<meas>:SOUR IMM` Measurements other than Swept SA
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 application 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 936

– "Trigger Delay" on page 939

– "Trigger Slope" on page 943

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 which 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 which support Video Trigger as an IF Envelope trigger, the units are typically in dBm.

Example	`:TRIG:SOUR VID`
	Swept SA measurement
	`:TRIG:<meas>:SOUR VID`
	Measurements other than Swept SA

Annunciation	Video (in the Meas Bar)

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 Visa Versa.

Example	`:TRIG:<meas>:SOUR ADC` Measurements other than Swept SA
Annunciation	ADC (in the Meas Bar)

8.1.1.3 Level

The Level trigger condition is met when the signal (the filtered and detected version of the input signal, including RBW filtering) crosses the trigger level.

The Level trigger level is shown as a labeled line on the display. The line is displayed as long as Level 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.

The Trigger Tab contains the following Trigger Source dependent controls when Level Trigger is selected:

– "Prot Frame Aligned" on page 936

– "Trigger Delay" on page 939

– "Time 1" on page 944

– "Time 2" on page 945

– "Time Criteria" on page 946

Additional controls are also present which are not dependent on the selected Trigger Source.

Example	`:TRIG:SOUR LEV`
	RTSA measurement
	`:TRIG:PULS:SOUR LEV`
	PULSE measurement

Dependencies	Level Trigger is unavailable while in the 1 GHz path (option H1G), it is grayed out and any attempt to set it will generate a message that it is unavailable. 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.
Couplings	If trigger is Level Trigger and you select the 1 GHz path (H1G), the Trigger is forced to Free Run and the message “1 GHz path selected; Trigger forced to Free Run” is displayed
Annunciation	Level (in the Meas Bar)

8.1.1.4 Line

When Line is selected a new sweep/measurement will start 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 analyzers like the VXT.

The Trigger Tab contains the following Trigger Source dependent controls when Line Trigger is selected:

– "Trigger Delay" on page 939

– "Trigger Slope" on page 943

Additional controls are also present which 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 will start 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 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 936

– "Trigger Delay" on page 939

– "Trigger Slope" on page 943

Additional controls are also present which 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 will start 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 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 936

– "Trigger Delay" on page 939

– "Trigger Slope" on page 943

Additional controls are also present which 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 will start when the external trigger condition is met using the TRIGGER 3 IN input connector on the rear panel.

This control only appears 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 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. 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 is chosen.

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).

The Trigger Tab contains the following Trigger Source dependent controls when External 3 Trigger is selected:

- "Prot Frame Aligned" on page 936
- "Trigger Delay" on page 939
- "Trigger Slope" on page 943

Additional controls are also present which 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 will start 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) which supports both rising edge and falling edge triggers.

This choice only appears in modular analyzers and only when the M9260A Audio Analyzer module is installed, such as is the case in the M8920A.

The Trigger Tab contains the following Trigger Source dependent controls when Audio External Trigger is selected:

– "Trigger Delay" on page 939

– "Trigger Slope" on page 943

Additional controls are also present which 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 will start 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 analyzer automatically chooses the appropriate trigger path based on the hardware configuration and other settings of the analyzer.

The Trigger Tab contains the following Trigger Source dependent controls when RF Burst is selected:

– "Trigger Level Absolute/Relative" on page 948

– "Absolute Trigger Level" on page 948

– "Relative Trigger Level" on page 949

– "Trigger Delay" on page 939

– "Trigger Slope" on page 943

Additional controls are also present which 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 analyzer 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 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 Notes below).

If you do not have a sync source selected (it is 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 950
- "Offset" on page 951
- "Reset Offset Display " on page 952
- "Sync Source" on page 953
- "Trigger Delay" on page 939

Additional controls are also present which are not dependent on the selected Trigger Source.

See "More Information" on page 929

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 figure below shows the action of the periodic timer trigger. Before reviewing the figure, we'll explain some uses for the periodic trigger.

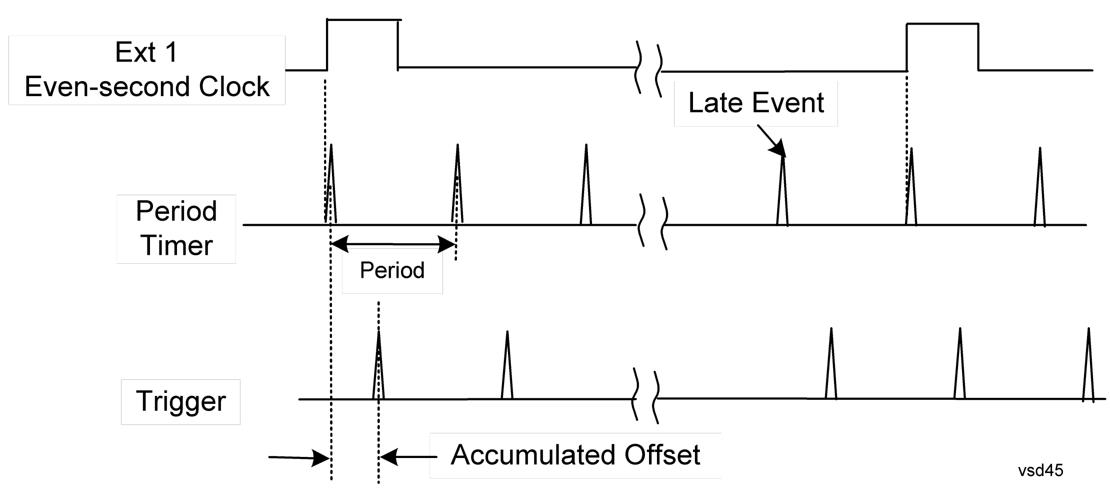
A common application is measuring periodic burst RF signals for which a trigger signal is not easily available. For example, we might be measuring a TDMA radio which bursts every 20 ms. Let's assume that the 20 ms period is very consistent.

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 analyzer 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 analyzer 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 analyzer, 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 FMT

When FMT is selected, the analyzer triggers on the amplitude spectrum with frequency mask triggering. The FMT Mask is set up using the controls on the FMT Mask tab.

The Trigger Tab contains the following Trigger Source dependent controls when FMT is selected:

– "Sync Source" on page 953
– "Trigger Mask" on page 955
– "Trigger Delay" on page 939
– "Time 1" on page 944
– "Time 2" on page 945
– "Time Criteria" on page 946

Additional controls are also present which are not dependent on the selected Trigger Source.

Example	`:TRIG:SOUR FMT`
	RTSA measurement
	`:TRIG:PULS:SOUR FMT`
	PULSE measurement

Notes	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	FMT is unavailable while in the 1 GHz path (option H1G), it is grayed out and any attempt to set it will generate a message that it is unavailable.
Couplings	If trigger is FMT and you select the 1 GHz path (H1G), the Trigger is forced to Free Run and the message “1 GHz path selected; Trigger forced to Free Run” is displayed
Annunciation	FMT (in the Meas Bar)

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 936

– "Trigger Delay" on page 939

– "Trigger Slope" on page 943

Additional controls are also present which 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 936

– "Trigger Delay" on page 939

– "Trigger Slope" on page 943

Additional controls are also present which 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 936

– "Trigger Delay" on page 939

– "Trigger Slope" on page 943

Additional controls are also present which 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 936

– "Trigger Delay" on page 939

– "Trigger Slope" on page 943

Additional controls are also present which 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 936

– "Trigger Delay" on page 939

– "Trigger Slope" on page 943

Additional controls are also present which 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 936
– "Trigger Delay" on page 939
– "Trigger Slope" on page 943
– "Trigger Center Frequency" on page 958
– "Trigger BW" on page 958

Additional controls are also present which 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 analyzer products.

The Trigger Tab contains the following Trigger Source dependent controls when PXI Trigger is selected:

– "Select PXI Line" on page 961
– "Trigger Delay" on page 939
– "Trigger Slope" on page 943

Additional controls are also present which are not dependent on the selected Trigger Source.

Example	`:TRIG:SOUR PXI`
	Swept SA measurement
	`:TRIG:<meas>:SOUR PXI`
	Measurements other than Swept SA

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 analyzer products.

The Trigger Tab contains the following Trigger Source dependent controls when Aux I/Q Mag Trigger is selected:

- "Prot Frame Aligned" on page 936
- "Trigger Delay" on page 939
- "Trigger Slope" on page 943

Additional controls are also present which 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	`:TRIG:SOUR INTernal`
	Swept SA measurement
	`:TRIG:<meas>:SOUR INTernal`
	Measurements other than Swept SA

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 found in the 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 found in the 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 found in the 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: 0 V	5 V VXT models M9410A/11A: 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), 1 dB (Lin)	Step/10, but 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/10, but never < 1 µV
Q	TRIG:QDEM	-1 V	1 V	0.25	4	Scale/	Step/10

Source	Example	Min	Max	Preset	Resolution	Step Key Incr.	Knob Incr.
(Demod)	:LEV 0.5 V			V	significant digits	Div	0, 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: 0 V	5 V VXT models M9410A/11A: 2.5 V	1.2 V	10 mV	.5 V	.1 V

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 might often 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 | VIDeo | 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 analyzer 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? :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 | AEXTernal | VIDeo | 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 Example: 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 user increases the Acq Time, it will increase this MaxValue
Preset	`OFF`
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.

Remote Command	`:TRIGger[:SEQuence]:DELay <time>`
	`:TRIGger[:SEQuence]:DELay?`
	`:TRIGger[:SEQuence]:DELay:STATe OFF | ON | 0 | 1`
	`:TRIGger[:SEQuence]:DELay:STATe?`

Example	`:TRIG:DEL 1 ms`
Preset	1 us
State Saved	Saved in instrument state
Backwards Compatibility Notes	In ESA/PSA, the Trigger Delay was global to all triggers. In the X-Series, the delay can be set individually for each Trigger Source. For backward compatibility, the global DELay command updates all instances of trigger slope (VID, LINE, EXT1, EXT2) except TV and RFBurst. The query returns the trigger delay setting of the currently selected trigger source

Remote Command	`:TRIGger[:SEQuence]:OFFSet <time>`
	`:TRIGger[:SEQuence]:OFFSet?`
	`:TRIGger[:SEQuence]:OFFSet:STATe OFF | ON | 0 | 1`
	`:TRIGger[:SEQuence]:OFFSet:STATe?`

Example	`:TRIG:OFFS ON` `:TRIG:OFFS -100 ms`
Notes	These are ESA commands for trigger offset that 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 analyzers 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 OFF
State Saved	Saved in instrument state
Min	-11 s
Max	+11 s

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.

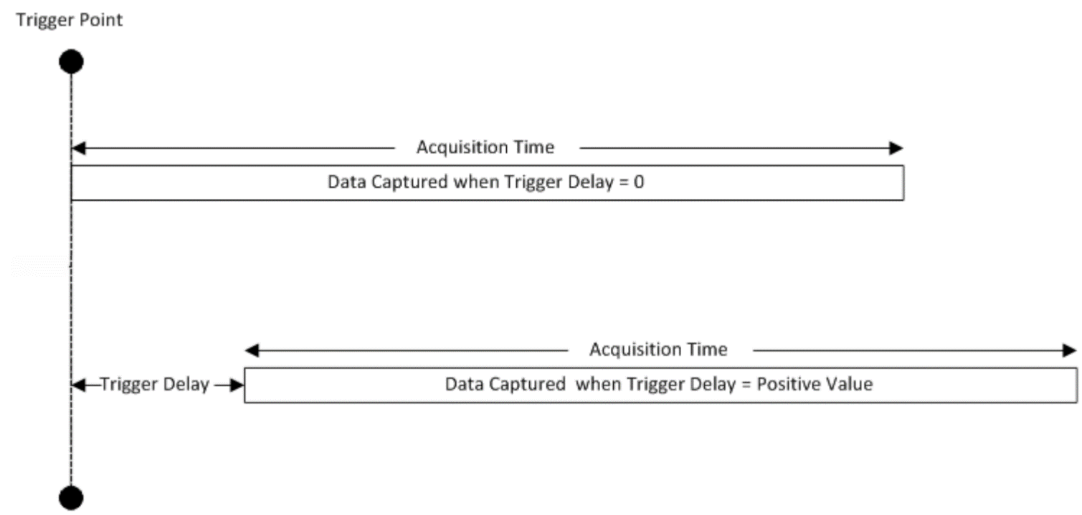
Source	Example	Preset	Min	Max	Resolution
Video	`TRIG:VID:DEL:STAT ON` `TRIG:VID:DEL 100 ms`	Off, 1 us	-150 ms (-10s in Swept SA Zero Span)	+500 ms	100 ns
Level	`TRIG:LEV:DEL:STAT ON` `TRIG:LEV:DEL 100 ms`	Off, 30 ms	0 ms	70 sec (but dependent on Acq Time like FMT)	Multiple of Acq Time (as is FMT)
FMT	`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` `TRIG:RFB:DEL 100 ms`	Off, 1 us	-150 ms (-10s in Swept SA Zero Span)	+500 ms	100 ns
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

Source	Example	Preset	Min	Max	Resolution
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 application, preset value of trigger delay is always (On, -20µs)

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 | AEXTernal | VIDeo | RFBurst | IQMag | IDEMod | QDEMod | IINPut | QINPut | AIQMag | PXI | INTernal`

Example	`:TRIG:VID:SLOP NEG`
	`:TRIG:VID:SLOP?`
	`:TRIG:EXT1: SLOP NEG`
	`:TRIG:EXT2: SLOP POS`
	`:TRIG:AEXT: SLOP POS`
	`:TRIG:LINE:SLOP NEG`
	`:TRIG:RFB:SLOP NEG`
	`:TRIG:IQM:SLOP POS`
	`:TRIG:IDEM:SLOP POS`
	`:TRIG:QDEM:SLOP POS`
	`:TRIG:IINP:SLOP POS`

	:TRIG:QINP:SLOP POS :TRIG:AIQM:SLOP POS :TRIG:PXI:SLOP POS :TRIG:INT:SLOP POS
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

Remote Command	:TRIGger[:SEQuence]:SLOPe POSitive | NEGative :TRIGger[:SEQuence]:SLOPe?
Example	:TRIG:SLOP NEG
Preset	POSitive
State Saved	Saved in instrument state

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 Time 1

Given that the acquired data is not captured until after the time duration has passed, the resulting data may only include part, if any, of the pulse that caused the trigger to occur. The “Time Qualified Trigger” properties (Time 1, Time 2, and Time Criteria) allow you to specify criteria to refine your time domain triggering. See the section on Time Criteria for a complete discussion of “Time Qualified Trigger” functionality.

Time 1 is a property of the Time Qualified Trigger feature. Time 1 is a time duration that may be used in addition to the current trigger criteria to determine when and if to trigger.

This control only appears in the RTSA and Pulse Modes.

Remote Command	:TRIGger[:SEQuence]:LEVel|FMT:TCRiteria:LOWer <time>

	`:TRIGger[:SEQuence]:LEVel|FMT:TCRiteria:LOWer?`
Example	`:TRIG:LEV:TCR:LOW 100 us`
Dependencies	This control only appears in the Real Time Spectrum Analyzer and Pulse apps and only when FMT or Level is the selected Trigger Source. Time 1 must always be less than Time 2 by at least “step size”. If the user changes Time 1 to equal to or greater than Time 2, Time 2 will be pushed to Time 1 + step size. If the user changes Time 2 to equal to or less than Time 1, then Time 1 will be reduced to Time 2 – step size. Step size = 1/(1.25 * Span). When Time Criteria is set to “> T1 and < T2”, the minimum gap changes to 2 Step Sizes. In FMT, Time Qualified Trigger properties are not available when Trigger Criteria is set to Inside, Outside, Enter->Leave, or Leave->Enter. If Time 1 or Time 2 are set to non-zero values, they will not be used since Time Criteria will be set to Disabled and all other Time Criteria are not available.
Preset	5.0 nsec 80.0 ns (PULSE, Trig Source = Level)
State Saved	Saved in instrument state
Min	1/ (1.25 * Span)
Max	10 sec

8.1.6 Time 2

Given that the acquired data is not captured until after the time duration has passed, the resulting data may only include part, if any, of the pulse that caused the trigger to occur. The “Time Qualified Trigger” properties (Time 1, Time 2, and Time Criteria) allow you to specify criteria to refine your time domain triggering. See the section on Time Criteria for a complete discussion of “Time Qualified Trigger” functionality.

Time 2 is a property of the Time Qualified Trigger feature. Time 2 is a time duration that may be used in addition to the current trigger criteria to determine when and if to trigger.

This control only appears in the RTSA and Pulse Modes.

Remote Command	`:TRIGger[:SEQuence]:LEVel|FMT:TCRiteria:UPPer <time>` `:TRIGger[:SEQuence]:LEVel|FMT:TCRiteria:UPPer?`
Example	`:TRIG:LEV:TCR:UPP 100 us`
Dependencies	This control only appears in the Real Time Spectrum Analyzer and Pulse apps and only when FMT or Level is the selected Trigger Source. Time 1 must always be less than Time 2 by at least “step size”. If the user changes Time 1 to equal to or greater than Time 2, Time 2 will be pushed to Time 1 + step size. If the user changes Time 2 to equal to or less than Time 1, then Time 1 will be reduced to Time 2 – step size. Step size = 1/(1.25 * Span). When Time Criteria is set to “> T1 and < T2”, the minimum gap changes to 2 Step Sizes. In FMT, Time Qualified Trigger properties are not available when Trigger Criteria is set to Inside, Outside, Enter->Leave, or Leave->Enter. If Time 1 or Time 2 are set to non-zero values, they will not be used since Time Criteria will be set to Disabled and all other Time Criteria are not available.
Preset	10.0 nsec

	160.0 ns (PULSE, Trig Source = Level)
State Saved	Saved in instrument state
Min	1/ (1.25 * Span)
Max	10 sec

8.1.7 Time Criteria

Given that the acquired data is not captured until after the time duration has passed, the resulting data may only include part, if any, of the pulse that caused the trigger to occur. The “Time Qualified Trigger” properties (Time 1, Time 2, and Time Criteria) allow you to specify criteria to refine your time domain triggering.

The Time Criteria parameter is used to define how Time 1 and Time 2 will be used to determine if and when to trigger. The different criteria specify when to trigger using the time duration(s). The time criterion is used to determine how long the trigger criterion needs to last prior to satisfying the trigger condition.

For Level Trigger and FMT, once the signal amplitude matches the trigger level the clock starts. Once the signal amplitude drops below the trigger level the clock stops. If the Time Criteria is “< Time1” and the clock duration is less than Time1, the trigger occurs and the box starts acquiring data. When the clock duration is equal to or greater than Time 1 and the signal amplitude is still above the trigger level, no trigger occurs.

If the Time Criteria is “> Time 1”, when the clock duration is greater than Time1 and the signal amplitude still matches or is above the trigger level, the trigger occurs and the box starts acquiring data. When the signal drops below the trigger level and the clock duration is equal to or greater than Time 1, no trigger occurs.

The user will see data starting with the acquisition that contained signal conditions meeting the Trigger Criteria and Time Qualified Trigger Criteria. For Trigger Criteria “Enter”, this means the user will see data starting with the acquisition that contained the signal leaving the mask. If the signal both “enters” and “leaves” the mask in the same acquisition, then the entire duration of the time qualified event will be visible in that acquisition. However, it is also possible that the signal will enter the mask in one acquisition and leave it during a later acquisition. In this case, only the falling edge of the event will be visible in the acquisition, and not the rising edge.

This control only appears in the RTSA and Pulse Modes.

Remote Command	`:TRIGger[:SEQuence]:LEVel|FMT:TCRiteria[:TYPE] OFF | LTLower | GTLower | INSide | OUTSide` `:TRIGger[:SEQuence]:LEVel|FMT:TCRiteria?`

Example	`:TRIG:LEV:TCR OFF`
	sets the time criteria to disabled
	`:TRIG:LEV:TCR LTL`

	sets the time criteria to < Time1
	`:TRIG:LEV:TCR GTL`
	sets the time criteria to > Time1
	`:TRIG:LEV:TCR INS`
	sets the time criteria to >T1 and <T2
	`:TRIG:LEV:TCR OUTS`
	sets the time criteria to < T1 or > T2
	`:TRIG:LEV:TCR?`

Dependencies	This control only appears in the Real Time Spectrum Analyzer and Pulse apps and only when FMT or Level is the selected Trigger Source. In FMT, Time Qualified Trigger properties are not available when Trigger Criteria is set to Inside, Outside, Enter->Leave, or Leave->Enter. If Time 1 or Time 2 are set to non-zero values, they will not be used since Time Criteria will be set to Disabled and all other Time Criteria are not available.
Couplings	When FMT Trigger Criteria is INSIDE or OUTSIDE, FMT Trigger Delay State is forced to OFF
Preset	OFF
State Saved	Saved in instrument state
Range	OFF|LTL|GTL|INSide|OUTSide

Additional information about Time Criteria

Criterion	SCPI Argument	Notes
Disabled	`OFF`	When the criterion is set to “Disabled”, no time duration is being used to control when the trigger occurs.
< Time1	`LTLower`	When the criterion is set to “< Time 1”, then the trigger condition cannot last as long as Time1. If it does last as long as Time1, then no trigger occurs. If the signal level lasts for < Time1, then the trigger occurs.
> Time1	`GTLower`	When the criterion is set to “> Time 1”, then the signal level must last at least as long as Time1 to trigger. If it does not last at least as long as Time1, then no trigger occurs.
>T1 and <T2	`INSide`	When the criterion is set to “> Time 1 and < Time 2”, then the specified signal level must last at least as long as Time 1, but not as long as Time 2 to trigger. If it does not last at least as long as Time1, then no trigger occurs. Or if the signal level lasts for Time 2 or more, then no trigger occurs.
< T1 or > T2	`OUTSide`	When the criterion is set to “< Time 1 or > Time 2”, then the specified signal level can last less than Time1, OR, the signal level can last longer than Time 2 to trigger. If the signal lever lasts for at least Time1, but less than Time 2, no trigger occurs.

8.1.8 Trigger Level Absolute/Relative

This control selects between Absolute and Relative Burst Triggering.

Remote Command	`:TRIGger[:SEQuence]:RFBurst:LEVel:TYPE ABSolute | RELative` `:TRIGger[:SEQuence]:RFBurst:LEVel:TYPE?`
Example	`:TRIG:RFB:LEV:TYPE REL` sets the trigger level type of the RF burst trigger to Relative.
Dependencies	Only appears when RF Burst is selected as the Trigger Source
Preset	ABSolute
State Saved	Saved in instrument state

8.1.9 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	`:TRIG:RFB:LEV:ABS 10 dBm` sets the trigger level of the RF burst envelope signal to the absolute level of 10 dBm
Notes	Sending this command does not switch the setting from relative to absolute; to switch it you need to send the :TRIGger[:SEQuence]:RFBurst:LEVel:TYPE command, below. If mode is Bluetooth, 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	-20 dBm
State Saved	Saved in instrument state
Min	-200 dBm
Max	100 dBm
Backwards Compatibility SCPI	`:TRIGger[:SEQuence]:FRAMe:RFBurst:LEVel:ABSolute`

8.1.10 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:

16. 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.
17. Now, 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:
18. absolute RF Burst level = peak level of the previous acquisition + relative RF Burst level
19. 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	`:TRIG:RFB:LEV:REL -10 dB` sets the trigger level of the RF burst envelope signal to the relative level of -10 dB
Notes	Sending this command does not switch the setting from absolute to relative; to switch it you need to send the :TRIGger[:SEQuence]:RFBurst:LEVel:TYPE command, above. The relative trigger level is not available in some measurements. In those measurements the RELative parameter, and the :TRIGger[:SEQuence]:RFBurst:LEVel:TYPE command (above), will generate an error if sent.
Dependencies	This control is grayed out and Absolute Trigger Level selected if the required hardware is not present in your analyzer 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 the 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 analyzer automatically chooses the appropriate trigger path based on the hardware configuration and other settings of the analyzer. 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.

8.1.11 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 the 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

8.1.12 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 section "Trigger Delay" on page 939. 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

8.1.13 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

8.1.14 Offset Adjust (Remote Command Only)

This remote command does not work at all like the related front panel keys. This command lets you advance the phase of the frame trigger by the amount you specify.

It 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 939. 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 a "command only" SCPI command, with no query.
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

8.1.15 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

8.1.16 Trigger Criteria

This parameter is used to define the event that will cause a trigger to occur. The events are ways in which the signal interacts with the frequency mask. The data captured by RTSA is generated using multiple FFT’s. The trigger criteria is used to determine which FFT’s are used in the data generation.

Remote Command	`:TRIGger[:SEQuence]:FMT:CRITeria ENTer | LEAVe | INSide | OUTSide | ELEave | LENTer` `:TRIGger[:SEQuence]:FMT:CRITeria?`

Example	`:TRIG:FMT:CRIT ENT`
Notes	Both upper and lower masks use the same Trigger Criteria and the trigger will occur when either mask meets the Trigger Criteria.
Dependencies	This control only appears in the Real Time Spectrum Analyzer and Pulse apps and only when FMT is the selected Trigger Source.
Preset	This setting is unaffected by a Mode Preset or power cycle It is Preset on Restore Mode Defaults
State Saved	Saved in instrument state
Range	Enter|Leave|Inside|Outside|Enter→Leave|Leave→Enter

Additional Information About Trigger Criteria

Criterion	SCPI Argument	Notes
Enter	`ENTer`	A trigger will occur when a signal enters the frequency mask area. The trigger event will not happen again until the signal leaves the mask and re-enters. When Trigger Criteria is set to Enter, once an FFT meets the Trigger Criteria, all subsequent FFT's will be computed for the duration of the acquisition time and all these FFT's will be used to generate the acquisition data. If Trigger Delay is a negative value, all FFT's computed during this time will also be included in the acquisition data.
Leave	`LEAVe`	A trigger will occur when a signal leaves the frequency mask. This requires a signal to be present in the mask area. When Trigger Criteria is set to Leave, once an FFT meets the Trigger Criteria, all subsequent FFT's will be computed for the duration of the acquisition time and all these FFT's will be used to generate the acquisition data. If Trigger Delay is a negative value, all FFT's computed during this time will also be included in the acquisition data.
Inside	`INSide`	A trigger event will occur when a signal is in the mask area and will continue to trigger until the signal is no longer in the mask area. When Trigger Criteria is set to Inside, once an FFT meets the Trigger Criteria, all subsequent FFT's will be computed for the duration of the acquisition time, but only FFT's meeting the Trigger Criteria will be used to generate the acquisition data. If Trigger Delay is a negative value, all FFT's computed during this time will also be included in the acquisition data.
Outside	`OUTSide`	A trigger event will occur when the signal is not in the mask area and will continue to trigger until the signal is in the mask area. When Trigger Criteria is set to Outside, once an FFT meets the

Criterion	SCPI Argument	Notes
		Trigger Criteria, all subsequent FFT’s will be computed for the duration of the acquisition time, but only FFT’s meeting the Trigger Criteria will be used to generate the acquisition data. If Trigger Delay is a negative value, all FFT’s computed during this time will also be included in the acquisition data.
Enter →Leave	ELEave	A trigger will occur when a signal enters the frequency mask area then leaves it. When Trigger Criteria is set to Enter→Leave, once an FFT meets the Trigger Criteria, all subsequent FFT’s will be computed for the duration of the acquisition time and all these FFT’s will be used to generate the acquisition data. If Trigger Delay is a negative value, all FFT’s computed during this time will also be included in the acquisition data.
Leave → Enter	LENTer	A trigger will occur when a signal leaves the frequency mask area then re-enters it. When Trigger Criteria is set to Leave→Enter, once an FFT meets the Trigger Criteria, all subsequent FFT’s will be computed for the duration of the acquisition time and all these FFT’s will be used to generate the acquisition data. If Trigger Delay is a negative value, all FFT’s computed during this time will also be included in the acquisition data.

8.1.17 Trigger Mask

Used to determine which mask is to be used for triggering.

Remote Command	`:TRIGger[:SEQuence]:FMT:MASK UPPer | LOWer | BOTH` `:TRIGger[:SEQuence]:FMT:MASK?`
Example	`:TRIG:FMT:MASK UPP`
Dependencies	This control only appears in the Real Time Spectrum Analyzer and Pulse apps and only when FMT is the selected Trigger Source.
Preset	This setting is unaffected by a Mode Preset or power cycle It is Preset on Restore Mode Defaults
State Saved	Saved in instrument state
Range	Upper, Lower, Both

8.1.18 TV Line

Selects the TV line number on which to trigger. Line number range is dependent on the settings of the **Standard** and **Field** 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?`
Notes	The range of the TV line number is dependent on the settings of the Standard and Field menus within the TV trigger setup functions.
Dependencies	none 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

8.1.19 Field

Selects the Field on which to trigger.

When you select Entire Frame it 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.

When you select Field One it 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.

When you select Field Two it 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`

Notes	ODD is Field 1 EVEN is Field 2
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 Frame|Field One|Field Two

8.1.20 Standard

Accesses the Standard menu keys which select from the following TV standards: **NTSC-M**, **NTSC-Japan**, **NTSC-4.43**, **PAL-M**, **PAL-B,D,G,H,I** , **PAL-N**, **PAL-N-Combin**, **PAL-60**, **SECAM-L**.

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`
	Sets NTSC-Japan
	`:TRIG:TV:STAN JNTS`
	Sets NTSC-4.43
	`:TRIG:TV:STAN NTSC443`
	Sets PAL-M
	`:TRIG:TV:STAN MPAL`
	Sets PAL-N
	`:TRIG:TV:STAN NPAL`

	Sets PAL-B,D,G,H,I
	`:TRIG:TV:STAN BPAL`
	Sets PAL-N Combin
	`:TRIG:TV:STAN CPAL`
	Sets PAL-60
	`:TRIG:TV:STAN PAL60`
	Sets L-SECAM
	`:TRIG:TV:STAN LSEC`
	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	NTSC-M|NTSC-Japan|NTSC-4.43|PAL-M|PAL-N|PAL-N Combin|PAL-B,D,G,H,I|PAL-60|SECAM-L

8.1.21 Trigger Center Frequency

This control 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

8.1.22 Trigger BW

This control 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 the 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 Freq 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

8.1.23 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 allows you to 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.

