R&S®CMW-KM5xx/-KS5xx
LTE UE Firmware Applications
User Manual

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Test & Measurement

User Manual

ROHDE&SCHWARZ

This user manual describes the following R&S®CMW options:

- R&S®CMW-KM500 (LTE FDD R8, TX measurement, uplink)
- R&S®CMW-KM502 (LTE FDD R10 UL CA, TX measurement, uplink)
- R&S®CMW-KM550 (LTE TDD R8, TX measurement, uplink)
- R&S®CMW-KM552 (LTE TDD R10 UL CA, TX measurement, uplink)
- R&S®CMW-KM012 (TX measurement, multi evaluation list mode)
- R&S®CMW-KS500 (LTE FDD R8, SISO, basic signaling)
- R&S®CMW-KS502 (LTE FDD R10, CA, basic signaling)
- R&S®CMW-KS510 (LTE R8, SISO, advanced signaling)
- R&S®CMW-KS512 (LTE R10, CA, advanced signaling)
- R&S®CMW-KS520 (LTE MIMO 2x2, generic signaling)
- R&S®CMW-KS521 (LTE MIMO 4x2, generic signaling)
- R&S®CMW-KS525 (LTE user-defined bands, generic signaling)
- R&S®CMW-KS550 (LTE TDD R8, SISO, basic signaling)
- R&S®CMW-KS552 (LTE TDD R10, CA, basic signaling)
- R&S®CMW-KE100 (Basic fading support: AWGN generator)
- R&S®CMW-KE500 (LTE fading profiles TS 36.521, excerpts)
- R&S®CMW-KE501 (LTE fading profiles MIMO 4x2 from TS 36.521 B2.3)

Mühldorfstr. 15, 81671 München, Germany
Phone: +49 89 41 29 - 0
Fax: +49 89 41 29 12 164
E-mail: info@rohde-schwarz.com
Internet: www.rohde-schwarz.com

The following abbreviations are used throughout this manual: R&S®CMW is abbreviated as R&S CMW.

Contents

1 Preface

The operation of the R&S CMW is described in several user manuals:

- The R&S CMW user manual describes the base software, common features of the firmware applications and basic principles for manual operation and remote control.
- Additional user manuals, like this document, describe the firmware applications.

Rohde & Schwarz provides registered users a "CMW Customer Web" section on GLORIS, the Global Rohde & Schwarz Information System: https://extranet.rohde-schwarz.com. From this resource you can download software updates, waveform library updates and documentation updates, e.g. updates of this document.

1.1 How to Read Firmware Application Chapters

Each firmware application is described in a separate chapter. These chapters can be read independently of each other. However, they are all organized as follows:

1. General Description
2. Application Sheets (optional)
3. GUI Reference
4. Programming Examples
5. Command Reference

The chapters "System Overview" and "Remote Control" in the R&S CMW user manual provide additional important information independent of the individual firmware applications. The most important parts are referenced by the firmware application descriptions.

1.1.1 General Description

This section provides a general description of the firmware application, independent of a specific operation mode (manual or remote control). It gives a high-level introduction to the capabilities of the firmware application. Background information related to the network standard is given as far as it is directly related to administrable parameters. For measurement applications a detailed description of measurement results and a description of configurable limits is given, including the relation to conformance requirements defined in network standard specifications.

1.1.2 Application Sheets

This optional section provides short application examples for select issues and related background information.

1.1.3 GUI Reference

The GUI reference describes the manual operation of the firmware application via the Graphical User Interface (GUI).

The description of a configuration dialog usually starts with a screenshot presenting the preset values of the parameters (sometimes preset values are modified to enable hidden parts of a dialog). Below the screenshot all shown parameters are described. For each single parameter a link to the corresponding command description in the "Command Reference" is provided. Ranges for numeric parameters and reset values are given there.

For measurement results links to the corresponding command descriptions are provided (commands to retrieve the results). The measurement results are described in detail in the "General Description".

1.1.4 Programming Examples

The programming examples show how to control and configure the firmware application via a remote-control program and how to retrieve measurement results. The examples consist of comprehensive command sequences. You can check just a single command of a sequence to get an example for the syntax of this single command. But you can also consider an entire sequence showing the commands in the context of a command script, under consideration of dependencies and required orders of the commands.

The command sequences are written with the intention to list most commands of the firmware application. They do not show the fastest way for a given configuration task. The fastest way would use many reset values and omit the corresponding commands.

The examples are referenced by the command descriptions of the "Command Reference".

1.1.5 Command Reference

The command reference provides information on the remote commands of the firmware application. The commands are grouped according to their function.

Each command description indicates the syntax of the command header and of the parameters. For input parameters the allowed ranges, reset values and default units are listed, for returned values the expected ranges and default units. Most commands have a command form and a query form. Exceptions are marked by "Setting only", "Query only" or "Event". Furthermore a link to the "Programming Examples" is provided and the first software version supporting the command is indicated.

2 LTE Signaling

The "LTE signaling" firmware application emulates an E-UTRAN cell and communicates with the UE under test. The UE can synchronize to the downlink signal and attach to the PS domain. A connection can be set up (3GPP compliant RMC or user-defined channel).

Two basic signaling options are available: R&S CMW-KS500 for R8 FDD signals and R&S CMW-KS550 for R8 TDD signals. At least one of these basic options is required to use the signaling application. Both basic options support only configurations with a single antenna (SISO).

The basic functionality can be enhanced via the following options:

- R&S CMW-KS502 adds support of DL carrier aggregation for FDD signals.
  R&S CMW-KS552 adds support of DL carrier aggregation for TDD signals.
- R&S CMW-KS510 provides advanced parameter settings for R8.
- R&S CMW-KS512 provides advanced parameter settings for R10.
- R&S CMW-KS520 adds support of DL beamforming, MIMO 2x2 and SIMO 1x2.
  R&S CMW-KS521 is additionally required for DL MIMO 4x2.
- R&S CMW-KS525 adds a user-defined operating band with configurable band indicator, frequencies and channel numbers.
- R&S CMW-KE100 and R&S CMW-KE500 enable internal fading.
  R&S CMW-KE501 is additionally required for MIMO 4x2 fading.

Tests can be performed using the LTE "Multi Evaluation" measurement, the "PRACH" measurement or the "SRS" measurement (all included in the options R&S CMW-KM500 and R&S CMW-KM550).

Data transfer tests can be performed using the Data Application Unit (DAU, option R&S CMW-B450x and R&S CMW-KM050). The DAU also provides an IMS server for voice over IMS and SMS over IMS. Audio tests can be performed using the audio board plus a speech codec (R&S CMW-B400B and R&S CMW-B405A).

The "LTE signaling" application provides additional measurements. For details refer to:

- chapter 2.3.1, "Combined Signal Path Measurements", on page 78
- chapter 2.2.18, "Relative Power Control Tests", on page 63
- chapter 2.3.2, "LTE IP-Based Data Tests", on page 82
- chapter 2.2.19, "Extended BLER Measurement", on page 66
- chapter 2.2.20, "RLC Throughput Measurement", on page 76

2.1 What's New in this Revision

This revision describes version 3.2.82 and later of the "LTE Signaling" firmware application. Compared to version 3.2.81, it provides the following new features and changes:

- The PCC scheduling can be copied to an SCC, see Copy (Button)

- Support of operating band 29 for LTE neighbor cells, see Neighbor Cell Settings
- Additional spectrum emission: new values NS_19, NS_21 to NS_24, see Additional Spectrum Emission
- Additional RMCs for transmission mode 7 and 8, see Scheduling Type RMC
- More flexible PDCCH settings, see PDCCH
- Reset value changed for the SPS interval, see SPS Configuration

V3.5.x Features

The following described features are available as beta software V3.5.x. They are not included in V3.2.82 and are not yet released:

- New scenarios "3CC..." for carrier aggregation with three downlink carriers (one PCC plus two SCCs), see Scenario, Fading

Software Version

To check your R&S CMW software version, open the "Setup" dialog and click "HW/SW Equipment". The initial software version for each remote control command is quoted in the reference description.

2.2 General Description

The following sections describe how to use the R&S CMW for LTE signaling tests and provide background information.

2.2.1 Test Setups

The following sections provide an overview of typical test setups for the individual scenarios.

2.2.1.1 Test Setup for Scenario 1 Cell - 1 RF Out

The basic test setup for a "1 Cell - 1 RF Out" scenario uses a bidirectional RF connection between the tester and the device under test (DUT). It carries both the downlink and the uplink signal:

- The R&S CMW transmits the downlink signal to which the DUT can synchronize in order to perform an attach. The downlink signal is used to transfer signaling messages and user data to the DUT.
- The DUT transmits an uplink signal that the R&S CMW can receive and decode in order to set up a connection and perform various measurements.

For this setup, the DUT is connected to one of the bidirectional RF COM connectors at the front panel of the R&S CMW. No additional cabling and no external trigger are needed. The input level ranges of all RF COM connectors are identical.

See also: "RF Connectors" in the R&S CMW user manual, chapter "Getting Started"

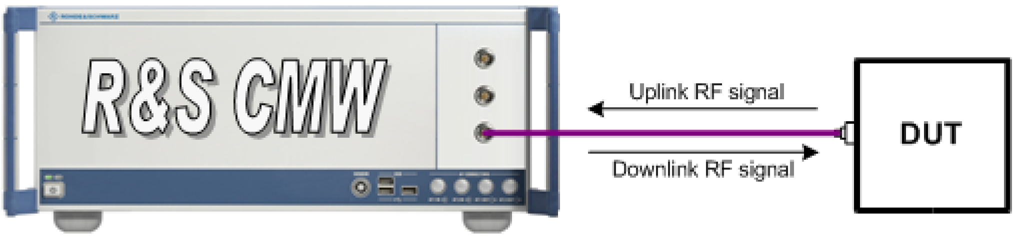


Fig. 2-1: Test setup for "1 Cell - 1 RF Out"

2.2.1.2 Test Setup for Scenario 1 Cell - 2 RF Out

The scenario "1 Cell - 2 RF Out" is used for setups with two UE RX antennas (SIMO 1x2, MIMO 2x2, MIMO 4x2 and beamforming). A test setup for this scenario involves one uplink and two downlink signals at the UE side. Typically, one bidirectional connection carries one uplink and one downlink signal. An additional connection carries the second downlink signal. The two downlink signals must be transmitted via different TX modules and different RF connectors, which implies that the instrument must support at least two TX paths. You can use for example RF 1 COM for the bidirectional connection and RF 3 COM for the second downlink connection.

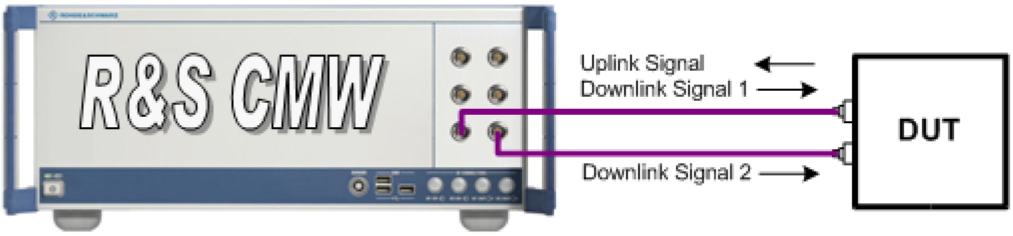


Fig. 2-2: Test setup for "1 Cell - 2 RF Out"

Using several signaling applications in parallel

Depending on the installed hardware and software options, you can run several signaling application instances in parallel.

Example: Assume an instrument with two Signaling Unit Wideband (SUW), one Signaling Unit Universal (SUU), four TX paths and four RX paths.

This instrument allows you to run for example:

- Two LTE signaling instances using the "1 Cell - 2 RF Out" scenario, or
- Two LTE signaling instances using the "1 Cell - 1 RF Out" scenario, plus one instance of an SUU signaling application (e.g. GSM / CDMA2000)
- One LTE signaling instance using the "1 Cell - 2 RF Out" scenario, plus one instance of an SUW signaling application (e.g. WCDMA)
- One LTE signaling instance using a carrier aggregation scenario with or without MIMO

The LTE and WCDMA signaling applications both use the SUW. Signaling instance 1 uses SUW1, while instance 2 uses SUW2. An SUW can only be used by one instance at a time. You can run for example LTE signaling instance 2 and WCDMA signaling instance 1 in parallel, but not instance 1 of both applications.

2.2.1.3 Test Setup for Scenario 1 Cell - 4 RF Out

The scenario "1 Cell - 4 RF Out" is used for MIMO 4x2 setups, where the four TX antenna signals must be available at the RF connectors. Typically, an external RF fader is inserted into the downlink connection and one bidirectional connection carries one uplink and one downlink signal. Three additional connections carry the other downlink signals.

All downlink signals must be transmitted via different TX modules and different RF connectors, which implies that the instrument must support four TX paths and must be equipped with two signaling units SUW.

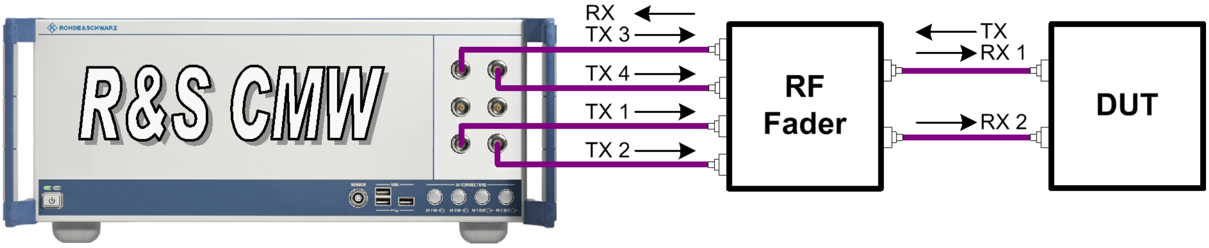


Fig. 2-3: Test setup for "1 Cell - 4 RF Out"

2.2.1.4 Test Setup for Carrier Aggregation Scenarios

The Carrier Aggregation (CA) scenarios allow you to establish a Release 10 connection with several component carriers in the downlink. There is always one Primary Component Carrier (PCC) and optionally one or two Secondary Component Carriers (SCC).

Depending on the scenario, a downlink carrier can have one output path (SISO) or two output paths (for example MIMO nx2). In total, up to four output paths are supported.

So a test setup for carrier aggregation involves one uplink and two, three or four downlink signals. Each output path must use a different TX module. The two output paths of a carrier must use different RF connectors.

With an advanced frontend, you can route two output paths to the same connector. This allows you to choose the optimum test setup depending on the number of RX antenna connectors of your UE. There is no need for external combiners.

The following example setup is suitable for CA with four downlinks and a UE with only two antenna connectors. There are two PCC downlinks (MIMO) and two SCC downlinks (one MIMO SCC or two SISO SCCs).

RF 1 COM is used for the uplink, the first PCC downlink and the first SCC downlink. RF 3 COM is used for the second PCC downlink and the second SCC downlink.

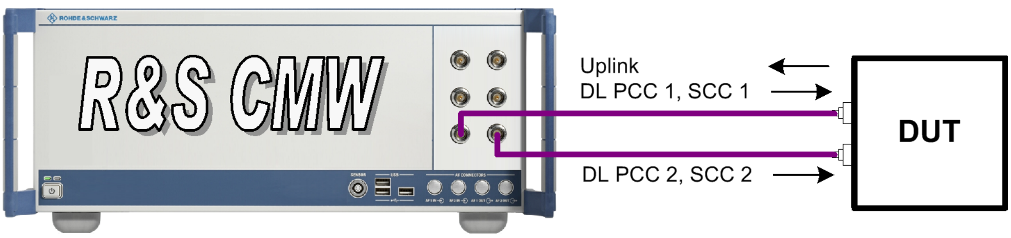


Fig. 2-4: Test setup for CA, four DL, 2 DUT antenna connectors

For a UE with four antenna connectors, the following test setup could be used instead. Each downlink signal is now routed to a different connector.

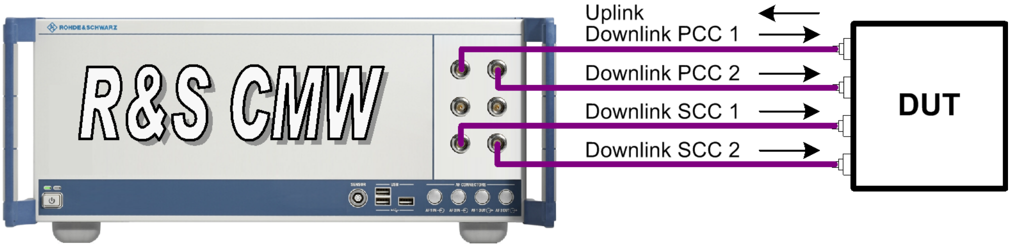


Fig. 2-5: Test setup for CA, four DL, 4 DUT antenna connectors

For CA with two downlinks, you could for example use only RF 1 COM (uplink, PCC downlink and SCC downlink). Or you could use RF 1 COM (uplink and PCC downlink) and RF 3 COM (SCC downlink).

2.2.1.5 Test Setup for Scenario IQ out - RF in

For the scenario "IQ out - RF in" the uplink RF signal is routed via an RF COM connector at the front panel. The downlink digital I/Q signal is routed via a DIG IQ OUT connector at the rear panel. This connector is only available if an I/Q board is installed (option R&S CMW-B510x/-B520x). Additional instruments can be inserted into the downlink path to manipulate the downlink signal.

A typical use case is to insert an R&S SMU200A into the downlink path to superimpose fading on the downlink signal. The following figure provides an overview of this setup. In this example the R&S SMU200A is synchronized to a 10-MHz reference signal provided by the R&S CMW. It is also possible to synchronize the R&S CMW to the R&S SMU200A.

The following figure shows a possible rear panel cabling using the first I/Q board (DIG IQ 1 to 4).

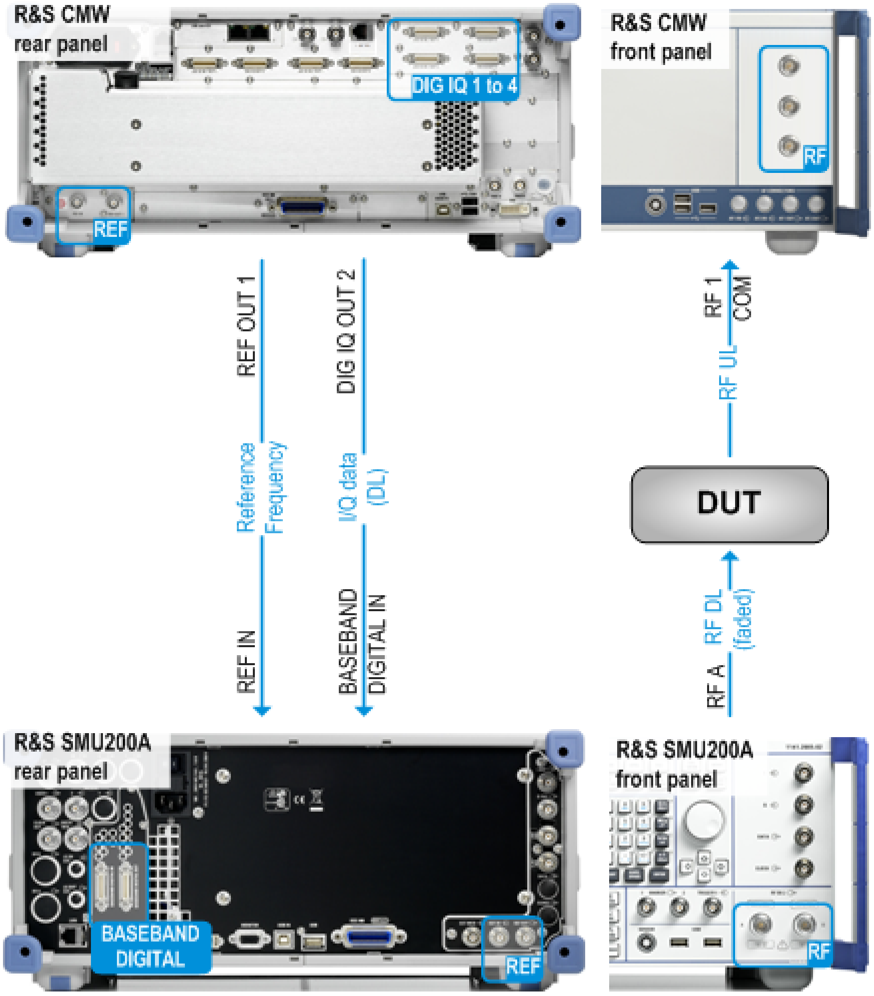


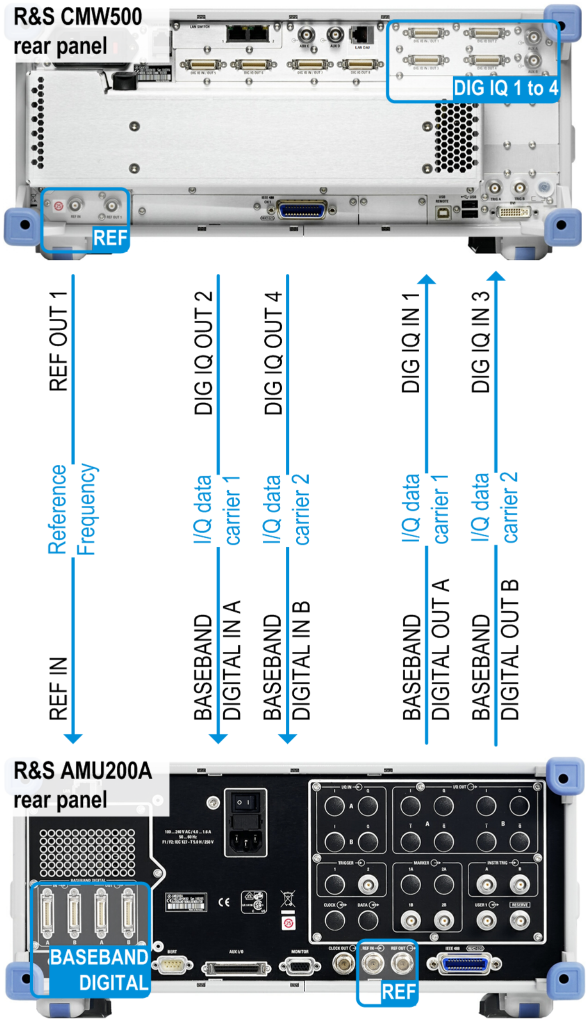
Fig. 2-6: Test setup for scenario "IQ out - RF in" (example)

2.2.1.6 Test Setup for External Fading Scenarios

In order to superimpose fading on the baseband signal, you can integrate an R&S AMU200A into a test setup. The R&S AMU200A must be connected to the digital I/Q interface of the R&S CMW. At least one I/Q board must be installed at the R&S CMW for that purpose (option R&S CMW-B510x/-B520x).

All connections between R&S CMW and R&S AMU200A are established via the rear panels of the instruments.

The following figure shows a setup with two downlink paths using the first I/Q board (DIG IQ 1 to 4).



For a setup with only one downlink path you need only two of the four I/Q data connections.

For MIMO 4x2 fading, you need two R&S AMU200A and two I/Q boards. One R&S AMU200A is connected to the first I/Q board, the other to the second I/Q board. To synchronize the external faders, you need a trigger signal. Route an LTE signaling trigger signal to the TRIG A R&S CMW connector and feed the signal to the external faders.

The RF connections between R&S CMW and DUT must be established in the same way as without external fading.

2.2.1.7 Test Setup for Internal Fading Scenarios

For internal fading scenarios, the test setup is the same as for the corresponding scenario without fading.

2.2.2 Initiating Signaling Tests

The signal generator of the "LTE signaling" application is controlled like any realtime signal generator, see chapter 2.4.2, "Signaling Control", on page 115.

The LTE downlink signal is turned on as long as the "LTE Signaling" softkey indicates the "ON" state. After switching on, wait until the hour glass symbol has disappeared.

When DL signal transmission has been turned on, the connection states can be controlled via hotkeys at the R&S CMW and via actions at the UE.

The default settings of the R&S CMW generally ensure a DL signal with suitable characteristics for connection setup. The most important settings can be modified directly in the main view.

Performing measurements

The required settings vary depending on the measurement to be performed. However, the following general procedure is applicable to most measurements.

1. Connect your UE to the R&S CMW (see chapter 2.2.1, "Test Setups", on page 13).
2. Open the "LTE signaling" firmware application.
3. Configure the signaling application according to the test to be performed.
4. To turn on the DL signal, press ON | OFF and wait until the "LTE Signaling" softkey indicates the "ON" state and the hour glass symbol has disappeared.
5. Switch on the UE.

   The UE synchronizes to the DL signal and attaches. Note the connection states displayed in the main view.
6. If the RRC connection has been released after the attach, set up a connection. You can configure, whether the RRC connection is kept or not, see "Keep RRC Connection" on page 169.
7. To switch to the measurement application, press the "LTE TX Meas" or "LTE Ext BLER" softkey. The LTE extended BLER measurement is provided by the "LTE Signaling" firmware application. The LTE TX measurements are available as option R&S CMW-KM500/-KM550.
8. Configure and start the measurement.

If the UE fails to attach

Check the following R&S CMW settings:

- The "Duplex Mode" must be supported by the UE.
- The "Frequency" of the generated DL signal must be within the frequency band supported by the UE.
- The "Downlink Power Levels", especially the "RS EPRE" must be sufficient so that the UE under test can receive the DL signal.
- The "Uplink Power Control" settings must be appropriate so that the UL signal is strong enough to be received and decoded by the R&S CMW.

- The UE capabilities must be in accordance with the security settings in the "Network" section of the configuration dialog.
  The attach procedure can fail if authentication or security is disabled but the UE expects/requires an authentication or security procedure. It can also fail if authentication or security is enabled but not supported by the UE or the secret key does not match.
  An appropriate USIM can be obtained from Rohde & Schwarz (R&S CMW-Z04, stock no. 1207.9901.02).
- Some UEs need a DL signal without padding bits for attach. You can disable downlink padding in the "Connection" section of the configuration dialog.

If the measurement does not start

If the measurement does not start at all while the signaling application generates a downlink signal, verify that the combined signal path scenario is selected in the measurement.

2.2.3 Carrier Aggregation

Carrier aggregation (CA) is an LTE-Advanced Release 10 feature. It aggregates several component carriers in order to reach a higher bandwidth. Each single component carrier is compliant with Release 8.

The R&S CMW supports the aggregation of two or three downlink carriers. With three 20 MHz carriers, you can reach a total bandwidth of 60 MHz.

The carriers can be located in the same operating band or in different operating bands. They can use a continuous spectrum or there can be gaps between the carriers. So all kinds of carrier aggregation are supported: intra-band contiguous CA, intra-band non-contiguous CA and inter-band CA.

Most settings can be configured independently per carrier, for example the carrier frequency, bandwidth, downlink power, scheduling type and related channel settings.

According to 3GPP, a connection setup with carrier aggregation is a two-step procedure. In the first step, a Release 8 single carrier connection is set up. The used carrier is called Primary Component Carrier (PCC). In the second step, one or more additional carriers are added, called Secondary Component Carrier (SCC). The individual SCCs are distinguished via a number (SCC1, SCC2, ...).

Access procedures like cell search, cell selection and initial random access are only performed on the PCC, not on the SCCs. The SCCs are added, deleted or modified using an "RRC Connection Reconfiguration" message.

Options required for carrier aggregation:

- R&S CMW-KS502 for FDD carrier aggregation
- R&S CMW-KS552 for TDD carrier aggregation
- R&S CMW-KS512 for aggregation of more than two carriers and advanced carrier aggregation settings
- One Signaling Unit Wideband (SUW) and one TX path per component carrier
  With MIMO nx2, two TX paths per component carrier

- For carrier aggregation with MIMO: MIMO software options R&S CMW-KS52x, as for MIMO without carrier aggregation

2.2.3.1 Setting up a Connection with Carrier Aggregation

The following procedure describes how to set up a downlink connection with several component carriers.

1. Connect your UE to the R&S CMW (see chapter 2.2.1.4, "Test Setup for Carrier Aggregation Scenarios", on page 15).
2. Select a scenario with carrier aggregation and configure the RF settings for the carriers. The DL channels of the carriers must not overlap.
3. Configure the SCC activation mode as desired, see "SCC Activation Mode" on page 124.
4. Configure any other signaling application settings as desired, for example DL power, cell setup and connection settings.
   If you change the physical cell ID or the E-UTRAN cell identifier, set a different value for each carrier.
   The connection setting "Keep RRC Connection" must be enabled if automatic SCC activation shall be used or if an SCC shall be added in packet switched state "Attached".
5. To turn on the primary cell signal, press "ON | OFF" and wait until the "LTE Signaling" softkey indicates the "ON" state and the hour glass symbol has disappeared.
6. Switch on the UE.

   The UE synchronizes to the DL signal and attaches. Note the packet switched state in the main view and wait until it equals "Attached".
7. If the RRC state is "Idle", press the "Connect" hotkey to set up an RRC connection on the PCC.
   Note the RRC state displayed in the main view and wait until it equals "Connected".
8. Depending on the configured SCC activation mode, the SCCs have already been added and activated automatically, or you can now activate them manually via hotkeys. All hotkeys are related to a single SCC. If the "PCC" tab is selected, the hotkeys affect SCC1. If an SCC tab is selected, the hotkeys affect the corresponding SCC.
   - Mode "Auto":
     The SCCs have been added and activated upon UE attach if the setting "Keep RRC Connection" is enabled. Otherwise, press the "Activate MAC" hotkey to add and activate an SCC.
   - Mode "Semiautomatic":
     Press the "Activate MAC" hotkey to add and activate an SCC.
   - Mode "Manual":

To add and activate an SCC, press the hotkey "SCC On", then "SCC add RRC", then "SCC activate MAC".

Note the SCC state displayed in the main view. After successful SCC activation, the state is "MAC Activated".

2.2.4 External Fading

An external fading scenario allows you to route the downlink baseband signal to an R&S AMU200A that superimposes fading on the signal and routes it back. Thus fading can be added to the downlink signal.

Configuring and activating fading

1. Connect the DUT and the R&S AMU200A to the R&S CMW (see chapter 2.2.1.6, "Test Setup for External Fading Scenarios", on page 17).
2. Configure the signaling application according to the test to be performed, especially select an external fading scenario and configure the downlink settings.
3. In the configuration tree, section "IQ Settings > IQ Out", note the "Baseband PEP" and the "Crest Factor".
4. Configure the R&S AMU200A, especially the following settings:

   Reference oscillator settings:
   - Source = External
   - External Reference Frequency = 10 MHz

   Baseband input settings for all used connectors:
   - Sample Rate = User-Defined, 100 MHz
   - Baseband Input Level: enter the crest factor and the PEP displayed in step 3.

   Digital I/Q output settings for all used connectors:
   - Sample Rate = User-Defined, 100 MHz
   - Set Level Via = PEP
   - PEP = PEP value displayed in step 3
5. In the R&S AMU200A, activate fading and note the signal level. If you add noise to the signal, note the signal level without noise.
6. Configure the I/Q input of the R&S CMW:
   In the configuration tree, section "IQ Settings > IQ In > Baseband Level", enter the signal level noted in the previous step.
   Alternatively it is also possible, to specify the signal output level of the R&S AMU200A, to note the resulting PEP and to enter this PEP value at the R&S CMW for "Baseband PEP". But this is not recommended.
7. Turn on the downlink signal at the signaling application and set up a connection.

   The configuration is now complete. Fading is active.

A reconfiguration of the settings at the R&S AMU200A during an active connection to the DUT may result in the loss of the connection or in erroneous measurement results.
After a reconfiguration of the baseband input settings of the R&S AMU200A, turn the downlink signal at the signaling application off and on again.

2.2.5 Internal Fading

Testing under realistic air interface conditions is important in order to verify the receiver performance and the correct operation of the protocol stack implementation. For example, block error rates, throughput performance and correct operation of layer 1 procedures like Hybrid Automatic Repeat Request (HARQ) retransmission can be evaluated.

The internal fading module comes with a fading simulator and AWGN generator that can be selectively enabled. It manipulates the generated downlink I/Q data stream to emulate typical signal conditions at the receiver.

The following options are required to use the internal fading simulator in LTE:

- fader I/Q board R&S CMW-B510F and/or R&S CMW-B520F (depends on scenario)
- option R&S CMW-KS510 "LTE R8, SISO, advanced signaling" for scenarios without carrier aggregation
- option R&S CMW-KS512 "LTE R10, CA, advanced signaling" for scenarios with carrier aggregation
- option R&S CMW-KE100 "Basic Fading support: AWGN generator"
- option R&S CMW-KE500 "LTE Fading Profiles TS 36.521, excerpts"
- option R&S CMW-KE501 "LTE Fading Profiles MIMO 4x2 from TS 36.521 B2.3" for MIMO 4x2

2.2.5.1 Fading Simulator

Multi-path fading is an effect which occurs in real world situations. A signal sent from the base station follows the direct line of sight and/or takes routes with reflections. At the receiving antenna this leads to a sum of phase shifted and, if the receiver is moving, frequency shifted signals.

The internal fading simulator supports multipath propagation conditions defined in Annex B.2 of 3GPP TS 36.101.

A faded signal has a higher crest factor than an unfaded one. In order to avoid distortion, the baseband signal must be attenuated before entering the fading module. The necessary attenuation (insertion loss) depends on the selected fading profile.

In LTE signaling, the insertion loss at the baseband level can be calculated automatically or set manually. It is automatically compensated on the HF level. This implies a shift of the allowed DL power range to the same extent, but in opposite direction.

2.2.5.2 AWGN Generator

Additional White Gaussian Noise (AWGN) is typically modeled in receiver tests, because it can lead to a decrease of throughput. The quality of the received signal is affected by the ratio of the signal power to the surrounding traffic noise level (signal to noise ratio). The modulated signals from neighbor cells simply appear as noise. This effect is simulated by adding AWGN to the signal.

The internal fading module supports AWGN insertion with configurable bandwidth and signal to noise ratio. Insertion loss at the baseband level is calculated and compensated automatically at the HF.

AWGN insertion via the signaling unit is disabled for fading scenarios (see "AWGN" on page 141).

2.2.6 Data Tests and Voice Over LTE

The LTE signaling application provides a test mode, using only layer 1 and 2 of the protocol stack. And it provides a data application mode that supports also layer 3.

To use the data application mode, you need the following options in addition to the "LTE signaling" application:

- Data Application Unit (DAU, R&S CMW-B450x, mandatory)
- IPv4 enabler (R&S CMW-KA100, mandatory)
  IPv6 enabler (R&S CMW-KA150, optional)
- DAU measurements (R&S CMW-KM050, optional)
- IMS server (R&S CMW-KAA20, optional)
- Installed DAU software package

If there is no space left for installation of a DAU in your instrument, you can install all these options in another R&S CMW and access the external DAU via LAN. For such a setup, you need additionally R&S CMW-KA120, both on the instrument hosting the external DAU and on the instrument where the LTE signaling application is running.

In data application mode, you can perform IP-based data tests using the DAU measurements or you can perform an RLC throughput measurement. You can also use the IMS server provided by the DAU to set up a Voice over LTE (VoLTE) call.

For further reference:

- chapter 2.2.20, "RLC Throughput Measurement", on page 76
- chapter 2.3.2, "LTE IP-Based Data Tests", on page 82
  This application sheet describes how to set up an LTE connection in data application mode and provides some examples for IP-based data tests.
- chapter 2.3.3, "VoLTE Call Setup and Audio Tests", on page 86
  This application sheet describes how to set up a VoLTE call and how to perform basic audio tests for the established call.
- "Data Application Unit" documentation
- "External DAU" on page 167

2.2.7 Audio Tests and Speech Quality Tests

You can connect the LTE signaling application to the speech codec of an installed audio board. This allows you, to feed an audio signal into an RF connection to the UE or to extract an audio signal from the RF connection, in order to perform audio measurements. You can for example connect the R&S UPV to the audio board of the R&S CMW and perform a speech quality analysis.

To set up a voice over LTE connection, you need the DAU, see chapter 2.2.6, "Data Tests and Voice Over LTE", on page 24.

To connect the LTE signaling application to the speech codec, you need the following options in addition to the "LTE signaling" application:

- Audio board, R&S CMW-B400B
- Speech codec, R&S CMW-B405A
- LTE R8, SISO, advanced signaling, R&S CMW-KS510
- Installed audio software package

For further reference:

- chapter 2.3.3, "VoLTE Call Setup and Audio Tests", on page 86
  This application sheet describes how to set up a VoLTE call and how to perform basic audio tests for the established call.
- "Audio Measurements" documentation

2.2.8 Connection States

An LTE connection is always a packet-switched connection. In uplink direction, there is only one carrier. In downlink direction, there can be several carriers (carrier aggregation).

A connection setup with carrier aggregation is a two-step procedure. In the first step, a Release 8 single carrier connection is set up. The used carrier is called Primary Component Carrier (PCC). In the second step, the additional carriers are added, called Secondary Component Carrier (SCC1, SCC2, ...).

The related connection states are described in the following sections. For a connection without carrier aggregation, only the packet-switched states are relevant.

2.2.8.1 Packet-Switched States

The main connection states related to the primary packet-switched connection are described in the following table. They are related to the PCC downlink connection and to the uplink connection. The states are displayed in the main view as "Packet Switched" (PS) state.

PS State	Description
(Cell) Off	No downlink signal transmission
(Cell) On	The R&S CMW emulates an E-UTRAN cell, transmitting an LTE signal to which the UE can synchronize. After synchronization, the UE can initiate an attach towards the instrument.
Attached	Synchronization and attach have been performed. A default bearer has been established. Depending on parameter Keep RRC Connection a Radio Resource Control (RRC) connection is still established or has been released. To send or receive SMS messages, to start an inter-RAT handover or to establish an SCC connection, an established RRC connection is required.
Connection Established	A dedicated bearer has been set up. An RRC connection has been established (during attach or during connect). User data can be exchanged via shared channels. The R&S CMW can vary connection parameters, perform transmitter and receiver tests, or initiate a handover.

A number of control commands initiated by the instrument or by the UE switch between the listed states. The following figure shows possible state transitions.

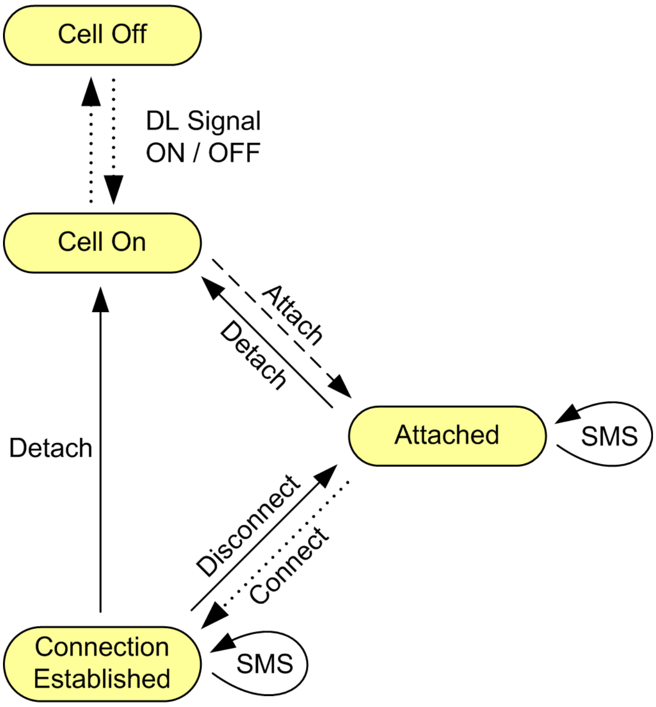


Fig. 2-7: PS state transitions

Dotted line = Action initiated by instrument
Dashed line = Action initiated by UE
Solid line = Action initiated by UE or instrument

In addition to the main states shown in the table and the figure the instrument indicates the following transitory states:

- **Signaling in Progress**
  Displayed e.g. during attach or when the channel changes for an established connection.

- **Connection in Progress**
  Displayed during connection setup.
- **Sending Message**
  Displayed while an SMS message is sent to the MS.
- **Receiving Message**
  Displayed while an SMS message is received from the MS. To check the received message, see chapter 2.4.15.2, "Incoming SMS", on page 195.
- **Incoming Handover in Progress**
  Displayed while a handover is received (not for handover within signaling application).
- **Outgoing Handover in Progress**
  Displayed while a handover to another signaling application / instrument is performed.
- **Disconnect in Progress**

Additional transitions and handover

The transitions in figure 2-7 are not complete. The "Off" state can be reached from any state by turning off the cell signal (ON | OFF). Moreover, incidents like an alerting timeout or a loss of the radio link cause additional transitions.

A handover within the signaling application can be performed in the "Connection Established" state. An inter-RAT / inter-instrument redirection can also be performed in the "Attached" state (established RRC connection required).

2.2.8.2 SCC States

The state of each Secondary Component Carrier (SCC) is displayed in the main view and described in the following table.

SCC State	Description
(SCC) Off	No downlink signal transmission via the SCC frequency
(SCC) On	An SCC downlink signal is transmitted, including synchronization signals, reference signal and system information. The UE is not yet informed about the SCC and ignores it. Prerequisite: Packet-switched state at least "Cell On"
RRC Added	An "RRC Connection Reconfiguration" message has been sent to the UE via the PCC. The UE has acknowledged this message. In this state, the UE is informed about the presence of the SCC and knows important SCC properties like the carrier frequency. Prerequisite: RRC connection established on the PCC (packet-switched state "Attached" or "Connection Established", depending on parameter Keep RRC Connection)
MAC Activated	The SCC has been activated via a MAC message, sent to the UE via the PCC. The UE has acknowledged this message. After SCC activation, the SCC scheduling is started. The scheduling information is sent to the UE via the PDCCH of the SCC (cross-carrier scheduling is not used).

You can set up the SCC automatically, semiautomatically or manually:

- Manual activation means that you initiate each state transition step separately.

- Semiautomatic activation means that you initiate the complete SCC setup. So one action initiates all transitions from "SCC Off" to "MAC Activated".
- Automatic activation means that the UE attach triggers also the setup of the SCC ("Keep RRC Connection" must be enabled).

The following figure shows the transitions between the SCC states.

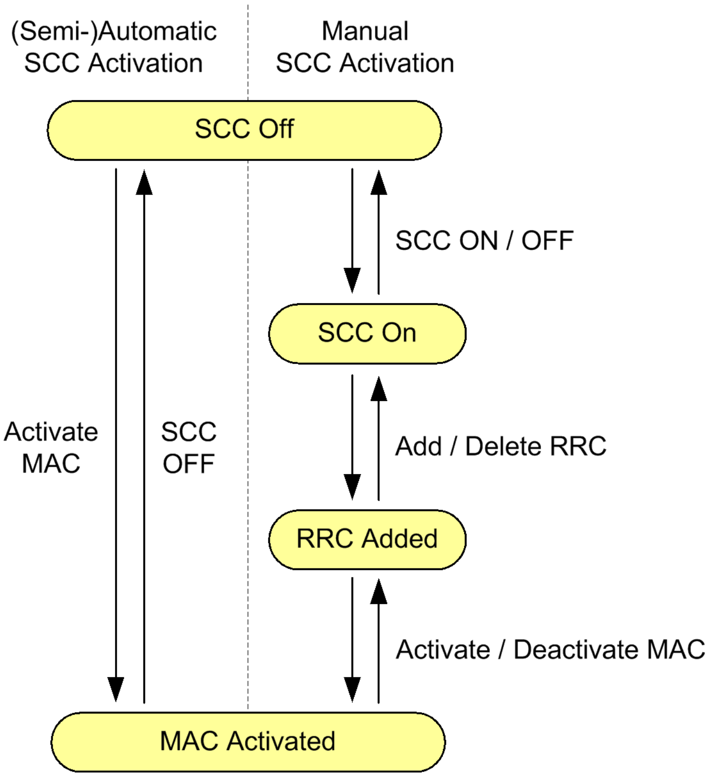


Fig. 2-8: SCC state transitions

For selection of the mode, see "SCC Activation Mode" on page 124.