	This control 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” In analyzers shipping N9060A, this feature requires N9060A-7FP. 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

8.1.24 #Acqs/Trigger

This control (Number of Acquisitions Per Trigger) specifies how many acquisitions worth of data to return for each satisfied trigger. This is most useful with Spectrogram when you have short Acquisition Times, yet you want more than 1 Spectrogram scan for every triggered result. If the number of acquisitions per trigger is 20 and the Acquisition Time is 30 msec, then you will get 600 msec (20 * 30 msec) worth of data after the trigger condition has been met.

This control only appears in the RTSA Mode.

The Total Time for all acquisitions is annotated on the menu panel below the #Acqs/Trigger control.

Remote Command	`:TRIGger [:SEQuence]:LEVel|LINE|EXTernal1|EXTernal2|RFBurst|FRAMe|FMT:APTRigger <number>` `:TRIGger [:SEQuence]:LEVel|LINE|EXTernal1|EXTernal2|RFBurst|FRAMe|FMT:APTRigger?`
Example	`:TRIG:FMT:APTR 20`
Dependencies	Only appears in the Real Time Spectrum Analyzer Mode.
Couplings	When FMT Trigger Criteria is INSIDE or OUTSIDE, Acq Per Trigger is limited to 1
Preset	1
State Saved	Saved in instrument state
Min	1
Max	MaxValue is limited as follows: Non-DP4 DP4 & DUA Spectrogram Only: 10000 50000 50000 PvT/Powergram Only: 5000 25000 25000 Both: 5000 25000 25000 When Averaging is ON, divide the value above by the Average Count for the maximum. MaxValue is limited to 1 when in FMT and FMT Trigger Criteria is INSIDE or OUTSIDE.

8.1.25 Select PXI Line

Controls which PXI_TRIG[0..7] backplane line is used for the trigger source.

This control is only found in the 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]

8.1.26 Reset Sync Monitor

Allows you to reset the status of Synchronization for Periodic trigger

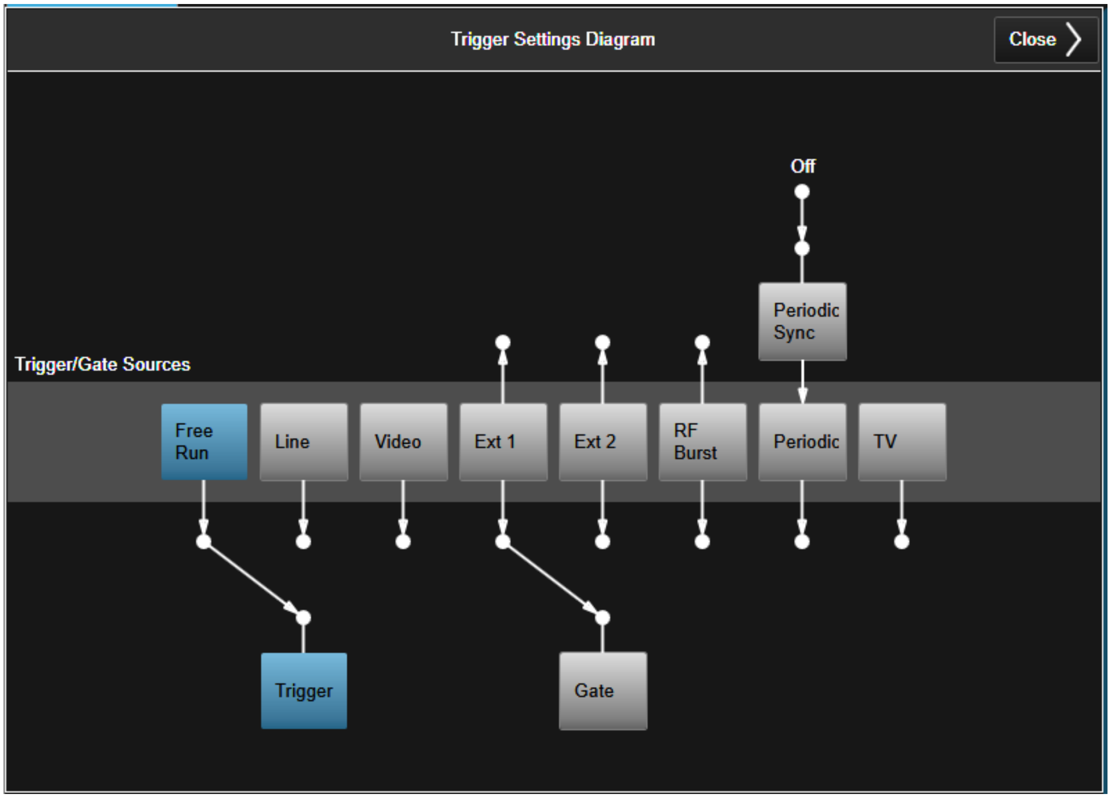
Remote Command	`:TRIGger[:SEQuence]:FRAMe:SMONitor:RESet`
Example	`:TRIG:FRAM:SMON:RES`
Notes	This control works together with status bit 10 “Periodic Trigger Synchronized” in Condition Errors – Signal Integrity. Message “Periodic Trigger, Waiting for Sync Source” will be generated show after pressing this control. And the status bit will be cleared. Message “Periodic Trigger Synchronized” will be generated after successfully synchronizing to Sync Source. And the status bit will be set.
Dependencies	Only appears when Periodic Timer is selected as the Trigger or Gate Source
Status Bits/OPC dependencies	Bit 10 of STATus:QUEStionable:INTegrity:SIGNal will be cleared after press this control.

8.1.27 Trigger Settings Diagram

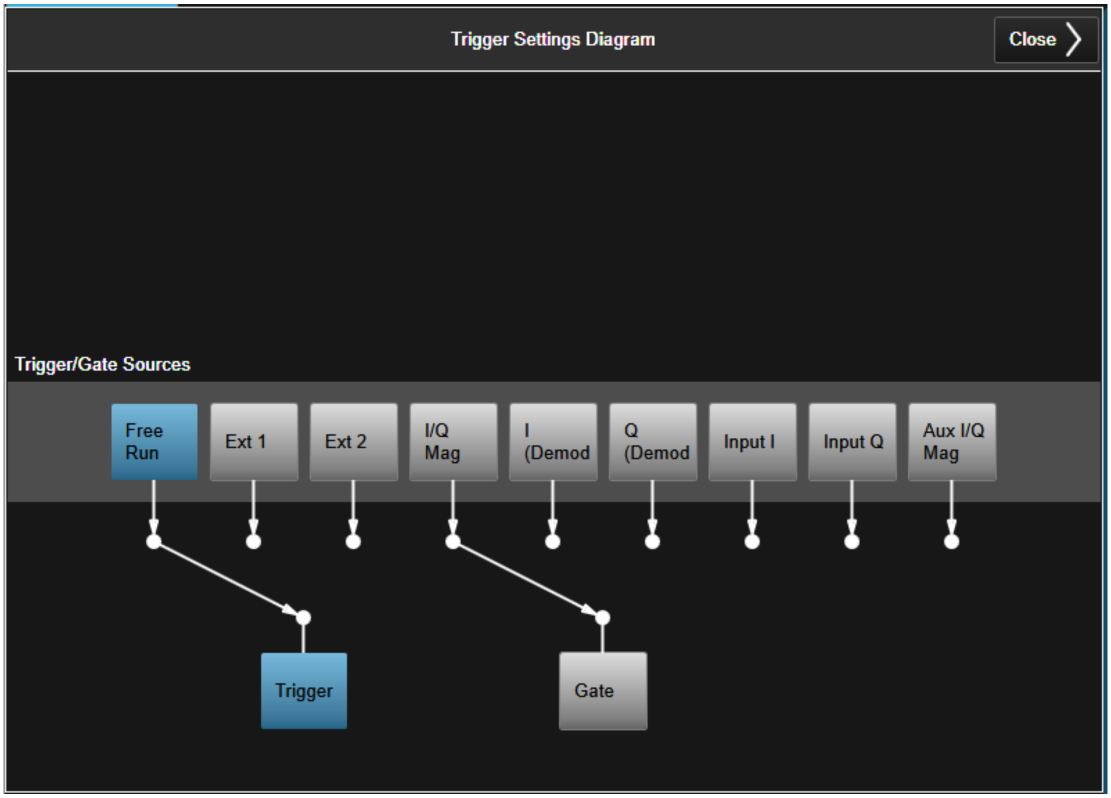
The Trigger Settings Diagram lets you configure the Trigger system using a visual utility.

First, pick what you want to configure (the Trigger, Gate or Periodic Sync Source) by clicking on the box for Trigger, Gate or Periodic Sync Source.

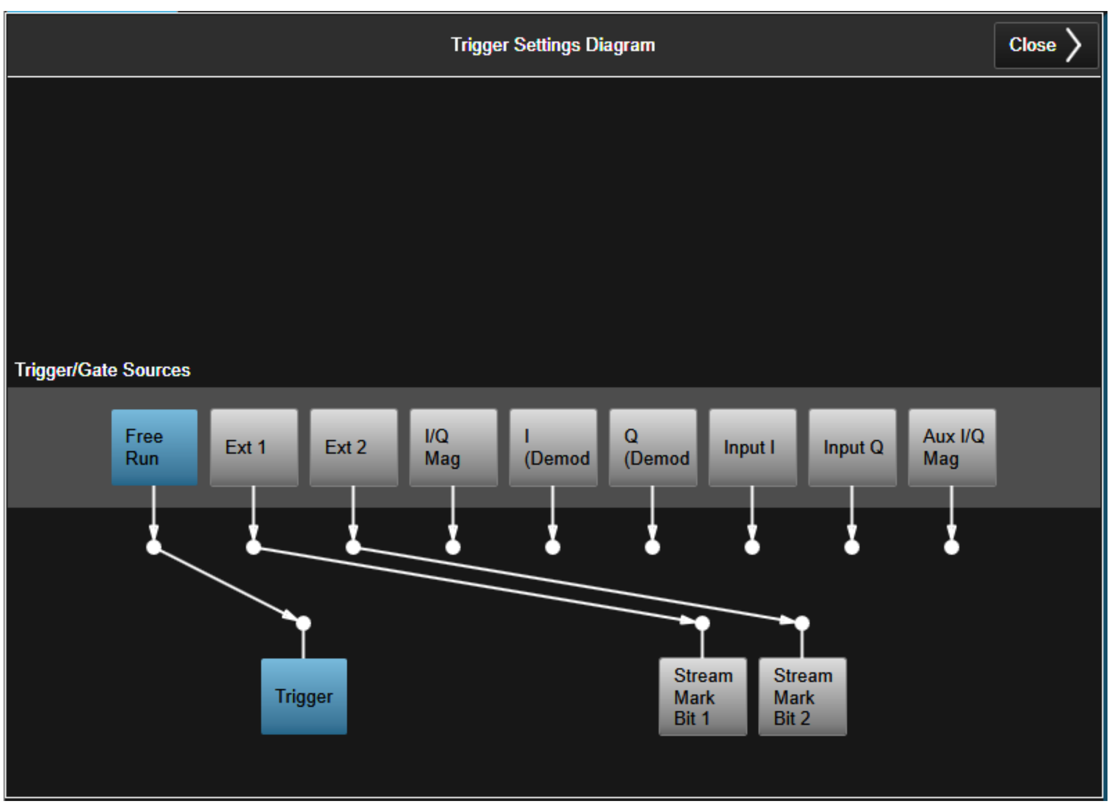
Next, click on any box in the gray row to choose a Trigger Source to connect to. For Periodic Sync Source you can also click on Off.



The Trigger Settings Diagram changes depending on context. The Trigger Sources that are available change depending on what input you have selected. For example, when you select the I/Q input you will see additional Trigger Sources, and no Periodic Sync Source:



Also, in RTSA and Pulse modes, the Stream Mark Bits appear in the Trigger Settings Diagram:



8.2 Gate Source

The Gate Source tab contains controls which let you select and configure Gate control signals.

The Gate Source tab appears in the Trigger menu panel for measurements that support gating. In measurements which do not support gating, the Gate Source 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 SCPI is sent to the TRIG node to change or set the setup functions that are left out of 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.

Selecting a Gate Source is similar to selecting a Trigger Source; you pick from the same sources as for Trigger Source, but the choices are limited to

- Line
- External 1|2
- Internal
- RF Burst
- Periodic

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, you need a different 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	The available choices for VXT are: Video, Internal, External 1, External 2, RF Burst, Periodic and PXI. Internal and Periodic are not available in Spectrum Analyzer Mode. In VXT, Internal is only in VXT models M9410A/11A, not in models M9420/21A. PXI is only found in VXT. The available choices for EXM are Video, Internal, External 1, External 2, RF Burst, and Periodic. This control is 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	EXTernal 1 GSM/EDGE: FRAMe MSR: EXTernal1 LTEATDD, 5G NR: EXTernal1 when Direction is Downlink, FRAMe when Direction is Uplink.
Backwards Compatibility Notes	In ESA, there is a single Gate input port. In PSA, the Gate Source may be taken from one of two specified input ports. In the X-Series, five Trigger Sources can be Gate Sources.

8.2.2 Sync Holdoff

Sync Holdoff, which only applies 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 will work 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?`
	`:TRIGger[:SEQuence]:FRAMe:SYNC:HOLDoff:STATe OFF | ON | 0 | 1`
	`:TRIGger[:SEQuence]:FRAMe:SYNC:HOLDoff:STATe?`

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, it does not appear in Swept SA.
Preset	On, 1.000 ms 5G NR: On, 250.0 us On
State Saved	Saved in instrument state
Min	0 ms
Max	+500 ms

8.3 Gate Settings

The Gate Settings tab contains controls which let you control the gating function. The Gate functionality is used to view signals best viewed by qualifying them with other events.

The Gate Settings tab appears in the Trigger menu panel for measurements that support gating. In measurements which do not support gating, the Gate Settings 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 by Gate being on.

8.3.1 Gate On/Off

Turns the gate function on and 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 is turned on without a gate signal present, Marker Count operation is 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	On|Off
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]` 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 analyzer 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	`:SWE:EGAT:VIEW ON` turns on the gate view.
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 the 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 section "Gate View Sweep Time" on page 975 – 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 analyzer to the Normal measurement view.

In the 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 analyzer 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 will be 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` 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 will be 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` ESA compatibility

8.3.5 Gate Method

This lets you choose one of the three different types of gating. Not all types of gating are available for all measurements.

For more information see "LO" on page 972, "Video" on page 972 or "FFT" on page 973

Remote Command	`[:SENSe]:SWEep:EGATe:METHod LO | VIDeo | FFT` `[: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
Preset	LO
State Saved	Saved in instrument state
Range	Video|LO|FFT
Annunciation	In Meas Bar

LO

In LO gating, when Gate is set to 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 analyzer 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 set to 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 analyzer 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 set to 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 which 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 cannot be done 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

In Edge triggering, 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

In Level triggering, 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.

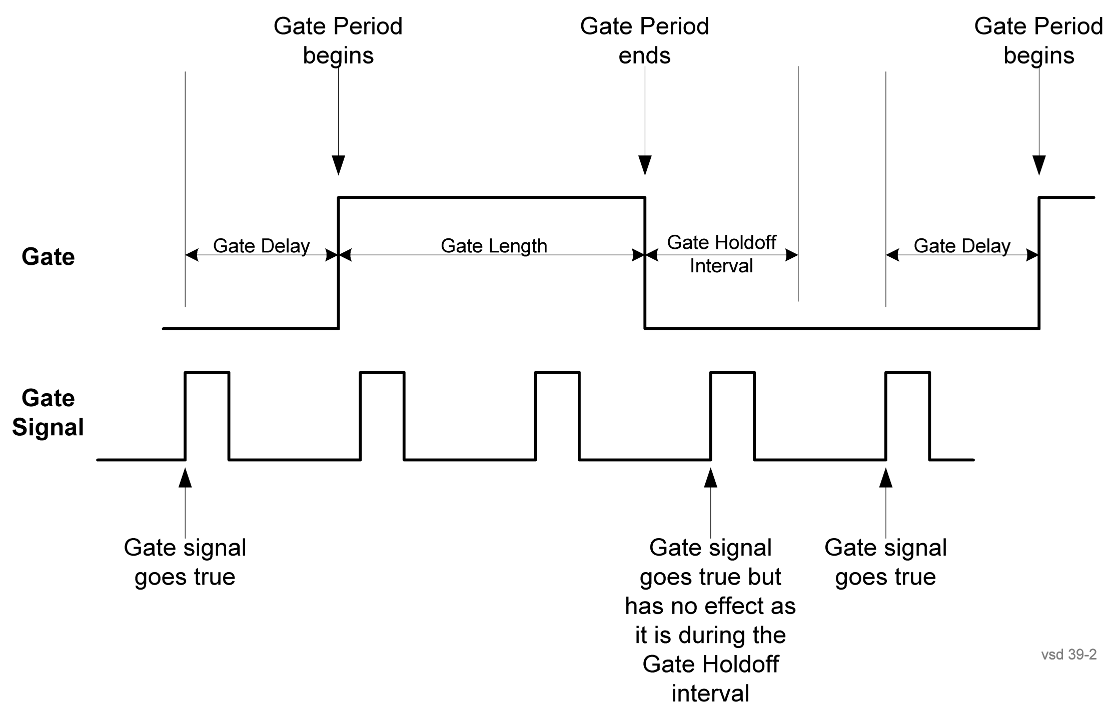
Remote Command	`[:SENSe]:SWEep:EGATe:CONTrol EDGE | LEVel` `[:SENSe]:SWEep:EGATe:CONTrol?`
Example	`:SWE:EGAT:CONT EDGE`

Dependencies	If the Gate Method is FFT, Control is grayed out and Edge is selected. If the Gate Source is TV, Frame, or Line, Control is grayed out and Edge is selected.
Preset	EDGE
State Saved	Saved in instrument state
Backwards Compatibility SCPI	[:SENSe]:SWEep:TIME:GATE:TYPE ESA Compatibility

8.3.7 Gate Holdoff

Enables you to increase or decrease the wait time after a gate event ends before the analyzer will respond to the next gate signal.

After any Gate event finishes, the analyzer must wait for the sweep system to settle before it can respond to another Gate signal. The analyzer 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 in Auto, the wait time calculated by the analyzer 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, 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?`
	`[:SENSe]:SWEep:EGATe:HOLDoff:AUTO OFF | ON | 0 | 1`
	`[:SENSe]:SWEep:EGATe:HOLDoff:AUTO?`

Example	`:SWE:EGAT:HOLD 0.0002`
	`:SWE:EGAT:HOLD?`
	`:SWE:EGAT:HOLD:AUTO ON`
	`:SWE:EGAT:HOLD:AUTO?`

Couplings	When **Gate Holdoff** is **Auto**, the **Gate Holdoff** control shows the value calculated by the analyzer 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 Auto/On
State Saved	Saved in instrument state
Range	Auto|Man
Min	1 µsec
Max	1 sec

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 analyzer 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 analyzers 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 analyzer 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 will be generated. See error -131.
Preset	0 ms
State Saved	Saved in instrument state
Min	0
Max	500 ms

8.3.10 Gate Delay Compensation

This function 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, **Delay Until RBW Settled** and **Compensate for RBW Group Delay**.

See "More Information" on page 977

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 going into 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: 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 mode: Compensate for RBW Group Delay All other modes: Delay Until RBW Settled
State Saved	Saved in instrument state
Range	Uncompensated|Delay Until RBW Settled|Compensate for RBW Group Delay

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 analyzer 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 which 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 Command Only)

This command queries the position of the MIN FAST line, relative to the delay reference (REF) line. See section "Gate View On/Off" on page 968. 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. Knowing this value lets you set an optimal gate delay value for the current measurement setup.

Remote Command	`[:SENSe]:SWEep:EGATe:MINFast?`
Example	`:SWE:EGAT:MIN?`

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

Remote Command	`[: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.

Remote Command	`[:SENSe]:SWEep:EGATe:EXTernal[1]|2:LEVel <voltage>` `[:SENSe]:SWEep:EGATe:EXTernal[1]|2:LEVel?`
Notes	This command is simply an alias to :TRIGger[:SEQuence]: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 (Pos) 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 (Neg) is selected, a negative-going edge (Edge) or a low voltage (Level) will satisfy the gate condition after the delay.

Remote Command	`[:SENSe]:SWEep:EGATe:POLarity NEGative | POSitive` `[:SENSe]:SWEep:EGATe:POLarity?`
Example	`:SWE:EGAT:POL NEG` `:SWE:EGAT:POL?`
Preset	POSitive
State Saved	Saved in instrument state
Backwards Compatibility SCPI	`[:SENSe]:SWEep:TIME:GATE:POLarity` ESA compatibility

Remote Command	`[:SENSe]:SWEep:TIME:GATE:LEVel HIGH | LOW`
	`[:SENSe]:SWEep:TIME:GATE:LEVel?`
	ESA compatibility

Preset	HIGH

8.4 Periodic Sync Src

The Periodic Sync Source tab contains controls which 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.

8.4.1 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.

One of the choices is Off. With the sync source off, the timing will drift unless the signal source frequency is locked to the analyzer 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. This control is not available in the 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. Forceful message -241.02
Preset	Off GSM/EDGE, LTE, LTETDD, 5G NR: RFBurst
State Saved	Saved in instrument state
Backwards Compatibility SCPI	`:TRIGger[:SEQuence]:FRAMe:SYNC EXTernal` For backward compatibility, the parameter EXTernal is mapped to EXTernal1

8.5 FMT Mask

The FMT Mask tab menus let you select and configure the frequency mask trigger parameters. To create a mask, select the FMT Mask tab. Pressing the Edit Mask control on this tab will switch into the FMT setup view, which consists of a Table Editor used to define the Frequency Mask points, controls to configure the Frequency Mask and a Preview Pane to graphically display and adjust the Frequency Mask points.

This tab only appears in the Real Time Spectrum Analyzer and Pulse 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.

8.5.1 Mask Type

Used to determine which Mask (upper or lower) is being viewed/edited. Only one mask can be viewed/edited at a time.

Remote Command	`:TRIGger[:SEQuence]:FMT:MASK:EDIT UPPer | LOWer` `:TRIGger[:SEQuence]:FMT:MASK:EDIT?`
Example	`:TRIG:FMT:MASK:EDIT UPPer`
Couplings	Changing the Mask Type may result in other Trigger Setup parameters changing, including the Frequency/Amplitude pairs and Mask Name.
Preset	This setting is unaffected by a Mode Preset or power cycle It is Preset on Restore Mode Defaults
State Saved	Saved in instrument state
Range	UPPer|LOWer

8.5.2 Mask Name

Provides a description of up to 60 characters by which the operator can easily identify the mask. Will be stored in the exported file. Can be displayed in the active function area by selecting as the active function, if desired to be in a screen dump.

Remote Command	`:TRIGger[:SEQuence]:FMT:MASK[1]|2:NAME <string>` `:TRIGger[:SEQuence]:FMT:MASK[1]|2:NAME?`
Example	`:TRIGger:FMT:MASK1:NAME "G1234MN"` `:TRIGger:FMT:MASK2:NAME "G1234MN"`
Notes	The upper and lower masks can have different settings therefore subop code 1 is for the upper mask and

	subop code 2 is for the lower mask.
Couplings	From the Front Panel, Mask Type (see section 19.3.1.3) determines which Mask will be deleted.
Preset	The original default value is empty string (""). Note that this Mask name parameter has a setting that is unaffected by a Mode Preset or power cycle It can be reset to its default value by using Restore Mode Defaults
State Saved	Saved in State.
Range	Lowercase, uppercase, Numeric,space

8.5.3 New Mask

Clears any existing mask and creates a new mask of 4 points. Two points will be at 20% +/- the Center frequency and at the Reference Level. The other two points will be at 10% +/- Center Frequency and 20% below the Reference Level.

Remote Command	:TRIGger[:SEQuence]:FMT:MASK[1]|2:NEW
Example	:TRIG:FMT:MASK:NEW
Notes	The mask points generated by New Mask Trace can use X and Y offset to adjust the mask position. The upper and lower masks can have a different X Offset therefore subop code 1 is for the upper mask and subop code 2 is for the lower mask.

8.5.4 Delete Mask

Remote Command	:TRIGger[:SEQuence]:FMT:MASK[1]|2:DELete
Example	:TRIG:FMT:MASK:DEL
Notes	The upper and lower masks can have different settings therefore subop code 1 is for the upper mask and subop code 2 is for the lower mask.
Couplings	From the Front Panel, Mask Type (see section "Mask Type" on page 981) determines which Mask will be deleted.

8.5.5 Delete All Masks

Delete both Upper and Lower Masks.

Remote Command	:TRIGger[:SEQuence]:FMT:MASK:DELete:ALL
Example	:TRIG:FMT:MASK:DEL:ALL

8.5.6 Build Mask from Trace

This allows the user to generate a mask from the trace displayed in the FMT setup view. The points generated will provide a rough outline of the current trace.

Remote Command	`:TRIGger[:SEQuence]:FMT:MASK[1]|2:BUILd`
Example	`:TRIG:FMT:MASK:BUIL`
Notes	The mask points generated by Build Mask from Trace can use X and Y offset to adjust the mask position. The upper and lower masks can have a different X Offset therefore subop code 1 is for the upper mask and subop code 2 is for the lower mask.

8.5.7 Edit Mask

Opens a diagram that enables you to configure the Frequency Mask Trigger system using a visual utility. You should select the Free Run trigger source before when you enter the Edit Mask dialog, which lets you configure the mask with a continually updating trace. When you exit the Edit Mask dialog the Trigger Source is automatically changed to FMT.

The Preview Pane consists of a graphical display with a trace. The trace will be active if the Trigger Source is Free Run. This will allow the user to visualize the mask as it is constructed.

The Frequency/Amplitude points are displayed on the graph as gray circles, except for the selected point which is displayed as a blue circle. For the upper mask, the circles are connected to make up the lower line of a polygon. For the lower mask, the circles are connected to form the top line of a polygon. The first and last mask point create the edges of the polygon by drawing a line vertically up for the upper mask and down for the lower mask.

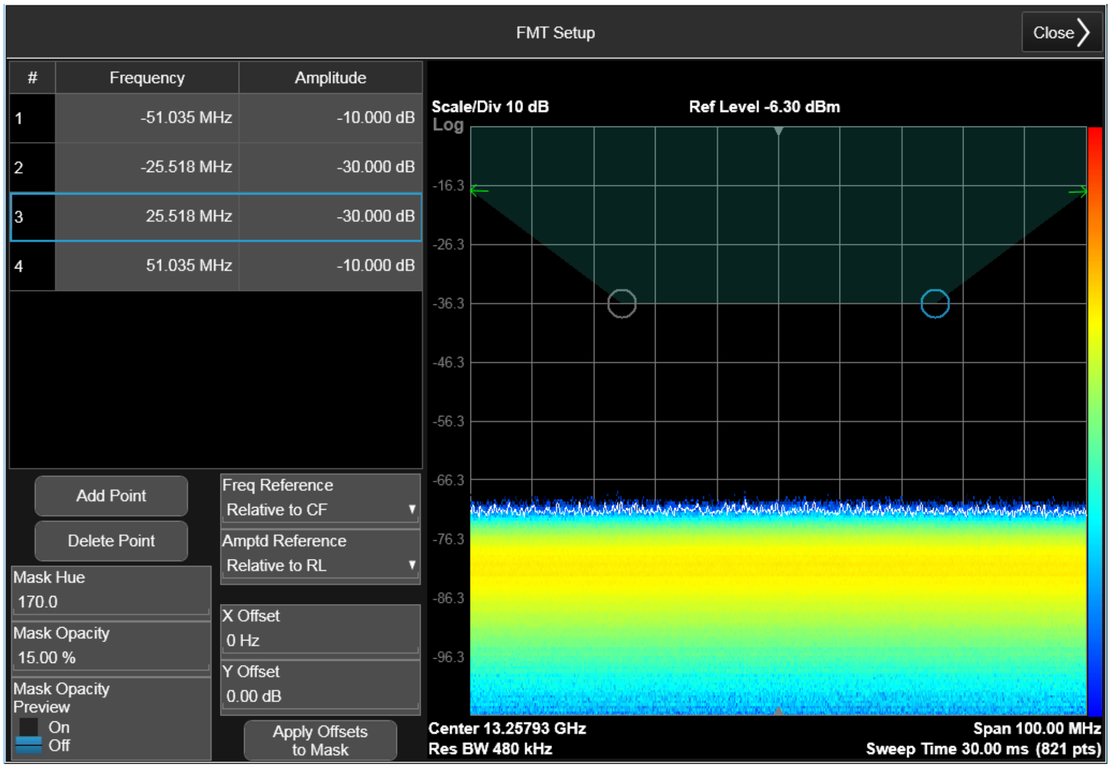
You can move the circles representing the points by touching and dragging them, or by using a mouse.

The minimum frequency of a new point is the frequency value of the point to the left, or the minimum value of the analyzer if it is the first point in the mask. The maximum frequency of a new point is the frequency value of the point to the right, or the maximum value of the analyzer if it is the last point in the mask. This is to allow a vertical line in the mask.

If the mask exceeds the available span, only the mask points that are within the available span are used for the trigger. Interpolation is used to determine the cutoff point between the last valid lower and upper points and the points that exceed the span.

Any points that exceed the current span use arrows to indicate they are off the screen.

See example below.