Additional transitions

The transitions in figure 2-8 are not complete. The "SCC Off" state can be reached at any time by releasing the RRC connection, for example by turning off the PCC cell signal. Incidents like a loss of the radio link also cause transitions.

2.2.9 Handover

The LTE signaling application supports a handover within the signaling application, a handover to another signaling application (e.g. to the WCDMA signaling application) and also a handover to an external instrument (e.g. another R&S CMW or an R&S CMU 200).

The following handover mechanisms are supported:

- Blind handover:

The R&S CMW performs an RRC connection reconfiguration.
This mechanism is only relevant for a handover within the signaling application. It supports changing the operating band and the channel, but not the cell bandwidth.

- Redirection:
  The R&S CMW performs an RRC connection release with redirection information.
  This mechanism is relevant for a handover within the signaling application as well as for a handover to another signaling application or another instrument.
  For a handover within the signaling application, it is possible to change the operating band, the channel and the cell bandwidth. A new connection with the changed parameters is established.
  A handover to another signaling application or instrument results in a new registration of the UE at the handover destination. No new connection is set up.
- Mobile terminating circuit switched fallback:
  The R&S CMW informs the UE via a CS service notification about an incoming mobile terminating call. The UE answers with an extended service request with Circuit Switched Fallback (CSFB) response. Then the R&S CMW performs an RRC connection release with redirection information. The UE sends a paging response to the handover destination and a new CS connection is established by the target signaling application.
  This mechanism is only supported for handover to another signaling application. Supported technologies are for example GSM and WCDMA. The target signaling application can be located at the same instrument or at another R&S CMW.
  Option R&S CMW-KS510 is required.

For a handover to another instrument, there is no communication at all between the two instruments and no cabling between the two instruments is required. The UE must be connected to both instruments, e.g. via an external combiner.

To perform a handover, proceed as follows:

1. For a handover within the signaling application, select the handover mechanism to be used, see "Operating Band Change, Frequency Change" on page 178.
2. For a handover to another signaling application, ensure that the two signaling applications use different RX/TX modules ("Converter" setting).
3. In the LTE signaling application, establish a connection to the UE.
4. Press the hotkey "Inter/Intra-RAT". A configuration dialog box opens.
5. Configure the settings in the dialog:
   a) Select the handover target - either the LTE signaling application or another signaling application or "No Connection" for an external instrument.
   b) For a handover to another signaling application, select the "Mobility Mode" (handover mechanism to be used).
   c) Configure the destination parameters. For a handover to an external instrument the parameters must reflect the actual configuration of the external instrument.
   d) If you have selected another signaling application as target, the target cell is activated automatically (downlink signal switched on). Wait until the cell icon includes "RDY" to indicate that the handover target is ready to receive the handover.

6. Press the button "Execute".

   You can monitor the process in the "Event Log" area of the main view of the signaling applications.

If you want to reconfigure only one parameter of the LTE signaling application, you can also do this directly, without using the "Inter/Intra-RAT" hotkey. Simply modify the channel or the operating band or the cell bandwidth during an established connection. The R&S CMW then initiates a redirection procedure to reconfigure the parameter.

2.2.10 Physical DL Channels and Signals

This section provides an overview of the LTE downlink radio resources, physical channels and physical signals.

See also chapter 2.2.16, "Operating Bands", on page 59.

2.2.10.1 Resources in Time and Frequency Domain

The DL radio resources in an LTE system are divided into time-frequency units called resource elements. In the time domain a resource element corresponds to one OFDM symbol. In the frequency domain it corresponds to one subcarrier (see next figure).

For the mapping of physical channels to resources, the resource elements are grouped into resource blocks (RB). Each RB consists of 12 consecutive subcarriers (180 kHz) and six or seven consecutive OFDM symbols (0.5 ms).

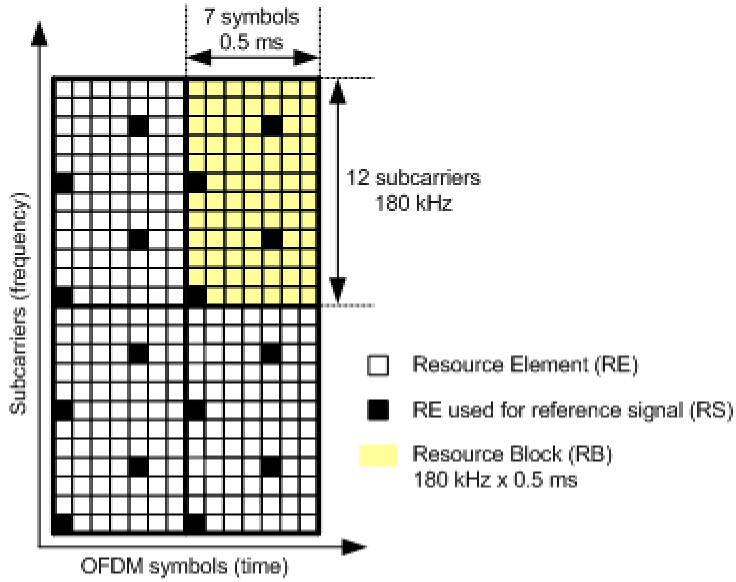


Fig. 2-9: Resource element grid (7 OFDM symbols per RB, 1 TX antenna)

The positions of resource elements carrying reference signals (pilots) are standardized and depend on the number of transmit antennas. The preceding figure applies to single-antenna configurations. If more than one transmit antenna is used, each antenna uses different resource elements for reference signals. These resource elements are reserved for one antenna and not used at all by the other antennas. The following figure shows the resource element grid for a two transmit antenna configuration, used e.g. for MIMO 2x2.

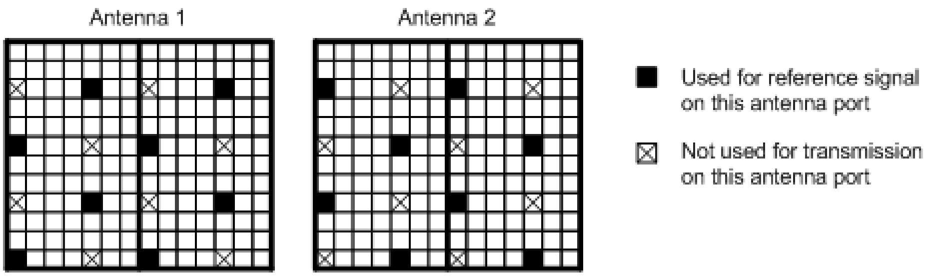


Fig. 2-10: Resource element grids for 2 TX antennas

The smallest resource unit that can be assigned to a UE consists of two resource blocks (180 kHz, 1 ms). The assignment of resources to a UE can vary in time and frequency domain (see next figure).

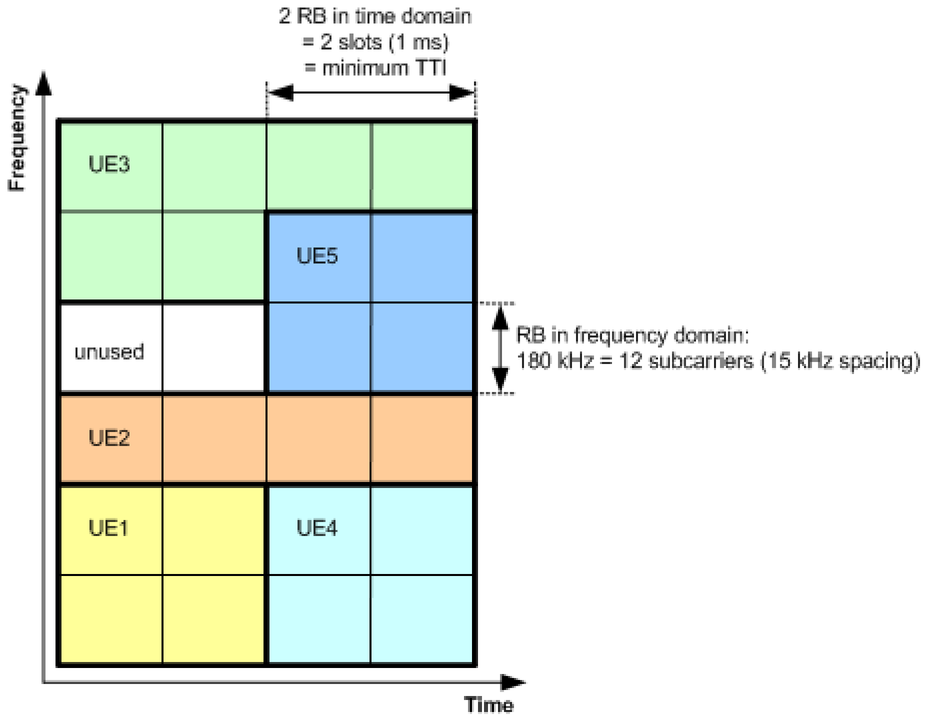


Fig. 2-11: Assignment of Resource Blocks (RB) to UEs

In the time domain the additional units radio frame, subframe and slot (containing the OFDM symbols) are defined. A guard time called Cyclic Prefix (CP) is added to each OFDM symbol. Depending on the duration of the guard time, it is either called normal CP or extended CP and the slot contains either seven or six OFDM symbols.

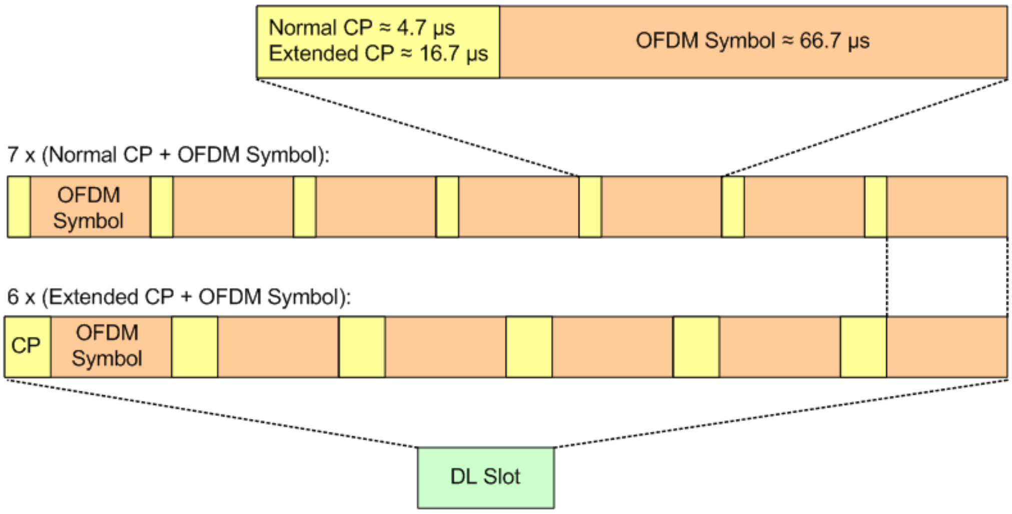


Fig. 2-12: LTE DL slot structure

The radio frame structure depends on the duplex mode. An FDD DL radio frame contains 20 DL slots, grouped into 10 subframes.

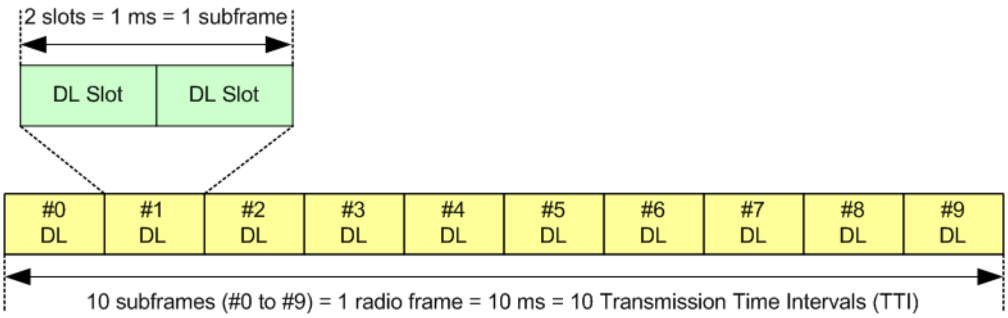


Fig. 2-13: LTE DL frame structure for FDD

A TDD radio frame is also divided into 10 subframes. But for TDD three subframe types are defined: DL subframe (two DL slots), UL subframe (two UL slots) and special subframe. A special subframe contains the fields DwPTS, GP and UpPTS. 3GPP defines several possible special subframe configurations, resulting in different lengths of these fields, see 3GPP TS 36.211, table 4.2-1. The total length of a special subframe equals 1 ms (same length for all subframe types).

The type of subframe number 0, 1, 2 and 5 is fixed. The type of the other subframes depends on the used UL-DL configuration, see table 2-1.

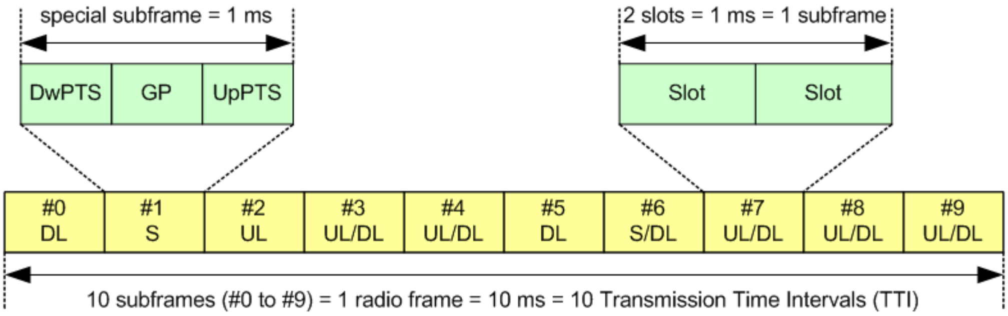


Fig. 2-14: LTE DL frame structure for TDD

Table 2-1: Uplink-downlink configuration 0 to 6

	Subframe Number									
Configuration	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
0	D	S	U	U	U	D	S	U	U	U
1	D	S	U	U	D	D	S	U	U	D
2	D	S	U	D	D	D	S	U	D	D
3	D	S	U	U	U	D	D	D	D	D
4	D	S	U	U	D	D	D	D	D	D
5	D	S	U	D	D	D	D	D	D	D
6	D	S	U	U	U	D	S	U	U	D
D = downlink, U = uplink, S = special subframe										

2.2.10.2 Physical Channel Overview

A downlink physical channel corresponds to a set of resource elements carrying information originating from higher layers. Physical channels can be either broadcast channels or shared channels. Dedicated channels are not used for LTE.

Broadcast channels carry messages that are not directed at a particular UE; they are point-to-multipoint channels. Shared channels are shared by several UEs. At a given time, a shared channel is assigned to one UE only, but the assignment can change within a few timeslots.

An overview of the physical channels of the generated downlink signal is given in the following table.

Physical DL Channel	Purpose / Type / Modulation Scheme
Physical Broadcast Channel (PBCH)	Provides physical layer information of the cell to be read during cell search, e.g. system bandwidth, number of transmit antennas, reference signal transmit power Broadcast; QPSK
Physical Control Format Indicator Channel (PCFICH)	Carries information about PDCCH format (number of OFDM symbols in the beginning of a subframe used for PDCCH) Broadcast; QPSK
Physical Hybrid ARQ Indicator Channel (PHICH)	Carries ACK/NACK indicators for uplink packets Shared; QPSK
Physical Downlink Control Channel (PDCCH)	Carries UE-specific control information, i.e. scheduling information or UL power control commands Shared; QPSK
Physical Downlink Shared Channel (PDSCH)	Carries user data Shared; QPSK, 16-QAM or 64-QAM

2.2.10.3 Physical Signal Overview

A downlink physical signal corresponds to a set of resource elements carrying information originating from the physical layer. Two types of downlink physical signals are available: Reference signals and synchronization signals.

Physical DL Signal	Purpose
Reference Signal (RS)	Enables channel estimation
Primary Synchronization Signal (PSS) Secondary Synchronization Signal (SSS)	Provides acquisition of cell timing and cell identity during cell search

2.2.11 MIMO and Beamforming

Multiple Input Multiple Output (MIMO) systems are essential for the LTE downlink in order to achieve the specified throughput and spectral efficiency requirements. The term MIMO refers to the use of multiple antennas at transmitter side (input to radio channel) and receiver side (output of radio channel). As a special MIMO technique, beamforming improves the transmission to users at the cell edges via directional downlink transmission.

Different gains can be achieved via MIMO depending on the used transmission scheme. The "LTE signaling" application supports the following transmission schemes:

- **Spatial multiplexing**
  Spatial multiplexing uses at least two transmit antennas and two receive antennas. Different data streams are transmitted simultaneously on the same resource blocks. The data streams can belong to one single user (SU-MIMO) or to different users (MU-MIMO). While SU-MIMO increases the data rate of one user, MU-MIMO increases the overall capacity.

Spatial multiplexing requires precoding at the transmitter side. Two types of spatial multiplexing are defined, using different mechanisms for selection of the precoding matrix. For Closed Loop (CL) spatial multiplexing, the UE estimates the radio channel, determines the optimum matrix and proposes this precoding matrix by reporting a PMI value to the eNodeB. This is not required for Open Loop (OL) spatial multiplexing, where the eNodeB selects a matrix without UE feedback.
The "LTE signaling" application supports open-loop and closed-loop spatial multiplexing for a single user.

- **Transmit diversity**
  Transmit diversity uses several antennas transmitting essentially the same stream of data. This increases the signal to noise ratio at the receiver side and thus the robustness of data transmission, especially in fading scenarios.
- **Receive diversity (SIMO)**
  Receive diversity uses several antennas at the receiver side to receive the same data stream. Like transmit diversity, this increases the signal to noise ratio.
- **Beamforming**
  Beamforming uses multiple antennas. It controls the direction of the wavefront by weighting the magnitude and phase of the individual antenna signals. This makes it possible, to provide better coverage to specific areas along the cell edges.
  The UE-specific reference signals and the data transmission use the same antenna weightings. The signals are transmitted via antenna port 5 for transmission mode 7, and port 8 for transmission mode 8 with single-layer beamforming. For dual-layer beamforming, they are transmitted via port 7 and port 8.
  For the cell-specific reference signals there is no beamforming. For transmission mode 7, they are transmitted via port 0. For transmission mode 8, they are transmitted via port 0 and port 1.

For transmission schemes without beamforming, the number of used antennas is denoted as AxB, indicating A transmit antennas and B receive antennas. The "LTE signaling" application supports the following antenna configurations for the LTE downlink:

- SISO 1x1
- SIMO 1x2 (requires R&S CMW-KS520)
- MIMO 2x2 (requires R&S CMW-KS520)
- MIMO 4x2 (requires R&S CMW-KS520 plus R&S CMW-KS521)

For MIMO configuration, you must set the parameters "Scenario" and "Transmission Mode" (see "Scenario, Fading" on page 122 and chapter 2.4.12.2, "MIMO Connection Settings", on page 170).

For some transmission modes, several DCI formats, antenna configurations, precoding matrix indices or transmission schemes are supported, so that you must also configure the corresponding settings. The following table provides an overview of the possible parameter combinations and the resulting transmission scheme and resource allocation type.

For more information about the transmission modes, DCI formats and resource allocation types, see 3GPP TS 36.213, section 7.1.

Table 2-2: Transmission scheme overview

Scenario[1)]	TM[1)]	DCI Format	TX x RX Antennas	Beamf. Matrix	PMI[1)4)]	Transmission Scheme	RA[1)] Type
1 Cell - 1 RF Out 1 Cell - Fading - 1 RF Out 1 Cell - IQ Out, RF In 2CC CA... 2 RF Out 3CC CA..., SISO carrier	1	1A	1x1	-	-	SISO	2
	7	1	-	1x1	-	Single-layer beamforming (port 5)	0
1 Cell - 2 RF Out 1 Cell - Fading - 2 RF Out[2)] 2CC CA... 4 RF Out[2)] 3CC CA..., MIMO carrier	1	1A	1x2	-	-	SIMO	2
	2	1A	2x2, 4x2	-	-	Transmit diversity	2
	3	1A[6)]	2x2, 4x2	-	-	Transmit diversity	2
		2A				OL spatial multiplexing	0
	4	2	2x2	-	0, 1	CL spatial multiplexing[5)]	0
			4x2		0 to 15		
	6	1B	2x2	-	0 to 3	CL spatial multiplexing, single layer	2
			4x2		0 to 15		
	7	1	-	1x2	-	Single-layer beamforming (port 5)	0
	8	2B	-	1x2, 2x2	-	Single-layer beamforming (port 8) Dual-layer beamforming (ports 7,8)	0
1 Cell - Fading - MIMO4x2 - 2 RF Out 1 Cell - 4 RF Out[3)]	2	1A	4x2	-	-	Transmit diversity	2
	3	1A[6)]	4x2	-	-	Transmit diversity	2
		2A	4x2	-	-	OL spatial multiplexing	0
	4	2	4x2	-	0 to 15	CL spatial multiplexing[5)]	0
	6	1B	4x2	-	0 to 15	CL spatial multiplexing, single layer	2

[1)] TM = transmission mode, PMI = precoding matrix indicator, 2CC/3CC = two/three component carriers, CA = carrier aggregation, RA = resource allocation

[2)] Fading not supported for 4x2 antenna configurations

[3)] Output before radio channel, for example for external RF fading

[4)] Depending on the scheduling type, the used PMI value is configured statically or it follows the PMI value reported by the UE

[5)] Depending on the scheduling type, the transmission scheme is configured statically or it follows the RI value reported by the UE. In the latter case, the scheme can change to transmit diversity.

[6)] For scheduling type "Follow WB CQI-RI", only DCI format 2A is supported.