A Spectrum window (either Spectrum or Density) must be onscreen when Edit Mask is selected or there will be no trace in the Edit Mask Preview pane. If the Density window is being displayed when Edit Mask is entered, Density will be used as the graphical display. If not, the Real Time Spectrum trace will be used for the graphical display.

You can import an existing Frequency Mask setup from a data file or export the current Frequency Mask setup to a data file by using the Recall and Save hardkeys, respectively.

8.5.7.1 Add Point

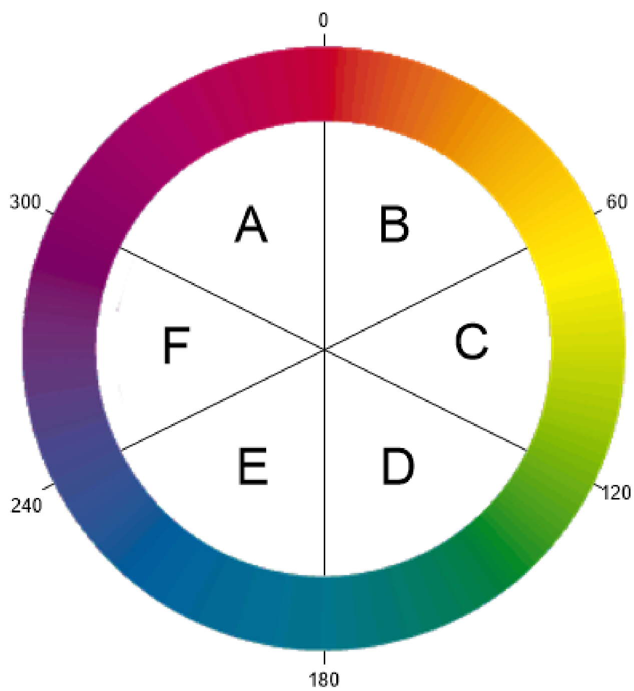
Pressing this control inserts a point below the current point. If added within the existing list, the new point is a copy of the next point in the list and becomes the current point. The new point is not yet entered into the underlying table, and the data in the row is displayed in light gray. If the point is added at the end of the existing list, the new point data is all zeroes, that is 0.0000 Hz and 0.0000 dBm.

8.5.7.2 Delete Point

This is an immediate action key. It will immediately delete the currently-selected point, whether or not that point is being edited.

8.5.7.3 Mask Hue

This parameter allows you to adjust the Hue of the Mask. The Hues of the colors run from 0 to 359 (360 is the same as 0) and are 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. Note this color wheel is only applicable when the Mask Opacity (refer to "Mask Opacity" on page 985) is 100%. Lowering the opacity value will result in less opaque colors.

Remote Command	`:TRIGger[:SEQuence]:FMT:MASK:HUE <real>` `:TRIGger[:SEQuence]:FMT:MASK:HUE?`
Example	`:TRIG:FMT:MASK:HUE 120`
Preset	170
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

8.5.7.4 Mask Opacity

This parameter allows you to adjust the Opacity of the mask. The Mask Opacity is fixed at 15% when in the FMT editor. This parameter affects the opacity of the mask when not in the FMT editor. To adjust the Mask Opacity when in the FMT editor turn on the Mask Opacity Preview which displays the Mask as it will look once you exit the FMT editor.

Remote Command	:TRIGger[:SEQuence]:FMT:MASK:OPACity <percent> :TRIGger[:SEQuence]:FMT:MASK:OPACity?
Example	:TRIG:FMT:MASK:OPAC 50
Couplings	When in FMT Editor, changes made to this parameter will only be visible with the Mask Opacity Preview (refer to "Mask Opacity Preview " on page 986) on.
Preset	15
State Saved	Saved in instrument state
Min	0
Max	100

8.5.7.5 Mask Opacity Preview

Displays the Mask Opacity that will be used when not in the FMT editor

Remote Command	:TRIGger[:SEQuence]:FMT:MASK:OPACity:PREView ON | OFF | 1 | 0 :TRIGger[:SEQuence]:FMT:MASK:OPACity:PREView?
Example	:TRIG:FMT:MASK:OPAC:PREV ON
Couplings	Changes to Mask Opacity (refer to "Mask Opacity" on page 985) will not be seen when in the FMT Editor unless this parameter is set to ON.
Preset	OFF
State Saved	Saved in instrument state.

8.5.7.6 Freq Reference

Chooses whether the mask frequency points are coupled to the instrument center frequency, and whether the frequency points are expressed as an offset from the instrument center frequency.

For example, assume the analyzer center frequency is at 1 GHz. If Freq Reference is “Fixed”, entering a mask point with a frequency coordinate of 300 MHz displays the mask point at 300 MHz, and the mask point will not change frequency if the center frequency changes. If Freq Reference is “Relative to CF”, entering mask point with a frequency coordinate of 300 MHz displays the mask point at CF + 300 MHz, or 1.3 GHz. Furthermore, if the center frequency changes to 2 GHz, mask point will be displayed at CF + 300 MHz, or 2.3 GHz.

It is possible to change this setting after a mask point has been entered. When changing from On to Off or vice-versa, the frequency values in the mask table change so that the mask points remains in the same position for the current frequency settings of the analyzer.

Remote Command	`:TRIGger[:SEQuence]:FMT:MASK:RELative:FREQuency ON | OFF | 1 | 0` `:TRIGger[:SEQuence]:FMT:MASK:RELative:FREQuency?`
Example	`:TRIG:FMT:MASK:REL:FREQ ON` makes frequency points relative to the center frequency.
Couplings	The Frequency Values in the Mask Table will be updated to be absolute or relative values so the mask remains in the same position. Frequency values in Mask Table and Export File will the Absolute when X Relative to CF is Off and Relative when X Relative to CF is On.
Preset	This setting is unaffected by a Mode Preset or power cycle It is Preset on Restore Mode Defaults.
State Saved	Saved in instrument state.

8.5.7.7 Amptd Reference

Chooses whether the mask 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 mask, and the reference level at –10 dBm. If Amptd Reference is "Fixed", entering a mask point with an amplitude coordinate of –20 dBm displays the mask point at –20 dBm, and the mask point will not change amplitude if the reference level amplitude changes. If Amptd Reference is "Relative to RL", entering mask point with an amplitude coordinate of –20 dB displays the mask point at RL – 20 dB, or –30 dBm. Furthermore, if the reference level amplitude changes to –30 dBm, the mask point will be displayed at RL – 20 dB, or –50 dBm.

It is possible to change this setting after a mask point has been entered. When changing from On to Off or vice-versa, the amplitude values in the mask table change so that the mask points remains in the same position for the current reference level settings of the analyzer.

Remote Command	`:TRIGger[:SEQuence]:FMT:MASK:RELative:AMPLitude ON | OFF | 1 | 0` `:TRIGger[:SEQuence]:FMT:MASK:RELative:AMPLitude?`
Example	`:TRIG:FMT:MASK:REL:AMPL ON` makes amplitude points relative to the reference level amplitude.
Couplings	The Amplitude Values in the Mask Table will be updated to be absolute or relative values so the mask remains in the same position. Amplitude values in Mask Table and Export File will be Absolute when Y Relative to RL is Off and Relative when Y Relative to RL is On.
Preset	This setting is unaffected by a Mode Preset or power cycle It is Preset on Restore Mode Defaults.
State Saved	Saved in instrument state.

8.5.7.8 X Offset

Offsets all the frequency points in the mask by the specified frequency.

Remote Command	`:TRIGger[:SEQuence]:FMT:MASK[1]|2:OFFSet:X <freq>` `:TRIGger[:SEQuence]:FMT:MASK[1]|2:OFFSet:X?`
Example	`:TRIG:FMT:MASK:OFFS:X 10 kHz`
Notes	The upper and lower masks can have a different X Offset therefore subop code 1 is for the upper mask and subop code 2 is for the lower mask.
Couplings	From the Front Panel, Mask Type (see "Mask Type" on page 981) determines which Mask the offset will be applied to.
Preset	This setting is unaffected by a Mode Preset or power cycle It is Preset on Restore Mode Defaults
State Saved	Saved in instrument state
Min	-500 GHz
Max	500 GHz

8.5.7.9 Y Offset

Offsets all the amplitude points in the mask by the specified amplitude.

Remote Command	`:TRIGger[:SEQuence]:FMT:MASK[1]|2:OFFSet:Y <rel_ampl>` `:TRIGger[:SEQuence]:FMT:MASK[1]|2:OFFSet:Y?`
Example	`:TRIG:FMT:MASK:OFFS:Y 10 dB`
Notes	The upper and lower masks can have different Y Offset therefore subop code 1 is for the upper mask and subop code 2 is for the lower mask.
Couplings	From the Front Panel, Mask Type (see "Mask Type" on page 981) determines which Mask the offset will be applied to.
Preset	This setting is unaffected by a Mode Preset or power cycle It is Preset on Restore Mode Defaults
State Saved	Saved in instrument state
Min	-Infinity
Max	+Infinity

8.5.7.10 Apply Offsets to Mask

Apply X and Y offsets to the selected mask.

Remote Command	`:TRIGger[:SEQuence]:FMT:MASK[1]|2:OFFSet:UPDate`

Example	`:TRIG:FMT:MASK:OFFS:UPD`
Notes	The upper and lower masks can have different Offsets therefore subopcode 1 is for the upper mask and subopcode 2 is for the lower mask
Couplings	From the Front Panel, Mask Type (see section "Mask Type" on page 981) determines which Mask the offset will be applied to

8.6 Auto/Holdoff

The Auto/Holdoff tab contains controls which let you adjust Auto Trigger and Trigger Holdoff parameters

This tab does not appear in Spectrum Analyzer Mode in VXT models M9420A/21A.

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?`
	`:TRIGger[:SEQuence]:HOLDoff:STATe OFF | ON | 0 | 1`
	`:TRIGger[:SEQuence]:HOLDoff:STATe?`

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	Off, 100 ms All modes but GSM/EDGE: OFF GSM/EDGE: ON OFF
State Saved	Saved in instrument state
Min	0 s
Max	0.5 s VXT models M9410A/11A: 2.86 s

8.6.2 Auto Trig

Sets the time that the analyzer will wait for the trigger conditions to be met. If they are not met after that much time, then the analyzer is triggered anyway.

Remote Command	`:TRIGger[:SEQuence]:ATRigger <time>`
	`:TRIGger[:SEQuence]:ATRigger?`
	`:TRIGger[:SEQuence]:ATRigger:STATe OFF | ON | 0 | 1`

	`:TRIGger[:SEQuence]:ATRigger:STATe?`
Example	`:TRIG:ATR:STAT ON` `:TRIG:ATR 100 ms`
Notes	The "time that the analyzer will wait" starts when the analyzer 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
Preset	Off, 100 ms OFF
State Saved	Saved in instrument state
Min	1 ms
Max	100 s

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 will not appear and the Holdoff Type will be Normal. If the Holdoff Type SCPI is sent while in such a measurement, the SCPI will be accepted and the setting remembered, but it will have 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	All modes but GSM/EDGE: Normal GSM/EDGE: Below
State Saved	Saved in instrument state

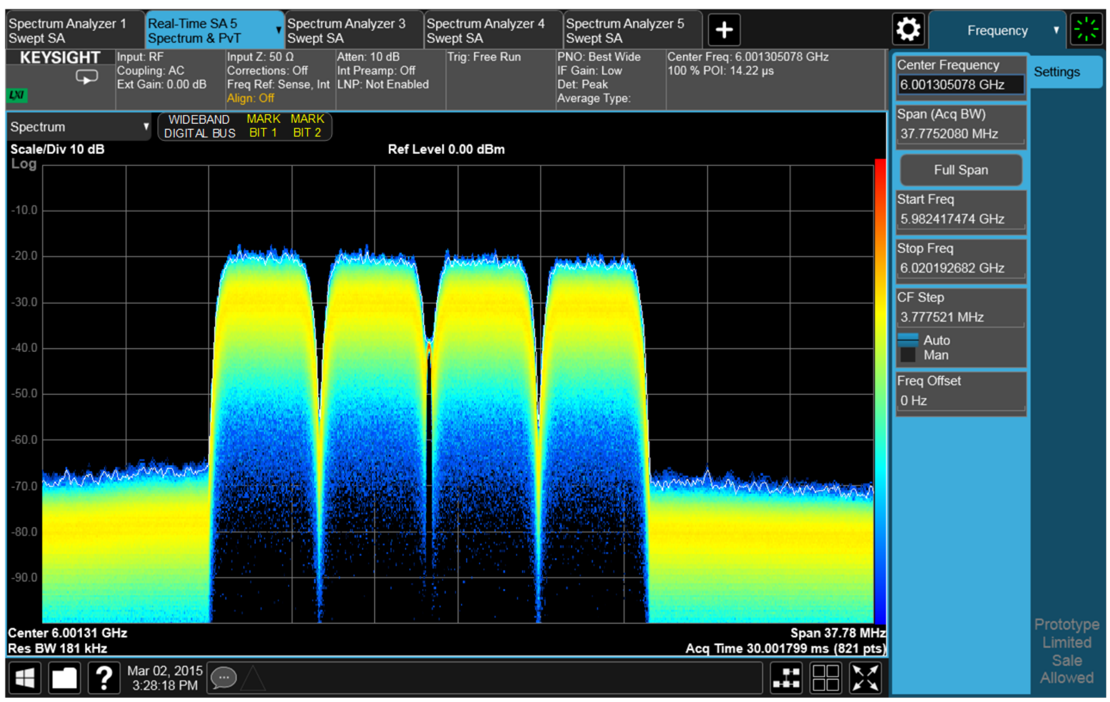
8.7 Stream Mark Bit 1

The “Stream Mark Bit 1” tab contains controls to select and set up a Trigger condition which will get output to Mark Bit 1 on the LVDS connector.

This tab only appears in the Real Time Spectrum Analyzer.

Just as for Gate and Periodic Sync Source, for any given trigger, the settings on these panels match the same settings seen on the Trigger panel when that trigger is selected. So the user can set up the conditions on the Trig panel and then simply select that trigger on the Mark Bits panel, then return the Trigger to Free Run.

When Streaming is turned on, the Mark Bits are displayed in a panel at the top of the display so the user can see when they are firing:



WIDEBAND DIGITAL BUS

8.7.1 Mark Bit 1 On/Off

This control turns on and off Mark Bit 1. When on, the Mark Bit will go true once on the Wideband LVDS port when the selected Trigger Condition is satisfied, and again (once) if it becomes unsatisfied then satisfied again. Thus this bit is effectively an “edge trigger” bit.

Note that for the Stream Mark Bits to function, Wideband Digital Bus must be turned on.

Remote Command	:OUTPut:DBUS2:MARKbit1|2[:STATe] ON | OFF | 1 | 0 :OUTPut:DBUS2:MARKbit1|2[:STATe]?
Example	:OUTP:DBUS2:MARK1 ON
Preset	OFF
State Saved	Saved in instrument state

8.7.2 Select Mark Bit 1

This control selects the Trigger Condition that will be output to Mark Bit 1. When on, the Mark Bit will go true once on the Wideband LVDS port when the selected Trigger Condition is satisfied, and again (once) if it becomes unsatisfied then satisfied again. Thus this bit is effectively an “edge trigger” bit.

Note that for the Stream Mark Bits to function, Wideband Digital Bus must be turned on.

Remote Command	:OUTPut:DBUS2:MARKbit1|2:SOURce EXTernal1 | EXTernal2 | FMT | IMMediate | LINE | RFBurst | VIDeo :OUTPut:DBUS2:MARKbit[1]|2?
Example	:OUTP:DBUS2:MARK1 FMT
Preset	EXT1
State Saved	Saved in instrument state

8.7.3 Scale Factor (Remote Command only)

The analyzer can be queried for the scale factor to be used to translate I/Q data from the Wideband Digital Bus streaming port into Volt values.

Remote Command	:OUTPut:DBUS2:SCALe?
Example	:OUTP:DBUS2:SCAL?
Notes	The query returns a single value, which when applied to the Wideband Digital Bus I/Q data, produces values in Volts. The scaling factor must be queried after any measurement setting is changed.
State Saved	Saved in Input/Output State

8.8 Stream Mark Bit 2

The “Stream Mark Bit 2” tab contains controls to select and set up a Trigger condition which will get output to Mark Bit 2 on the LVDS connector.

For more information see "Stream Mark Bit 1" on page 993.

This tab only appears in the Real Time Spectrum Analyzer.

8.8.1 Mark Bit 2 On/Off

This control turns on and off Mark Bit 2. When on, the Mark Bit will go true once on the Wideband LVDS port when the selected Trigger Condition is satisfied, and again (once) if it becomes unsatisfied then satisfied again. Thus this bit is effectively an “edge trigger” bit.

Note that for the Stream Mark Bits to function, Wideband Digital Bus must be turned on.

Remote Command	See Mark Bit 1 On/Off
Example	`:OUTP:DBUS2:MARK2 ON`
Preset	`OFF`
State Saved	Saved in instrument state

8.8.2 Select Mark Bit 2

This control selects the Trigger Condition that will be output to Mark Bit 2. When on, the Mark Bit will go true once on the Wideband LVDS port when the selected Trigger Condition is satisfied, and again (once) if it becomes unsatisfied then satisfied again. Thus this bit is effectively an “edge trigger” bit.

Note that for the Stream Mark Bits to function, Wideband Digital Bus must be turned on.

Remote Command	See Select Mark Bit 1
Example	`:OUTP:DBUS2:MARK2 FMT`
Preset	`EXT2`
State Saved	Saved in instrument state

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 either the N9061C Remote Language Compatibility measurement application, or 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.

*

```
*CAL
*CAL?
*CLS
*ESE
*ESE?
*ESR?
*IDN?
*OPC
*OPC?
*OPT?
*RCL
*RST
*SAV
*SRE
*SRE?
*STB?
*TRG
*TST?
*WAI
```

C

```
CALCulate:<meas>:MARKer[1]|2|...|12:MAXimum:LEFT
CALCulate:<meas>:MARKer[1]|2|...|12:MAXimum:NEXT
CALCulate:<meas>:MARKer[1]|2|...|12:MAXimum:RIGHt
CALCulate:<meas>:MARKer[1]|2|...|12:MINimum
CALCulate:<meas>:MARKer[1]|2|...|12:PTPeak
CALCulate:<meas>:MARKer:AOFF
CALCulate:BWIDth|BANDwidth:NDB
CALCulate:BWIDth|BANDwidth:NDB?
CALCulate:BWIDth|BANDwidth:RESult?
CALCulate:BWIDth|BANDwidth:RLEFt?
CALCulate:BWIDth|BANDwidth:RRIGht?
CALCulate:BWIDth|BANDwidth[:STATe]
CALCulate:BWIDth|BANDwidth[:STATe]?
CALCulate:CLIMits:FAIL?
CALCulate:CLIMits:FAIL?
CALCulate:DATA<n>:COMPress?
```

```
CALCulate:DATA[1]|2|...|6:PEAKs?
CALCulate:DATA:RTDensity?
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:LLINe[1]|2|...|6:AMPLitude:CMODe:RELative
CALCulate:LLINe[1]|2|...|6:AMPLitude:CMODe:RELative?
CALCulate:LLINe[1]|2|...|6:AMPLitude:INTerpolate:TYPE
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:COMMent?
CALCulate:LLINe[1]|2|...|6:CONTrol:INTerpolate:TYPE
CALCulate:LLINe[1]|2|...|6:CONTrol:INTerpolate:TYPE?
CALCulate:LLINe[1]|2|...|6:COPY
CALCulate:LLINe[1]|2|...|6:DATA
CALCulate:LLINe[1]|2|...|6:DATA?
CALCulate:LLINe[1]|2|...|6:DATA:MERGe
CALCulate:LLINe[1]|2|...|6:DELete
CALCulate:LLINe[1]|2|...|6:DESCription
CALCulate:LLINe[1]|2|...|6:DESCription?
CALCulate:LLINe[1]|2|...|6:DISPlay
CALCulate:LLINe[1]|2|...|6:DISPlay?
CALCulate:LLINe[1]|2|...|6:FREQuency:CMODe:RELative
CALCulate:LLINe[1]|2|...|6:FREQuency:CMODe:RELative?
CALCulate:LLINe[1]|2|...|6:MARGin
CALCulate:LLINe[1]|2|...|6:MARGin?
CALCulate:LLINe[1]|2|...|6:MARGin:STATe
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:X?
CALCulate:LLINe[1]|2|...|6:OFFSet:Y
CALCulate:LLINe[1]|2|...|6:OFFSet:Y?
CALCulate:LLINe[1]|2|...|6:TRACe
CALCulate:LLINe[1]|2|...|6:TRACe?
CALCulate:LLINe[1]|2|...|6:TYPE
CALCulate:LLINe[1]|2|...|6:TYPE?
CALCulate:LLINe:ALL:DELete
CALCulate:LLINe:CONTrol:DOMain
CALCulate:LLINe:CONTrol:DOMain?
CALCulate:LLINe:TEST
CALCulate:LLINe:TEST?
CALCulate:MARKer[1]|2|...|12:CPSearch[:STATe]
CALCulate:MARKer[1]|2|...|12:CPSearch[:STATe]?
CALCulate:MARKer[1]|2|...|12:FUNCtion:BAND:LEFT
CALCulate:MARKer[1]|2|...|12:FUNCtion:BAND:LEFT?
```

```
CALCulate:MARKer[1]|2|...|12:FUNCtion:BAND:RIGHt
CALCulate:MARKer[1]|2|...|12:FUNCtion:BAND:RIGHt?
CALCulate:MARKer[1]|2|...|12:FUNCtion:BAND:SPAN
CALCulate:MARKer[1]|2|...|12:FUNCtion:BAND:SPAN?
CALCulate:MARKer[1]|2|...|12:FUNCtion:BAND:SPAN:AUTO
CALCulate:MARKer[1]|2|...|12:FUNCtion:BAND:SPAN:AUTO?
CALCulate:MARKer[1]|2|...|12:LINes[:STATe]
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:MODE?
CALCulate:MARKer[1]|2|...|12:PTPeak
CALCulate:MARKer[1]|2|...|12:REFerence
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:STATe
CALCulate:MARKer[1]|2|...|12:STATe?
CALCulate:MARKer[1]|2|...|12:TRACe
CALCulate:MARKer[1]|2|...|12:TRACe?
CALCulate:MARKer[1]|2|...|12:TRACe:AUTO
CALCulate:MARKer[1]|2|...|12:TRACe:AUTO?
CALCulate:MARKer[1]|2|...|12:X
CALCulate:MARKer[1]|2|...|12:X?
CALCulate:MARKer[1]|2|...|12:X:POSition
CALCulate:MARKer[1]|2|...|12:X:POSition?
CALCulate:MARKer[1]|2|...|12:X:READout
CALCulate:MARKer[1]|2|...|12:X:READout?
CALCulate:MARKer[1]|2|...|12:X:READout:AUTO
CALCulate:MARKer[1]|2|...|12:X:READout:AUTO?
CALCulate:MARKer[1]|2|...|12:Y
CALCulate:MARKer[1]|2|...|12:Y?
CALCulate:MARKer[1]|2|...|12:Z?
CALCulate:MARKer[1]|2|...|12:Z:POSition
CALCulate:MARKer[1]|2|...|12:Z:POSition?
CALCulate:MARKer[1]|2|...|4:X:POSition:SPAN
CALCulate:MARKer[1]|2|...|4:X:POSition:SPAN?
CALCulate:MARKer[1]|2|...|4:X:POSition:STARt
CALCulate:MARKer[1]|2|...|4:X:POSition:STARt?
```

```
CALCulate:MARKer[1]|2|...|4:X:POSition:STOP
CALCulate:MARKer[1]|2|...|4:X:POSition:STOP?
CALCulate:MARKer:AOFF
CALCulate:MARKer:COUPle[:STATe]
CALCulate:MARKer:COUPle[:STATe]?
CALCulate:MARKer:PEAK:EXCursion
CALCulate:MARKer:PEAK:EXCursion?
CALCulate:MARKer:PEAK:EXCursion:STATe
CALCulate:MARKer:PEAK:EXCursion:STATe?
CALCulate:MARKer:PEAK:SEARch:MODE
CALCulate:MARKer:PEAK:SEARch:MODE?
CALCulate:MARKer:PEAK:SORT
CALCulate:MARKer:PEAK:SORT?
CALCulate:MARKer:PEAK:TABLe:DTLimit
CALCulate:MARKer:PEAK:TABLe:DTLimit?
CALCulate:MARKer:PEAK:TABLe:DTLimit:STATe
CALCulate:MARKer:PEAK:TABLe:DTLimit:STATe?
CALCulate:MARKer:PEAK:TABLe:READout
CALCulate:MARKer:PEAK:TABLe:READout?
CALCulate:MARKer:PEAK:TABLe:STATe
CALCulate:MARKer:PEAK:TABLe:STATe?
CALCulate:MARKer:PEAK:THReshold
CALCulate:MARKer:PEAK:THReshold?
CALCulate:MARKer:PEAK:THReshold:STATe
CALCulate:MARKer:PEAK:THReshold:STATe?
CALCulate:MARKer:TABLe[:STATe]
CALCulate:MARKer:TABLe[:STATe]?
CALCulate:MATH
CALCulate:MATH?
CALCulate:NTData[:STATe]
CALCulate:NTData[:STATe]?
CALibration[:ALL]
CALibration[:ALL]?
CALibration[:ALL]:NPENding
CALibration:AUTO
CALibration:AUTO?
CALibration:AUTO:ALERt
CALibration:AUTO:ALERt?
CALibration:AUTO:MODE
CALibration:AUTO:MODE?
CALibration:AUTO:TIME:OFF?
CALibration:DATA:BACKup
CALibration:DATA:DEFault
CALibration:DATA:INTernal:BACKup
CALibration:DATA:INTernal:RESTore
CALibration:EMIXer
CALibration:EMIXer?
CALibration:EXPired?
CALibration:FREQuency:REFerence:COARse
CALibration:FREQuency:REFerence:COARse?
CALibration:FREQuency:REFerence:FINE
CALibration:FREQuency:REFerence:FINE?
CALibration:FREQuency:REFerence:MODE
```

```
CALibration:FREQuency:REFerence:MODE?
CALibration:INTernal:ASFRanges?
CALibration:INTernal:ASFRanges:EXTend[:STATe]
CALibration:INTernal:ASFRanges:EXTend[:STATe]?
CALibration:INTernal:ASFRanges:FRANges
CALibration:INTernal:ASFRanges[:STATe]
CALibration:INTernal:EMPath
CALibration:INTernal:EMPath?
CALibration:INTernal:FAST[:ALL]
CALibration:INTernal:FAST[:ALL]?
CALibration:INTernal:HBANd[:ALL]
CALibration:INTernal:HBANd[:ALL]?
CALibration:INTernal:IFCable
CALibration:INTernal:IFCable?
CALibration:INTernal:LBANd[:ALL]
CALibration:INTernal:LBANd[:ALL]?
CALibration:INTernal:LOLeakage
CALibration:INTernal:LOLeakage?
CALibration:INTernal:RECeiver[:ALL]
CALibration:INTernal:RECeiver[:ALL]?
CALibration:INTernal:SOURce[:ALL]
CALibration:INTernal:SOURce[:ALL]?
CALibration:INTernal:SOURce[:ALL]:NPENding
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:NFLoor?
CALibration:NRF
CALibration:NRF?
CALibration:NRF:NPENding
CALibration:NRFPselector
CALibration:NRFPselector?
CALibration:REFerence:CLOCk?
CALibration:REFerence:CLOCk:END?
CALibration:REFerence:CLOCk:INITialize?
CALibration:RF
CALibration:RF?
CALibration:RF:NPENding
```

```
CALibration:RFPSelector:ONLY
CALibration:RFPSelector:ONLY?
CALibration:RFPSelector:SCHeduler:TIME:NEXT?
CALibration:SOURce:STATe
CALibration:SOURce:STATe?
CALibration:TEMPerature:CURRent?
CALibration:TEMPerature:INTernal:EMPath?
CALibration:TEMPerature:INTernal:FAST?
CALibration:TEMPerature:INTernal:HBANd?
CALibration:TEMPerature:INTernal:IFCable?
CALibration:TEMPerature:INTernal:LBANd?
CALibration:TEMPerature:INTernal:LOLeakage?
CALibration:TEMPerature:INTernal:RECeiver?
CALibration:TEMPerature:INTernal:SOURce?
CALibration:TEMPerature:LALL?
CALibration:TEMPerature:LIF?
CALibration:TEMPerature:LPReselector?
CALibration:TEMPerature:LRF?
CALibration:TEMPerature:NFLoor?
CALibration:TEMPerature:RFPSelector:LCONducted?
CALibration:TEMPerature:RFPSelector:LRADiated?
CALibration:TIME:ELAPsed:NFLoor?
CALibration:TIME:INTernal:EMPath?
CALibration:TIME:INTernal:FAST?
CALibration:TIME:INTernal:HBAN?
CALibration:TIME:INTernal:IFCable?
CALibration:TIME:INTernal:LBANd?
CALibration:TIME:INTernal:LOLeakage?
CALibration:TIME:INTernal:RECeiver?
CALibration:TIME:INTernal:SOURce?
CALibration:TIME:LALL?
CALibration:TIME:LIF?
CALibration:TIME:LPReselector?
CALibration:TIME:LRF?
CALibration:TIME:NFLoor?
CALibration:TIME:REFerence:CLOCk?
CALibration:TIME:RFPSelector:LCONducted?
CALibration:TIME:RFPSelector:LRADiated?
CALibration:YTF
CALibration:YTF?
CALibration:YTF:NPENding
CONFigure?
CONFigure?
CONFigure:<measurement>[:NDEFault]
CONFigure:CATalog?
CONFigure:RTSA
COUPle
```

D

```
DISPlay:ACTivefunc[:STATe]
DISPlay:ACTivefunc[:STATe]?
```

```
DISPlay:ANNotation:MBAR[:STATe]
DISPlay:ANNotation:MBAR[:STATe]?
DISPlay:ANNotation:SCReen[:STATe]
DISPlay:ANNotation:SCReen[:STATe]?
DISPlay:BACKlight
DISPlay:BACKlight?
DISPlay:FSCReen[:STATe]
DISPlay:FSCReen[:STATe]?
DISPlay:GRATicule[:STATe]
DISPlay:GRATicule[:STATe]?
DISPlay:THEMe
DISPlay:THEMe?
DISPlay:TRACe:COUPle[:STATe]
DISPlay:TRACe:COUPle[:STATe]?
DISPlay:UINTerface:CSIZe
DISPlay:UINTerface:CSIZe?
DISPlay:UINTerface:HTABs
DISPlay:UINTerface:HTABs?
DISPlay:UINTerface:STAB
DISPlay:UINTerface:TYPE?
DISPlay:VIEW:ADVanced:DELete
DISPlay:VIEW:ADVanced:NAME
DISPlay:VIEW:ADVanced:REName
DISPlay:VIEW:ADVanced:SELect
DISPlay:VIEW:ADVanced:SELect?
DISPlay:VIEW:DENSity:AADJust
DISPlay:VIEW:DENSity:CNONlinear
DISPlay:VIEW:DENSity:CNONlinear?
DISPlay:VIEW:DENSity:CPALettes
DISPlay:VIEW:DENSity:CPALettes?
DISPlay:VIEW:DENSity:HDHue
DISPlay:VIEW:DENSity:HDHue?
DISPlay:VIEW:DENSity:LDHue
DISPlay:VIEW:DENSity:LDHue?
DISPlay:VIEW:DENSity:PERSistence
DISPlay:VIEW:DENSity:PERSistence?
DISPlay:VIEW:DENSity:PERSistence:INFinite
DISPlay:VIEW:DENSity:PERSistence:INFinite?
DISPlay:VIEW[:SELect]
DISPlay:WINDow[1]:ANNotation[:ALL]
DISPlay:WINDow[1]:ANNotation[:ALL]?
DISPlay:WINDow[1]:TRACe:X:FLINe[1]|2|...|4
DISPlay:WINDow[1]:TRACe:X:FLINe[1]|2|...|4?
DISPlay:WINDow[1]:TRACe:X:FLINe[1]|2|...|4:STATe
DISPlay:WINDow[1]:TRACe:X:FLINe[1]|2|...|4:STATe?
DISPlay:WINDow[1]:TRACe:X:TLINe[1]|2|...|4
DISPlay:WINDow[1]:TRACe:X:TLINe[1]|2|...|4?
DISPlay:WINDow[1]:TRACe:X:TLINe[1]|2|...|4:STATe
DISPlay:WINDow[1]:TRACe:X:TLINe[1]|2|...|4:STATe?
DISPlay:WINDow[1]:TRACe:Y:DLINe[1]
DISPlay:WINDow[1]:TRACe:Y:DLINe[1]
DISPlay:WINDow[1]:TRACe:Y:DLINe[1]|2|...|4
DISPlay:WINDow[1]:TRACe:Y:DLINe[1]|2|...|4?
```

```
DISPlay:WINDow[1]:TRACe:Y[:SCALe]:NRLevel
DISPlay:WINDow[1]:TRACe:Y[:SCALe]:NRLevel?
DISPlay:WINDow[1]:TRACe:Y[:SCALe]:NRPosition
DISPlay:WINDow[1]:TRACe:Y[:SCALe]:NRPosition?
DISPlay:WINDow[1]:TRACe:Y[:SCALe]:PDIVision
DISPlay:WINDow[1]:TRACe:Y[:SCALe]:PDIVision?
DISPlay:WINDow[1]:TRACe:Y[:SCALe]:RLEVel
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:STATe
DISPlay:WINDow[1]:TRACe:Y[:SCALe]:RLEVel:OFFSet:STATe?
DISPlay:WINDow[1]:TRACe:Y[:SCALe]:SPACing
DISPlay:WINDow[1]:TRACe:Y[:SCALe]:SPACing?
DISPlay:WINDow4:AADJust
DISPlay:WINDow4:BOTTom
DISPlay:WINDow4:BOTTom?
DISPlay:WINDow4:HUE
DISPlay:WINDow4:HUE?
DISPlay:WINDow4:REFerence
DISPlay:WINDow4:REFerence?
DISPlay:WINDow4:TRACe:COUPle
DISPlay:WINDow4:TRACe:COUPle?
DISPlay:WINDow4:TRACe:POSition
DISPlay:WINDow4:TRACe:POSition?
DISPlay:WINDow4:TRACe:TIME
DISPlay:WINDow4:TRACe:TIME?
DISPlay:WINDow8:TRACe:Y[:SCALe]:PDIVision
DISPlay:WINDow8:TRACe:Y[:SCALe]:PDIVision?
DISPlay:WINDow9:AADJust
DISPlay:WINDow9:BOTTom
DISPlay:WINDow9:BOTTom?
DISPlay:WINDow9:HUE
DISPlay:WINDow9:HUE?
DISPlay:WINDow9:REFerence
DISPlay:WINDow9:REFerence?
DISPlay:WINDow9:TRACe:COUPle
DISPlay:WINDow9:TRACe:COUPle?
DISPlay:WINDow9:TRACe:POSition
DISPlay:WINDow9:TRACe:POSition?
DISPlay:WINDow9:TRACe:TIME
DISPlay:WINDow9:TRACe:TIME?
```

F

```
FETCh:<measurement>[n]?
FORMat:BORDer
FORMat:BORDer?
FORMat[:TRACe][:DATA]
FORMat[:TRACe][:DATA]?
```

G

GLOBal:FREQuency:CENTer[:STATe]
GLOBal:FREQuency:CENTer[:STATe]?

H

HCOPy:ABORt
HCOPy[:IMMediate]

I

ID?
INITiate:<measurement>
INITiate:CONTinuous
INITiate:CONTinuous?
INITiate[:IMMediate]
INITiate:PAUSe
INITiate:RESTart
INITiate:RESume
INITiate:RTSA
INPut[1]:IQ:BALanced[:STATe]
INPut[1]:IQ:BALanced[:STATe]?
INPut[1]:IQ[:I]:IMPedance
INPut[1]:IQ[:I]:IMPedance?
INPut[1]:IQ:Q:IMPedance
INPut[1]:IQ:Q:IMPedance?
INPut[1]:IQ:TYPE
INPut[1]:IQ:TYPE?
INPut:COUPling
INPut:COUPling?
INPut:COUPling:I
INPut:COUPling:I?
INPut:COUPling:Q
INPut:COUPling:Q?
INPut:IMPedance:IQ
INPut:IMPedance:IQ?
INPut:IMPedance:REFerence
INPut:IMPedance:REFerence?
INPut:IQ[:I]:DIFFerential
INPut:IQ[:I]:DIFFerential?
INPut:IQ:MIRRored
INPut:IQ:MIRRored?
INPut:IQ:Q:DIFFerential
INPut:IQ:Q:DIFFerential?
INPut:MIXer
INPut:MIXer?
INPut:OFFSet:I
INPut:OFFSet:I?

INPut:OFFSet:Q
INPut:OFFSet:Q?
INSTrument:CATalog?
INSTrument:CONFigure:<mode>:<meas>
INSTrument:COUPle:DEFault
INSTrument:COUPle:FREQuency:BAND:EXTend
INSTrument:COUPle:FREQuency:BAND:EXTend?
INSTrument:COUPle:FREQuency:CENTer
INSTrument:COUPle:FREQuency:CENTer?
INSTrument:COUPle:SCReen:INPut
INSTrument:COUPle:SCReen:INPut?
INSTrument:DEFault
INSTrument:NSELect
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:SELect?
INSTrument:SCReen:STAB?
INSTrument[:SELect]
INSTrument[:SELect]
INSTrument[:SELect]
INSTrument[:SELect]
INSTrument[:SELect]
INSTrument[:SELect]
INSTrument[:SELect]
INSTrument[:SELect]?

L

LXI:IDENtify[:STATe]
LXI:IDENtify[:STATe]?

M

MEASure:<measurement>[n]?
MMEMory:CATalog?
MMEMory:CDIRectory
MMEMory:CDIRectory?
MMEMory:COPY
MMEMory:COPY:DEVice
MMEMory:DATA
MMEMory:DATA?
MMEMory:DELete
MMEMory:HEADer:ID?

```
MMEMory:LOAD:CCORrection
MMEMory:LOAD:CORRection
MMEMory:LOAD:CORRection:GROup
MMEMory:LOAD:FMT
MMEMory:LOAD:LIMit
MMEMory:LOAD:RESults:SPECtrogram
MMEMory:LOAD:RTYPe:ALL
MMEMory:LOAD:SCONfig
MMEMory:LOAD:STATe
MMEMory:LOAD:TRACe
MMEMory:LOAD:TRACe:DATA
MMEMory:LOAD:TRACe:REGister
MMEMory:MDIRectory
MMEMory:MOVE
MMEMory:RDIRectory
MMEMory:REGister:STATe:LABel
MMEMory:REGister:STATe:LABel?
MMEMory:REGister:TRACe:LABel
MMEMory:REGister:TRACe:LABel?
MMEMory:RMEDia:LABel
MMEMory:RMEDia:LABel?
MMEMory:RMEDia:LIST?
MMEMory:RMEDia:SIZE?
MMEMory:RMEDia:WPRotect?
MMEMory:STORe:CORRection
MMEMory:STORe:CORRection:GROup
MMEMory:STORe:FMT
MMEMory:STORe:LIMit
MMEMory:STORe:QSAVe
MMEMory:STORe:QSAVe?
MMEMory:STORe:RESults
MMEMory:STORe:RESults:DENSity
MMEMory:STORe:RESults:MTABle
MMEMory:STORe:RESults:PTABle
MMEMory:STORe:SCONfig
MMEMory:STORe:SCReen
MMEMory:STORe:SCReen:THEMe
MMEMory:STORe:SCReen:THEMe?
MMEMory:STORe:STATe
MMEMory:STORe:TRACe
MMEMory:STORe:TRACe:DATA
MMEMory:STORe:TRACe:REGister
```

O

```
OUTPut:ANALog
OUTPut:ANALog?
OUTPut:ANALog:AUTO
OUTPut:ANALog:AUTO?
OUTPut:ANALog:SVIDeo
OUTPut:ANALog:SVIDeo?
OUTPut:AUX
```

```
OUTPut:AUX?
OUTPut:AUX:AIF
OUTPut:AUX:AIF?
OUTPut:AUX:IO
OUTPut:AUX:IO?
OUTPut:AUX:IO:DATA0
OUTPut:AUX:IO:DATA1
OUTPut:AUX:IO:DATA2
OUTPut:AUX:IO:DATA3
OUTPut:AUX:IO:DATA4
OUTPut:AUX:IO:DATA5
OUTPut:AUX:IO:DATA6
OUTPut:AUX:IO:DATA7
OUTPut:DBUS[1][:STATe]
OUTPut:DBUS[1][:STATe]?
OUTPut:DBUS2:DATA
OUTPut:DBUS2:DATA?
OUTPut:DBUS2:MARKbit[1]|2?
OUTPut:DBUS2:MARKbit1|2:SOURce
OUTPut:DBUS2:MARKbit1|2[:STATe]
OUTPut:DBUS2:MARKbit1|2[:STATe]?
OUTPut:DBUS2:SCALe?
OUTPut:DBUS2[:STATe]
OUTPut:DBUS2[:STATe]?
OUTPut:EIF
OUTPut:EIF?
OUTPut:EREFerence:OUTPut
OUTPut:EREFerence:OUTPut?
OUTPut[:EXTernal][:STATe]
OUTPut[:EXTernal][:STATe]?
OUTPut:IF2
OUTPut:IF2?
OUTPut:IQ:OUTPut
OUTPut:IQ:OUTPut?
OUTPut:LO:OUTPut
OUTPut:LO:OUTPut?
OUTPut:MODulation[:STATe]
OUTPut:MODulation[:STATe]?
```

R

```
READ:<measurement>[n]?
```

S

```
[:SENSe]:<meas>:FREQuency:SPAN
[:SENSe]:<meas>:FREQuency:SPAN?
[:SENSe]:<measurement>:PFILter[:STATe]
[:SENSe]:<measurement>:PFILter[:STATe]?
[:SENSe]:ACQuisition:POINts?
[:SENSe]:ACQuisition:POINts:PVTime?
```

```
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[:SENSe]:ACQuisition:TIME?
[:SENSe]:ACQuisition:TIME:AUTO
[:SENSe]:ACQuisition:TIME:AUTO?
[:SENSe]:ACQuisition:TIME:CAPTure
[:SENSe]:ACQuisition:TIME:CAPTure?
[:SENSe]:ACQuisition:TIME:PVTime
[:SENSe]:ACQuisition:TIME:PVTime?
[:SENSe]:ACQuisition:TIME:PVTime:AUTO
[:SENSe]:ACQuisition:TIME:PVTime:AUTO?
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[:SENSe]:AFINput[1]|2:COUPling?
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[:SENSe]:AFINput[1]|2:IMPedance?
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[:SENSe]:AVERage:COUNt
[:SENSe]:AVERage:COUNt?
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[:SENSe]:BANDwidth|BWIDth[:RESolution]:SELect?
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[:SENSe]:CORRection:CSET[1]|2|...|16:COMMent?
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```

```
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[:SENSe]:CORRection:CSET:GROup[1]|2|...|10:DATA?
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```

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```
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[:SENSe]:POWer[:RF]:ATTenuation:AUTO?
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[:SENSe]:POWer[:RF]:ATTenuation:STEP[:INCRement]?
```

```
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```

```
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SOURce:AM[:DEPTh][:LINear]?
SOURce:AM:INTernal:FREQuency
SOURce:AM:INTernal:FREQuency?
SOURce:AM:INTernal:FREQuency:STEP[:INCRement]
SOURce:AM:INTernal:FREQuency:STEP[:INCRement]?
SOURce:AM:STATe
SOURce:AM:STATe?
SOURce:FM[:DEViation]
SOURce:FM[:DEViation]?
SOURce:FM:INTernal:FREQuency
SOURce:FM:INTernal:FREQuency?
SOURce:FM:INTernal:FREQuency:STEP[:INCRement]
SOURce:FM:INTernal:FREQuency:STEP[:INCRement]?
SOURce:FM:STATe
SOURce:FM:STATe?
SOURce:FREQuency:CHANnels:BAND
```

```
SOURce:FREQuency:CHANnels:BAND?
SOURce:FREQuency:CHANnels:NUMBer
SOURce:FREQuency:CHANnels:NUMBer?
SOURce:FREQuency:COUPling
SOURce:FREQuency:COUPling?
SOURce:FREQuency:COUPling:OFFSet
SOURce:FREQuency:COUPling:OFFSet?
SOURce:FREQuency[:CW]
SOURce:FREQuency[:CW]?
SOURce:FREQuency:OFFSet
SOURce:FREQuency:OFFSet?
SOURce:FREQuency:REFerence
SOURce:FREQuency:REFerence?
SOURce:FREQuency:REFerence:SET
SOURce:FREQuency:REFerence:STATe
SOURce:FREQuency:REFerence:STATe?
SOURce:FREQuency:STEP[:INCRement]
SOURce:FREQuency:STEP[:INCRement]?
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SOURce:LIST:NUMBer:STEPs?
SOURce:LIST:REPetition:TYPE
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SOURce:LIST:SETup:AMPLitude?
SOURce:LIST:SETup:CLEar
SOURce:LIST:SETup:CNFRequency
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SOURce:LIST:SETup:OUTPut:TRIGger?
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SOURce:LIST:SETup:RADio:BAND?
SOURce:LIST:SETup:RADio:BAND:LINK
SOURce:LIST:SETup:RADio:BAND:LINK?
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SOURce:LIST:SETup:TOCount?
SOURce:LIST:SETup:TRANsition:TIME
SOURce:LIST:SETup:TRANsition:TIME?
SOURce:LIST:SETup:WAVeform
SOURce:LIST:SETup:WAVeform?
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SOURce:LIST[:STATe]?
SOURce:LIST:STEP[1]|2|...|4..1000:SETup
SOURce:LIST:STEP[1]|2|...|4..1000:SETup?
SOURce:LIST:STEP[1]|2|3…1000:SETup:RADio:BAND?
SOURce:LIST:STEP[1]|2|3…1000:SETup:AMPLitude
SOURce:LIST:STEP[1]|2|3…1000:SETup:AMPLitude?
SOURce:LIST:STEP[1]|2|3…1000:SETup:CNFRequency
SOURce:LIST:STEP[1]|2|3…1000:SETup:CNFRequency
SOURce:LIST:STEP[1]|2|3…1000:SETup:CNFRequency?
```

```
SOURce:LIST:STEP[1]|2|3…1000:SETup:CNFRequency?
SOURce:LIST:STEP[1]|2|3…1000:SETup:DURation:TCOunt
SOURce:LIST:STEP[1]|2|3…1000:SETup:DURation:TCOunt
SOURce:LIST:STEP[1]|2|3…1000:SETup:DURation:TCOunt?
SOURce:LIST:STEP[1]|2|3…1000:SETup:DURation:TCOunt?
SOURce:LIST:STEP[1]|2|3…1000:SETup:DURation:TYPE
SOURce:LIST:STEP[1]|2|3…1000:SETup:DURation:TYPE?
SOURce:LIST:STEP[1]|2|3…1000:SETup:INPut:TRIGger
SOURce:LIST:STEP[1]|2|3…1000:SETup:INPut:TRIGger?
SOURce:LIST:STEP[1]|2|3…1000:SETup:OUTPut:TRIGger
SOURce:LIST:STEP[1]|2|3…1000:SETup:OUTPut:TRIGger
SOURce:LIST:STEP[1]|2|3…1000:SETup:RADio:BAND
SOURce:LIST:STEP[1]|2|3…1000:SETup:RADio:BAND:LINK
SOURce:LIST:STEP[1]|2|3…1000:SETup:RADio:BAND:LINK?
SOURce:LIST:STEP[1]|2|3…1000:SETup:TRANsition:TIME
SOURce:LIST:STEP[1]|2|3…1000:SETup:TRANsition:TIME?
SOURce:LIST:STEP[1]|2|3…1000:SETup:WAVeform
SOURce:LIST:STEP[1]|2|3…1000:SETup:WAVeform?
SOURce:LIST:TRIGger[:IMMediate]
SOURce:LIST:TRIGger:INITiate[:IMMediate]
SOURce:LIST:TRIGger:OUTPut:TYPE
SOURce:LIST:TRIGger:OUTPut:TYPE?
SOURce:LIST:TRIGger:OUTPut:TYPE:MARKer M1M2|M3|M4
SOURce:LIST:TRIGger:OUTPut:TYPE:MARKer?
SOURce:PM[:DEViation]
SOURce:PM[:DEViation]?
SOURce:PM:INTernal:FREQuency
SOURce:PM:INTernal:FREQuency?
SOURce:PM:INTernal:FREQuency:STEP[:INCRement]
SOURce:PM:INTernal:FREQuency:STEP[:INCRement]?
SOURce:PM:STATe
SOURce:PM:STATe?
SOURce:POWer[:LEVel][:IMMediate][:AMPLitude]
SOURce:POWer[:LEVel][:IMMediate][:AMPLitude]?
SOURce:POWer[:LEVel][:IMMediate][:AMPLitude]:UNIT
SOURce:POWer[:LEVel][:IMMediate][:AMPLitude]:UNIT?
SOURce:POWer[:LEVel][:IMMediate]:OFFSet
SOURce:POWer[:LEVel][:IMMediate]:OFFSet?
SOURce:POWer:REFerence
SOURce:POWer:REFerence?
SOURce:POWer:REFerence:STATe
SOURce:POWer:REFerence:STATe?
SOURce:POWer:STEP[:INCRement]
SOURce:POWer:STEP[:INCRement]?
SOURce:PRESet
SOURce:RADio:ARB:DEFault:DIRectory?
SOURce:RADio:ARB:BASeband:FREQuency:OFFSet
SOURce:RADio:ARB:BASeband:FREQuency:OFFSet?
SOURce:RADio:ARB:BASeband:POWer
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:DELay?
SOURce:RADio:ARB:IQADjustment:GAIN
SOURce:RADio:ARB:IQADjustment:GAIN?
SOURce:RADio:ARB:IQADjustment:[STATe]
SOURce:RADio:ARB:IQADjustment:[STATe]?
SOURce:RADio:ARB:LOAD
SOURce:RADio:ARB:LOAD:ALL
SOURce:RADio:ARB:MDEStination:ALCHold
SOURce:RADio:ARB:MDEStination:ALCHold?
SOURce:RADio:ARB:MDEStination:PULSe
SOURce:RADio:ARB:MDEStination:PULSe?
SOURce:RADio:ARB:MPLicensed:NAME:LOCKed?
SOURce:RADio:ARB:MPLicensed:UID:LOCKed?
SOURce:RADio:ARB:MPOLarity:MARKer1
SOURce:RADio:ARB:MPOLarity:MARKer1?
SOURce:RADio:ARB:MPOLarity:MARKer2
SOURce:RADio:ARB:MPOLarity:MARKer2?
SOURce:RADio:ARB:MPOLarity:MARKer3
SOURce:RADio:ARB:MPOLarity:MARKer3?
SOURce:RADio:ARB:MPOLarity:MARKer4
SOURce:RADio:ARB:MPOLarity:MARKer4?
SOURce:RADio:ARB:RETRigger
SOURce:RADio:ARB:RETRigger?
SOURce:RADio:ARB:RMS
SOURce:RADio:ARB:RMS?
SOURce:RADio:ARB:RMS:CALCulate
SOURce:RADio:ARB:RMS:CALCulation:MODE
SOURce:RADio:ARB:RMS:CALCulation:MODE?
SOURce:RADio:ARB:RSCaling
SOURce:RADio:ARB:RSCaling?
SOURce:RADio:ARB:SCLock:RATE
SOURce:RADio:ARB:SCLock:RATE?
SOURce:RADio:ARB:SEQuence[:MWAVeform]
SOURce:RADio:ARB:SEQuence[:MWAVeform]?
SOURce:RADio:ARB:SEQuence:SYNC
SOURce:RADio:ARB:SEQuence:SYNC
SOURce:RADio:ARB:SEQuence:SYNC?
SOURce:RADio:ARB:SEQuence:SYNC?
SOURce:RADio:ARB[:STATe]
SOURce:RADio:ARB[:STATe]?
SOURce:RADio:ARB:TRIGger:INITiate
SOURce:RADio:ARB:TRIGger[:SOURce]
SOURce:RADio:ARB:TRIGger[:SOURce]?
SOURce:RADio:ARB:TRIGger[:SOURce]:EXTernal:DELay
SOURce:RADio:ARB:TRIGger[:SOURce]:EXTernal:DELay?
```