2.2.11.1 Radio Channel Coefficients for MIMO

A MIMO 2x2 configuration uses two transmit antennas (TX) and two receive antennas (RX). An ideal radio channel would provide isolated connections between pairs of antennas, so that each RX antenna receives only the signal of one TX antenna.

In practice, an ideal radio channel is not possible. A real radio channel couples the sent signals, so that the RX antennas always receive a combination of the TX antenna signals. This is illustrated in the following figure for MIMO 2x2, assuming that there is only one signal path between each TX and RX antenna.

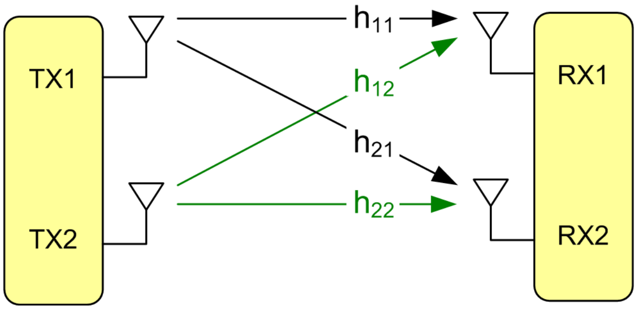


Fig. 2-15: Radio channel for MIMO 2x2

The channel amplitude and phase responses for the individual transmission paths can be characterized by the complex coefficients h_{11} to h_{22}. The indices always specify the receiver first.

In a test setup with the R&S CMW and a UE, the radio channel is typically located within the instrument. Each RF output connector is connected directly to one UE antenna connector.

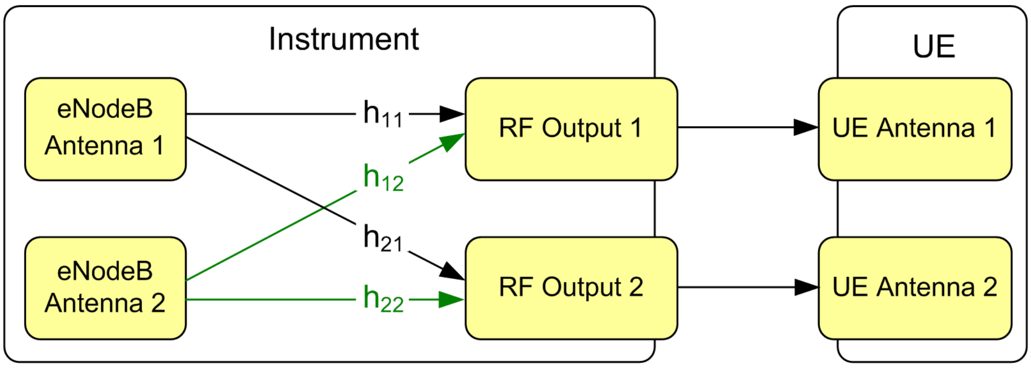


Fig. 2-16: "Radio channel" in a test setup, MIMO 2x2

For fading scenarios, the coefficients are determined dynamically. For scenarios without fading, you can configure static channel coefficients, see "Static Channel Model" on page 172.

A MIMO 4x2 configuration uses four TX and two RX antennas. So the setup is as follows:

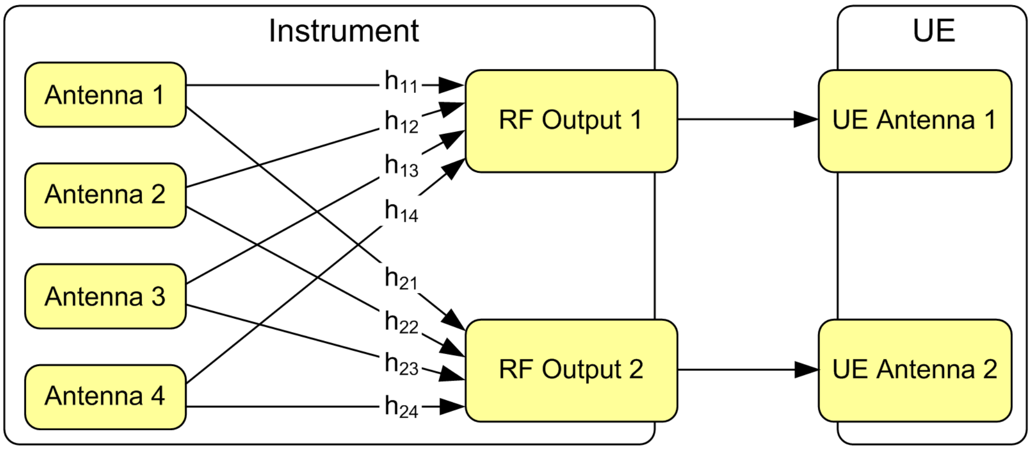


Fig. 2-17: "Radio channel" in a test setup, MIMO 4x2

For MIMO 4x2 with external RF fading, use the scenario "1 Cell - 4 RF Out". This scenario provides the four antenna signals at four different RF connectors.

2.2.11.2 Beamforming Matrix

For transmission schemes with beamforming, the beamforming matrix defines the mapping of the antenna ports to the RF output ports.

For cell-specific signals, there is no beamforming (antenna port 0 and 1). The beamforming matrix is only relevant for antenna ports with UE-specific signals (antenna port 5, 7 and 8).

The size of the matrix depends on the number of antenna ports and the number of RF output ports. These parameters are configured indirectly, via the scenario, the transmission mode and - for mode 8 - via the number of layers. The matrix size is listed in table 2-2.

The channel coefficients are similar to the coefficients of a channel matrix. They are complex coefficients, have a magnitude and a phase and define an amplitude response and a phase response.

The following example shows a 2x2 matrix for dual-layer beamforming, applied to antenna port 7 and port 8.

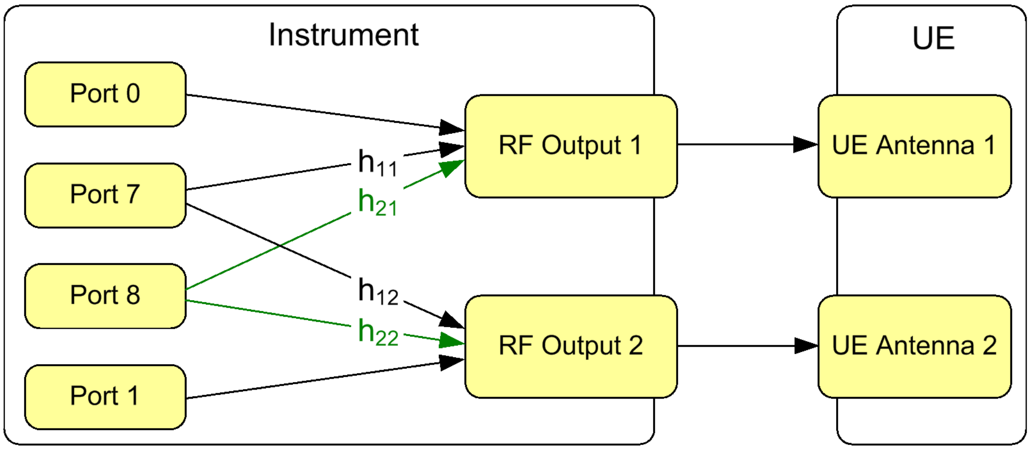


Fig. 2-18: Beamforming matrix, 2x2, transmission mode 8

The following example shows a 1x2 matrix for single-layer beamforming, applied to antenna port 5.

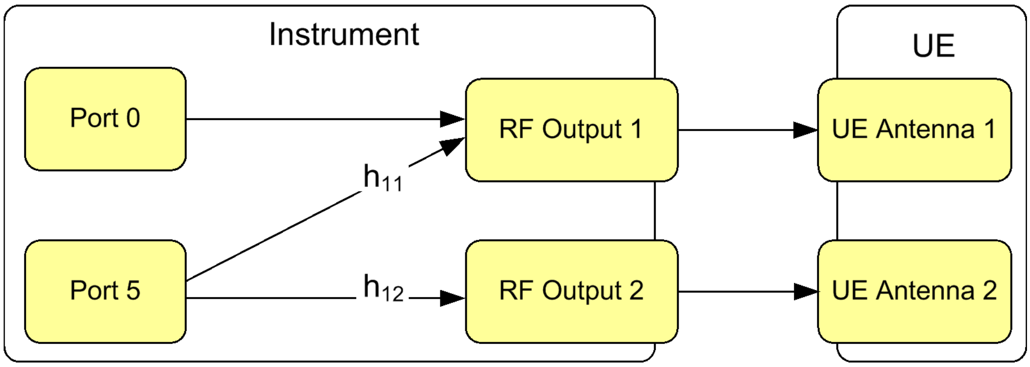


Fig. 2-19: Beamforming matrix, 1x2, transmission mode 7

2.2.12 Scheduling Type RMC

Reference Measurement Channels (RMC) as defined in 3GPP TS 36.521 are required for various transmitter and receiver conformance tests.

An RMC can be defined via the following set of parameters:

- Channel bandwidth
- Number of allocated Resource Blocks (RB)
- Position of the first allocated RB
- Modulation type
- Transport block size index

The parameter combinations supported by the R&S CMW are listed in the following sections. Many other parameters are indirectly determined by these parameters. Refer to 3GPP TS 36.521 for detailed tables. Some of these parameters are also displayed at the GUI for information.

In addition to the 3GPP-compliant combinations, the tables list also the configurable combinations without RB allocation ("Allocated RBs" = 0).

If you want to force the UE to use the PUCCH instead of the PUSCH, set the number of UL resource blocks to 0. Thus the UE is not allowed to use the PUSCH and must use the PUCCH to send ACK/NACKs.

2.2.12.1 UL RMCs

The following table lists the supported parameter sets for UL RMCs.

The resource blocks allocated in the UL are contiguous. The position of the first allocated RB is indicated as follows:

- L: lower end of channel bandwidth, starting with first RB
- H: upper end of channel bandwidth, up to last RB
- M: middle position, one RB allocated
  The allocated RB is located in the middle of the channel bandwidth. Its position is calculated as the smallest integer number ≥ N_{RB} / 2, with N_{RB} being the number of RBs in a full RB allocation.
- Additional start positions are only supported for specific operating bands (and network signaled values). The conditions are listed as table footnotes.

Table 2-3: UL RMCs for FDD

Channel Bandwidth	Allocated RBs	Position First RB	Modulation Type	Transport Block Size Index
1.4 MHz	0	L, H	QPSK	0
	1	L, H, M, 1[5)]	QPSK	5
		L, H, M	16-QAM	19
	2	L, H, M[1)]	QPSK	6
	3	L, H	QPSK	6
	4	L, H	QPSK	6
	5	L, H, 1[5)]	QPSK	5
		L, H	16-QAM	19
	6	L, H	QPSK	6
			16-QAM	19
3 MHz	0	L, H	QPSK	0
	1	L, H, M	QPSK	5
			16-QAM	19

Channel Bandwidth	Allocated RBs	Position First RB	Modulation Type	Transport Block Size Index
	2	L, H	QPSK	6
	3	L, H	QPSK	6
	4	L, H, 4[5]	QPSK	6
		L, H	16-QAM	19
	5	L, H, M[1]	QPSK	5
	6	L, H, 7[8]	QPSK	6
		L, H	16-QAM	19
	10	L, H, 4[5]	QPSK	5
	12	L, H, 1[8][9]	QPSK	5
	15	L, H	QPSK	6
			16-QAM	14
5 MHz	0	L, H	QPSK	0
	1	L, H, M	QPSK	5
			16-QAM	19
	2	L, H	QPSK	6
	5	L, H	QPSK	5
	6	L, H, 14[8]	QPSK	6
	8	L, H, M[2], 7[5]	QPSK	6
		L, H	16-QAM	19
	10	L, H	QPSK	5
	12	L, H, 2[9]	QPSK	5
	15	L, H, 7[5], 7[6]	QPSK	5
	16	L, H, 9[8]	QPSK	5
	18	L, H, 2[9]	QPSK	6
	20	L, H, 2[9]	QPSK	5
	24	L, H	QPSK	6
	25	L, H	QPSK	5
			16-QAM	11
10 MHz	0	L, H	QPSK	0
	1	L, H, M, 10[8][9], 39[8]	QPSK	5
		L, H, M	16-QAM	19
	2	L, H, 48[4]	QPSK	6

Channel Bandwidth	Allocated RBs	Position First RB	Modulation Type	Transport Block Size Index
	3	L, H	QPSK	6
	5	L, H	QPSK	5
	6	L, H, 13[4)], 43[4)]	QPSK	6
	8	L, H	QPSK	6
	10	L, H	QPSK	5
	12	L, H, 13[4)], 19[4)]	QPSK	6
		L, H	16-QAM	19
	15	L, H	QPSK	5
	16	L, H, M[2)], 19[4)]	QPSK	5
		L, H, 19[4)]	16-QAM	14
	18	L, H	QPSK	6
	20	L, H, 3[8)], 13[4)], 25[8)]	QPSK	5
	24	L, H	QPSK	6
	25	L, H, 1[7)]	QPSK	5
	27	L, H, 15[9)]	QPSK	6
	30	L, H, 19[4)]	QPSK	5
			16-QAM	19
	32	L, H, 15[9)]	QPSK	5
	36	L, H, 1[8)]	QPSK	6
		L, H, 13[4)]	16-QAM	19
	40	L, H, 1[9)]	QPSK	6
	45	L, H	QPSK	6
	48	L, H	QPSK	5
	50	L, H	QPSK	6
			16-QAM	19
15 MHz	0	L, H	QPSK	0
	1	L, H, M	QPSK	5
			16-QAM	19
	2	L, H	QPSK	6
	5	L, H	QPSK	5
	6	L, H	QPSK	6
			16-QAM	19

Channel Bandwidth	Allocated RBs	Position First RB	Modulation Type	Transport Block Size Index
	8	L, H	QPSK	6
			16-QAM	19
	9	L, H	QPSK	5
			16-QAM	19
	10	L, H	QPSK	5
	16	L, H	QPSK	5
			16-QAM	14
	18	L, H, 36[8)], 44[8)]	QPSK	6
		L, H	16-QAM	14
	20	L, H, 11[3)]	QPSK	5
		L, H	16-QAM	11
	24	L, H	QPSK	6
			16-QAM	11
	25	L, H, 1[8)]	QPSK	5
	27	L, H	QPSK	6
	36	L, H	QPSK	6
	40	L, H	QPSK	6
	48	L, H	QPSK	5
	50	L, H, 15[7)]	QPSK	6
	54	L, H	QPSK	5
	60	L, H, 2[8)]	QPSK	4
	75	L, H	QPSK	3
			16-QAM	14
20 MHz	0	L, H	QPSK	0
	1	L, H, M	QPSK	5
			16-QAM	19
	2	L, H	QPSK	6
			16-QAM	19
	5	L, H	QPSK	5
	6	L, H	QPSK	6
	8	L, H	QPSK	6
	10	L, H	QPSK	5

Channel Bandwidth	Allocated RBs	Position First RB	Modulation Type	Transport Block Size Index
	16	L, H	QPSK	5
			16-QAM	14
	18	L, H	QPSK	6
			16-QAM	14
	20	L, H, 16[3)]	QPSK	5
		L, H	16-QAM	11
	24	L, H	QPSK	6
			16-QAM	11
	25	L, H	QPSK	5
	48	L, H	QPSK	5
	50	L, H	QPSK	6
	54	L, H	QPSK	5
	75	L, H	QPSK	3
			16-QAM	14
	100	L, H	QPSK	2
			16-QAM	11

Special start position for 3GPP TS 36.521, Table...:

1) Table 7.3A.1.3-0b, only for FDD band 12

2) Table 7.3A.1.3-0b, only for FDD band 12 and 17

3) Table 7.3.3-2 and Table 7.3.5-2, only for FDD band 20

4) Table 6.2.4.4.1-5, Table 6.6.2.2.4.1-3 and Table 6.6.3.3.4.1-2, only for FDD band 13 plus NS_07

5) Table 6.2.4.4.1-10, only for FDD band 26 combined with NS_12

6) Table 6.2.4.4.1-11, only for FDD band 26 combined with NS_13

7) Table 6.2.4.4.1-12, only for FDD band 26 combined with NS_14

8) Table 6.2.4.4.1-13, only for FDD band 26 combined with NS_15

9) Table 6.2.4.4.1-14, only for FDD band 27 combined with NS_16

Table 2-4: UL RMCs for TDD

Channel Bandwidth	Allocated RBs	Position First RB	Modulation Type	Transport Block Size Index
1.4 MHz	0	L, H	QPSK	0
	1	L, H, M	QPSK	5
			16-QAM	19
	2	L, H	QPSK	6
	3	L, H	QPSK	6

Channel Bandwidth	Allocated RBs	Position First RB	Modulation Type	Transport Block Size Index
	4	L, H	QPSK	6
	5	L, H	QPSK	5
			16-QAM	19
	6	L, H	QPSK	6
			16-QAM	19
3 MHz	0	L, H	QPSK	0
	1	L, H, M	QPSK	5
			16-QAM	19
	2	L, H	QPSK	6
	3	L, H	QPSK	6
	4	L, H	QPSK	6
			16-QAM	19
	5	L, H	QPSK	5
	6	L, H	QPSK	6
	10	L, H	QPSK	5
	15	L, H	QPSK	6
			16-QAM	14
5 MHz	0	L, H	QPSK	0
	1	L, H, M	QPSK	5
			16-QAM	19
	2	L, H	QPSK	6
	5	L, H	QPSK	5
	6	L, H	QPSK	6
	8	L, H	QPSK	6
			16-QAM	19
	10	L, H	QPSK	5
	15	L, H	QPSK	5
	18	L, H	QPSK	6
	20	L, H	QPSK	5
	24	L, H	QPSK	6
	25	L, H	QPSK	5
			16-QAM	11
10 MHz	0	L, H	QPSK	0

Channel Bandwidth	Allocated RBs	Position First RB	Modulation Type	Transport Block Size Index
	1	L, H, M, 49[1)]	QPSK	5
		L, H, M	16-QAM	19
	2	L, H	QPSK	6
	5	L, H	QPSK	5
	6	L, H	QPSK	6
	8	L, H	QPSK	6
	10	L, H	QPSK	5
	12	L, H, 37[1)]	QPSK	6
		L, H	16-QAM	19
	16	L, H	QPSK	5
			16-QAM	14
	18	L, H	QPSK	6
	20	L, H	QPSK	5
	24	L, H, 13[1)]	QPSK	6
			16-QAM	11
	25	L, H	QPSK	5
	27	L, H	QPSK	6
	30	L, H	QPSK	5
			16-QAM	19
	36	L, H, 13[1)]	QPSK	6
		L, H	16-QAM	19
	40	L, H	QPSK	6
	48	L, H	QPSK	5
	50	L, H	QPSK	6
			16-QAM	19
15 MHz	0	L, H	QPSK	0
	1	L, H, M, 74[1)]	QPSK	5
		L, H, M	16-QAM	19
	2	L, H	QPSK	6
	5	L, H	QPSK	5
	6	L, H	QPSK	6
	8	L, H	QPSK	6

Channel Bandwidth	Allocated RBs	Position First RB	Modulation Type	Transport Block Size Index
	10	L, H	QPSK	5
	16	L, H	QPSK	5
			16-QAM	14
	18	L, H, 56[1)]	QPSK	6
	20	L, H	QPSK	5
	24	L, H	QPSK	6
	25	L, H	QPSK	5
	27	L, H	QPSK	6
	36	L, H, 19[1)]	QPSK	6
			16-QAM	19
	40	L, H	QPSK	6
	48	L, H	QPSK	5
	50	L, H, 19[1)]	QPSK	6
	54	L, H	QPSK	5
	75	L, H	QPSK	3
			16-QAM	14
20 MHz	0	L, H	QPSK	0
	1	L, H, M, 99[1)]	QPSK	5
		L, H, M	16-QAM	19
	2	L, H	QPSK	6
	5	L, H	QPSK	5
	6	L, H	QPSK	6
	8	L, H	QPSK	6
	10	L, H	QPSK	5
	18	L, H	QPSK	6
			16-QAM	14
	20	L, H	QPSK	5
	24	L, H	QPSK	6
	25	L, H, 75[1)]	QPSK	5
	48	L, H	QPSK	5
	50	L, H, 25[1)]	QPSK	6
			16-QAM	19

Channel Bandwidth	Allocated RBs	Position First RB	Modulation Type	Transport Block Size Index
	54	L, H	QPSK	5
	75	L, H, 25[1)]	QPSK	3
		L, H	16-QAM	14
	100	L, H	QPSK	2
			16-QAM	11

[1)] Special start position for 3GPP TS 36.521, Table 6.2.4.4.1-2 and Table 6.6.2.2.4.1-4. Only supported for TDD operating band 41 combined with the network signaled value NS_04.

2.2.12.2 DL RMCs, One TX Antenna (TM 1)

The following table lists the supported parameter sets for downlink RMCs when only one TX antenna is used in the downlink.

The resource blocks allocated in the DL are contiguous. The position of the first allocated RB is indicated as follows:

- L: lower end of channel bandwidth, starting with first RB
- H: upper end of channel bandwidth, up to last RB
- 5, 10, 23, 35, 48: special start positions for 3GPP TS 36.521, Table C.2-2.