SOURce:RADio:ARB:TRIGger[:SOURce]:EXTernal:DELay:STATe
SOURce:RADio:ARB:TRIGger[:SOURce]:EXTernal:DELay:STATe?
SOURce:RADio:ARB:TRIGger[:SOURce]:EXTernal:SLOPe
SOURce:RADio:ARB:TRIGger[:SOURce]:EXTernal:SLOPe?
SOURce:RADio:ARB:TRIGger[:SOURce]:PXI:DELay
SOURce:RADio:ARB:TRIGger[:SOURce]:PXI:DELay?
SOURce:RADio:ARB:TRIGger[:SOURce]:PXI:DELay:STATe
SOURce:RADio:ARB:TRIGger[:SOURce]:PXI:DELay:STATe?
SOURce:RADio:ARB:TRIGger[:SOURce]:PXI:LINE
SOURce:RADio:ARB:TRIGger[:SOURce]:PXI:LINE?
SOURce:RADio:ARB:TRIGger[:SOURce]:PXI:SLOPe
SOURce:RADio:ARB:TRIGger[:SOURce]:PXI:SLOPe?
SOURce:RADio:ARB:TRIGger:SYNC[:STATe]
SOURce:RADio:ARB:TRIGger:SYNC[:STATe]?
SOURce:RADio:ARB:TRIGger:TYPE
SOURce:RADio:ARB:TRIGger:TYPE?
SOURce:RADio:ARB:TRIGger:TYPE:CONTinuous[:TYPE]
SOURce:RADio:ARB:TRIGger:TYPE:CONTinuous[:TYPE]?
SOURce:RADio:ARB:TRIGger:TYPE:SADVance[:TYPE]
SOURce:RADio:ARB:TRIGger:TYPE:SADVance[:TYPE]?
SOURce:RADio:ARB:WAVeform
SOURce:RADio:ARB:WAVeform?
SOURce:RADio:BAND:LINK
SOURce:RADio:BAND:LINK?
SOURce:SYNC:CONFig
SOURce:SYNC:CONFig?
SOURce:SYNC:REMote:ADDRess
SOURce:SYNC:REMote:ADDRess:ADD
SOURce:SYNC:REMote:ADDRess:DELete
SOURce:SYNC:REMote:IPPort
SOURce:SYNC:REMote:SEC1?
SOURce:SYNC:REMote:SECondary
SOURce:SYNC:SETTings:ENABle
SOURce:SYNC:SETTings:ENABle?
SOURce:SYNC:SETTings:SEGMent2:ENABle
SOURce:SYNC:SETTings:SEGMent2:ENABle?
SOURce:SYNC:SETTings:SEGMent2:FREQuency
SOURce:SYNC:SETTings:SEGMent2:FREQuency?
SOURce:SYNC:STARt
SOURce:SYNC:STOP
SOURce:SYNC:TYPE
SOURce:SYNC:TYPE?
STATus:OPERation:CONDition?
STATus:OPERation:ENABle
STATus:OPERation:ENABle?
STATus:OPERation[:EVENt]?
STATus:OPERation:NTRansition
STATus:OPERation:NTRansition?
STATus:OPERation:PTRansition
STATus:OPERation:PTRansition?
STATus:PRESet
STATus:QUEStionable:CALibration:CONDition?
STATus:QUEStionable:CALibration:ENABle

```
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:ENABle?
STATus:QUEStionable:CALibration:EXTended:FAILure[:EVENt]?
STATus:QUEStionable:CALibration:EXTended:FAILure:NTRansition
STATus:QUEStionable:CALibration:EXTended:FAILure:NTRansition?
STATus:QUEStionable:CALibration:EXTended:FAILure:PTRansition
STATus:QUEStionable:CALibration:EXTended:FAILure:PTRansition?
STATus:QUEStionable:CALibration:EXTended:NEEDed:CONDition?
STATus:QUEStionable:CALibration:EXTended:NEEDed:ENABle
STATus:QUEStionable:CALibration:EXTended:NEEDed:ENABle?
STATus:QUEStionable:CALibration:EXTended:NEEDed[:EVENt]?
STATus:QUEStionable:CALibration:EXTended:NEEDed:NTRansition
STATus:QUEStionable:CALibration:EXTended:NEEDed:NTRansition?
STATus:QUEStionable:CALibration:EXTended:NEEDed:PTRansition
STATus:QUEStionable:CALibration:EXTended:NEEDed:PTRansition?
STATus:QUEStionable:CALibration:NTRansition
STATus:QUEStionable:CALibration:NTRansition?
STATus:QUEStionable:CALibration:PTRansition
STATus:QUEStionable:CALibration:PTRansition?
STATus:QUEStionable:CALibration:SKIPped:CONDition?
STATus:QUEStionable:CALibration:SKIPped:ENABle
STATus:QUEStionable:CALibration:SKIPped:ENABle?
STATus:QUEStionable:CALibration:SKIPped[:EVENt]?
STATus:QUEStionable:CALibration:SKIPped:NTRansition
STATus:QUEStionable:CALibration:SKIPped:NTRansition?
STATus:QUEStionable:CALibration:SKIPped:PTRansition
STATus:QUEStionable:CALibration:SKIPped:PTRansition?
STATus:QUEStionable:CONDition?
STATus:QUEStionable:ENABle
STATus:QUEStionable:ENABle?
STATus:QUEStionable[:EVENt]?
STATus:QUEStionable:FREQuency:CONDition?
STATus:QUEStionable:FREQuency:ENABle
STATus:QUEStionable:FREQuency:ENABle?
STATus:QUEStionable:FREQuency[:EVENt]?
STATus:QUEStionable:FREQuency:NTRansition
STATus:QUEStionable:FREQuency:NTRansition?
STATus:QUEStionable:FREQuency:PTRansition
STATus:QUEStionable:FREQuency:PTRansition?
STATus:QUEStionable:INTegrity:CONDition?
STATus:QUEStionable:INTegrity:ENABle
STATus:QUEStionable:INTegrity:ENABle?
STATus:QUEStionable:INTegrity[:EVENt]?
STATus:QUEStionable:INTegrity:NTRansition
STATus:QUEStionable:INTegrity:NTRansition?
STATus:QUEStionable:INTegrity:PTRansition
STATus:QUEStionable:INTegrity:PTRansition?
STATus:QUEStionable:INTegrity:SIGNal:CONDition?
STATus:QUEStionable:INTegrity:SIGNal:ENABle
STATus:QUEStionable:INTegrity:SIGNal:ENABle?
```

```
STATus:QUEStionable:INTegrity:SIGNal[:EVENt]?
STATus:QUEStionable:INTegrity:SIGNal:NTRansition
STATus:QUEStionable:INTegrity:SIGNal:NTRansition?
STATus:QUEStionable:INTegrity:SIGNal:PTRansition
STATus:QUEStionable:INTegrity:SIGNal:PTRansition?
STATus:QUEStionable:INTegrity:UNCalibrated:CONDition?
STATus:QUEStionable:INTegrity:UNCalibrated:ENABle
STATus:QUEStionable:INTegrity:UNCalibrated:ENABle?
STATus:QUEStionable:INTegrity:UNCalibrated[:EVENt]?
STATus:QUEStionable:INTegrity:UNCalibrated:NTRansition
STATus:QUEStionable:INTegrity:UNCalibrated:NTRansition?
STATus:QUEStionable:INTegrity:UNCalibrated:PTRansition
STATus:QUEStionable:INTegrity:UNCalibrated:PTRansition?
STATus:QUEStionable:NTRansition
STATus:QUEStionable:NTRansition?
STATus:QUEStionable:POWer:CONDition?
STATus:QUEStionable:POWer:ENABle
STATus:QUEStionable:POWer:ENABle?
STATus:QUEStionable:POWer[:EVENt]?
STATus:QUEStionable:POWer:NTRansition
STATus:QUEStionable:POWer:NTRansition?
STATus:QUEStionable:POWer:PTRansition
STATus:QUEStionable:POWer:PTRansition?>
STATus:QUEStionable:PTRansition
STATus:QUEStionable:PTRansition?
STATus:QUEStionable:TEMPerature:CONDition?
STATus:QUEStionable:TEMPerature:ENABle
STATus:QUEStionable:TEMPerature:ENABle?
STATus:QUEStionable:TEMPerature[:EVENt]?
STATus:QUEStionable:TEMPerature:NTRansition
STATus:QUEStionable:TEMPerature:NTRansition?
STATus:QUEStionable:TEMPerature:PTRansition
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:CALibration:ABORt
SYSTem:CALibration:CGRoup
SYSTem:CALibration:CGRoup?
SYSTem:CALibration:CGRoup:APPLy
SYSTem:CALibration:CGRoup:APPLy?
SYSTem:CALibration:CGRoup:APPLy:AOFF
SYSTem:CALibration:CGRoup:COPY
SYSTem:CALibration:CGRoup:COPY:FROM
SYSTem:CALibration:CGRoup:COPY:FROM?
SYSTem:CALibration:DELete:ALL
SYSTem:CALibration:DESCription
SYSTem:CALibration:DESCription?
SYSTem:CALibration:FREQuency:OFFSet
```

```
SYSTem:CALibration:FREQuency:OFFSet?
SYSTem:CALibration:IDENtify
SYSTem:CALibration:INITiate:SELected
SYSTem:CALibration:INPut
SYSTem:CALibration:INPut?
SYSTem:CALibration:MODule:SELect
SYSTem:CALibration:MODule:SELect?
SYSTem:CALibration:REFerence
SYSTem:CALibration:REFerence?
SYSTem:CALibration:ROW[1]|2|…|100:FEATtenuation:TYPE?
SYSTem:CALibration:ROW[1]|2|…|100:APPLy:STATe
SYSTem:CALibration:ROW[1]|2|…|100:APPly:STATe?
SYSTem:CALibration:ROW[1]|2|…|100:ATTenuation:STARt
SYSTem:CALibration:ROW[1]|2|…|100:ATTenuation:STARt?
SYSTem:CALibration:ROW[1]|2|…|100:ATTenuation:STEP
SYSTem:CALibration:ROW[1]|2|…|100:ATTenuation:STEP?
SYSTem:CALibration:ROW[1]|2|…|100:ATTenuation:STOP
SYSTem:CALibration:ROW[1]|2|…|100:ATTenuation:STOP?
SYSTem:CALibration:ROW[1]|2|…|100:ATTenuation:TYPE
SYSTem:CALibration:ROW[1]|2|…|100:ATTenuation:TYPE?
SYSTem:CALibration:ROW[1]|2|…|100:CALibrate:STATe
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: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:STARt?
SYSTem:CALibration:ROW[1]|2|…|100:EATTenuation:STEP
SYSTem:CALibration:ROW[1]|2|…|100:EATTenuation:STEP?
SYSTem:CALibration:ROW[1]|2|…|100:EATTenuation:STOP
SYSTem:CALibration:ROW[1]|2|…|100:EATTenuation:STOP?
SYSTem:CALibration:ROW[1]|2|…|100:EATTenuation:TYPE
SYSTem:CALibration:ROW[1]|2|…|100:EATTenuation:TYPE?
SYSTem:CALibration:ROW[1]|2|…|100:FATTenuation:STARt
SYSTem:CALibration:ROW[1]|2|…|100:FATTenuation:STARt?
SYSTem:CALibration:ROW[1]|2|…|100:FATTenuation:STOP
SYSTem:CALibration:ROW[1]|2|…|100:FATTenuation:STOP?
SYSTem:CALibration:ROW[1]|2|…|100:FATTenuation:TYPE
SYSTem:CALibration:ROW[1]|2|…|100:FATTenuation:TYPE?
SYSTem:CALibration:ROW[1]|2|…|100:FEATtenuation:STARt
SYSTem:CALibration:ROW[1]|2|…|100:FEATtenuation:STARt?
SYSTem:CALibration:ROW[1]|2|…|100:FEATtenuation:STEP
SYSTem:CALibration:ROW[1]|2|…|100:FEATtenuation:STEP?
SYSTem:CALibration:ROW[1]|2|…|100:FEATtenuation:STOP
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:POINts?
SYSTem:CALibration:ROW[1]|2|…|100:FREQuency:STARt
SYSTem:CALibration:ROW[1]|2|…|100:FREQuency:STARt?
SYSTem:CALibration:ROW[1]|2|…|100:FREQuency:STEP
```

```
SYSTem:CALibration:ROW[1]|2|…|100:FREQuency:STEP?
SYSTem:CALibration:ROW[1]|2|…|100:FREQuency:STOP
SYSTem:CALibration:ROW[1]|2|…|100:FREQuency:STOP?
SYSTem:CALibration:ROW[1]|2|…|100:FREQuency:SYNThesis:ALL
[:STATe]ON|OFF|1|0
SYSTem:CALibration:ROW[1]|2|…|100:FREQuency:SYNThesis[:STATe]
SYSTem:CALibration:ROW[1]|2|…|100:FREQuency:SYNThesis[: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]HIGH|LOW|ALL
SYSTem:CALibration:ROW[1]|2|…|100:IF:PATH
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:LO:MMODe?
SYSTem:CALibration:ROW[1]|2|…|100:MATCh[:STATe]
SYSTem:CALibration:ROW[1]|2|…|100:MATCh[:STATe]?
SYSTem:CALibration:ROW[1]|2|…|100:NAME
SYSTem:CALibration:ROW[1]|2|…|100:NAME?
SYSTem:CALibration:ROW[1]|2|…|100:POWer:GAIN:BAND
SYSTem:CALibration:ROW[1]|2|…|100:POWer:GAIN:BAND?
SYSTem:CALibration:ROW[1]|2|…|100:POWer[:RF]:GAIN:LNA[:STATe]
SYSTem:CALibration:ROW[1]|2|…|100:POWer[:RF]:GAIN:LNA[:STATe]?
SYSTem:CALibration:ROW[1]|2|…|100POWer[:RF]:MW:PATH
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:TYPE?
SYSTem:CALibration:ROW[1]|2|…|100:UCMeas
SYSTem:CALibration:STATus:ALL?
SYSTem:CALibration:TUNE:FREQuency
SYSTem:CALibration:TUNE:FREQuency?
SYSTem:CALibration:TUNE:OUTput[:STATe]
SYSTem:CALibration:TUNE:OUTput[:STATe]?
SYSTem:CALibration:TUNE:REFerence
SYSTem:CALibration:TUNE:REFerence?
SYSTem:CALibration:TUNE[:SELected]
SYSTem:CALibration:TUNE[:SELected]?
SYSTem:CALibration:TUNE:SPACing
SYSTem:CALibration:TUNE:SPACing?
SYSTem:CALibration:TUNE:TYPE
SYSTem:CALibration:TUNE:TYPE?
SYSTem:COMMunicate:GPIB[1][:SELF]:ADDRess
SYSTem:COMMunicate:GPIB[1][:SELF]:ADDRess?
SYSTem:COMMunicate:GPIB[1][:SELF]:CONTroller[:ENABle]
SYSTem:COMMunicate:GPIB[1][:SELF]:CONTroller[:ENABle]?
SYSTem:COMMunicate:LAN:INSTrument:PORT?
SYSTem:COMMunicate:LAN:IPV4:CONFig
SYSTem:COMMunicate:LAN:IPV4:CONFig?
SYSTem:COMMunicate:LAN:IPV6: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:EOSession:DCLEar:ENABle?
SYSTem:COMMunicate:LAN:SCPI:HISLip:ENABle
SYSTem:COMMunicate:LAN:SCPI:HISLip:ENABle?
SYSTem:COMMunicate:LAN:SCPI:SICL:ENABle
SYSTem:COMMunicate:LAN:SCPI:SICL:ENABle?
SYSTem:COMMunicate:LAN:SCPI:SOCKet:CONTrol?
SYSTem:COMMunicate:LAN:SCPI:SOCKet:ENABle
SYSTem:COMMunicate:LAN:SCPI:SOCKet:ENABle?
SYSTem:COMMunicate:LAN:SCPI:TELNet:ENABle
SYSTem:COMMunicate:LAN:SCPI:TELNet:ENABle?
SYSTem:COMMunicate:USB:CONNection?
SYSTem:COMMunicate:USB:PACKets?
SYSTem:COMMunicate:USB:STATus?
SYSTem:CONFigure[:SYSTem]?
SYSTem:CSYStem?
SYSTem:DATE
SYSTem:DATE?
SYSTem:DEFault
SYSTem:DISPlay:BACKlight:INTensity
SYSTem:DISPlay:BACKlight:INTensity?
SYSTem:DISPlay:CFORmat
SYSTem:DISPlay:CFORmat?
SYSTem:DISPlay:HINTs[:STATe]
SYSTem:DISPlay:HINTs[:STATe]?
SYSTem:DISPlay:LANGuage
SYSTem:DISPlay:LANGuage?
SYSTem:DISPlay:MPPosition
SYSTem:DISPlay:MPPosition?
SYSTem:DISPlay:MPTab
SYSTem:DISPlay:MPTab?
SYSTem:DISPlay:NEPimmediate
SYSTem:DISPlay:NEPimmediate?
SYSTem:ERRor[:NEXT]?
SYSTem:ERRor:VERBose
SYSTem:ERRor:VERBose?
SYSTem:HELP:HEADers?
SYSTem:HID?
SYSTem:IDN
SYSTem:IDN?
SYSTem:IDN:CONFigure
SYSTem:IDN:CONFigure?
SYSTem:KLOCk
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?
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:DEFault?
SYSTem:PERSona:MANufacturer
SYSTem:PERSona:MANufacturer?
SYSTem:PERSona:MANufacturer:DEFault
SYSTem:PERSona:MANufacturer:DEFault?
SYSTem:PERSona:MODel
SYSTem:PERSona:MODel?
SYSTem:PERSona:MODel:DEFault
SYSTem:PERSona:MODel:DEFault?
SYSTem:PON:APPLication:LLISt
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:MODE?
SYSTem:PON:TIME?
SYSTem:PON:TYPE
SYSTem:PON:TYPE?
SYSTem:PRESet
SYSTem:PRESet:FULL
SYSTem:PRESet:PERSistent
SYSTem:PRESet:TYPE
SYSTem:PRESet:TYPE?
SYSTem:PRESet:USER
SYSTem:PRESet:USER:ALL
SYSTem:PRESet:USER:SAVE
SYSTem:PRINt:THEMe
SYSTem:PRINt:THEMe?
SYSTem:PUP
SYSTem:PUP:PROCess
SYSTem:SECurity:USB:WPRotect[:ENABle]
SYSTem:SECurity:USB:WPRotect[:ENABle]?
SYSTem:SEQuencer
SYSTem:SEQuencer?
SYSTem:SET
SYSTem:SET?
SYSTem:SHOW
SYSTem:SHOW?
SYSTem:SOFTware:VERSion:DATE?
SYSTem:TEMPerature:HEXTreme?
SYSTem:TEMPerature:LEXTreme?
SYSTem:TIME
SYSTem:TIME?
SYSTem:VERSion?
```

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```
TRACe[1]|2|...|6:DISPlay[:STATe]
TRACe[1]|2|...|6:DISPlay[:STATe]?
TRACe[1]|2|...|6:TYPE
TRACe[1]|2|...|6:TYPE?
TRACe[1]|2|...|6:UPDate[:STATe]
TRACe[1]|2|...|6:UPDate[:STATe]?
TRACe:CAPTure:MAXimum
TRACe:CLEar
TRACe:CLEar:ALL
TRACe:COPY
TRACe:COPY?
TRACe[:DATA]
TRACe[:DATA]?
TRACe:EXCHange
TRACe:EXCHange?
TRACe:MATH:MEAN?
TRACe:MATH:PEAK[:DATA]?
TRACe:MATH:PEAK:POINts?
```

```
TRACe:MATH:SMOoth
TRACe:MATH:SMOoth:POINts
TRACe:MATH:SMOoth:POINts?
TRACe:PRESet:ALL
TRACe:PRESet:ALL
TRACe:TRIGger:COUPle
TRACe:TRIGger:COUPle?
TRIGger|TRIGger1|TRIGger2|TRIGger3|TRIGger4[:SEQuence]:OUTPut
TRIGger|TRIGger1|TRIGger2|TRIGger3|TRIGger4[:SEQuence]:OUTPut?
TRIGger|TRIGger1|TRIGger2|TRIGger3|TRIGger4
[:SEQuence]:OUTPut:DIRection
TRIGger|TRIGger1|TRIGger2|TRIGger3|TRIGger4
[:SEQuence]:OUTPut:DIRection?
TRIGger|TRIGger1|TRIGger2|TRIGger3|TRIGger4
[:SEQuence]:OUTPut:POLarity
TRIGger|TRIGger1|TRIGger2|TRIGger3|TRIGger4
[:SEQuence]:OUTPut:POLarity?
TRIGger:<measurement>[:SEQuence]:IQ:SOURce
TRIGger:<measurement>[:SEQuence]:IQ:SOURce?
TRIGger:<measurement>[:SEQuence]:RF:SOURce
TRIGger:<measurement>[:SEQuence]:RF:SOURce?
TRIGger:<measurement>[:SEQuence]:SOURce
TRIGger:<measurement>[:SEQuence]:SOURce?
TRIGger:PXIE:ANALyzer[:SEQuence]:OUTPut
TRIGger:PXIE:ANALyzer[:SEQuence]:OUTPut?
TRIGger:PXIE:ANALyzer[:SEQuence]:OUTPut:LINE
TRIGger:PXIE:ANALyzer[:SEQuence]:OUTPut:LINE?
TRIGger:PXIE:ANALyzer[:SEQuence]:OUTPut:POLarity
TRIGger:PXIE:ANALyzer[:SEQuence]:OUTPut:POLarity?
TRIGger:PXIE:SOURce[:SEQuence]:OUTPut
TRIGger:PXIE:SOURce[:SEQuence]:OUTPut?
TRIGger:PXIE:SOURce[:SEQuence]:OUTPut:LINE
TRIGger:PXIE:SOURce[:SEQuence]:OUTPut:LINE?
TRIGger:PXIE:SOURce[:SEQuence]:OUTPut:POLarity
TRIGger:PXIE:SOURce[:SEQuence]:OUTPut:POLarity?
TRIGger[:SEQuence]:<trig_source>:DELay
TRIGger[:SEQuence]:<trig_source>:DELay?
TRIGger[:SEQuence]:<trig_source>:DELay:STATe
TRIGger[:SEQuence]:<trig_source>:DELay:STATe?
TRIGger[:SEQuence]:<trig_source>:LEVel
TRIGger[:SEQuence]:<trig_source>:LEVel?
TRIGger[:SEQuence]:<trig_source>:SLOPe
TRIGger[:SEQuence]:<trig_source>:SLOPe?
TRIGger[:SEQuence]:AIQMag:BANDwidth
TRIGger[:SEQuence]:AIQMag:BANDwidth?
TRIGger[:SEQuence]:AIQMag:CENTer
TRIGger[:SEQuence]:AIQMag:CENTer?
TRIGger[:SEQuence]:ATRigger
TRIGger[:SEQuence]:ATRigger?
TRIGger[:SEQuence]:ATRigger:STATe
TRIGger[:SEQuence]:ATRigger:STATe?
TRIGger[:SEQuence]:DELay
```