Table 2-5: DL RMCs, single TX antenna

Channel bandwidth	Allocated RBs	Position First RB	Modulation Type	Transport Block Size Index
1.4 MHz	0	L, H	QPSK	0
	3	L, H	QPSK	1
	6	L, H	QPSK	4
			16-QAM	12
			64-QAM	21
3 MHz	0	L, H	QPSK	0
	1	L, H	16-QAM	13
	4	L, H	QPSK	5
	6	L, H, 5	16-QAM	12
	15	L, H	QPSK	5
			64-QAM	23
5 MHz	0	L, H	QPSK	0
	6	L, H, 10	16-QAM	12
	8	L, H	QPSK	5
	16	L, H	64-QAM	25*

Channel bandwidth	Allocated RBs	Position First RB	Modulation Type	Transport Block Size Index
	18	L, H	64-QAM	23
	25	L, H	QPSK	5
			16-QAM	13
			64-QAM	23
10 MHz	0	L, H	QPSK	0
	1	L, H	16-QAM	14
	6	L, H, 23	16-QAM	12
	16	L, H	QPSK	5
			64-QAM	25*
	17	L, H	64-QAM	24
	50	L, H	QPSK	5
			16-QAM	14
			64-QAM	24
15 MHz	0	L, H	QPSK	0
	6	L, H, 35	16-QAM	12
	16	L, H	64-QAM	25*
	17	L, H	64-QAM	24
	25	L, H	QPSK	5
	75	L, H	QPSK	5
			64-QAM	25
20 MHz	0	L, H	QPSK	0
	1	L, H	16-QAM	14
	6	L, H, 48	16-QAM	12
	16	L, H	64-QAM	25*
	17	L, H	64-QAM	24
	30	L, H	QPSK	5
	83	L, H	64-QAM	24
	100	L, H	QPSK	5
			64-QAM	24

*) The entries with a * in the last column have been removed from 3GPP TS 36.521, but are still supported for FDD for backward compatibility reasons. They are not supported for TDD.

2.2.12.3 DL RMCs, Multiple TX Antennas (TM 2 to 6)

For multiple TX antennas (e.g. MIMO 2x2), 3GPP has not yet specified DL RMCs for all channel bandwidths. For that reason, the R&S CMW supports also some RMCs only specified for single-antenna configurations. All supported parameter combinations are listed in the following tables.

The allocated resource blocks are contiguous and located at one end of the channel bandwidth (low or high).

Table 2-6: DL RMCs for FDD, multiple TX antennas

Channel bandwidth	Allocated RBs	Modulation Type	Transport Block Size Index
1.4 MHz	0	QPSK	0
	6	QPSK	4
3 MHz	0	QPSK	0
	15	QPSK	5
5 MHz	0	QPSK	0
	25	QPSK	5
		16-QAM	12
10 MHz	0	QPSK	0
	40	16-QAM	13
	50	QPSK	5
		16-QAM	13
		64-QAM	18
15 MHz	0	QPSK	0
	75	QPSK	5
20 MHz	0	QPSK	0
	100	16-QAM	13

Some TDD RMCs defined by 3GPP have the same channel bandwidth, number of RBs, modulation type and transport block size index. The additional parameter "Version" is introduced to distinguish between these RMCs. The RMCs are defined in 3GPP TS 36.521, Table A.3.4.2.1-1.

Table 2-7: DL RMCs for TDD, multiple TX antennas

Channel bandwidth	Allocated RBs	Modulation Type	Transport Block Size Index	Version
1.4 MHz	0	QPSK	0	-
	6	QPSK	4	-
3 MHz	0	QPSK	0	-

Channel bandwidth	Allocated RBs	Modulation Type	Transport Block Size Index	Version
	15	QPSK	5	-
5 MHz	0	QPSK	0	-
	25	16-QAM	5	-
10 MHz	0	QPSK	0	-
	40	16-QAM	13	-
	50	QPSK	5	-
		16-QAM	13	0: R.11 1: R.11-1
		64-QAM	18	-
15 MHz	0	QPSK	0	-
	75	QPSK	5	-
20 MHz	0	QPSK	0	-
	100	16-QAM	13	0: R.30 1: R.30-1

2.2.12.4 DL RMCs, Transmission Mode 7

The following tables list the supported parameter sets for downlink RMCs when transmission mode 7 is used.

The TDD RMCs for 5 MHz and 10 MHz bandwidth are defined in 3GPP TS 36.521, Table A.3.4.3.1-1. For the other bandwidths and FDD, 3GPP has not yet specified DL RMCs for TM7, but the listed parameter combinations are supported.

The listed allocated resource blocks are contiguous and located at one end of the channel bandwidth (low or high). In subframe 0, a non-contiguous RB allocation is applied (not indicated in the tables).

Table 2-8: DL RMCs for FDD, TM7

Channel bandwidth	Allocated RBs	Modulation Type	Transport Block Size Index
1.4 MHz	0	16-QAM	0
	6	16-QAM	13
3 MHz	0	16-QAM	0
	15	16-QAM	13
5 MHz	0	16-QAM	0
	25	16-QAM	12
10 MHz	0	16-QAM	0
	50	16-QAM	13

Channel bandwidth	Allocated RBs	Modulation Type	Transport Block Size Index
15 MHz	0	16-QAM	0
	75	16-QAM	13
20 MHz	0	16-QAM	0
	100	16-QAM	13

Table 2-9: DL RMCs for TDD, TM7

Channel bandwidth	Allocated RBs	Modulation Type	Transport Block Size Index
1.4 MHz	0	16-QAM	0
	6	16-QAM	13
3 MHz	0	16-QAM	0
	15	16-QAM	13
5 MHz	0	16-QAM	0
	25	16-QAM	12
10 MHz	0	QPSK	0
	1	16-QAM	13
	18	64-QAM	23
	50	QPSK	5
		16-QAM	13
		64-QAM	23
15 MHz	0	16-QAM	0
	75	16-QAM	13
20 MHz	0	16-QAM	0
	100	16-QAM	13

2.2.12.5 DL RMCs, Transmission Mode 8

The following tables list the supported parameter sets for downlink RMCs when transmission mode 8 is used.

The TDD RMCs for 5 MHz and 10 MHz bandwidth are defined in 3GPP TS 36.521, Table A.3.4.3.2-1. For the other bandwidths and FDD, 3GPP has not yet specified DL RMCs for TM8, but the listed parameter combinations are supported.

The listed allocated resource blocks are contiguous and located at one end of the channel bandwidth (low or high). In subframe 0, a non-contiguous RB allocation is applied (not indicated in the tables).

Table 2-10: DL RMCs for FDD, TM8

Channel bandwidth	Allocated RBs	Modulation Type	Transport Block Size Index
1.4 MHz	0	16-QAM	0
	6	16-QAM	12
3 MHz	0	16-QAM	0
	15	16-QAM	12
5 MHz	0	16-QAM	0
	25	16-QAM	12
10 MHz	0	16-QAM	0
	50	16-QAM	12
15 MHz	0	16-QAM	0
	75	16-QAM	12
20 MHz	0	16-QAM	0
	100	16-QAM	12

Table 2-11: DL RMCs for TDD, TM8

Channel bandwidth	Allocated RBs	Modulation Type	Transport Block Size Index
1.4 MHz	0	16-QAM	0
	6	16-QAM	12
3 MHz	0	16-QAM	0
	15	16-QAM	12
5 MHz	0	16-QAM	0
	25	16-QAM	12
10 MHz	0	QPSK	0
	18	64-QAM	22
	50	QPSK	4
		16-QAM	12
		64-QAM	17
			22
15 MHz	0	16-QAM	0
	75	16-QAM	12
20 MHz	0	16-QAM	0
	100	16-QAM	12

2.2.13 User-Defined Channels

In addition to RMCs required by conformance tests the signaling application supports flexibly configurable user-defined channels (option R&S CMW-KS510 required).

User-defined channels are specified via a set of parameters:

- Channel bandwidth
- Number of allocated Resource Blocks (RB)
- Position of the first allocated RB
- Modulation type
- Transport block size index

The allocated resource blocks are contiguous and the position of the first RB can be configured. The supported modulation types are independent of the selected number of allocated RBs. For each modulation type a range of transport block size indices is available.

Two modes are available. One mode allows you to configure UL and DL channels globally, for all subframes. The other mode supports individual settings for each subframe (TTI) of a radio frame (all parameters except channel bandwidth configurable per TTI).

Force PUCCH

If you want to force the UE to use the PUCCH instead of the PUSCH, set the number of resource blocks to 0. Thus the UE is not allowed to use the PUSCH and must use the PUCCH to send ACK/NACKs.

2.2.13.1 Supported Number of RB / Position of First RB (DL)

Different resource allocation types are used depending on the selected transmission scheme, see table 2-2.

For transmission schemes with resource allocation type 2, the number of resource blocks allocated in the downlink is only restricted by an upper limit. Any number of RBs between 0 and this upper limit can be allocated. The maximum number of RBs depends on the channel bandwidth and is listed in table 2-12. The position of the first allocated RB is freely selectable within the channel bandwidth. Thus allowed positions are 0 to <Maximum no of RBs> - 1.

For transmission schemes with resource allocation type 0, the maximum number of RBs is divided into Resource Block Groups (RBG) with a certain size (see 3GPP TS 36.213, section 7.1.6.1). The RBG size depends on the maximum number of RBs and thus on the channel bandwidth. If the maximum number of RBs is not a multiple of the RBG size, the last RBG is smaller than the other RBGs.

Only entire RBGs can be allocated with resource allocation type 0. This restricts both the number of RBs that can be allocated and the allowed positions for the first RB. The following tables provide an overview.

Table 2-12: RB parameters depending on channel bandwidth

Channel bandwidth	Maximum no of RBs	RBG size	Size of last RBG	Start RB, resource allocation type 0
1.4 MHz	6	1	1	0 to 5
3 MHz	15	2	1	0, 2, ..., 12, 14
5 MHz	25	2	1	0, 2, ..., 22, 24
10 MHz	50	3	2	0, 3, ..., 45, 48
15 MHz	75	4	3	0, 4, ..., 68, 72
20 MHz	100	4	4	0, 4, ..., 92, 96

Table 2-13: Example: Allowed combinations for resource allocation type 0, 3 MHz channel bandwidth

Start RB	0	2	4	6	8	10	12	14
No of RBs	2, 4, ..., 14, 15	2, 4, ..., 12, 13	2, 4, ..., 10, 11	2, 4, ..., 8, 9	2, 4, 6, 7	2, 4, 5	2, 3	1

2.2.13.2 Supported Number of RB / Position of First RB (UL)

In the uplink the position of the first allocated RB is freely selectable within the channel bandwidth. The number of resource blocks is restricted by the maximum number of RBs, depending on the channel bandwidth in the same way as for the downlink. Additionally the number of RBs is restricted by the following formula specified in 3GPP TS 36.211:

$N_{RB} = 2^i \times 3^j \times 5^k$, with i, j, k being non-negative integer values

You can also allocate no resource blocks at all ($N_{RB} = 0$). As a result, the UE is not allowed to use the PUSCH and must use the PUCCH instead, e.g. to send ACK/NACK messages.

Example:

For a channel bandwidth of 3 MHz the following values are allowed in the uplink: 0, 1, 2, 3, 4, 5, 6, 8, 9, 10, 12, 15. Not allowed are 7, 11, 13 and 14.

2.2.13.3 Supported Transport Block Size Indices

The allowed transport block size indices depend on the modulation type as shown in the following table.

Table 2-14: Range of transport block size index depending on modulation type

Modulation Type	QPSK	16-QAM	64-QAM
Indices for uplink channels	0 to 10	10 to 26	n.a.
Indices for downlink channels	0 to 9	9 to 15	15 to 26

2.2.14 CQI Channels

The CQI reporting tests specified in chapter 9 of 3GPP TS 36.521 require downlink signals with a specific CQI index value. For some tests, the CQI index value must be static (for example reported median CQI value plus or minus one). For other tests, the CQI index value must follow the wideband CQI value reported by the UE.

The LTE signaling application provides the following scheduling types for CQI tests:

- Fixed CQI
- Follow wideband CQI
- Follow wideband PMI
- Follow wideband CQI-RI
- Follow wideband CQI-PMI-RI

The downlink channel for the individual scheduling types is described in the following sections.

The uplink channel is identical to a user-defined uplink channel, see chapter 2.2.13, "User-Defined Channels", on page 54.

2.2.14.1 Fixed CQI Channels

For fixed CQI channels, option R&S CMW-KS510 is required.

The downlink channel is configured via a set of parameters:

- Channel bandwidth
- Number of allocated Resource Blocks (RB)
- Position of the first allocated RB
- CQI index

All parameters except the channel bandwidth can be configured individually for each downlink subframe (TTI) of a radio frame.

The allocated resource blocks are contiguous and the position of the first RB can be configured. The configuration rules are the same as for user-defined downlink channels, see chapter 2.2.13.1, "Supported Number of RB / Position of First RB (DL)", on page 54.

The CQI index determines also the modulation scheme and the channel code rate. The code rate is defined as the number of downlink information bits (including CRC bits) divided by the number of physical channel bits on the PDSCH. The relation is defined in 3GPP TS 36.213, table 7.2.3-1 as follows.

CQI Index	Modulation Scheme	Target Code Rate
1	QPSK	0.07617
2		0.11719
3		0.18848
4		0.30078

CQI Index	Modulation Scheme	Target Code Rate
5		0.43848
6		0.58789
7	16-QAM	0.36914
8		0.47852
9		0.60156
10	64-QAM	0.45508
11		0.55371
12		0.65039
13		0.75391
14		0.85254
15		0.92578

The modulation scheme is selected automatically according to the table. Indirectly, the table also determines the transport block size. The transport block size is selected automatically so that the resulting effective channel code rate approaches the listed target code rate as far as possible. Thus the transport block size depends on the CQI index and on the number of allocated RBs.

2.2.14.2 Follow WB CQI Channels

This scheduling type is supported for the transmission modes 1 to 7. Option R&S CMW-KS510 is required.

The downlink signal reacts to the reported CQI index value. That means, the MCS index value used for the downlink depends on the previous wideband CQI value reported by the UE.

The dependency between CQI and MCS is configured via a mapping table. The table assigns an MCS index value (0 to 28) to each possible reported wideband CQI index value (1 to 15).

The reported PMI and RI values have no effect on the downlink signal.

In addition to the mapping table, you can configure the following downlink settings:

- Channel bandwidth
- Number of allocated Resource Blocks (RB)
- Position of the first allocated RB

All downlink settings are configured globally, not per TTI. The rules for configuration of the number of RB and the position of the first RB are exactly the same as for user-defined downlink channels, see chapter 2.2.13.1, "Supported Number of RB / Position of First RB (DL)", on page 54.

Subframe 0 and 5 are not scheduled. This complies with the reference channel definition for CQI tests, as defined in 3GPP TS 36.521, Table C3.2-4.

2.2.14.3 Follow WB PMI Channels

This scheduling type is supported for the transmission modes 4 and 6. Option R&S CMW-KS510/-KS512 is required (without CA/with CA).

The PMI value used for the downlink signal follows the reported PMI value. The reported CQI and RI values have no effect on the downlink signal.

The downlink signal settings are similar to the settings for user-defined downlink channels (global configuration, not per TTI), see chapter 2.2.13, "User-Defined Channels", on page 54.

Subframe 5 is not scheduled. This complies with the reference channel definition for CQI tests, as defined in 3GPP TS 36.521, Table C3.2-3.

2.2.14.4 Follow WB CQI-RI and CQI-PMI-RI Channels

The scheduling type "Follow WB CQI-RI" is only relevant for the transmission mode 3, scheduling type "Follow WB CQI-PMI-RI" only for the transmission mode 4. Option R&S CMW-KS510/-KS512 is required (without CA/with CA).

The downlink signal reacts to the reported values.

The reported CQI index value determines the MCS index value used for the downlink. The dependency between CQI and MCS is configured via a mapping table, as for "Follow wideband CQI". The resource block settings are also similar to the "Follow wideband CQI" settings.

The reported Rank Indicator (RI) value determines the used transmission scheme. For RI=2 spatial multiplexing is used. For RI=1 transmit diversity is used.

For scheduling type "Follow WB CQI-PMI-RI", the used PMI value follows the reported PMI value.

Subframe 0 and 5 are not scheduled. This complies with the reference channel definition for CQI tests, as defined in 3GPP TS 36.521, Table C3.2-4.

2.2.15 Semi-Persistent Scheduling (SPS)

Applications like voice over LTE require constant but few radio resources. Voice data is sent in small packets that are transmitted in regular intervals.

For such applications, semi-persistent scheduling (SPS) can be used instead of dynamic scheduling. This reduces the control channel overhead on the PDCCH, so that a cell can handle more voice calls in parallel. With SPS, the UE gets a semi-persistent grant. The grant allows the UE to use every n^{th} subframe until further notice.

The LTE signaling application supports SPS in transmission mode 1 and 2, uplink and downlink.

The configuration of the resource block allocation is similar to the configuration for a user-defined channel, see chapter 2.2.13, "User-Defined Channels", on page 54. The rules for the allowed number of RBs and position of the first RB are identical. Exception: For SPS, setting the number of RBs to 0 is not allowed.

In contrast to user-defined channels, SPS does not support 64-QAM modulation. The maximum transport block size index is 14, see following table.

Table 2-15: Range of transport block size index depending on modulation type

Modulation Type	QPSK	16-QAM	64-QAM
Indices for uplink channels	0 to 10	10 to 14	not supported
Indices for downlink channels	0 to 9	9 to 14	not supported

The configured resource block allocation is granted every n^{th} subframe, where n is configurable between 10 and 640.

If the UE does not use the granted uplink resources for transmission, the allocation expires after some unused subframes (implicit release). In that case, a new grant is sent automatically to the UE.

SPS is only supported for the PCC, not for SCCs. HARQ can not be combined with SPS. Connected DRX is supported, but without UL dynamic scheduling.

2.2.16 Operating Bands

The carrier frequencies for LTE signals are defined in 3GPP TS 36.101. Each operating band contains a number of carrier frequencies identified by channel numbers (EARFCN, E-UTRA Absolute Radio Frequency Channel Number). The assignment between channel numbers N and carrier center frequencies F is defined as:

$$F = F_{Offset} + 0.1\,\mathrm{MHz} \cdot (N - N_{Offset})$$

The tables in this section provide an overview of all supported FDD and TDD operating bands. For each band they list F_{Offset}, N_{Offset}, channel numbers N and carrier center frequencies F. For frequencies above 3.3 GHz, option R&S CMW-KB036 is required.

The table for FDD uplink signals lists also the separation between uplink carrier frequency and downlink carrier frequency (frequency pair for one UE in FDD mode).

In addition to the 3GPP defined bands listed in the tables, a user-defined operating band is supported (option R&S CMW-KS525 required). It uses a 100-kHz channel raster like the 3GPP defined bands. The frequency range and the channel number range are configurable for uplink and downlink. For configuration see "Band Definition" on page 131.

Table 2-16: Operating bands for FDD uplink signals

FDD Band	$F_{Offset, UL}$ [MHz]	$N_{Offset, UL}$	Channel No N_{UL}	F_{UL} [MHz]	F_{DL}-F_{UL} [MHz]
1	1920	18000	18000 to 18599	1920 to 1979.9	190
2	1850	18600	18600 to 19199	1850 to 1909.9	80
3	1710	19200	19200 to 19949	1710 to 1784.9	95
4	1710	19950	19950 to 20399	1710 to 1754.9	400
5	824	20400	20400 to 20649	824 to 848.9	45

FDD Band	$F_{Offset, UL}$ [MHz]	$N_{Offset, UL}$	Channel No N_{UL}	F_{UL} [MHz]	F_{DL}-F_{UL} [MHz]
6	830	20650	20650 to 20749	830 to 839.9	45
7	2500	20750	20750 to 21449	2500 to 2569.9	120
8	880	21450	21450 to 21799	880 to 914.9	45
9	1749.9	21800	21800 to 22149	1749.9 to 1784.8	95
10	1710	22150	22150 to 22749	1710 to 1769.9	400
11	1427.9	22750	22750 to 22949	1427.9 to 1447.8	48
12	699	23010	23010 to 23179	699 to 715.9	30
13	777	23180	23180 to 23279	777 to 786.9	-31
14	788	23280	23280 to 23379	788 to 797.9	-30
15	1900	23380	23380 to 23579	1900 to 1919.9	700
16	2010	23580	23580 to 23729	2010 to 2024.9	575
17	704	23730	23730 to 23849	704 to 715.9	30
18	815	23850	23850 to 23999	815 to 829.9	45
19	830	24000	24000 to 24149	830 to 844.9	45
20	832	24150	24150 to 24449	832 to 861.9	-41
21	1447.9	24450	24450 to 24599	1447.9 to 1462.8	48
22	3410	24600	24600 to 25499	3410 to 3499.9	100
23	2000	25500	25500 to 25699	2000 to 2019.9	180
24	1626.5	25700	25700 to 26039	1626.5 to 1660.4	-101.5
25	1850	26040	26040 to 26689	1850 to 1914.9	80
26	814	26690	26690 to 27039	814 to 848.9	45
27	807	27040	27040 to 27209	807 to 823.9	45
28	703	27210	27210 to 27659	703 to 747.9	55
29	downlink only, not relevant for PCC, only for SCC				
30	2305	27660	27660 to 27759	2305 to 2314.9	45
31	452.5	27760	27760 to 27809	452.5 to 457.4	10

Table 2-17: Operating bands for FDD downlink signals

FDD Band	$F_{Offset, DL}$ [MHz]	$N_{Offset, DL}$	Channel No N_{DL}	F_{DL} [MHz]
1	2110	0	0 to 599	2110 to 2169.9
2	1930	600	600 to 1199	1930 to 1989.9
3	1805	1200	1200 to 1949	1805 to 1879.9
4	2110	1950	1950 to 2399	2110 to 2154.9

FDD Band	$F_{Offset, DL}$ [MHz]	$N_{Offset, DL}$	Channel No N_{DL}	F_{DL} [MHz]
5	869	2400	2400 to 2649	869 to 893.9
6	875	2650	2650 to 2749	875 to 884.9
7	2620	2750	2750 to 3449	2620 to 2689.9
8	925	3450	3450 to 3799	925 to 959.9
9	1844.9	3800	3800 to 4149	1844.9 to 1879.8
10	2110	4150	4150 to 4749	2110 to 2169.9
11	1475.9	4750	4750 to 4949	1475.9 to 1495.8
12	729	5010	5010 to 5179	729 to 745.9
13	746	5180	5180 to 5279	746 to 755.9
14	758	5280	5280 to 5379	758 to 767.9
15	2600	5380	5380 to 5579	2600 to 2619.9
16	2585	5580	5580 to 5729	2585 to 2599.9
17	734	5730	5730 to 5849	734 to 745.9
18	860	5850	5850 to 5999	860 to 874.9
19	875	6000	6000 to 6149	875 to 889.9
20	791	6150	6150 to 6449	791 to 820.9
21	1495.9	6450	6450 to 6599	1495.9 to 1510.8
22	3510	6600	6600 to 7499	3510 to 3599.9
23	2180	7500	7500 to 7699	2180 to 2199.9
24	1525	7700	7700 to 8039	1525 to 1558.9
25	1930	8040	8040 to 8689	1930 to 1994.9
26	859	8690	8690 to 9039	859 to 893.9
27	852	9040	9040 to 9209	852 to 868.9
28	758	9210	9210 to 9659	758 to 802.9
29	717	9660	9660 to 9769	717 to 727.9
30	2350	9770	9770 to 9869	2350 to 2359.9
31	462.5	9870	9870 to 9919	462.5 to 467.4

Table 2-18: Operating bands for TDD signals

TDD Band	F_{Offset} [MHz]	N_{Offset}	Channel No N	F [MHz]
33	1900	36000	36000 to 36199	1900 to 1919.9
34	2010	36200	36200 to 36349	2010 to 2024.9
35	1850	36350	36350 to 36949	1850 to 1909.9

TDD Band	F_{Offset} [MHz]	N_{Offset}	Channel No N	F [MHz]
36	1930	36950	36950 to 37549	1930 to 1989.9
37	1910	37550	37550 to 37749	1910 to 1929.9
38	2570	37750	37750 to 38249	2570 to 2619.9
39	1880	38250	38250 to 38649	1880 to 1919.9
40	2300	38650	38650 to 39649	2300 to 2399.9
41	2496	39650	39650 to 41589	2496 to 2689.9
42	3400	41590	41590 to 43589	3400 to 3599.9
43	3600	43590	43590 to 45589	3600 to 3799.9
44	703	45590	45590 to 46589	703 to 802.9

2.2.17 Trigger Signals

The LTE signaling application provides trigger signals that can be used by other R&S CMW applications to synchronize to the generated LTE downlink signal.