```
TRIGger[:SEQuence]:DELay?
TRIGger[:SEQuence]:DELay:STATe
TRIGger[:SEQuence]:DELay:STATe?
TRIGger[:SEQuence]:EXTernal1|EXTernal2|RFBurst:DELay:COMPensation
TRIGger[:SEQuence]:EXTernal1|EXTernal2|RFBurst:DELay:COMPensation?
TRIGger[:SEQuence]:FMT:CRITeria
TRIGger[:SEQuence]:FMT:CRITeria?
TRIGger[:SEQuence]:FMT:MASK
TRIGger[:SEQuence]:FMT:MASK?
TRIGger[:SEQuence]:FMT:MASK[1]|2:BUILd
TRIGger[:SEQuence]:FMT:MASK[1]|2:DELete
TRIGger[:SEQuence]:FMT:MASK[1]|2:NAME
TRIGger[:SEQuence]:FMT:MASK[1]|2:NAME?
TRIGger[:SEQuence]:FMT:MASK[1]|2:NEW
TRIGger[:SEQuence]:FMT:MASK[1]|2:OFFSet:UPDate
TRIGger[:SEQuence]:FMT:MASK[1]|2:OFFSet:X
TRIGger[:SEQuence]:FMT:MASK[1]|2:OFFSet:X?
TRIGger[:SEQuence]:FMT:MASK[1]|2:OFFSet:Y
TRIGger[:SEQuence]:FMT:MASK[1]|2:OFFSet:Y?
TRIGger[:SEQuence]:FMT:MASK:DELete:ALL
TRIGger[:SEQuence]:FMT:MASK:EDIT
TRIGger[:SEQuence]:FMT:MASK:EDIT?
TRIGger[:SEQuence]:FMT:MASK:HUE
TRIGger[:SEQuence]:FMT:MASK:HUE?
TRIGger[:SEQuence]:FMT:MASK:OPACity
TRIGger[:SEQuence]:FMT:MASK:OPACity?
TRIGger[:SEQuence]:FMT:MASK:OPACity:PREView
TRIGger[:SEQuence]:FMT:MASK:OPACity:PREView?
TRIGger[:SEQuence]:FMT:MASK:RELative:AMPLitude
TRIGger[:SEQuence]:FMT:MASK:RELative:AMPLitude?
TRIGger[:SEQuence]:FMT:MASK:RELative:FREQuency
TRIGger[:SEQuence]:FMT:MASK:RELative:FREQuency?
TRIGger[:SEQuence]:FRAMe:ADJust
TRIGger[:SEQuence]:FRAMe:OFFSet
TRIGger[:SEQuence]:FRAMe:OFFSet?
TRIGger[:SEQuence]:FRAMe:OFFSet:DISPlay:RESet
TRIGger[:SEQuence]:FRAMe:PERiod
TRIGger[:SEQuence]:FRAMe:PERiod?
TRIGger[:SEQuence]:FRAMe:SMONitor:RESet
TRIGger[:SEQuence]:FRAMe:SYNC
TRIGger[:SEQuence]:FRAMe:SYNC?
TRIGger[:SEQuence]:FRAMe:SYNC:HOLDoff
TRIGger[:SEQuence]:FRAMe:SYNC:HOLDoff?
TRIGger[:SEQuence]:FRAMe:SYNC:HOLDoff:STATe
TRIGger[:SEQuence]:FRAMe:SYNC:HOLDoff:STATe?
TRIGger[:SEQuence]:HOLDoff
TRIGger[:SEQuence]:HOLDoff?
TRIGger[:SEQuence]:HOLDoff:STATe
TRIGger[:SEQuence]:HOLDoff:STATe?
TRIGger[:SEQuence]:HOLDoff:TYPE
TRIGger[:SEQuence]:HOLDoff:TYPE?
TRIGger[:SEQuence]:INTernal:SOURce:OUTPut
TRIGger[:SEQuence]:INTernal:SOURce:OUTPut?
```

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TRIGger[:SEQuence]:INTernal:SOURce:OUTPut:POLarity
TRIGger[:SEQuence]:INTernal:SOURce:OUTPut:POLarity?
TRIGger[:SEQuence]:LEVel|FMT:TCRiteria?
TRIGger[:SEQuence]:LEVel|FMT:TCRiteria:LOWer
TRIGger[:SEQuence]:LEVel|FMT:TCRiteria:LOWer?
TRIGger[:SEQuence]:LEVel|FMT:TCRiteria[:TYPE]
TRIGger[:SEQuence]:LEVel|FMT:TCRiteria:UPPer
TRIGger[:SEQuence]:LEVel|FMT:TCRiteria:UPPer?
TRIGger
[:SEQuence]:LEVel|LINE|EXTernal1|EXTernal2|RFBurst|FRAMe|FMT:APTRi
gger
TRIGger
[:SEQuence]:LEVel|LINE|EXTernal1|EXTernal2|RFBurst|FRAMe|FMT:APTRi
gger?
TRIGger[:SEQuence]:OFFSet
TRIGger[:SEQuence]:OFFSet?
TRIGger[:SEQuence]:OFFSet:STATe
TRIGger[:SEQuence]:OFFSet:STATe?
TRIGger[:SEQuence]:PXI:LINE
TRIGger[:SEQuence]:PXI:LINE?
TRIGger[:SEQuence]:RFBurst:LEVel:ABSolute
TRIGger[:SEQuence]:RFBurst:LEVel:ABSolute?
TRIGger[:SEQuence]:RFBurst:LEVel:RELative
TRIGger[:SEQuence]:RFBurst:LEVel:RELative?
TRIGger[:SEQuence]:RFBurst:LEVel:TYPE
TRIGger[:SEQuence]:RFBurst:LEVel:TYPE?
TRIGger[:SEQuence]:SLOPe
TRIGger[:SEQuence]:SLOPe?
TRIGger[:SEQuence]:SOURce
TRIGger[:SEQuence]:SOURce?
TRIGger[:SEQuence]:TV:FMODe
TRIGger[:SEQuence]:TV:FMODe?
TRIGger[:SEQuence]:TV:LINE
TRIGger[:SEQuence]:TV:LINE?
TRIGger[:SEQuence]:TV:STANdard
TRIGger[:SEQuence]:TV:STANdard?
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```
UNIT:POWer
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 1029 (Align Now All equivalent)
– "*CLS - Clear Status" on page 1030
– "*ESE - Standard Event Status Enable" on page 1030
– "*ESR? - Standard Event Status Register Query" on page 1031
– "*IDN? - Identification Query" on page 1031
– "*OPC? - Operation Complete" on page 1032
– "*OPT? - Query Instrument Options" on page 1033
– "*RCL - Recall Instrument State" on page 1033 (Recall State equivalent)
– "*RST - Reset" on page 1034 (Mode Preset equivalent)
– "*SAV - Save Instrument State" on page 1034 (Save State equivalent)
– "*SRE - Service Request Enable" on page 1035
– "*STB? - Status Byte Query" on page 1035
– "*TRG - Trigger" on page 1035
– "*TST? - Self Test Query" on page 1036
– "*WAI - Wait-to-Continue" on page 1036

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 432.

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 432

9.2.2 *CLS - Clear Status

Clears the status byte register. It does this 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 the `:SYSTem:ERRor[:NEXT]?` command. See also the `:STATus:PRESet` command and all commands in the STATus subsystem
Status Bits/OPC dependencies	Resets all bits in all event registers to 0, which resets all the status byte register bits to 0 also
Backwards Compatibility Notes	In general the status bits used in the X-Series status system are backwards compatible with ESA and PSA. However, unlike ESA and PSA, all conditions generate events that go into the event log, and some will also generate status bits

9.2.3 *ESE - Standard Event Status Enable

Sets the desired bits in the Event Enable Register of the "Standard Event Status Register" on page 1069, 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 OR'd to become a summary bit (bit 5) in the byte register, which can be queried.

The query returns the state of the standard event status enable register.

Numeric values for bit patterns can be entered using decimal or hexadecimal representations (that is, 0 to 32767 is 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 subsystem and `:SYSTem:ERRor[:NEXT]?` commands
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 1069. (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 the `STATus` subsystem commands
Preset	0
Min	0
Max	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 will contain the model number, serial number, and firmware revision.

The response is organized into four fields separated by commas. The field definitions are as follows:

– Manufacturer

– Model

– Serial number

– Firmware version

Remote Command	`*IDN?`

Example	`*IDN?`
	Returns instrument identification information, such as:
	`Keysight Technologies,N9040B,US01020004,A.15.02`

Remote Command	`:ID?`

Example	`:ID?`
	Returns model number, such as:
	`N9040B`

Notes	ID? Is provided for backwards compatibility When in Remote Language Compatibility mode, the `ID?` query returns the model number of the emulated instrument When in any other mode, the returned model number is that of the actual instrument

9.2.6 *OPC? - Operation Complete

The `*OPC` command sets bit 0 in the standard event status register (SER) 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 SER, or by setting up the status system such that a service request (SRQ) is asserted when the OPC bit is set.

The `*OPC?` query returns a “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 considers operation that was initiated on the same port that the `*OPC` command was issued from `*OPC` is an overlapped command, but `*OPC?` is sequential
Backwards Compatibility Notes	1. Commands such as, *`OPC/*OPC?/*WAI/*RST` used to be global. They considered front panel operation in conjunction with the GPIB functionality. Now they are evaluated on a per channel basis. That is, the various rear panel remote ports and the front panel i/o are all considered separately. Only the functionality initiated on the port where the `*OPC` was sent, is considered for its operation 2. `*OPC` used to hold off until the operation bits were cleared. Now it holds off until all overlapping commands are completed. Also, earlier instruments did not wait for completion of all processes, only the ones identified here (in the STATus:OPERation register):

- Calibrating: monitored by PSA, ESA, VSA (E4406A)
- Sweeping: monitored by PSA, ESA, VSA (E4406A)
- Waiting for Trigger: monitored by PSA, ESA, VSA (E4406A)
- Measuring: monitored by PSA and ESA (but not in all Modes)
- Paused: monitored by VSA (E4406A)
- Printing: monitored by VSA (E4406A)
- Mass memory busy: monitored by VSA (E4406A)

9.2.7 *OPT? - Query Instrument Options

Returns a string of all the installed instrument options. It is a comma separated list with quotes, such as:

`“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

This command 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, the instrument will only load the parts of the state that apply to the older revision.

Remote Command	`*RCL <register #>`
Example	`*RCL 7` Recalls the instrument state that is currently stored in register 7 (register 8 in the UI)
Notes	Registers 0 through 15 are accessible from the front panel in menu keys for Recall Registers. Register 0 is the 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 remote command is preferred over the Mode Preset remote 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`
Example	`*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 is set to 0
Backwards Compatibility Notes	In legacy analyzers, `*RST` did not set the analyzer to **Single**, but in the X-Series it does, for compliance with the IEEE 488.2 specification. In the Swept SA measurement, you can configure the instrument to be compatible with legacy analyzers in this regard, using the Meas Setup, Legacy Compat, `*RST` function In the X-Series, `*RST` does not do a `*CLS` (clear the status bits and the error queue). In legacy analyzers, `*RST` used to do the equivalent of `:SYSTem:PRESet`, `*CLS` and `:INITiate:CONTinuous OFF`. But to be 488.2 compliant, `*RST` in the X-Series does not do a `*CLS`

9.2.10 *SAV - Save Instrument State

This command saves the current instrument state and mode to the specified instrument memory register.

Remote Command	`*SAV <register #>`
Example	`*SAV 9` Saves the instrument state in register 9 (register 10 in the UI)
Notes	Registers 0 through 15 are accessible from the front panel in menu keys for Save Registers. Register 0 is the front panel Register 1
Min	0
Max	127
Status Bits/OPC dependencies	The command is sequential

9.2.11 *SRE - Service Request Enable

This command enables the desired bits of the "Service Request Enable Register" on page 1068.

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 (that is, 0 to 32767 is equivalent to #H0 to #H7FFF).

Remote Command	`*SRE <integer>` `*SRE?`
Example	`*SRE 22` Enables bits 1, 2, and 4 in the service request enable register
Notes	For related commands, see the `STATus` subsystem and `:SYSTem:ERRor[:NEXT]?` commands
Preset	0
Min	0
Max	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 1065 without erasing its contents.

Remote Command	`*STB?`
Example	`*STB?` Returns a decimal value for the bits in the status byte register For example, if a 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`
Status Bits/OPC dependencies	Status Byte Register (all bits, 0 – 7)

9.2.13 *TRG - Trigger

This command triggers the instrument. Use the `:TRIGger[:SEQuence]:SOURce` command to select the trigger source.

Remote	`*TRG`

Command	
Example	*TRG Triggers the instrument to take a sweep or start a measurement, depending on the current instrument settings
Notes	See related command :INITiate:IMMediate

9.2.14 *TST? - Self Test Query

This query performs the internal self-test routines, and returns a number indicating the success of the testing.

A zero is returned if the test is successful, 1 if it fails.

Remote Command	*TST?
Example	*TST? Runs the self-test routines and returns: 0=passed, 1=some part failed

9.2.15 *WAI - Wait-to-Continue

This command causes the instrument to wait until all overlapped commands are completed before executing any additional commands. There is no query form for the command.

Remote Command	*WAI
Example	:INIT:CONT OFF; INIT;*WAI Sets the instrument to single sweep. Starts a sweep and waits for its completion.
Status Bits/OPC dependencies	Not global to all remote ports or front panel. *OPC only considers operation that was initiated on the same port as the *OPC command was issued from.

9.3 SCPI Operation and Results Query

Remote control of measurements and query of measurement result data is performed using SCPI commands. There are a number of different 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 the Measurement Application, for example, Spectrum Analyzer or 5G NR.

9.3.1 Mode Control

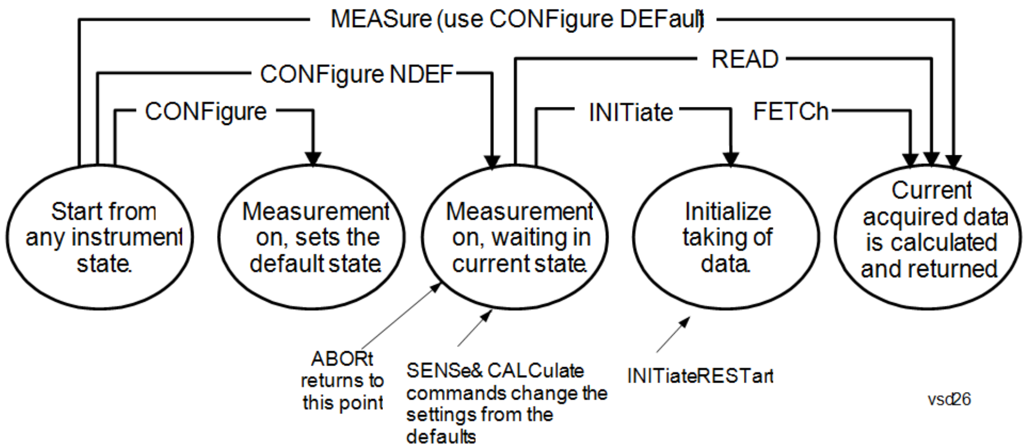
You can use either `INSTrument:SELect` (:INST:SEL) or `INSTrument:NSELect` (:INST:NSEL) to select the instrument's "Mode" on page 47.

The `:INSTrument:CONFigure` command causes a Mode *and* Measurement switch at the same time. This results in faster overall switching than sending the `:INSTrument:SELect` and `CONFigure` commands separately. See "Mode and Measurement Select" on page 48.

9.3.2 Measurement Control

Here are the measurement control commands and their functions, also illustrated in the diagram below. Note that some of these commands also result in data being returned.

"CONFigure" on page 1038	Switches to the desired measurement
"INITiate" on page 1039	Starts the measurement
"FETCh" on page 1039	Queries the data
"READ" on page 1040	Starts the measurement and queries the data
"MEASure" on page 1041	Switches to the desired measurement, starts the measurement and queries the data



9.3.2.1 CONFigure

This command stops the current measurement (if any) and sets up the instrument for the specified measurement using the factory default instrument settings. It does not initiate the taking of measurement data unless `:INIT:CONTinuous` is `ON`. If you change any measurement settings after using the `:CONFigure` command, the `:READ` command can be used to initiate a measurement without changing the settings back to their defaults.

Normally the `:CONFigure` command presets the measurement after selecting it; however, 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 the `:FETCh<meas>` command 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	`:INIT:SAN` Switches to the SANalyzer (Swept SA) measurement if not already there, and starts the measurement

`: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 will initiate a new ACP measurement using the same instrument settings as the last time ACP was run.

If another measurement is running, `:INIT` will switch to the specified measurement. For example, suppose you are running the Channel Power measurement. If you send `:INIT:ACP?`, it will change from channel power to ACP and will initiate an ACP measurement.

If your selected measurement is currently in the idle state, it triggers the measurement, assuming the trigger conditions are met. Then it completes one trigger cycle. Depending upon the measurement and the number of averages, there may be multiple data acquisitions, with multiple trigger events, for one full trigger cycle.

`:INIT` also holds off additional commands until the acquisition is complete.

9.3.2.3 FETCh

The `:FETCh` command puts selected data from the most recent measurement into the output buffer. Use `:FETCh` if you have already made a good measurement and you want to return data. You can issue `:FETCh` multiple times to get data for different `n` values, for example, both scalars and trace data from a single measurement, without restarting or re-making the measurement.

Remote Command	`:FETCh:<measurement>[n]?`
Example	`:FETCh:SAN2?` Fetches 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` 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` command that you sent.

You can only `:FETCh` results from the measurement that is currently active, it will 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 the `:READ` command, which is equivalent to `:INITiate` 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. (`:FORMat:DATA`)

Note that the data returned in response to a `:FETCh?` uses the data setting specified by the `:FORMat:BORDer` and `:FORMat:DATA` 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	`:READ:SAN2?` Switches to the SANalyzer (Swept SA) measurement if not already there, starts the measurement, and returns item 2 (Trace 2) from the measurement when the measurement completes

`:READ` does not change any of the measurement settings. For example, if have already run the ACP measurement and you send `:READ:ACP?`, it will initiate a new ACP measurement using the same instrument settings as the last time ACP was run.

`:READ` will switch to the specified measurement if the instrument is not already in that measurement. 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 will change from channel power back to ACP and, using the previous ACP settings, will initiate 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. (`:FORMat:DATA`)

Note that the data returned in response to a `:READ?` query uses the data setting specified by the `:FORMat:BORDer` and `:FORMat:DATA` commands, and can return real or ASCII data. If the format is set to `INT,32`, it returns REAL,32 data

`:READ` holds off additional commands until the acquisition is complete.

9.3.2.5 MEASure

`:MEASure` stops the current measurement (if any) and sets up the instrument for the specified measurement using the factory default instrument settings, initiates a trigger cycle for the specified measurement and outputs the requested data.

Remote Command	`:MEASure:<measurement>[n]?`
Example	`:MEAS:SAN2?` Switches to the SANalyzer (Swept SA) measurement, starts the measurement, and reads back item 2 (Trace 2) when the measurement completes

This is a fast single-command way to make a measurement using the factory default instrument settings. These are the settings and units that conform to the Mode Setup settings (e.g., Radio Standard) that you have currently selected.

- Stops the current measurement (if any) and sets up the instrument for the specified measurement using the factory defaults
- Initiates the data acquisition for the measurement
- Blocks other SCPI communication, waiting until the measurement is complete before returning results.
- If the function does averaging, it is turned on and the number of averages is set to 10.
- After the data is valid it 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.
- The scalar measurement results 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 trace data results will be returned. See each command for details of what types of scalar results or trace data results are available.
- ASCII is the default format for the data output. (Older versions of Spectrum Analysis and Phase Noise mode measurements only supported ASCII.) The binary data formats should be used for handling large blocks of data, since they are smaller and faster than the ASCII format. Refer to the `:FORMat:DATA` command for more information.

If you need to change some of the measurement parameters from the factory default settings, you can set up the measurement using the `:CONFigure` command. Use the commands in the `:SENSe:<measurement>` and `:CALCulate:<measurement>`

subsystems to change the settings. Then you can use the `:READ?` command to initiate the measurement and query the results.

If you need to make a given measurement repeatedly, with settings other than the factory defaults, you can use the commands in the `:SENSe:<measurement>` and `:CALCulate:<measurement>` subsystems to set up the measurement. Then use the `:READ?` command 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:<measurement>?` if you want to use those persistent settings. If you want to go back to the default settings, use `:MEASure:<measurement>?`

Note that the data returned in response to a `:MEASure?` query uses the data setting specified by the `:FORMat:BORDer` and `:FORMat:DATA` commands and can return real or ASCII data. If the format is set to `INT,32`, it returns REAL,32 data.

9.3.3 Trace Control 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`. It does this even if Update = Off.

Remote Command	`:TRACe:CLEar TRACE1 | TRACE2 | TRACE3 | TRACE4 | TRACE5 | TRACE6`
Example	`:TRAC:CLE TRACE1` Clears trace 1

9.3.3.2 Send/Query Trace Data (Remote Command Only)

This command 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 that 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 also:

– "Query Trace Data" on page 1043

– "More Information" on page 1043

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 The `:FORMat:DATA` command ("Format Data: Numeric Data (Remote Command Only)" on page 1044) describes the different types of data formats that can be used with trace data Use the `:FORMat:BORDer` command to set the byte order ("Format Data: Byte Order (Remote Command Only)" on page 1045)

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 the X-Series, the legacy `RAWTRACE`, `LLINE1`, `LLINE2` parameters for trace data query are no longer available

More Information

The format and byte-ordering of the sent or received data will be dependent on the `:FORMat:DATA` and `:FORMat:BORDer` commands. `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` and `:FORMat:BORDer` 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)

This command specifies the format of the trace data input and output. It specifies the formats used for trace data during data transfer across any remote port. It affects only the data format for setting and querying trace data for the `:TRACe[:DATA]`, `:TRACe[:DATA]?`, `:CALCulate:DATA[n]?` and `:FETCh:SANalyzer[n]?` commands and queries.

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 analyzer that 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" 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 applied only to the command, `:TRACe:DATA`, to preserve backwards compatibility for the Swept SA measurement. For all other commands/queries that honor `:FORMat:DATA`, if `INT,32` is sent, the instrument behaves as though it were set to `REAL,32`

The specs 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 is 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. It controls whether binary data is transferred in `NORMal` or `SWAPped` mode.

Affects only the byte order for setting and querying trace data for the `:TRACe[:DATA]`, `:TRACe[:DATA]?`, `:CALCulate:DATA[n]?` and `:FETCh:SANalyzer[n]?` commands and queries.

By definition any command that specifies that it uses `:FORMat:DATA` uses any format supported by `:FORMat:DATA`.

– `NORMal` order. The byte sequence 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. 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` where:

`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 set Update = Off.

This query 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 query 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. Note that the last 4 (`<soffset>`,`<length>`,`<roffset>`,`<rlimit>`) are optional, but these 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`, 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 – Then 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 returns 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)

$$\text{MEAN} = \frac{1}{n} \sum_{\text{Xi} \in \text{region(s)}} \text{Xi}$$

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)

$$\text{MEAN} = \frac{1}{n} \sum_{\text{Xi} \in \text{region(s)}} |\text{Xi}|$$

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)

$$\text{DME} = 10 \text{ x } \log_{10}\left(\frac{1}{n} \sum_{\text{Xi} \in \text{region(s)}} 10^{\frac{\text{Xi}}{10}} \right)$$

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)

$$\text{RMS} = \sqrt{\frac{1}{n} \sum_{\text{Xi} \in \text{region(s)}} \text{Xi}^2}$$

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)

$$\mathrm{RMS} = \sqrt{\frac{1}{n} \sum_{Xi \in \mathrm{region(s)}} Xi\, Xi^*}$$

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(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:

$$\sqrt{\frac{1}{n}\sum_{Xi \in region} Xi\ Xi^*}$$

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:

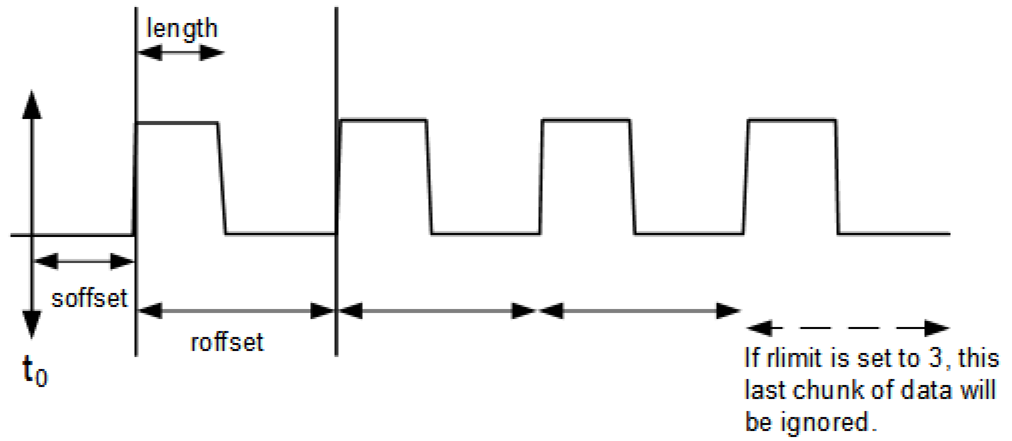
$$\frac{1}{n}\sum_{Yi \in region} Yi$$

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.

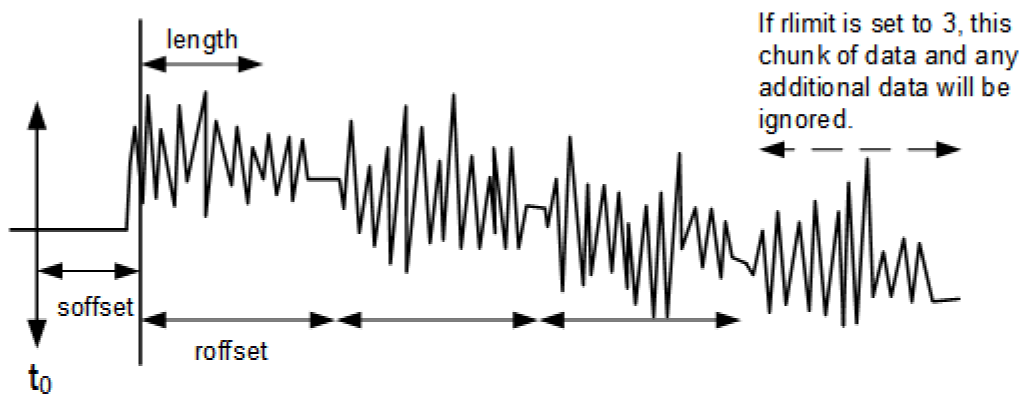
Sample Trace Data - Constant Envelope

(See below for explanation of variables.)



Sample Trace Data - Not Constant Envelope

(See below for explanation of variables.)



`<soffset>` — *Start Offset* is an optional real number. (It is in seconds for time-domain traces, and is a dimensionless index 0 to Npoints – 1, for frequency-domain traces)\

It 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>` — *Length* is an optional real number. (It is in seconds for time-domain traces, and is a dimensionless index 0 to Npoints – 1, for frequency-domain traces)

It defines how much data will be compressed into one value

This parameter has a default value equal to the current trace length

`<roffset>` — *Repeat Offset* is an optional real number. (It is in seconds for time-domain traces, and is a dimensionless index 0 to Npoints – 1, for frequency-domain traces)

It 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` above)
`<rlimit>`	*Repeat Limit* is an optional integer. It specifies the number of data items that you want returned. It will ignore 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>?` query description for 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. Sub-opcode n = 1 is often calculated results values, which also cannot be searched for peaks.

This command uses the data setting specified by the `:FORMat:BORDer` and `:FORMat:DATA` commands, 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:

- Threshold (in dBm)
- Excursion (in dB)
- Sorting order (amplitude, frequency, time)
- 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	`<n>` - The trace that will be used `<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 (default if optional parameter not sent)
- `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

As an example, for Swept SA measurement in Spectrum Analyzer Mode:

`:CALC:DATA4:PEAK? –40,10,FREQ,GTDL`

This 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 1:

With `:FORMat:DATA REAL,32` 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 the `:CALCulate:DATA:COMPress` command instead.

Smoothes the trace according to the number of points specified in `:TRACe:MATH:SMOoth:POINts`. There is no equivalent front panel function.

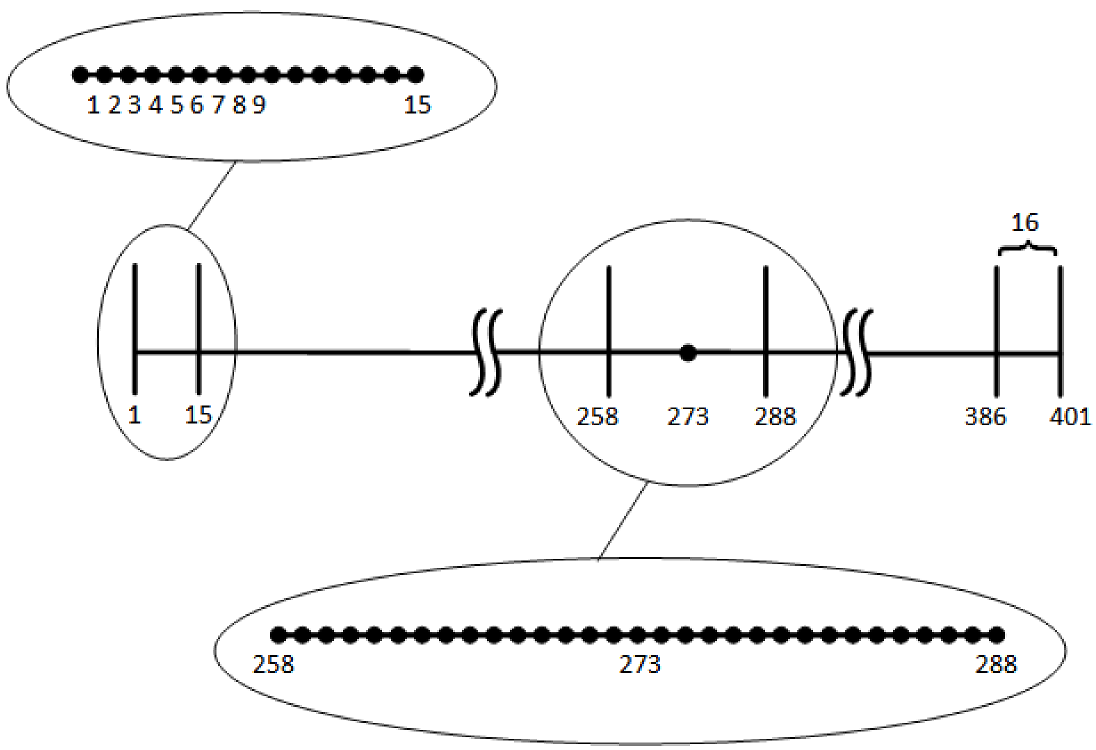
The purpose of this function is to perform a spatial video averaging, as compared to the temporal version supplied by the video-average command `[:SENSe]:AVERage:TYPE VIDeo`. The functions of `:TRACe:MATH:SMOoth <trace>` and `[:SENSe]:AVERage:TYPE VIDeo|POWer` are not interchangeable.

Remote Command	`:TRACe:MATH:SMOoth TRACE1 | TRACE2 | TRACE3 | TRACE4 | TRACE5 | 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. This 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.



The following discussion of the end-point smoothing phenomenon refers to the illustration above.

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 the `:CALCulate:DATA:COMPress` command instead: "Calculate/Compress Trace Data Query (Remote Command Only)" on page 1046.

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.

Remote Command	`:TRACe:MATH:SMOoth:POINts <integer>` `:TRACe:MATH:SMOoth:POINts?`
Example	`:TRAC:MATH:SMO:POIN 501`
Notes	Only odd values are allowed; if an even `<integer>` value is specified, add 1 unless `<integer>` = number of sweep points, in which case subtract 1 Used with the `:TRACe:MATH:SMOoth` command: "Smooth Trace Data (Remote Command Only) " on page 1053
Preset	11
Min	3
Max	Number of sweep points

9.3.3.9 Mean Trace Data (Remote Command Only)

Included for ESA compatibility. Not recommended for new designs. Use the `:CALCulate:DATA:COMPress` command instead: "Calculate/Compress Trace Data

Query (Remote Command Only)" on page 1046.

Returns the mean of the amplitudes of the trace amplitude elements, in measurement units.

Remote Command	`:TRACe:MATH:MEAN? TRACE1 | TRACE2 | TRACE3 | TRACE4 | TRACE5 | TRACE6`
Example	`:TRAC:MATH:MEAN? TRACE2`

9.4 STATus Subsystem

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 Registers

This section provides an overview of SCPI status registers and how to manage them. The section "STATus Subsystem Registers and Commands" on page 1062 gives detailed programming information for each of the X-Series status registers.

9.4.1.1 What Are Status Registers

The status system contains multiple registers that are arranged in a hierarchical order. The lower-level status registers propagate their data to the higher-level registers in the data structures by means of summary bits. The status byte register 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. For a diagram of the registers and their interconnections, see above.

The operation and questionable status registers are sets of registers that monitor the overall instrument condition. They are accessed with the STATus:OPERation and STATus:QUEStionable commands in the STATus command subsystem. Each register set is made up of five registers:

- 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
- Positive Transition Register—This 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)
- Negative Transition Register—This 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)
- 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
- 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

The STATus:QUEStionable registers report abnormal operating conditions. The status register hierarchy is:

1. The summary outputs from the six STATus:QUEStionable:<keyword> detail registers are inputs to the STATus:QUEStionable register
2. The summary output from the STATus:QUEStionable register is an input to the Status Byte Register. See the overall system in Figure at the beginning of this section

The STATus:OPERation register set has no summarized inputs. The inputs to the STATus:OPERation:CONDition register indicate the real time state of the instrument. The STATus:OPERation:EVENt register summary output is an input to the Status Byte Register.

9.4.1.2 What Are Status Register SCPI Commands

Monitoring of the instrument conditions is done at the highest level using the following IEEE 488.2 common commands. Complete command descriptions are available in the section "IEEE 488.2 Common Commands" on page 1029. Individual status registers can be set and queried using the commands in the "STATus Subsystem Registers and Commands" on page 1062 section.

- *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.

9.4.1.3 How to Use the 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
- The service request (SRQ) method

In the polling method, the instrument has a passive role. It only tells the controller that conditions have changed when the controller asks the right question. In the SRQ method, the instrument takes a more active role. It tells the controller when there has been a condition change without the controller asking. Either method allows you to monitor one or more conditions.

The polling method works well if you do not need to know about changes the moment they occur. The SRQ method should be used if you must know immediately when a condition changes. To detect a change using the polling method, the program must repeatedly read the registers.

Use the SRQ 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

Use polling 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 that reads that register.
- Examine the bit to see if the condition has changed.

You can monitor conditions in different ways.

- **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.
- **Monitor a particular condition (bit).** You can enable a particular bit(s), using the event enable register. The instrument will then monitor that particular condition (s). 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 sending the *CLS command.

- Monitor a particular type of change in a condition (bit).
- The transition registers are preset to register if the condition goes from 0 to 1 (false to true, or a positive transition).
- This can be changed so the selected condition is detected if the bit goes from 1 to 0 (true to false, or a negative transition).
- It can also be set for both types of transitions occurring.
- Or it can be set for neither transition. If both transition registers are set to 0 for a particular bit position, that bit will not be set in the event register for either type of change.

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:

1. Determine which bit monitors the condition
2. Determine how that bit reports to the request service (RQS) bit of the status byte
3. 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
4. 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 is the request service (RQS) bit. The *SRE command is used 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 with *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 of 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 who's RQS bit is set to 1 is the device that requested service.

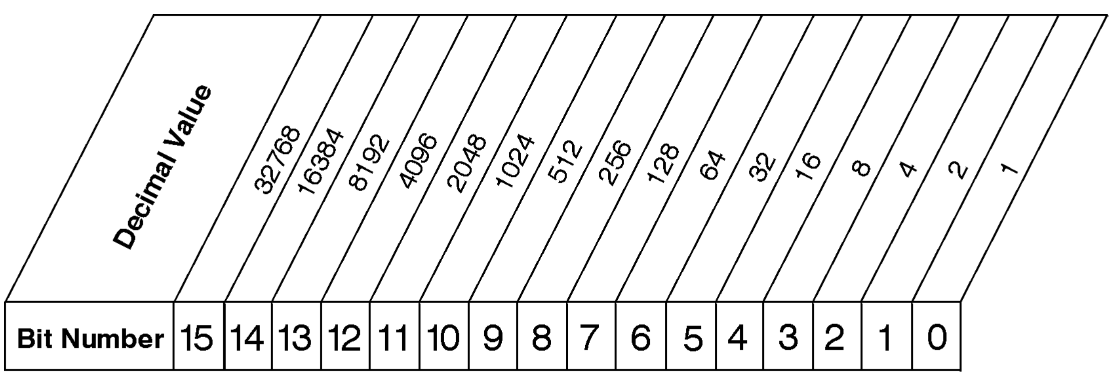
NOTE **When you read the instrument's status byte register with a serial poll, the RQS bit is reset to 0. Other bits in the register are not affected.**

If the status register is configured to SRQ on end-of-measurement and the measurement is in continuous mode, then restarting a measurement (INIT command) can cause the measuring bit to pulse low. This causes an SRQ when you have not actually reached the "end-of-measurement" condition. To avoid this:

1. Set `:INITiate:CONTinuous` off
2. Set/enable the status registers
3. Restart the measurement (send INIT)

9.4.1.4 Status Register Bit Parameters

The figure below shows a typical status register, the Standard Operation Event Enable register. Each bit in a register is represented by a numerical value based on its location. This number is sent with the command to enable a particular bit. If you want to enable more than one bit, you would send the sum of all the bits that you want to monitor.



STATus:OPERation:ENABle <num>
STATus:OPERation:ENABle?

Standard Operation Event Enable Register

ck730a

NOTE: Bit 15 is not used to report status.

Example 1:

1. To enable bit 0 and bit 6 of standard event status register, you would send the command `*ESE 65` because 1 + 64 = 65
2. 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:

1. 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
2. It’s usually a good idea to start by clearing all the status registers with `*CLS`
3. Sending the STAT:QUES:INT:ENAB 1024 command 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 wanted to know when the Auto-trigger timeout condition is cleared, then you would set the STAT:QUES:INT:PTR 0 and the STAT:QUES:INT:NTR 32767
4. So now the only output from the Status Questionable Integrity register will come from a bit 10 positive transition. That output goes to the Integrity Sum bit 9 of the Status Questionable register
5. You can do a similar thing with this register to only look at bit 9 using, STAT:QUES:ENAB 512
6. The Status Questionable register output goes to the “Status Questionable Summary” bit 3 of the Status Byte Register. The output from this register can be enabled using the `*SRE 8` command
7. Finally, you would use the serial polling functionality available for the particular bus/software that you are using to monitor the Status Byte Register. (You could also use `*STB?` to poll the Status Byte Register)

9.4.2 STATus Subsystem Registers and Commands

The STATus subsystem remote commands set and query the status registers. This system of registers monitors various events and conditions in the instrument. Software written to control the instrument may need to monitor some of these events and conditions.

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.

Specific status bits are assigned to monitor various aspects of the instrument operation and status. See the "Status Register Diagram" on page 1063 for information about the bit assignments and status register interconnections. 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.

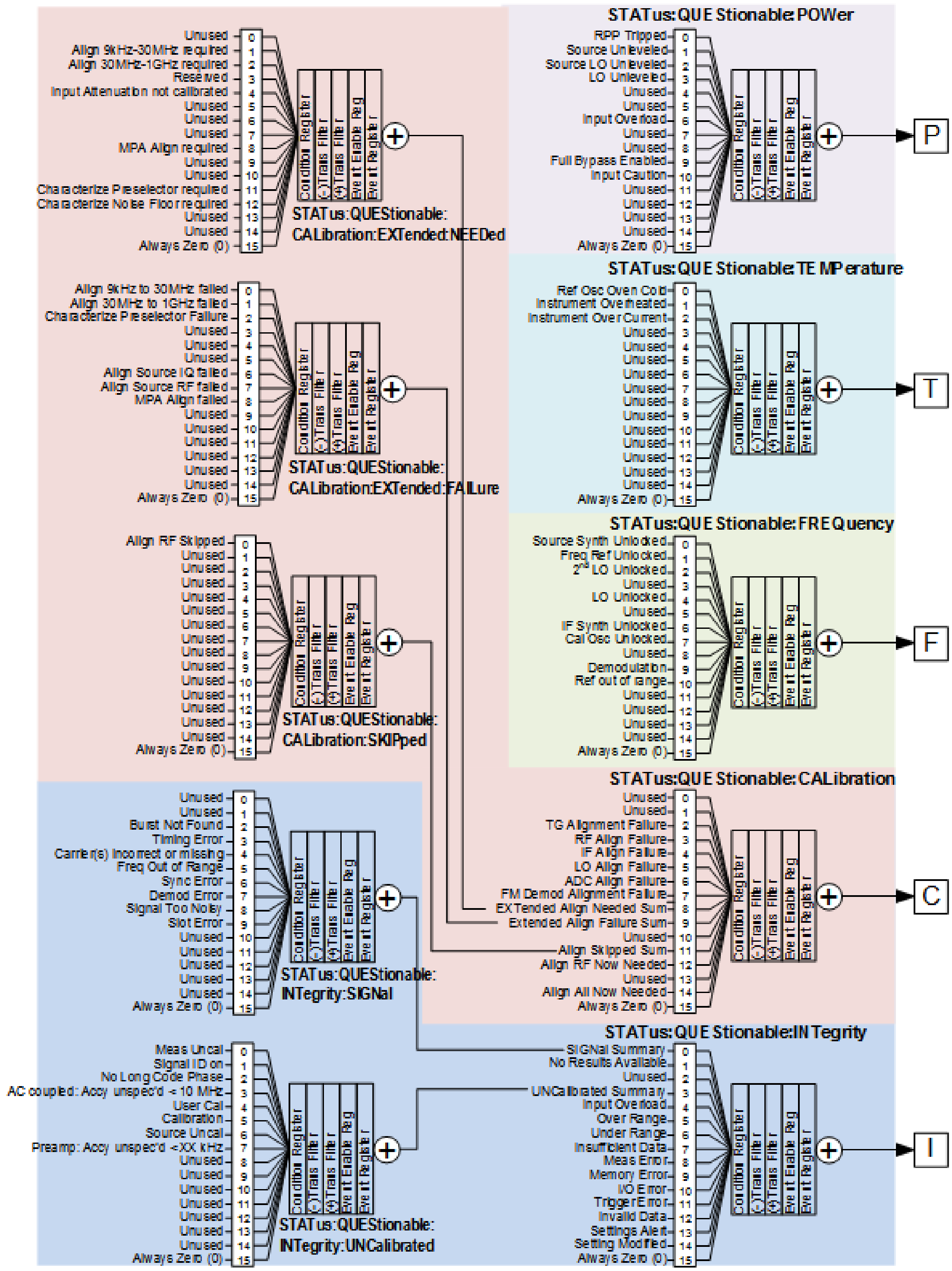
The STATus subsystem controls and queries the SCPI-defined instrument status reporting structures. Each status register has a set of five commands used for querying or masking that particular register.

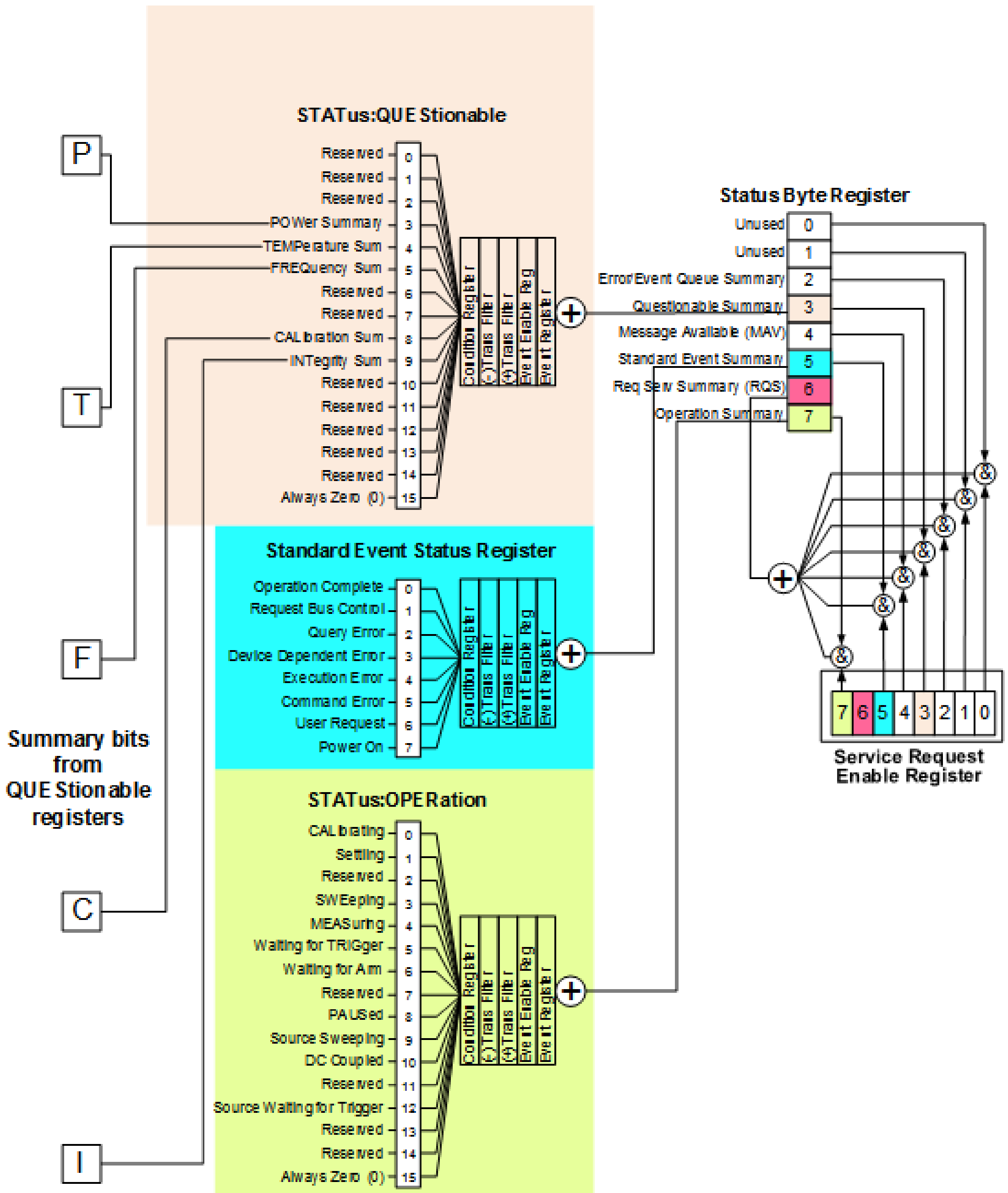
Numeric values for bit patterns can be entered using decimal or hexadecimal representations. (i.e. 0 to 32767 is equivalent to #H0 to #H7FFF. It is also equal to all ones, 111111111111111). See "Status Register Bit Parameters" on page 1061 for information about using bit patterns for variable parameters.

9.4.2.1 Status Register Diagram

The following diagram provides a graphical overview of the entire X-Series Status Register Subsystem.

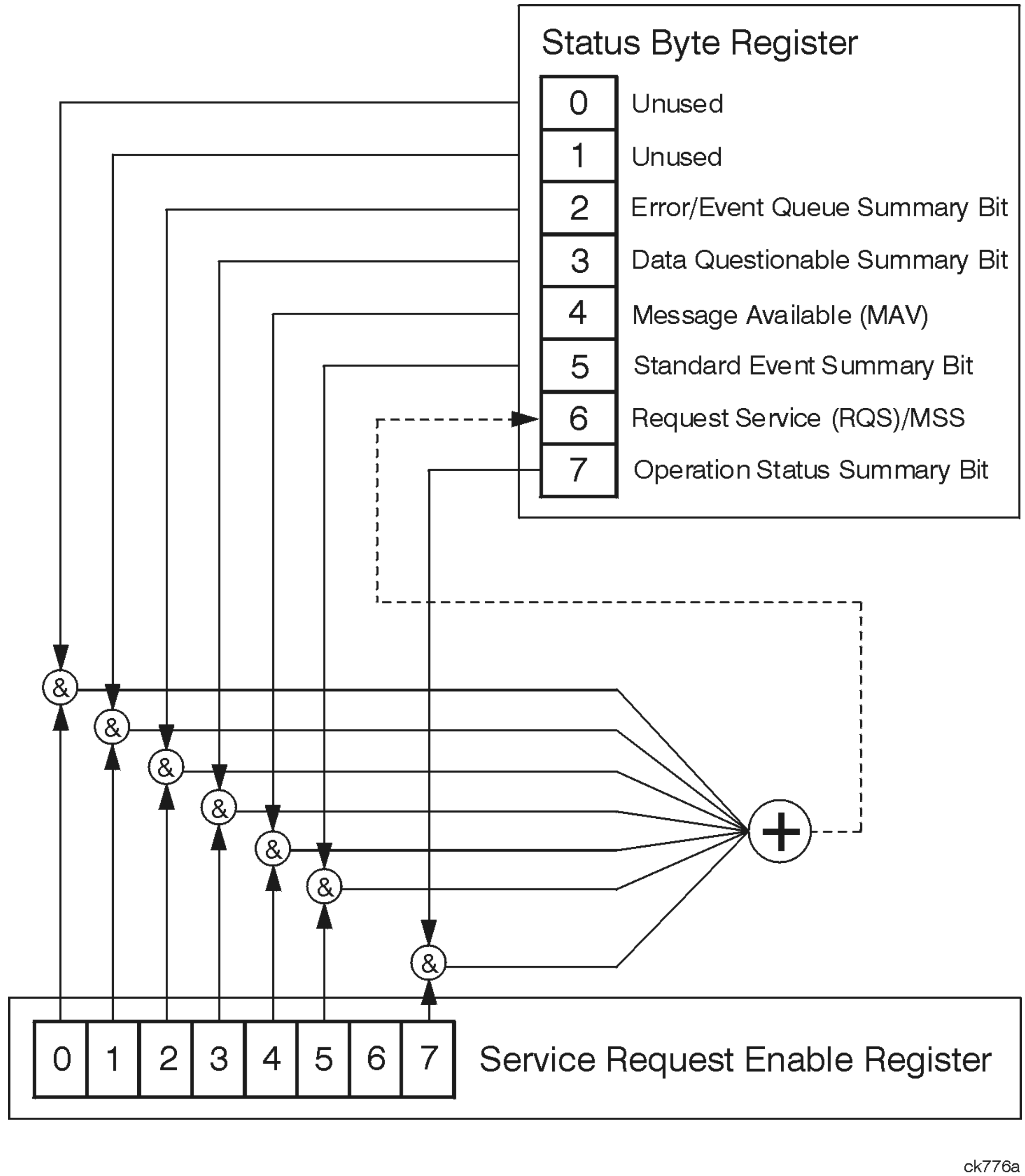
For readability, the diagram is split into two sections.

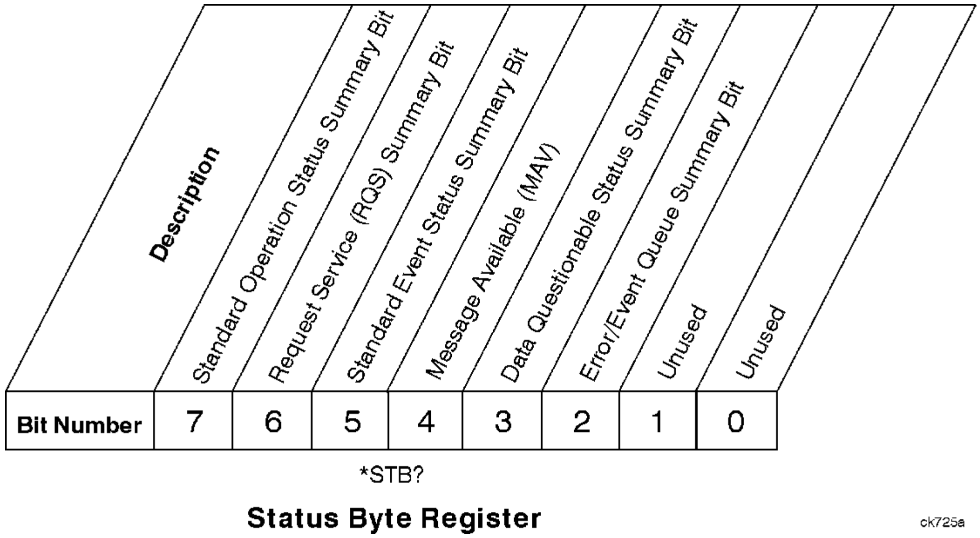

STATus:QUEStionable:CALibration:EXTended:NEEDed