To address the trigger signals in remote commands, use the following strings, with <i> replaced by the instance number of the signaling application:

- "LTE Sig<i>: FrameTrigger"
- "LTE Sig<i>: PRACH Trigger"
- "LTE Sig<i>: TPC Trigger"

Frame Trigger

Trigger event at the beginning of each radio frame.

This signal can be used to trigger LTE "Multi Evaluation" measurements (option R&S CMW-KM500 / -KM550).

PRACH Trigger

Trigger event for each received PRACH preamble. When a preamble has been successfully received and detected by the "LTE Signaling" application, a trigger signal is generated. It is aligned to the beginning of the fourth subframe after the subframe in which the preamble has started. The following figure illustrates this timing for preamble format 3.

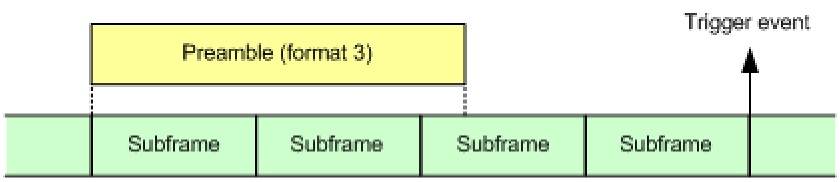


Fig. 2-20: PRACH trigger timing

The PRACH trigger signal can be used to trigger LTE "PRACH" measurements (option R&S CMW-KM500 / -KM550). When the measurement receives a trigger event, it evaluates already measured data to provide results for the preamble.

TPC Trigger

Trigger event generated when a single TPC pattern is executed ("Single Pattern" or "User-defined Single Pattern").

This signal can be used to trigger a single shot power measurement using the LTE "Multi Evaluation" measurement (option R&S CMW-KM500 / -KM550).

2.2.18 Relative Power Control Tests

Uplink power control tests with relative commands are specified in 3GPP TS 36.521, section 6.3.5.2 "Power Control Relative power tolerance". The first two subtests require special TPC power control patterns combined with a dynamic resource block allocation. Such patterns are provided by the signaling application and are described in this section.

The basic test procedure specified by 3GPP for both subtests is as follows:

1. Command the UE to the initial target power, depending on the carrier frequency.
2. Configure the initial RB allocation, depending on the duplex mode and the channel bandwidth.
3. Send the TPC pattern and measure the resulting power steps. In parallel, change the resource block allocation.

For subtest 1, the test has to be performed three times, with the ramping up TPC patterns A, B and C. All three patterns consist of +1 dB commands over 40 active uplink subframes. Within each pattern there is one RB allocation change. The change depends on the channel bandwidth. The position of the change within the pattern differs for pattern A, B and C.

Subtest 2 is similar, with ramping down TPC patterns instead of ramping up patterns.

The following figure shows the ramping up TPC pattern A for FDD as an example. The RB allocation change is located after the first radio frame (10 subframes).

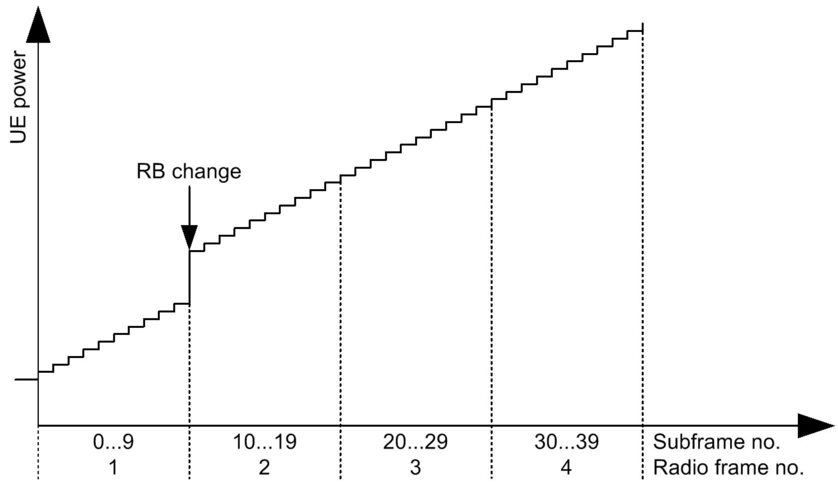


Fig. 2-21: Ramping up pattern A for FDD

The 3GPP specification allows us to interrupt the power ramping. The interruptions must be whole numbers of radio frames without power change (0 dB commands). The R&S CMW inserts such interruptions in order to reconfigure the input path according to the changing expected nominal power.

Thus the measured UE power diagram with TPC pattern A for FDD looks typically as follows.

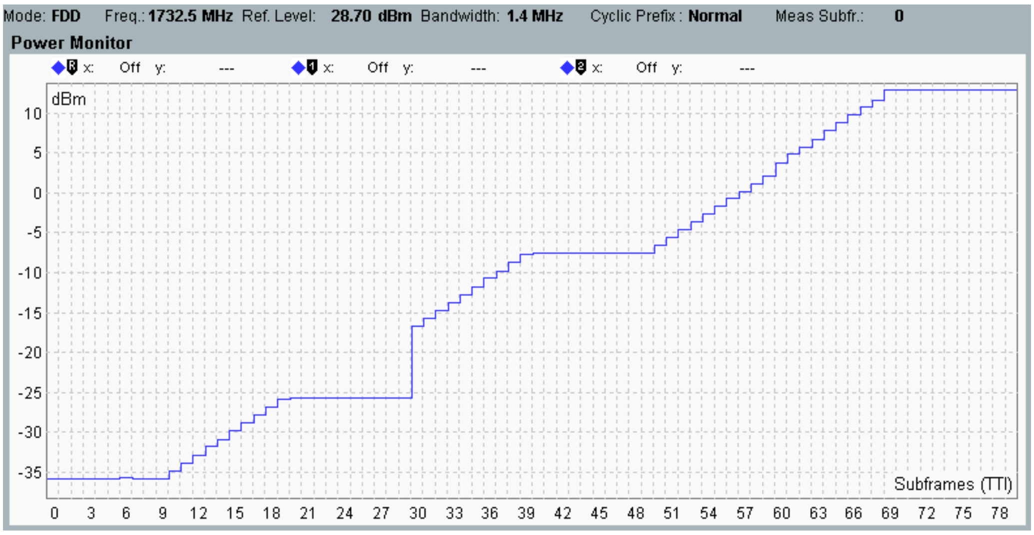


Fig. 2-22: Power measurement with ramping up pattern A for FDD

Explanation of the diagram:

- Frame 1: constant initial target power
- Frame 2: ramping up
- Frame 3: constant power for input path configuration
- End of frame 3: change of RB allocation
  In this example the channel bandwidth is 1.4 MHz. Thus the allocation changes from 1 RB to 6 RB (8.78 dB power step expected).

- Frame 4: ramping up
- Frame 5: constant power for input path configuration
- Frame 6 and 7: ramping up

To perform a relative power control test

You need the LTE signaling application and the LTE measurement application (option R&S CMW-KM500/550, LTE FDD/TDD R8, TX measurement).

1. Set up an RMC connection with the desired duplex mode and cell bandwidth.
   Note that the expected nominal power is configured automatically during the test. You do not need to set a specific value.
2. Switch to the "LTE Multi Evaluation" measurement:
   In the signaling application press the "LTE TX Meas" softkey.

   The measurement application is opened and the combined signal path scenario is selected.
3. In the measurement, select the TPC trigger signal provided by the signaling application:
   Press the softkey "Trigger" followed by the hotkey "Trigger Source" and select "LTE Sig<n>: TPC Trigger".
4. Ensure that the number of measured subframes is sufficient (e.g. 80):
   Press the softkey "Multi Evaluation" followed by the hotkey "Measurement Subframes" and set "No. of Subframes".
5. Press "ON | OFF" to start the measurement.
   Ignore an indicated trigger timeout.
6. Configure the TPC pattern and execute it:
   a) Press the "Signaling Parameter" softkey followed by the "TPC" hotkey.
   b) Set "Active TPC Setup" to "3GPP Relative Power Control".
   c) Set "3GPP..." > "Pattern" to the desired ramping pattern (A, B or C up or down).
   d) Press "Execute".

   The TPC pattern is executed. The initial RB allocation and the RB change are configured automatically. The expected nominal power is also configured automatically. After completion of the TPC pattern, the RB allocation is reset to the allocation used before TPC pattern execution.
   To check the measurement results, open the "Power Monitor" view.
7. To repeat the measurement with another pattern, select the pattern and press the "Execute" button again.

2.2.19 Extended BLER Measurement

The extended BLER measurement is installed together with the "LTE Signaling" application. To access the measurement, press the softkey "LTE RX Meas" in the LTE signaling main view. Then select the tab "Extended BLER".

The measurement sends data to the UE via PDSCH subframes. It evaluates the positive ACKnowledgments (ACK) and Negative ACKnowledgments (NACK) returned by the UE to determine the Block Error Ratio (BLER) and the throughput. The CQI indices reported by the UE are also evaluated.

With enabled HARQ / CQI reporting, the HARQ (re-)transmissions, reported PMI values and rank indicators are also evaluated. For the uplink, the results of a Cyclic Redundancy Check (CRC) are provided.

The measurement is especially suitable to assess the characteristics and the performance of the UE receiver at low RF power levels.

The LTE standard does not request the implementation of test loops at the UE. Bit Error Rate (BER) measurements are therefore no issue for LTE.

2.2.19.1 Performing a BLER Measurement

To measure the downlink BLER, you must set up a connection and transfer data via the downlink. In test mode, activate downlink padding to transfer data (see "Downlink MAC Padding" on page 169). In data application mode, transfer data for example via FTP.

If you want to set up a downlink signal with a specific CQI index value, use a "CQI" scheduling type.

When you start the measurement, the R&S CMW sends data to the UE via PDSCH subframes and requests the UE to confirm the correct reception. The UE confirms each received subframe with an ACK or NACK via the PUSCH. The R&S CMW calculates the DL BLER from the received ACKs and NACKs. It determines the CQI, PMI and RI results from the corresponding reported values. For the uplink, the R&S CMW performs a CRC check and calculates the UL BLER from the results of the check

For transmission schemes using several downlink streams, the ACKs, NACKs and CQI indices reported for the streams are evaluated separately.

Note: As the transmit time interval for LTE equals one subframe, a subframe corresponds to one transport block.

It is possible to insert block errors into the downlink data (send wrong CRC value). For configuration see "Downlink MAC Error Insertion" on page 170.

Active neighbor cell measurements cause an increased number of NACKs. So it is recommended to disable neighbor cell measurements for BLER evaluation, see Neighbor Cell Settings.

Reduced PDCCH resources may also result in an increased number of NACKs. So it is recommended to disable "Reduced PDCCH", see PDCCH.

For configuration of CQI, PMI and RI reporting, see CQI Reporting.

For configuration of DL HARQ settings, see DL HARQ.

Confidence BLER measurements

In a normal BLER measurement, typically a fixed number of subframes is transmitted, leading to a fixed test time. The idea behind confidence BLER measurements is to apply probability theory and predict a range for the BLER at an early stage of the measurement. The measurement is stopped if the probability of the UE to pass or fail the receiver quality test is large enough (early pass or early fail decision).

Confidence BLER measurements can reduce test times considerably, especially if the BLER of a receiver is very low or very high. They are specified in Annex G of 3GPP TS 36.521 as "Statistical Testing". Option R&S CMW-KS510/-KS512 (without CA/with CA) is required for confidence BLER measurements.

To perform a confidence BLER measurement, configure especially the following measurement settings (see also chapter 2.4.18.3, "Settings", on page 198):

- Set "Stop Condition" to "Confidence Level"
- Select the "Error Ratio Calculation" according to the test case
- Configure the "Minimum Test Time" according to the test case
- Select a "Limit Error Rate"
  Depending on this selection, the pass/fail decision is made according to the rules specified in 3GPP TS 36.521 Annex G.2 or Annex G.4.
- For tests with carrier aggregation, select the "Over All Stop Decision"

2.2.19.2 Result Overview

The results of the "Extended BLER" measurement are displayed in several different views on the "Extended BLER" tab. The result overview provides a summary of the most important results of the detailed result views.

Fig. 2-23: Result overview

You can enlarge one of the diagrams in the overview and show a detailed view with additional measurement results, see chapter 2.2.19.9, "Selecting and Modifying Views", on page 76. The individual results are described in the "Detailed Views" sections.

For the following UL BLER results, there is no "Detailed View". Option R&S CMW-KS510 is required for these results.

- **Uplink BLER**:
  Block Error Ratio, percentage of received uplink subframes with failed CRC check.
  The following formula is used:
  BLER = CRC Fail / (CRC Pass + CRC Fail)
- **Uplink Throughput**:
  Throughput calculated from the CRC Pass / Fail results and the maximum possible uplink throughput. The following formula is used:
  *Throughput = CRC Pass / (CRC Pass + CRC Fail) * Max possible throughput*
  The uplink throughput indicates the average uplink throughput since the start of the measurement.
  The maximum possible throughput is calculated from the UL settings. It is displayed for example in the "Connection Setup" section of the signaling application main view.
- **CRC Pass / Fail**:
  Number of uplink subframes with passed / failed CRC check, received since the start of the measurement.

2.2.19.3 Detailed View: BLER

The "BLER" view provides a table of downlink BLER and throughput results. The table contains always an overall result section at the top (results over all streams of one carrier). For configurations with several downlink streams it provides the results additionally per downlink stream.

For carrier aggregation scenarios, the results for the individual component carriers are presented on different tabs. The overall results for the sum of all component carriers are provided in the "Throughput" view.

The BLER view shows also common settings of the "LTE signaling" application, see chapter 2.4.1.6, "Settings", on page 105.

The following figure shows the results of two measurements. On the left, you see the results of a measurement without stop condition and two downlink streams. On the right, you see the results of a confidence BLER measurement with one downlink stream.

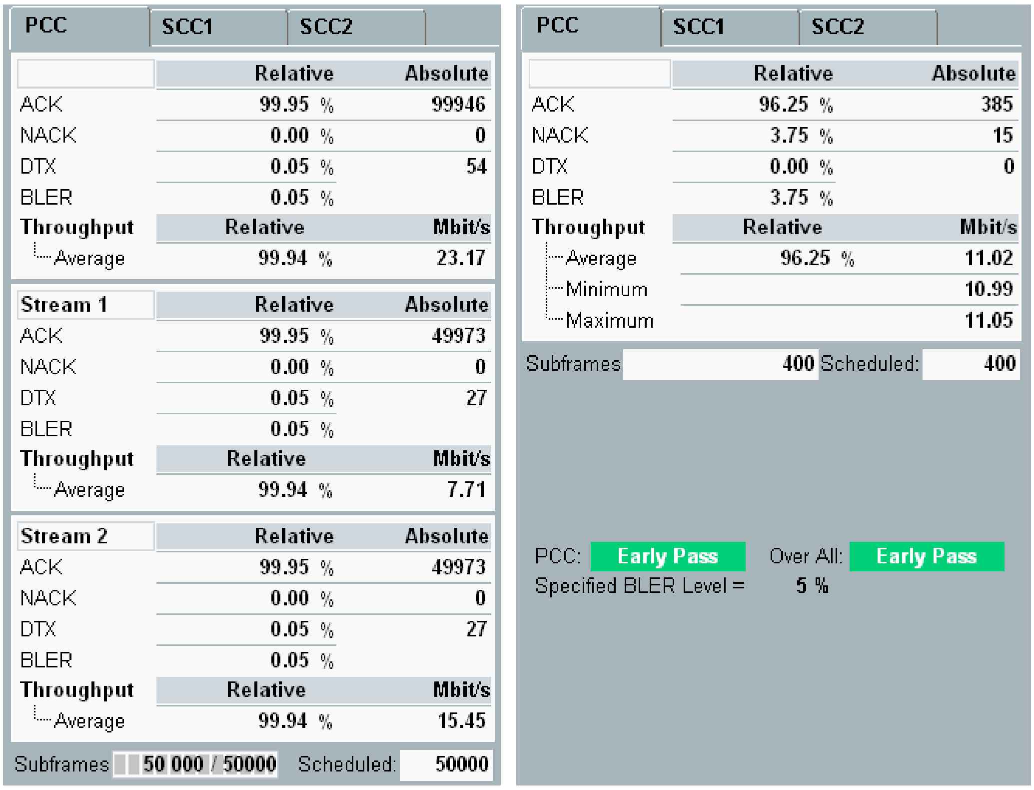


Fig. 2-24: BLER view results (two streams normal measurement / one stream confidence BLER)

Result tables

- **ACK / NACK / DTX**:
  Number of acknowledgments and negative acknowledgments received via the PUSCH since the start of the measurement. No answer at all (neither ACK or NACK) is counted as DTX.

The results are presented as absolute number and as percentage relative to the number of sent scheduled subframes.

- **BLER**:
  Block Error Ratio, percentage of sent scheduled subframes for which no acknowledgment has been received. The formula used to calculate the BLER is configurable, see "Error Ratio Calculation" on page 200. By default the following formula is used:
  BLER = (NACK + DTX) / (ACK + NACK + DTX)
- **Throughput**:
  Throughput calculated from the number of acknowledged transport blocks (number of received ACK multiplied with bits per transport block, divided by the time).
  The throughput is calculated for each 200 processed subframes. From the resulting throughput values the instrument determines the average value and the minimum and maximum values.
  The "Relative" average throughput indicates the average throughput as percentage of the maximum possible throughput, i.e. of the throughput that would be reached with ACK = 100%.

Confidence BLER results

- **PCC or SCC Pass/Fail**:
  When a pass/fail decision has been made for the carrier, one of the following result values is displayed:
  – "Early Pass" / "Early Fail":
    An early pass or early fail limit was exceeded and an early decision has been made.
  – "Pass" / "Fail":
    The configured minimum test time is larger than the early decision table. The pass/fail decision has been made using the test limit.

  The pass/fail decision is always based on the overall BLER results of the carrier, independent of the number of downlink streams.
  When a pass/fail result is displayed for a carrier, the measurement may continue to derive the pass/fail result for another carrier and the overall pass/fail result.
- **Over All Pass/Fail**:
  For measurements with carrier aggregation, an overall pass/fail result is derived from the PCC/SCC pass/fail results.
  The meaning of the overall result depends on the configured "Over All Stop Decision". For the stop decision "PCC only", the overall result equals the PCC result. For the stop decision "SCC<n> only", the overall result equals the SCC<n> result. For the "All Carrier, ..." stop decisions, the overall result has the following meaning:
  – "Early Fail": at least one carrier "Early Fail"
  – "Fail": no carrier "Early Fail", at least one carrier "Fail"
  – "Early Pass": all carriers "Early Pass"
  – "Pass": at least one carrier "Pass", no "Fail", no "Early Fail"
- **Specified BLER Level**:
  Indicates the currently configured "Limit Error Rate".

For "Subframes" and "Scheduled" see chapter 2.2.19.8, "Common View Elements", on page 75.

2.2.19.4 Detailed View: Throughput

The "Throughput" view provides a graphical presentation of downlink throughput and median CQI results for the previous measurement cycle. The X-axis indicates the processed subframes, with the last processed subframe labeled 0, the previously processed subframe labeled -1, and so on. The diagram displays one result value per 200 processed subframes.

The BLER, throughput and median CQI results below the diagram are related to the entire measurement duration. They are also provided in the "BLER" or "CQI Reporting" views. For details, refer to the descriptions of these views.

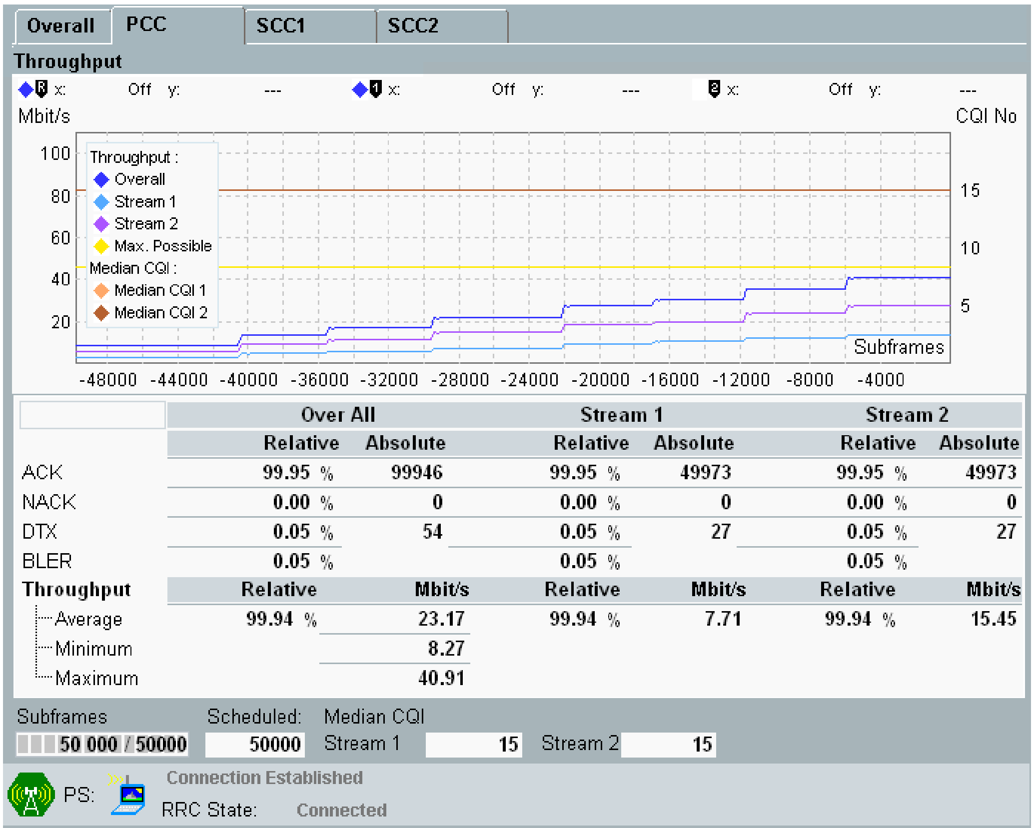


Fig. 2-25: Throughput view (two streams)

For carrier aggregation scenarios, the "Throughput" view presents the results on several tabs. The "PCC" and "SCC<n>" tabs provide the results for the PCC downlink and for the SCC downlinks. The results for the sum of all PCC plus SCC downlink streams are provided on the "Overall" tab.

2.2.19.5 Detailed View: CQI Reporting

The main focus of the "CQI Reporting" view is on evaluation of the CQI index values reported by the UE. This view is only available if CQI reporting is enabled in the signaling application (see "Enable CQI Reporting" on page 189).

For transmission mode 4 (closed loop spatial multiplexing), the UE reports CQI values per stream. So all results are displayed per stream as in the following figure. For all other transmission modes, only "Stream 1" results are available.

For carrier aggregation scenarios, the results for the individual component carriers are presented on different tabs. If you want to evaluate CQI reports for several carriers, ensure that the configured "CQI/PMI Config Index" of the carriers is compatible, see "CQI/PMI Config Index" on page 189.

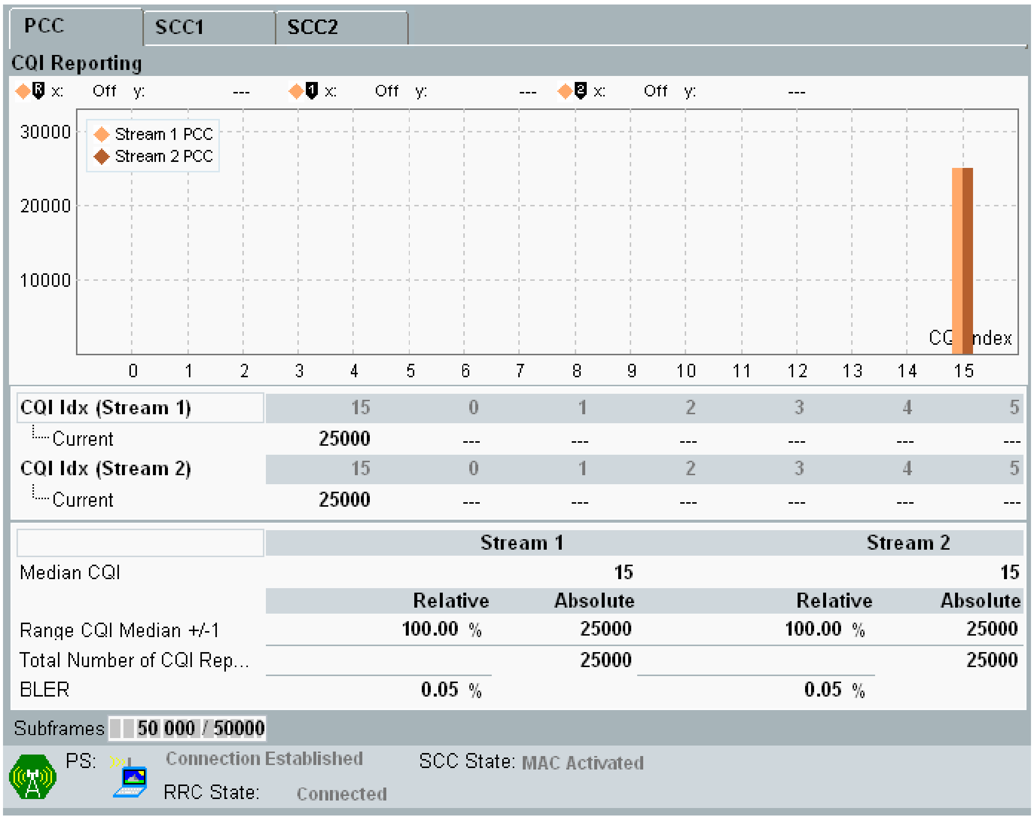


Fig. 2-26: CQI Reporting view (two streams)

The bar graph shows how often the CQI indices 0 to 15 have been reported by the UE since the measurement has been started. The table directly below the bar graph provides the index value and the height of the seven highest bars in the diagram.

The table at the bottom provides the following additional information:

- **Median CQI**: median of the CQI values reported by the UE
  Add the bars of one stream from left to right. The median CQI value is the index value where the sum reaches/crosses 50% of the total sum. This definition of the median value is specified in 3GPP TS 36.521, section 9.

- **Range CQI Median +/-1**: evaluation of three adjacent bars, from median CQI - 1 to median CQI + 1
  The absolute value indicates the sum of the three bars. The relative value indicates the percentage of the absolute value relative to the sum of all bars of the stream.
- **Total Number of CQI Reports**: total number of received CQI index values (sum of all bars per stream)
- **BLER**: relative BLER result per stream, as shown in the "BLER" view

For "Subframes" see chapter 2.2.19.8, "Common View Elements", on page 75.

2.2.19.6 Detailed View: PMI - RI

The "PMI - RI" view provides a statistical evaluation of the Precoding Matrix Indicator (PMI) values and Rank Indicator (RI) values reported by the UE.

This view is only available if CQI reporting is enabled in the signaling application (see "Enable CQI Reporting" on page 189).

Whether PMI and/or RI reports are sent by the UE, depends on the transmission mode.

For carrier aggregation scenarios, the results for the individual component carriers are presented on different tabs. If you want to evaluate PMI reports for several carriers, ensure that the configured "CQI/PMI Config Index" of the carriers is compatible, see "CQI/PMI Config Index" on page 189.

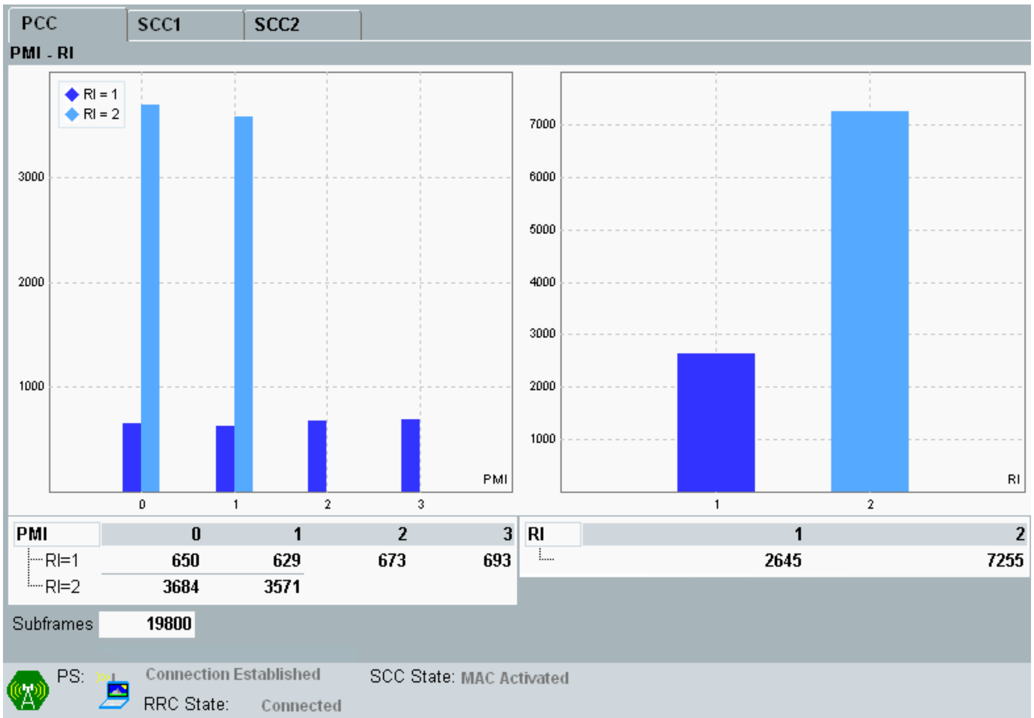


Fig. 2-27: PMI - RI view (TM 4, 2 antennas)

The bar graphs show how often specific values have been reported by the UE since the measurement has been started. The tables below the bar graphs provide the same information as numbers instead of bars.

The bar graph on the right shows how often the RI values 1 and 2 have been reported.

The bar graph on the left shows how often specific PMI - RI combinations have been reported. It provides separate bars for all possible combinations. The possible PMI values depend on the number of DL TX antennas:

- Two antennas: PMI = 0 to 3 for RI = 1, PMI = 0 to 1 for RI = 2
- Four antennas: PMI = 0 to 15, for RI =1 or 2

For "Subframes" see chapter 2.2.19.8, "Common View Elements", on page 75.

2.2.19.7 Detailed View: HARQ

The "HARQ" view provides an overview of all downlink subframe transmissions performed since the measurement was started.

If you cannot access the view, check whether HARQ is enabled, see chapter 2.4.12.3, "Miscellaneous Connection Settings Part 2", on page 174.

For carrier aggregation scenarios, the results for the individual component carriers are presented on different tabs.

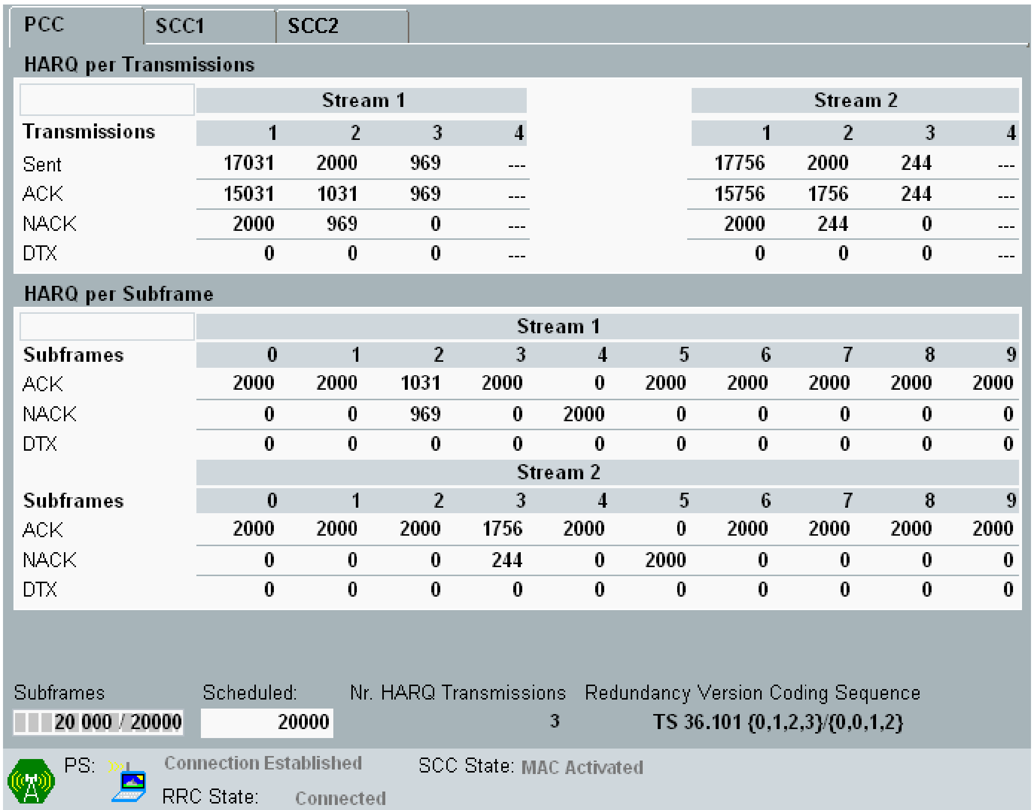


Fig. 2-28: HARQ view (two streams, absolute results)

The view displays two types of tables for each downlink stream:

- The "HARQ per Transmissions" table lists the initial transmissions and all retransmissions. Column 1 indicates the initial transmissions (first redundancy version), column 2 the first retransmission (second redundancy version), column 3 the second retransmission (third redundancy version), and so on.
  For each transmission type the number of sent subframes, received ACK, received NACK and DTX (neither ACK nor NACK received) is displayed.
- The "HARQ per Subframe" table lists the ACK, NACK and DTX received in the individual subframes of the radio frame. So column 0 indicates the ACK/NACK/DTX received in the first subframe of a radio frame, column 9 the ACK/NACK/DTX received in the last subframe of a radio frame.

You can display all results in the tables as absolute numbers or as percentages. To toggle the presentation, use the softkey > hotkey combination "Display" > "Absolute / Relative".

A relative "Sent" value indicates the percentage of the absolute "Sent" value relative to the total number of sent subframes (sum of the table row). A relative ACK, NACK or DTX value indicates the percentage of the absolute value, relative to the sum of the absolute ACK, NACK and DTX values in the table column.

At the bottom of the view some HARQ settings are displayed for information, in addition to the view-independent GUI elements. For a description see "DL HARQ" on page 179.

2.2.19.8 Common View Elements

Each view displays at least one of the following elements to indicate the progress of the measurement:

- **Subframes**:
  This value indicates the number of already processed subframes. For single-shot measurements with fixed length, also the total number of subframes to be processed is displayed.
  For FDD all downlink subframes are counted, scheduled subframes as well as subframes without allocated resource blocks. For TDD special subframes and uplink subframes are also counted.
  A scheduled downlink subframe that is sent via several downlink streams in parallel is counted as one subframe.
- **Scheduled**:
  Displays the number of already measured subframes (scheduled downlink subframes). This number equals the sum of the absolute values for ACK, NACK and DTX for one downlink stream.
  Examples for a single-shot measurement with fixed length:
  – FDD: You set the no. of subframes to 10000, schedule every fifth subframe and use two downlink streams. Thus 2000 subframes are scheduled. The UE is expected to send 2000 responses per stream, 4000 in total. At the end of the measurement the parameter "Subframes" displays 10000/10000 and the parameter "Scheduled" displays 2000.
  – TDD: You set the no. of subframes to 10000. You use UL/DL configuration 1 and transfer downlink data via subframe 0, 1, 4, 6 and 9 (subframe 5 not

scheduled, subframe 2, 3, 7, 8 = uplink). Thus 5 of 10 subframes are used for downlink data transfer and 5000 of 10000 subframes are scheduled. At the end of the measurement the parameter "Subframes" displays 10000/10000 and the parameter "Scheduled" displays 5000.

2.2.19.9 Selecting and Modifying Views

Use the "Display" hotkeys to select the views and to change the appearance and contents of the views. Depending on the selected view the following "Display" hotkeys are available at the bottom of the GUI:

Table 2-19: "Display" hotkeys

Hotkey	Description
"Select View ..."	Switch to a certain detailed view or to the overview. Alternatively select a diagram in the overview and press ENTER or the rotary knob.
"Select Trace ..."	Select the trace types to be displayed in the view.
"X Scale... / Y Scale..."	Modify the ranges of the X-axis and the Y-axis.
"Absolute | Relative"	Toggles between display of absolute and relative results in the HARQ detailed view.

2.2.19.10 Using Markers

The "Marker" softkey displays the following hotkeys at the bottom of the GUI:

Hotkey	Description
"Ref. Marker ..."	Enable or disable the reference marker and select the marker position. If several traces can be displayed, a trace can also be selected.
"Marker 1/2 ..."	Enable or disable marker 1 or 2 and define the marker position (absolute or relative to the reference marker). Depending on the trace mode, a trace can also be selected.
"Select Trace Mode"	Define whether marker 1 and 2 are set to the same trace as the reference marker (collective) or to selectable individual traces.

See also: "Markers" in the R&S CMW user manual, chapter "System Overview"

2.2.20 RLC Throughput Measurement

The RLC throughput measurement is installed together with the "LTE Signaling" application. To access the measurement, press the softkey "LTE RX Meas" in the LTE signaling main view. Then select the tab "RLC Throughput".

The RLC throughput measurement evaluates the total data throughput in the downlink and in the uplink.

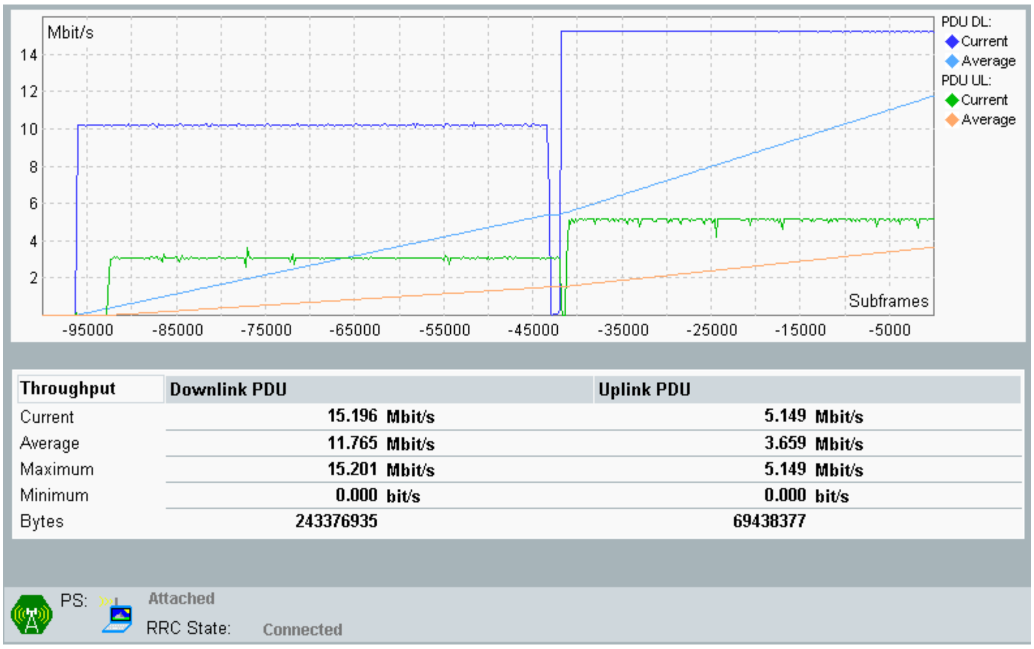
2.2.20.1 Performing RLC Throughput Measurements

To measure the RLC throughput, you must set up a connection in data application mode and generate IP traffic.

1. Set up a connection as described in chapter 2.3.2, "LTE IP-Based Data Tests", on page 82.
   The required options are also listed there.
2. Use the Data Application Unit (DAU) to generate IP traffic in the direction to be measured (uplink and/or downlink). You may for example perform an IPerf measurement. Or you could transfer data via FTP.
   For details refer to the DAU documentation.
3. Start the RLC throughput measurement and evaluate the results.

2.2.20.2 Measurement Results

All results of the measurement are shown on the "RLC Throughput" tab. The results are described below.



Throughput	Downlink PDU	Uplink PDU
Current	15.196 Mbit/s	5.149 Mbit/s
Average	11.765 Mbit/s	3.659 Mbit/s
Maximum	15.201 Mbit/s	5.149 Mbit/s
Minimum	0.000 bit/s	0.000 bit/s
Bytes	243376935	69438377

Fig. 2-29: RLC throughput tab

Diagram

The diagram provides a graphical presentation of the data throughput results for the previous measurement cycle. The X-axis indicates the processed subframes, with the last processed subframe labeled 0, the previously processed subframe labeled -1, and so on.

The diagram displays one result value per "Update Interval". The number of subframes per interval is configurable. The number of subframes per measurement cycle is also configurable ("Window Size", number of subframes on the X-axis).

You can enable/disable the display of the individual traces via the softkey - hotkey combination "Display > Select Trace".

Table
The throughput table indicates statistical throughput results for downlink and uplink.

The "Bytes" value indicates the number of bytes that the R&S CMW has transmitted (DL) or received (UL) since the measurement was started.

Statistical Results
The statistical values are calculated as follows:

- **Current:** Value obtained in the last update interval
- **Average:** Average of all "Current" values within the last measurement cycle (window size)
- **Minimum, Maximum:** Largest or smallest "Current" value since the start of the measurement

2.3 Application Sheets

Application sheets describe short application examples for select issues and provide related background information. The following application sheets are related to the "LTE Signaling" firmware application.