Unused
Align 9kHz-30MHz required
Align 30MHz-1GHz required
Reserved
Input Attenuation not calibrated
MPA Align required
Characterize Preselector required
Characterize Noise Floor required
Always Zero (0)
STATus:QUEStionable:CALibration:EXTended:FAILure
Align 9kHz to 30MHz failed
Align 30MHz to 1GHz failed
Characterize Preselector Failure
Align Source IQ failed
Align Source RF failed
MPA Align failed
STATus:QUEStionable:CALibration:SKIPped
Align RF Skipped
STATus:QUEStionable:INTegrity:SIGNal
Burst Not Found
Timing Error
Carrier(s) Incorrect or missing
Freq Out of Range
Sync Error
Demod Error
Signal Too Noisy
Slot Error
STATus:QUEStionable:INTegrity:UNCalibrated
Meas Uncal
Signal ID on
No Long Code Phase
AC coupled: Accy unspec'd < 10 MHz
User Cal
Calibration
Source Uncal
Preamp: Accy unspec'd <XX kHz
STATus:QUEStionable:POWer
RPP Tripped
Source Unleveled
Source LO Unleveled
LO Unleveled
Input Overload
Full Bypass Enabled
Input Caution
STATus:QUEStionable:TEMPerature
Ref Osc Oven Cold
Instrument Overheated
Instrument Over Current
STATus:QUEStionable:FREQuency
Source Synth Unlocked
Freq Ref Unlocked
2nd LO Unlocked
LO Unlocked
IF Synth Unlocked
Cal Osc Unlocked
Demodulation
Ref out of range
STATus:QUEStionable:CALibration
TG Alignment Failure
RF Align Failure
IF Align Failure
LO Align Failure
ADC Align Failure
FM Demod Alignment Failure
EXTended Align Needed Sum
Extended Align Failure Sum
Align Skipped Sum
Align RF Now Needed
Align All Now Needed
STATus:QUEStionable:INTegrity
SIGNal Summary
No Results Available
UNCalibrated Summary
Input Overload
Over Range
Under Range
Insufficient Data
Meas Error
Memory Error
I/O Error
Trigger Error
Invalid Data
Settings Alert
Setting Modified
Condition Register
(-)Trans Filter
(+)Trans Filter
Event Enable Reg
Event Register
P
T
F
C
I



9.4.2.2 Status Byte Register

The Status Byte register provides a one-byte overview of the entire STATus subsystem. All the other registers funnel into this register with summary bits, as shown in the "Status Register Diagram" on page 1063.


Status Byte Register
0 Unused
1 Unused
2 Error/Event Queue Summary Bit
3 Data Questionable Summary Bit
4 Message Available (MAV)
5 Standard Event Summary Bit
6 Request Service (RQS)/MSS
7 Operation Status Summary Bit
&
+
0 1 2 3 4 5 6 7
Service Request Enable Register
ck776a



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 the query `*STB?` The response will be the decimal sum of the bits which 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. The `*STB` command 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 the *STB? query. 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 the IEEE 488.2 standard, section 11. In addition to the status byte register, the status byte group also contains the service request enable register. This register lets you choose which bits in the status byte register will trigger a service request.

See also "*STB? - Status Byte Query" on page 1035

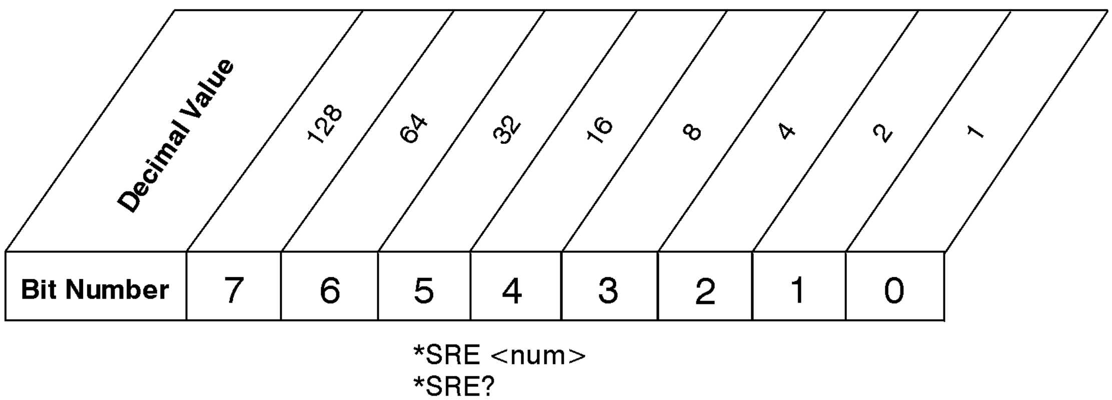
Service Request Enable Register

This register enables the desired bits of the Service Request (SRQ) subsystem.

Send the `*SRE <integer>` command, 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.

The query `*SRE?` returns the decimal value of the sum of the bits previously enabled with the `*SRE <integer>` command.

The service request enable register presets to zeros (0).



Service Request Enable Register

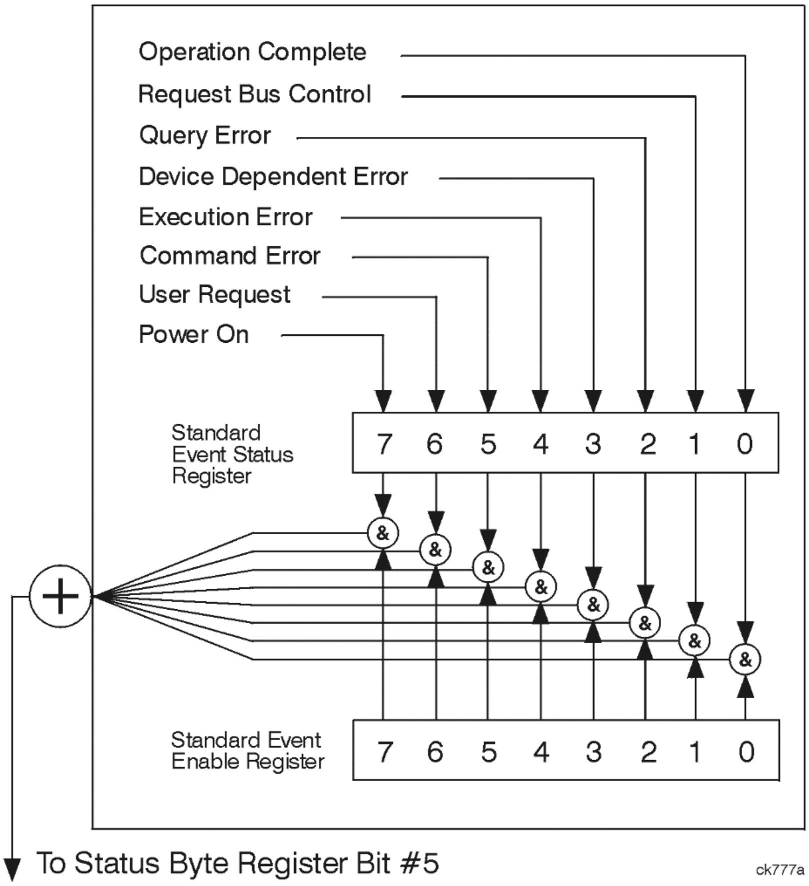
See also "*SRE - Service Request Enable" on page 1035

Preset the Status Byte

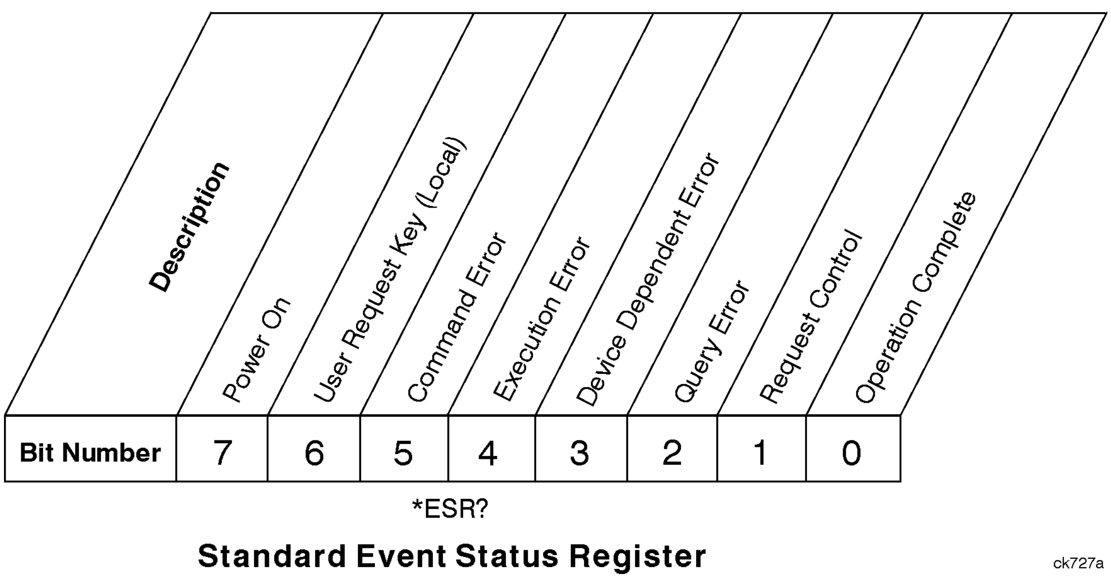
Sets bits in most of the enable and transition registers to their default state. It presets all the Transition Filters, Enable Registers, and the Error/Event Queue Enable. It has no effect on Event Registers, Error/Event QUEue, IEEE 488.2 ESE, and SRE Registers as described in IEEE Standard 488.2-1992, IEEE Standard Codes, Formats, Protocols, and Common Commands for Use with ANSI/IEEE Std 488.1-1987. New York, NY, 1992.

Remote Command	`:STATus:PRESet`
Example	`:STAT:PRES`

9.4.2.3 Standard Event Status Register



The standard event status register contains the following bits:



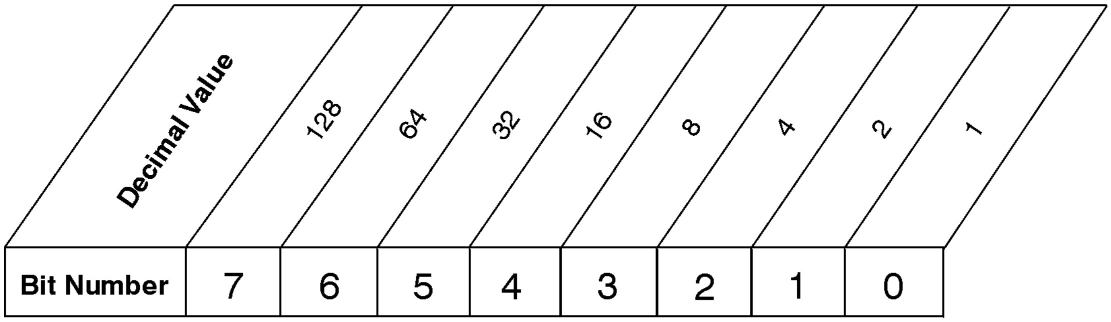
Bit	Description
0	A 1 in this bit position indicates that all pending operations were completed following execution of the *OPC command
1	This bit is for GPIB handshaking to request control. Currently it is set to 0 because there are no implementations where the spectrum analyzer controls another instrument
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 event that set bit 5 in the status byte register. To query the standard event status register, send the query `*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 1031

The Standard Event Status Enable Register

In addition to the standard event status register, 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 the `*ESE <integer>` command 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 the command `*ESE 192` (128 + 64). The command `*ESE?` returns the decimal value of the sum of the bits previously enabled with the `*ESE <integer>` command.

The standard event status enable register presets to zeros (0).



*ESE <num>
*ESE?

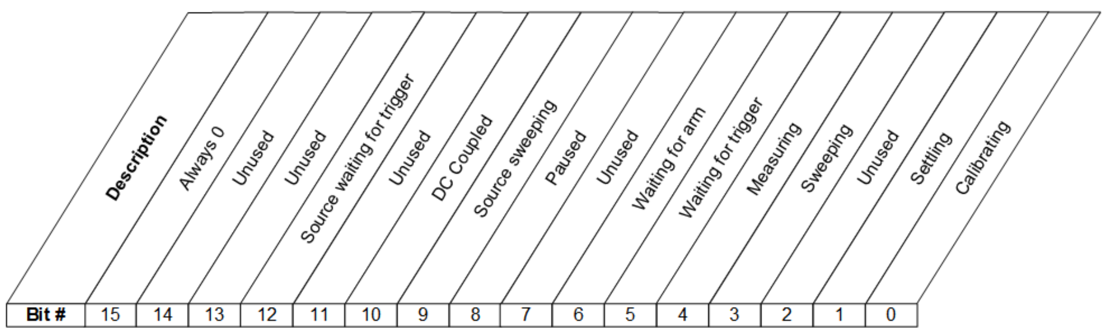
Standard Event Status Enable Register ck728a

See also "*ESE - Standard Event Status Enable" on page 1030

9.4.2.4 STATus:OPERation Register

The operation and questionable status registers are registers that monitor the overall instrument condition. They are accessed with the STATus:OPERation and STATus:QUEStionable commands.

The operation status 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. Also see "*OPC? - Operation Complete" on page 1032.



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 keys under the **MEASURE** key 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.

Bit	Condition	Operation
6	Waiting for arm	The instrument is waiting for the trigger to be armed
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
12	Source Waiting for Trigger	The built in source is waiting for a trigger

Operation Condition Query

This 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

This command determines which bits in the Operation Event register, will set the Operation Status Summary bit (bit 7) in the Status Byte Register. 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

This query returns the decimal value of the sum of the bits in the Operation Event register.

NOTE The register requires that the associated PTR or NTR 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

This command determines which bits in the Operation Condition register will set the corresponding bit in the Operation Event 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

This command determines which bits in the Operation Condition register will set the corresponding bit in the Operation Event 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

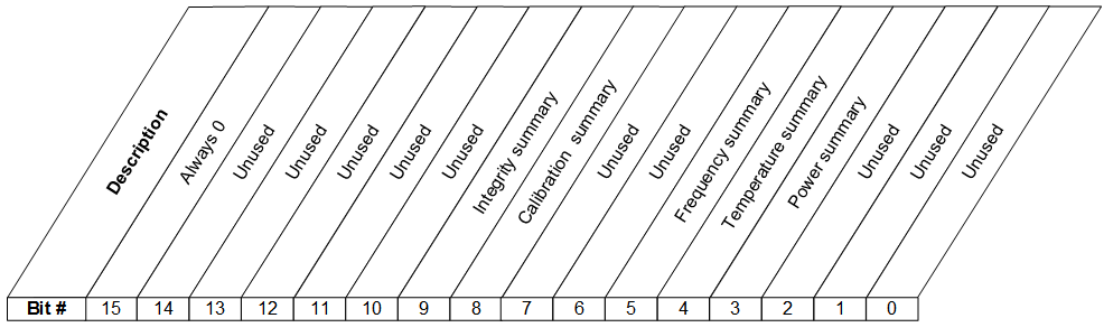
Backwards Compatibility

1. The STATus:OPERation register bit 4 is a “Measuring” bit. The bit is valid for SA mode and all the application modes. In older products the bit was only valid for ESA/PSA Spectrum Analysis, Phase Noise, and Noise Figure modes. It was also in ESA’s Bluetooth, cdmaOne, and GSM modes.
2. The STATus:OPERation register bit 8 is a “Paused” bit. The bit is valid for SA mode and all the application modes. In older products the bit was only valid for ESA/PSA Spectrum Analysis, Phase Noise, and Noise Figure modes. It was also in ESA’s Bluetooth, cdmaOne, and GSM modes.
3. The STATus:OPERation register bit 11 was a “Printing” bit in VSA and in the VSA/PSA applications. Bit 11 is not used in Next Generation because it is not needed in a Windows operation system.
4. The STATus:OPERation register bit 12 was a “Mass memory busy” bit in VSA and in the VSA/PSA applications. Bit 12 is not used in Next Generation because it is not needed in a Windows operation system.

9.4.2.5 STATus:QUEStionable Register

The operation and questionable status registers are registers that monitor the overall instrument condition. They are accessed with the STATus:OPERation and STATus:QUEStionable commands.

The questionable status register monitors the instrument’s condition to see if anything questionable has happened to it. It is looking for anything that might cause an error or a bad measurement like 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	This bit is the summary bit for the STATus:QUEStionable:POWer register
4	Temperature summary	This bit is the summary bit for the STATus:QUEStionable:TEMPerature register
5	Frequency summary	This bit is the summary bit for the STATus:QUEStionable:FREQuency register
8	Calibration summary	This bit is the summary bit for the STATus:QUEStionable:CALibration register
9	Integrity summary	This bit is the summary bit for the STATus:QUEStionable:INTegrity register

See:

– "Questionable Condition" on page 1075
– "Questionable Enable" on page 1076
– "Questionable Event Query" on page 1076
– "Questionable Negative Transition" on page 1077
– "Questionable Positive Transition" on page 1077

Questionable Condition

This query 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 the current conditions.**

Remote Command	`:STATus:QUEStionable:CONDition?`
Example	`:STAT:QUES:COND?`
Preset	0
Status Bits/OPC dependencies	Sequential command

Questionable Enable

This command determines which bits in the Questionable Event register will set the Questionable Status Summary bit (bit3) in the Status Byte Register. 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 have any Questionable Events reported to the Status Byte Register, one or more bits need to be set to 1. The Status Byte Event Register 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?`
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

This query returns the decimal value of the sum of the bits in the Questionable Event register.

NOTE **The register requires that the associated PTR or NTR 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

This command determines which bits in the Questionable Condition register will set the corresponding bit in the Questionable Event 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

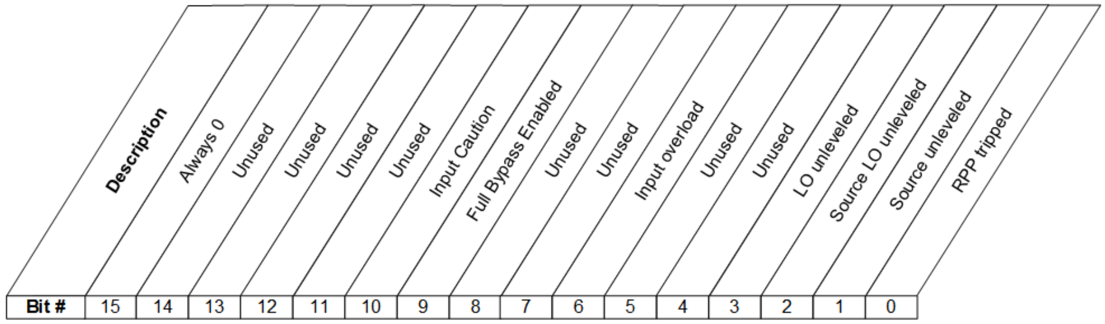
Questionable Positive Transition

This command determines which bits in the Questionable Condition register will set the corresponding bit in the Questionable Event 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

9.4.2.6 Questionable Power Register

The STATus:QUEStionable:POWer register monitors power-related conditions within the instrument and summarizes them in bit 3 of the STATus:QUEStionable register.



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 Overload	A power overload condition exists at an input
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

See:

– "Questionable Power Condition" on page 1078

– "Questionable Power Enable" on page 1079

– "Questionable Power Event Query" on page 1079

– "Questionable Power Negative Transition" on page 1079

– "Questionable Power Positive Transition" on page 1080

Questionable Power Condition

This query 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

This command determines which bits in the Questionable Power Condition Register will set bits in the Questionable Power Event register, which also sets the Power Summary bit (bit 3) in the Questionable Register. 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 Unleveled 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

This query returns the decimal value of the sum of the bits in the Questionable Power Event register.

NOTE **The register requires that the associated PTR or NTR 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

This command determines which bits in the Questionable Power Condition register will set the corresponding bit in the Questionable Power Event 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

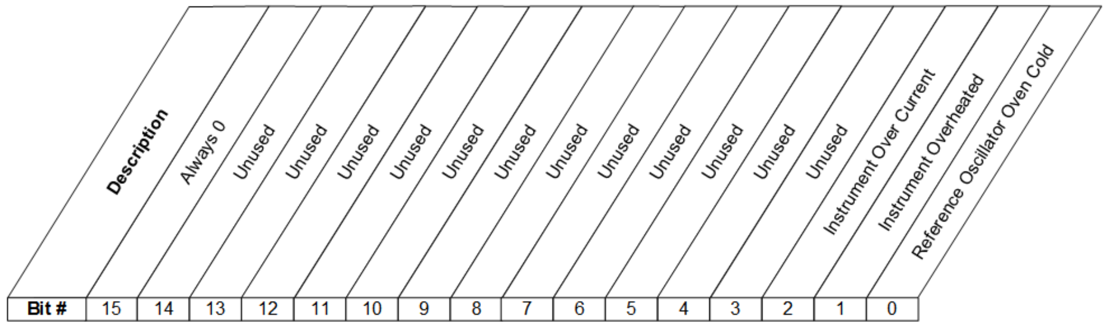
Questionable Power Positive Transition

This command determines which bits in the Questionable Power Condition register will set the corresponding bit in the Questionable Power Event 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 Unleveled 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

9.4.2.7 Questionable Temperature Register

The STATus:QUEStionable:TEMPerature register monitors temperature-related conditions within the instrument and summarizes them in bit 4 of the STATus:QUEStionable register.



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

See:

– "Questionable Temperature Condition" on page 1081
– "Questionable Temperature Enable" on page 1082
– "Questionable Temperature Event Query" on page 1082
– "Questionable Temperature Negative Transition" on page 1082
– "Questionable Temperature Positive Transition" on page 1083

Questionable Temperature Condition

This query 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

This command determines which bits in the Questionable Temperature Condition Register will set bits in the Questionable Temperature Event register, which also sets the Temperature Summary bit (bit 4) in the Questionable Register. 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 Status Questionable register
Preset	32767
Min	0
Max	32767
Status Bits/OPC dependencies	Sequential command

Questionable Temperature Event Query

This query returns the decimal value of the sum of the bits in the Questionable Temperature Event register.

NOTE

The register requires that the associated PTR or NTR 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

This command determines which bits in the Questionable Temperature Condition register will set the corresponding bit in the Questionable Temperature Event 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

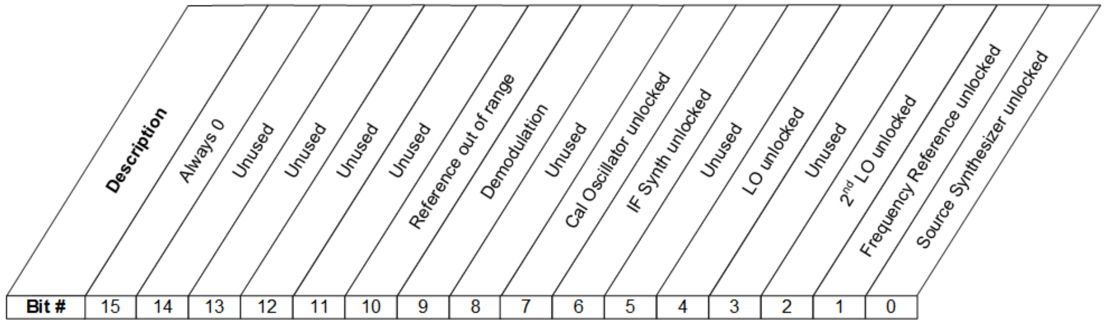
Questionable Temperature Positive Transition

This command determines which bits in the Questionable Temperature Condition register will set the corresponding bit in the Questionable Temperature Event 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 Status Questionable register
Preset	32767
Min	0
Max	32767
Status Bits/OPC dependencies	Sequential command

9.4.2.8 Questionable Frequency Register

The STATus:QUEStionable:FREQuency register monitors frequency-related conditions within the instrument and summarizes them in bit 5 of the STATus:QUEStionable register.



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	2nd 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
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

See:

– "Questionable Frequency Condition" on page 1084

– "Questionable Frequency Enable" on page 1085

– "Questionable Frequency Event Query" on page 1085

– "Questionable Frequency Negative Transition" on page 1086

– "Questionable Frequency Positive Transition" on page 1086

Questionable Frequency Condition

This query 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

This command determines which bits in the Questionable Frequency Condition Register will set bits in the Questionable Frequency Event register, which also sets the Frequency Summary bit (bit 5) in the Questionable Register. 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

This query returns the decimal value of the sum of the bits in the Questionable Frequency Event register.

NOTE The register requires that the associated PTR or NTR 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

This command determines which bits in the Questionable Frequency Condition register will set the corresponding bit in the Questionable Frequency Event 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

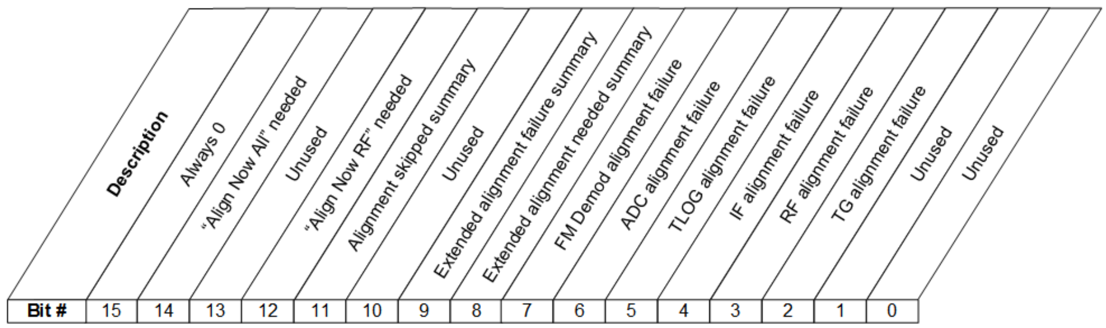
This command determines which bits in the Questionable Frequency Condition register will set the corresponding bit in the Questionable Frequency Event register when the condition register bit has a positive transition (0 to 1). The variable `<integer>` is the sum of the decimal values of the bits that 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

9.4.2.9 Questionable Calibration Register

The STATus:QUEStionable:CALibration register monitors calibration-related conditions within the instrument and summarizes them in bit 8 of the

STATus:QUEStionable register. 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 the STATus:QUEStionable:CALibration:EXTended:NEEDed sub-register
9	Extended Align Failure Summary	Summary bit for the STATus:QUEStionable:CALibration:EXTended:FAILure sub-register
11	Align Skipped Sum Summary	Summary bit for the STATus:QUEStionable:CALibration:SKIPped sub-register
12	“Align Now RF” required	Go to the System, Alignments, Align Now menu and perform an “Align Now RF”
14	“Align Now All” required	Go to the System, Alignments, Align Now menu and perform an “Align Now All”

See:

– "Questionable Calibration Condition" on page 1088
– "Questionable Calibration Enable" on page 1088
– "Questionable Calibration Event Query" on page 1088
– "Questionable Calibration Negative Transition" on page 1089
– "Questionable Calibration Positive Transition" on page 1089

Questionable Calibration Condition

This query 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

This command determines which bits in the Questionable Calibration Condition Register will set bits in the Questionable Calibration Event register, which also sets the Calibration Summary bit (bit 8) in the Questionable Register. 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

This query returns the decimal value of the sum of the bits in the Questionable Calibration Event register.

NOTE The register requires that the associated PTR or NTR 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

This command determines which bits in the Questionable Calibration Condition register will set the corresponding bit in the Questionable Calibration Event 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

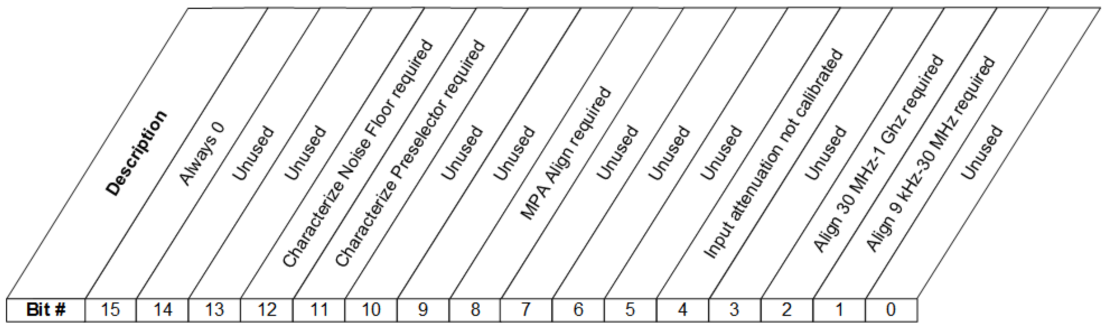
Questionable Calibration Positive Transition

This command determines which bits in the Questionable Calibration Condition register will set the corresponding bit in the Questionable Calibration Event 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

9.4.2.10 Questionable Calibration Extended Needed Register

The STATus:QUEStionable:CALibration:EXTended:NEEDed register monitors conditions which occur because a calibration or alignment is required to guarantee accurate measurements. It summarizes them in bit 8 of the STATus:QUEStionable:CALibration register.



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
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”

See:

– "Questionable Calibration Extended Needed Condition " on page 1091
– "Questionable Calibration Extended Needed Enable" on page 1091
– "Questionable Calibration Extended Needed Event Query" on page 1091
– "Questionable Calibration Extended Needed Negative Transition" on page 1092
– "Questionable Calibration Extended Needed Positive Transition" on page 1092

Questionable Calibration Extended Needed Condition

This query 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

This command determines which bits in the Questionable Calibration Extended Needed Condition Register will set bits in the Questionable Calibration Extended Needed Event register, which also sets bit 14 of the Questionable Calibration Register. The variable <integer> is the sum of the decimal values of the bits 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

This 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 PTR or NTR 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

This command determines which bits in the Questionable Calibration Extended Needed Condition register will set the corresponding bit in the Questionable Calibration Extended Needed Event 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

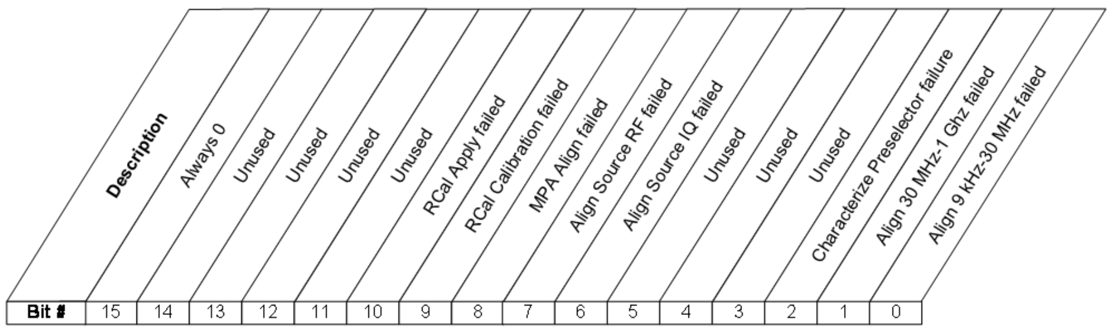
Questionable Calibration Extended Needed Positive Transition

This command determines which bits in the Questionable Calibration Extended Needed Condition register will set the corresponding bit in the Questionable Calibration Extended Needed Event 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

9.4.2.11 Questionable Calibration Extended Failure Register

The STATus:QUEStionable:CALibration:EXTended:FAILure register monitors conditions which occur because a calibration or alignment has failed to complete properly. It summarizes them in bit 9 of the STATus:QUEStionable:CALibration register.



STATus:QUEStionable:CALibration:EXTended:FAILure Register

Bit	Condition	Operation
0	Align 9kHz-30MHz failed	EMI receiver alignment failed, 9kHz-30 MHz (conducted band)
1	Align 30MHz-1GHz failed	EMI receiver alignment failed, 30 MHz-1 GHz (radiated band)
2	Characterize Preselector required	The preselector characterization failed
6	Align Source IQ failed	The alignment of the built-in source IQ section failed
7	Align Source RF failed	The alignment of the built-in source RF section failed
8	MPA Align failed	The Multiport Adaptor must be calibrated (EXT only)
9	RCal Calibration failed	The calibration request sent to the RCal module failed
10	RCal Apply failed	The applying of the calibration data failed

See:

– "Questionable Calibration Extended Failure Condition" on page 1094

– "Questionable Calibration Extended Failure Enable" on page 1094

– "Questionable Calibration Extended Failure Event Query" on page 1094

– "Questionable Calibration Extended Failure Negative Transition" on page 1095

– "Questionable Calibration Extended Failure Positive Transition" on page 1095

Questionable Calibration Extended Failure Condition

This query 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

This command determines which bits in the Questionable Calibration Extended Failure Condition Register will set bits in the Questionable Calibration Extended Failure Event register, which also sets bit 9 of the Questionable Calibration Register. The variable `<integer>` is the sum of the decimal values of the bits 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

This 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 PTR or NTR 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

This command determines which bits in the Questionable Calibration Extended Failure Condition register will set the corresponding bit in the Questionable Calibration Extended Failure Event 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

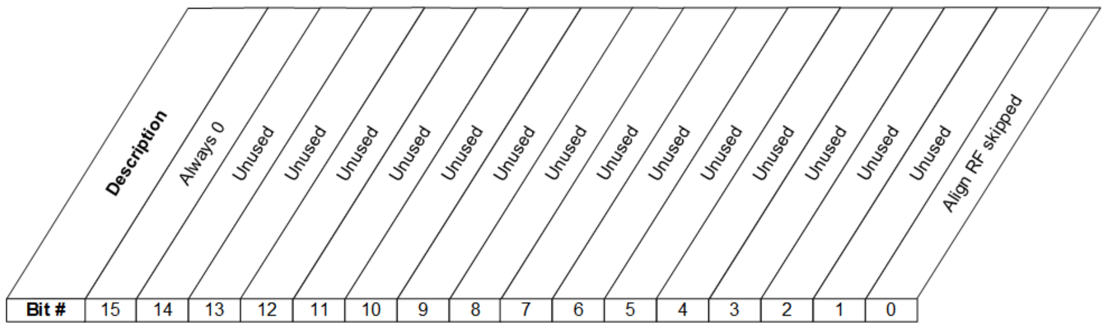
Questionable Calibration Extended Failure Positive Transition

This command determines which bits in the Questionable Calibration Extended Failure Condition register will set the corresponding bit in the Questionable Calibration Extended Failure Event 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

9.4.2.12 Questionable Calibration Skipped Register

The STATus:QUEStionable:CALibration:EXTended:NEEDed register monitors conditions which occur because a calibration or alignment has been skipped due to various settings or conditions. It summarizes them in bit 11 of the STATus:QUEStionable:CALibration register.



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 "Auto Align" on page 426, "Align Now All" on page 432 and "Align Now RF" on page 436

See:

- "Questionable Calibration Skipped Condition" on page 1096
- "Questionable Calibration Skipped Enable" on page 1097
- "Questionable Calibration Skipped Event Query" on page 1097
- "Questionable Calibration Skipped Negative Transition" on page 1097
- "Questionable Calibration Skipped Positive Transition" on page 1098

Questionable Calibration Skipped Condition

This query 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

This command determines which bits in the Questionable Calibration Skipped Condition Register will set bits in the Questionable Calibration Skipped Event register, which also sets bit 11 of the Questionable Calibration Register. The variable <integer> is the sum of the decimal values of the bits 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

This query returns the decimal value of the sum of the bits in the Questionable Calibration Event register.

NOTE **The register requires that the associated PTR or NTR 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

This command determines which bits in the Questionable Calibration Skipped Condition register will set the corresponding bit in the Questionable Calibration Skipped Event 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

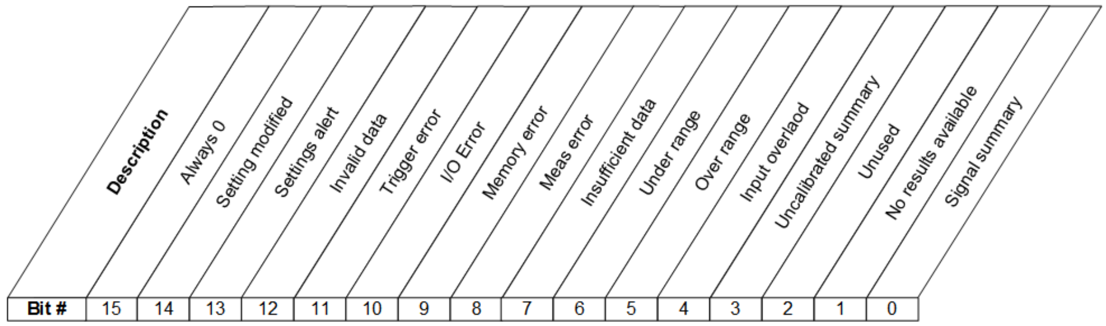
Questionable Calibration Skipped Positive Transition

This command determines which bits in the Questionable Calibration Skipped Condition register will set the corresponding bit in the Questionable Calibration Skipped Event 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

9.4.2.13 Questionable Integrity Register

The STATus:QUEStionable:INTegrity register monitors measurement integrity-related conditions within the instrument and summarizes them in bit 9 of the STATus:QUEStionable register. Two of the bits are summary bits from lower-level event registers.



STATus:QUEStionable:INTegrity Register

Bit	Condition	Operation
0	Signal Summary	This bit is the summary bit for the STATus:QUEStionable:INTegrity:SIGNal sub-register
1	No Result	The current measurement is incompatible with a setting or combination of settings, such as the selected Input, Radio Standard, etc.
3	Uncalibrated Summary	This bit is the summary bit for the STATus:QUEStionable:INTegrity:UNCalibrated sub-register
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

See:

– "Questionable Integrity Condition" on page 1100

– "Questionable Integrity Enable" on page 1100

– "Questionable Integrity Event Query" on page 1100
– "Questionable Integrity Negative Transition" on page 1101
– "Questionable Integrity Positive Transition" on page 1101

Questionable Integrity Condition

This query 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

This command determines which bits in the Questionable Integrity Condition Register will set bits in the Questionable Integrity Event register, which also sets the Integrity Summary bit (bit 9) in the Questionable Register. The variable `<integer>` is the sum of the decimal values of the bits 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

This query returns the decimal value of the sum of the bits in the Questionable Integrity Event register.

NOTE The register requires that the associated PTR or NTR 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

This command determines which bits in the Questionable Integrity Condition register will set the corresponding bit in the Questionable Integrity Event 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

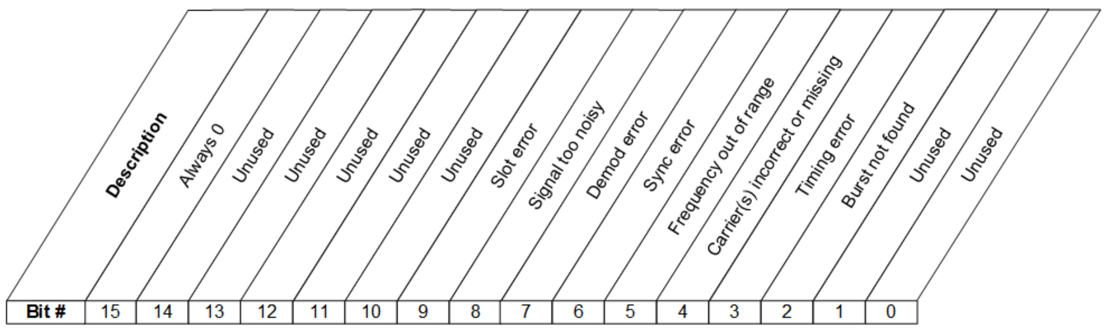
This command determines which bits in the Questionable Integrity Condition register will set the corresponding bit in the Questionable Integrity Event register when the condition register bit has a positive transition (0 to 1). The variable <integer> is the sum of the decimal values of the bits that 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

9.4.2.14 Questionable Integrity Signal Register

The STATus:QUEStionable:INTegrity:SIGNal register monitors conditions which 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 STATus:QUEStionable:INTegrity register.



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 can't establish appropriate timing from the signal
4	Carrier(s) incorrect or missing	The instrument can't 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 can't establish sync with the measured signal
7	Demod error	The instrument cannot demodulate the signal due to inappropriate 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

See:

Questionable Integrity Signal Condition

This query 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

This command determines which bits in the Questionable Integrity Signal Condition Register will set bits in the Questionable Integrity Signal Event register, which also sets the Integrity Summary bit (bit 9) in the Questionable Register. The variable `<integer>` is the sum of the decimal values of the bits you want to enable.

Remote Command	`:STATus:QUEStionable:INTegrity:SIGNal:ENABle <integer>` `: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

This 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 PTR or NTR 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

This command determines which bits in the Questionable Integrity Signal Condition register will set the corresponding bit in the Questionable Integrity Signal Event 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

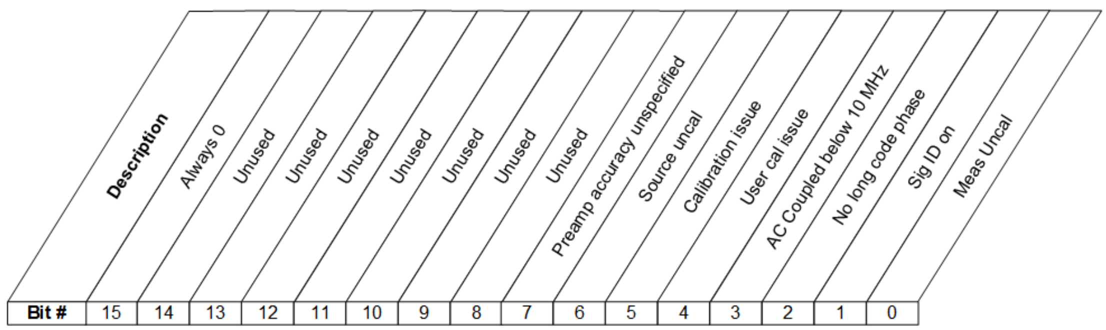
This command determines which bits in the Questionable Integrity Signal Condition register will set the corresponding bit in the Questionable Integrity Signal Event register when the condition register bit has a positive transition (0 to 1). The variable `<integer>` is the sum of the decimal values of 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

9.4.2.15 Questionable Integrity Uncalibrated Register

The STATus:QUEStionable:INTegrity:UNCalibrated register monitors conditions which 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 STATus:QUEStionable:INTegrity register.



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 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

Bit	Condition	Operation
		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

See:

– "Questionable Integrity Uncalibrated Condition" on page 1106
– "Questionable Integrity Uncalibrated Enable" on page 1106
– "Questionable Integrity Uncalibrated Event Query" on page 1107
– "Questionable Integrity Uncalibrated Negative Transition" on page 1107
– "Questionable Integrity Uncalibrated Positive Transition" on page 1108

Questionable Integrity Uncalibrated Condition

This query 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

This command determines which bits in the Questionable Integrity Uncalibrated Condition Register will set bits in the Questionable Integrity Uncalibrated Event register, which also sets the Data Uncalibrated Summary bit (bit 3) in the Questionable Integrity Register. The variable `<integer>` is the sum of the decimal values of the bits 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) 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 Uncalibrated Event Query

This query returns the decimal value of the sum of the bits in the Questionable Integrity Uncalibrated Event register.

NOTE **The register requires that the associated PTR or NTR 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

This command determines which bits in the Questionable Integrity Uncalibrated Condition register will set the corresponding bit in the Questionable Integrity Uncalibrated Event 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 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 Uncalibrated Positive Transition

This command determines which bits in the Questionable Integrity Uncalibrated Condition register will set the corresponding bit in the Questionable Integrity Uncalibrated Event 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 will be 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 results. 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.

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, e.g., `: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. See the appropriate Function parameter for more information.

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	The acquisition time parameter 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	The center frequency parameter sets the frequency that the measurement is centered around The Offset Frequency parameter 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	The DC coupled parameter allows you to specify whether the DC blocking capacitor is utilized Set this parameter 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 The detector type parameter 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 analyzer, 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 analyzer will automatically take two acquisitions using two different internal analog LO frequencies. The FFT spectra 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 analyzer 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	The electronic attenuation bypass parameter allows you to either utilize or bypass the electronic

	attenuator. The electronic attenuator is only available for frequencies up to 3.6 GHz – Set this parameter to True when using frequencies above 3.6 GHz – 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 IF Gain

Example	`:CALC:FPOW:POW1:DEF "IFGain=10"`
Notes	The IF gain parameter allows you to specify the gain at the IF stage anywhere from -6 to 16 dB (1 dB steps) This is an advanced feature, and for most cases this should remain at its default value 0 dB
Preset	0 dB
Range	-6 – 16 dB (1 dB steps)

10.2.10 IF Type

Example	`:CALC:FPOW:POW1:DEF "IFType=B25M"`
Notes	The IF type parameter 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

10.2.11 Include Power Spectrum

Example	`:CALC:FPOW:POW1:DEF "IncludePowerSpectrum=True"`

Notes	The power spectrum parameter 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: Return only channel power

10.2.12 Mechanical Attenuation

Example	`:CALC:FPOW:POW1:DEF "MechAttenuation=10"`
Notes	The mechanical attenuation value parameter 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)

10.2.13 Preamp Mode

Example	`:CALC:FPOW:POW1:DEF "PreAmpMode=Low"`
Notes	The license for the appropriate preamp is required The preamp mode parameter specifies whether the preamps are being utilized: – `Low` allows any preamps up to 3.6 GHz – `Full` allows all licensed preamps Set "ElecAttBypass=True" in order to utilize any preamps
Preset	Off
Range	Off, Low, Full

10.2.14 Resolution Bandwidth Mode

Example	`:CALC:FPOW:POW1:DEF "PreAmpMode=Low"`
Notes	The resolution bandwidth mode parameter 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

10.2.15 Resolution Bandwidth

Example	`:CALC:FPOW:POW1:DEF "ResolutionBW=25e3"`
Notes	The resolution bandwidth parameter 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

10.2.16 Trigger Delay

Example	`:CALC:FPOW:POW1:DEF "TriggerDelay=0.025"`
Notes	The trigger delay parameter sets the time after an external trigger is detected until the measurement is performed
Preset	0 s
Range	0 – 1 s

10.2.17 Trigger Level

Example	`:CALC:FPOW:POW1:DEF "TriggerLevel=2"`
Notes	The trigger level parameter sets the voltage value at which an external trigger is detected
Preset	1.2 V
Range	-5 to 5 V

10.2.18 Trigger Slope

Example	`:CALC:FPOW:POW1:DEF "TriggerSlope=Negative"`
Notes	The trigger slope parameter indicates the direction of the edge trigger voltage for detection
Preset	Positive
Range	Positive, Negative

10.2.19 Trigger Source

Example	`:CALC:FPOW:POW1:DEF "TriggerSource=Ext1"`
Notes	The trigger source parameter allows you to choose whether a measurement triggers freely, or is controlled by an external input Ext1 and Ext2 correspond to Trigger 1 In and Trigger 2 In, respectively
Preset	Free
Range	Free, Ext1, Ext2

10.2.20 Trigger Timeout

Example	`:CALC:FPOW:POW1:DEF "TriggerTimeout=0.1"`
Notes	The trigger timeout parameter sets the time for which the instrument will wait for a trigger before automatically performing the measurement
Preset	1 s
Range	0 – 1 s

10.2.21 Signal Input

Example	`:CALC:FPOW:POW1:DEF "SignalInput=Fp50MHzCW"`
Notes	The signal input parameter allows you to select between using the main RF input or the internal analyzer reference CW signal of 50 MHz
Preset	FpMainRf
Range	FpMainRf, Fp50MHzCW

10.2.22 Use Preselector

Example	`:CALC:FPOW:POW1:DEF "UsePreSelector=True"`
Notes	The preselector parameter 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), or False (preselector bypassed)

10.2.23 Channel Bandwidth Array

Example	`:CALC:FPOW:POW1:DEF "Bandwidth=[3.84e6, 5e6, 3.84e6]"`
Notes	The bandwidth parameter array 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

10.2.24 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

10.2.25 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 To use this parameter, set FilterType to `RRC` 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

10.2.26 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 OccupiedBandwidthPercent 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

10.2.27 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

10.2.28 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

10.2.29 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)

The `DEFine?` query is used to retrieve a list of all defined parameters in an ASCII string format.

The following is an example of the returned results:

```
"DCCoupled=False,ElecAttBypass=True,ElecAttenuation=0,IFGain=0,MechAttenuat
ion=0,PreAmpMode=Off,PreSelectorOffset=0,UsePreSelector=False,ExternalRefer
enceFrequency=10000000,FrequencyReferenceSource=AutoExternalFrequencyRefere
nce,IFType=B40M,LOMode=SLW,SignalInput=FpMainRf,AcquisitionTime=0.001,Cente
rFrequency=1000000000,ResolutionBW=0,ResolutionBWMode=BestSpeed,DetectorTyp
e=RmsAverage,Bandwidth=[1000000],OffsetFrequency=[0],Function=
[BandPower],FilterType=[IBW],FilterAlpha=[0.22],OccupiedBandwidthPercent=
[0.99],XdBBandwidth=
[3.01],DoNoiseCorrection=False,DoSpurSuppression=False,MeasurementMethod=Ha
rdwareFFT,IncludePowerSpectrum=False,TriggerDelay=0,TriggerLevel=1.2,Trigge
rSlope=Positive,TriggerSource=Free,TriggerTimeout=1"
```

Remote Command	`:CALCulate:FPOWer:POWer[1,2,…,999]:DEFine?`
Example	`:CALC:FPOW:POW1:DEF?`
Notes	This command query is used to retrieve a list of all defined parameters, in an ASCII format

10.4 Configure Fast Power Measurement (Remote Command Only)

The `CONFigure` command 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)

The `INITiate` command 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)

The `FETCh` command query is used to retrieve the results of an acquisition initiated by the `INIT` command. 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 as 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 command query is used as shorthand for an `INIT` command immediately followed by a `FETC?` command. 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 used as shorthand for an `INIT` command immediately followed by a `FETC?` command. The returned results are in a 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 used as shorthand for an `INIT` command immediately followed by a `FETC?` command. The returned results are in a 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]

This information is subject to change without notice.

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