2.3.1 Combined Signal Path Measurements

This application sheet describes how to establish a connection to an LTE User Equipment (UE) and perform TX measurements on the received uplink signal using the "LTE Multi Evaluation" measurement. For SRS and PRACH measurements, see chapter 2.3.1.5, "SRS and PRACH Measurements", on page 82.

Sequencer tool R&S CMWrun

The automated test capabilities of R&S CMWrun make many measurement tasks easier. Option R&S CMW-KT055 provides configurable LTE test modules and test plans for R&S CMWrun.

2.3.1.1 Options and Equipment Required

An LTE combined signal path measurement requires the following equipment:

- Wideband Radio Communication Tester R&S CMW500 with software version ≥ V1.0.15.20. The latest software version is recommended.
  This application sheet describes software version V3.2.10.
- Option R&S CMW-KS500, LTE FDD R8, basic signaling
  or option R&S CMW-KS550, LTE TDD R8, basic signaling
- Option R&S CMW-KM500, LTE FDD R8, TX measurement
  or option R&S CMW-KM550, LTE TDD R8, TX measurement

The following sections describe a combined signal path measurement for FDD. A combined signal path measurement for TDD is performed in the same way, using the R&S CMW-Kx550 options instead of the R&S CMW-Kx500 options.

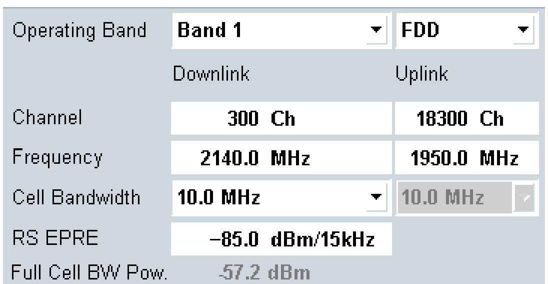
2.3.1.2 Setting up a Connection

An established connection to the UE is a prerequisite for many signaling tests, including the combined signal path measurement described in this application sheet. The following example uses a single downlink stream. For MIMO tests, additional cabling and related configuration of routing settings are required.

To set up a connection,

1. Reset your R&S CMW to ensure a definite instrument state.
2. Connect your UE to the RF 1 COM connector.
3. Open the "LTE Signaling" application, e.g. from the task bar (press "TASKS" to open the task bar).
   If the application is not present in the task bar, enable it in the "Generator/Signaling Controller" dialog (press "SIGNAL GEN" to open the dialog).
4. In the main view of the signaling application, adjust the RF settings to the capabilities of your UE.

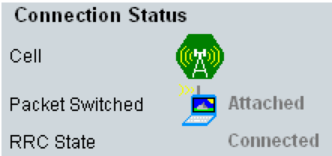
   Configure especially the duplex mode (FDD / TDD), the band, the channel and the cell bandwidth. The "RS EPRE" must be sufficient so that the UE under test can receive the DL signal.

5. Press the "Config" hotkey to open the configuration dialog.

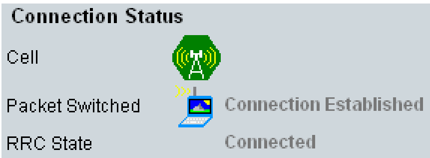
6. In section "RF Settings", select a bidirectional RF connector for input and output. In this example RF 1 COM is used.
   If necessary, also adjust the "External Attenuation" settings.
7. Close the configuration dialog.
8. To turn on the DL signal, press ON | OFF and wait until the "LTE Signaling" softkey indicates the "ON" state and the hour glass symbol has disappeared.
9. Switch on the UE.

   The UE synchronizes to the DL signal and attaches. A default bearer is established.
   Note the connection states displayed in the main view and wait until the attach procedure is complete.
   By default, the RRC connection is kept after the attach is complete.

10. The default bearer and the established RRC connection are usually sufficient for testing.
    If you want to set up a dedicated bearer, press the "Connect" hotkey.

    Note the connection states displayed in the main view and wait until the connection has been established.

Failed attach

If the attach procedure fails, check whether the UE capabilities are in accordance with the security settings in the "Network" section of the configuration dialog.

The default power settings are usually appropriate, but you may check them in the configuration dialog sections "Downlink Power Levels" and "Uplink Power Control".

If your UE needs a DL signal without padding bits for attach, disable downlink padding in the "Connection" section of the configuration dialog.

2.3.1.3 Analyzing the UL Signal from the UE

While an established connection is available, the UL signals from the UE can be monitored using the "LTE Multi Evaluation" measurement (included in option R&S CMW-KM500).

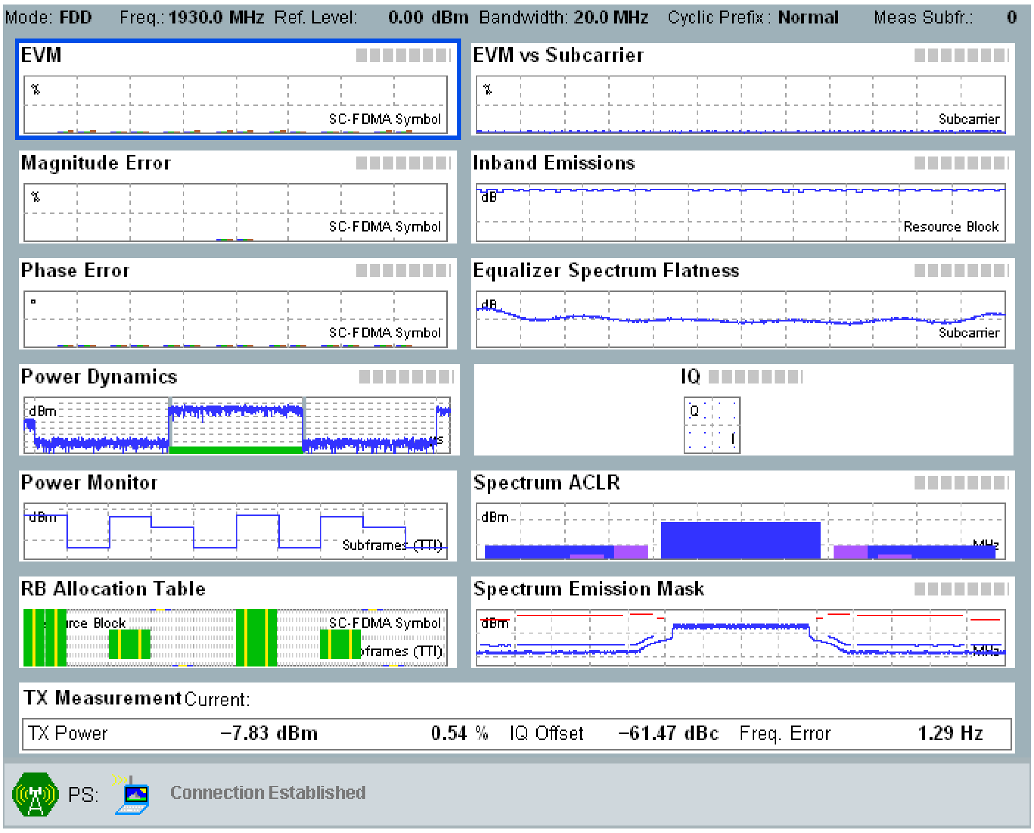
To ensure compatible measurement settings, the measurement must be coupled to the "LTE Signaling" application. This is done by selecting the combined signal path scenario in the measurement. As a result the measurement application uses the most important settings of the signaling application, e.g. the RF settings.

Proceed as follows:

1. Use the "LTE TX Meas" softkey to switch to the multi evaluation measurement.

   The measurement application is opened and the combined signal path scenario is selected automatically. Furthermore the frame trigger signal provided by the "LTE Signaling" application is selected as trigger source.

2. Press "ON | OFF" to start the measurement.
   The main view provides an overview of the measurement results.



To enlarge a diagram perform one of the following actions:

- Double-click it using a connected mouse.
- Select it by turning the rotary knob and open it by pressing the rotary knob.

2.3.1.4 Possible Extensions

While the connection is established, you can vary "LTE Signaling" settings and observe the behavior of the UE under test using the "LTE Multi Evaluation" measurement. E.g. you can configure the signaling application to send Transmit Power Control

(TPC) commands to the UE and observe the resulting uplink power in the measurement dialogs. Or you can modify the channel configuration for the uplink and observe the result in the "RB Allocation Table".

2.3.1.5 SRS and PRACH Measurements

In addition to the "LTE Multi Evaluation" measurement, option R&S CMW-KM500 provides also an SRS measurement and a PRACH measurement.

Performing a combined signal path SRS measurement is similar to performing a multi evaluation measurement. Before switching on the downlink signal, you must enable SRS in section "Physical Cell Setup" of the signaling application. As a result the UE will send an SRS signal after connection setup. The other steps are similar.

For PRACH measurements you do not establish a connection. Configure the PRACH settings in section "Physical Cell Setup" of the signaling application. It is recommended to activate "No Response to Preambles" and to set "Power Ramping Step" to 0 dB.

When you have configured all required settings, switch on the downlink signal and the UE. The UE will send random access preambles which are not answered by the instrument. Use the PRACH measurement to measure these preambles.

2.3.2 LTE IP-Based Data Tests

This application sheet provides examples for testing LTE data transfer over IP, using the LTE signaling application and the Data Application Unit (DAU). It describes how to prepare the measurements, how to measure the network latency using ping and how to measure the downlink throughput for data transfer via UDP/IP.

2.3.2.1 Options and Equipment Required

The described tests require the following equipment:

- Wideband Radio Communication Tester R&S CMW500 with software version ≥ V2.0.20. The latest software version is recommended.
  This application sheet describes software version V3.2.60.
- Option R&S CMW-KS500, LTE FDD R8, basic signaling
  or option R&S CMW-KS550, LTE TDD R8, basic signaling
- Option R&S CMW-KM050, data application measurements (requires hardware R&S CMW-B450x, data application unit)
- Option R&S CMW-KA100, Enabling of IP-Data interface for IPv4

2.3.2.2 Preparing the Tests

For test preparation, you need to configure the signaling application, set up a connection and configure the measurement.

Proceed as follows:

1. Set up a connection. The general procedure for connection setup is described in the application sheet "LTE Combined Signal Path Measurements", see chapter 2.3.1.2, "Setting up a Connection", on page 79.
   For IP-based data tests, insert the following step after opening the configuration dialog:
   a) In section "Connection", set parameter "Connection Type" to "Data Application".
      This step enables the support of protocol stack layer 3 in the signaling application.
2. In the main view of the signaling application, note the IPv4 address assigned to the UE during attach. You need this information in the following sections.
   Alternatively, if your UE is connected to a PC with Windows operating system, open a command shell at the PC and type `IPconfig` to retrieve the IP address information.
3. Open the "Data Application Measurements", e.g. from the task bar (press "TASKS" to open the task bar).
   If the application is not present in the task bar, enable it in the "Measurement Controller" dialog (press "MEASURE" to open the dialog).
4. At the top of the GUI, select the LTE signaling application (parameter "Select RAN").

   The expected maximum throughput resulting from the current signaling settings is displayed to the right for information.

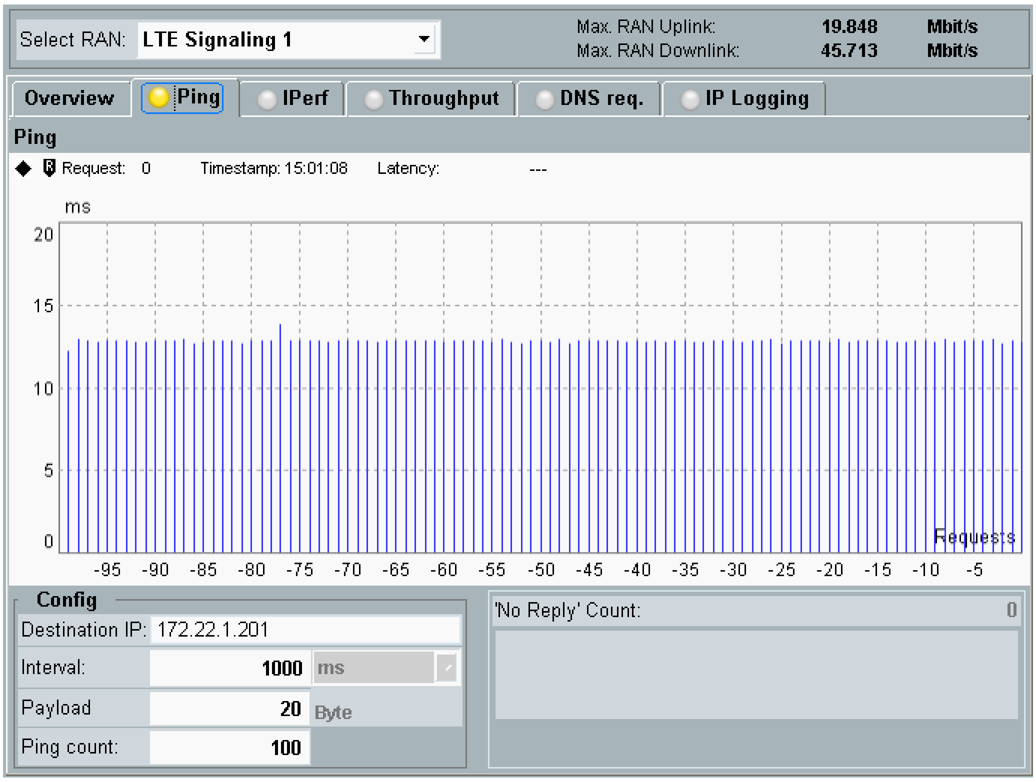
2.3.2.3 Measuring the Latency with Ping

After completed test preparation, you may ping your UE and evaluate the reported round-trip latency.

Proceed as follows:

1. Select the "Ping" tab.
2. For parameter "Destination IP" enter the IP address of the UE.
3. Press ON | OFF.

   The measurement starts and the "Ping" softkey indicates the "RUN" state.
   The graph shows the measured round-trip latency for each executed ping request.

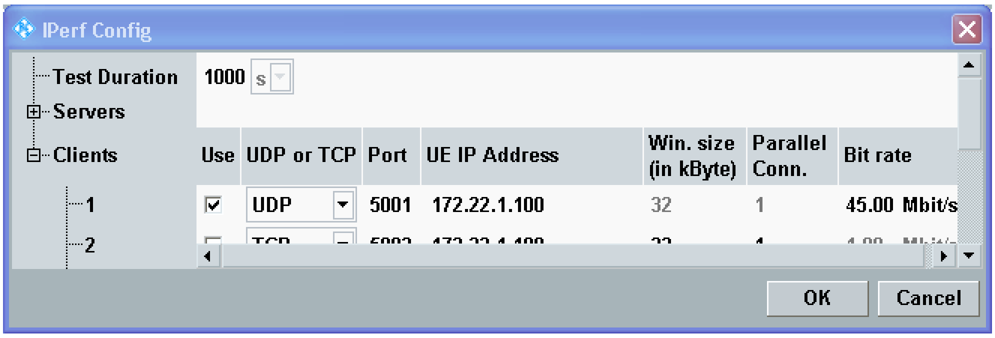


2.3.2.4 Measuring the Throughput with IPerf

The following steps describe how to measure the downlink throughput for data transfer via UDP/IP. As a prerequisite, the IPerf tool must be installed on the UE, or on a PC connected to the UE. A compatible program version can be downloaded from the web pages provided by the DAU. Refer to the DAU documentation for details.

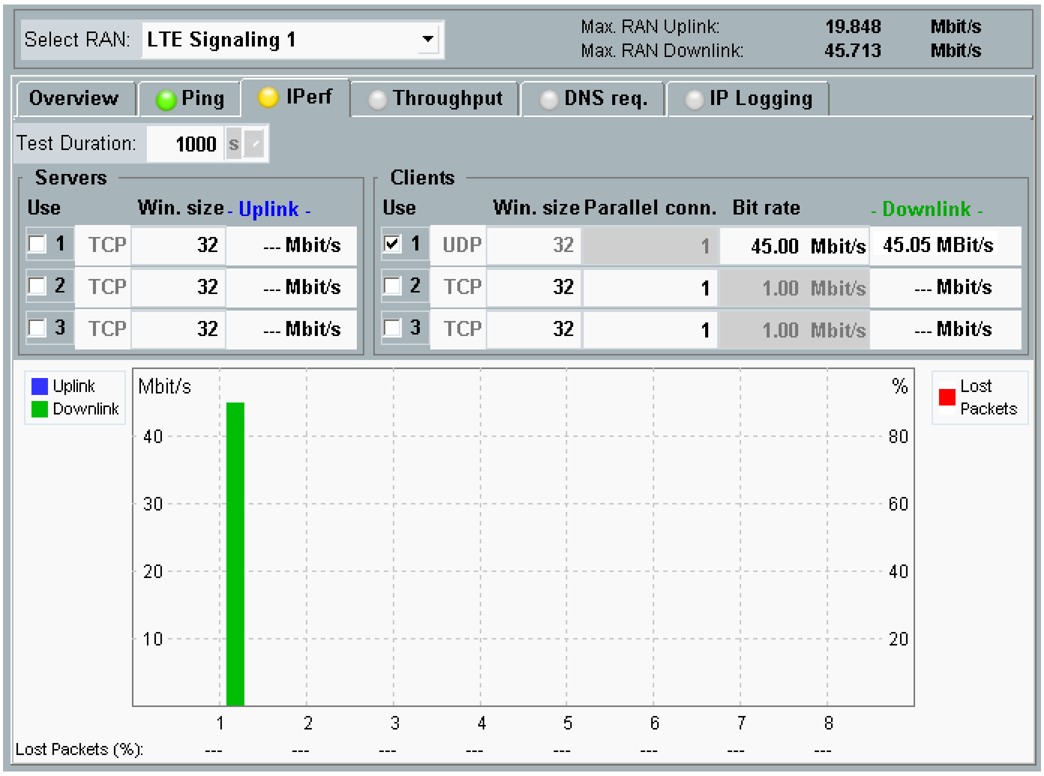
Proceed as follows:

1. Select the "IPerf" tab.
2. Press "Config..." to open the configuration dialog.
3. In section "Servers" disable all entries (column "Use").
4. In section "Clients" configure the first entry:
   a) Enable the entry.
   b) Select "UDP".
   c) Note the port. You need it in a later step.
   d) Enter the IP address of the UE (see Preparing the Tests).
   e) Configure a bit rate compatible to the expected maximum downlink bit rate displayed at the top of the IPerf view as "Max. Downlink".



5. Press OK to close the configuration dialog.
6. Press ON | OFF.

   The application starts and the "Iperf" softkey indicates the "RUN" state.
   The R&S CMW sends data packets to the UE, using the downlink bit rate indicated in the last column and the graphic.
7. Configure the IPerf tool at UE side so that it listens to the UDP port configured for the used client entry.
8. Start the IPerf tool at UE side and compare the bit rates received at the UE with the sent bit rates at the R&S CMW.



2.3.2.5 Possible Extensions

While the connection is established, you can vary "LTE Signaling" settings and "Data Application Measurements" settings and observe the impact on the measurement results. You can for example modify the downlink power levels, the downlink channel configuration and the sent bit rate. You may also set up a MIMO configuration (option required, see below) and perform LTE end-to-end data tests with MIMO.

The applications can be enhanced for example by the following options:

- Option R&S CMW-KS510 provides advanced parameter settings for "LTE Signaling"
- Option R&S CMW-KS520 adds support of MIMO 2x2 in the downlink
- Option R&S CMW-KS521 adds support of MIMO 4x2 in the downlink
- Option R&S CMW-KA150 adds support of IPv6
- Option R&S CMW-KAA20 provides an IMS server

2.3.3 VoLTE Call Setup and Audio Tests

This application sheet describes how to set up a Voice over LTE (VoLTE) call with the R&S CMW, using the LTE signaling application and the IMS server of the Data Application Unit (DAU).

For the established VoLTE call, basic audio tests are performed with the R&S CMW audio board. For speech quality tests with a connected R&S UPV, the R&S CMW configuration and the test setup are described.

2.3.3.1 Required Equipment

The following equipment is required to set up a voice over LTE call and to perform audio tests with the R&S CMW:

- Wideband Radio Communication Tester R&S CMW500
- Hardware options:
  – Signaling unit wideband, R&S CMW-B300x
  – Audio board, R&S CMW-B400B
    Speech codec, R&S CMW-B405A
  – Option carrier, R&S CMW-B660A
    Ethernet switch, R&S CMW-B661A
    Data application unit, R&S CMW-B450x
- RF cable, for connection of a UE antenna port to an RF COM port
- Audio cables between the UE microphone / speaker and the AF OUT / IN ports
  Alternatives at UE side:
  – UE headset jack or UE microphone/speaker jacks
  – Microphone at UE speaker plus speaker at UE microphone
    Use a high quality microphone and speaker designed for that purpose, for example an artificial head.
- Software options:

  - LTE R8, SISO, basic signaling, R&S CMW-KS500 (FDD) or -KS550 (TDD)
  - LTE R8, SISO, advanced signaling, R&S CMW-KS510
  - IPv4 enabler, R&S CMW-KA100, for IPv6 additionally R&S CMW-KA150
  - IMS basic service, R&S CMW-KAA20
- Software and minimum software versions:
  - Base software ≥ V3.2.40
  - LTE signaling ≥ V3.2.70
  - Audio measurements ≥ V3.2.10
  - Data application software ≥ V3.2.30

For a functional test of the audio transmission, a handset is required (option R&S CMW-Z50, only for chapter 2.3.3.3, "Checking the Audio Transmission", on page 92).

To perform a speech quality analysis, the following additional equipment is required (only for chapter 2.3.3.5, "Testing the Speech Quality with an R&S UPV", on page 95):

- Audio analyzer R&S UPV with relevant software options
- Audio cables for the following connections:
  - R&S UPV, generator output – UE, microphone input
  - UE, speaker output – R&S UPV, analyzer input
  - R&S UPV, generator output – R&S CMW, AF IN
  - R&S CMW, AF OUT – R&S UPV, analyzer input

  For details, refer to the R&S UPV documentation.

2.3.3.2 Setting up a VoLTE Call

The following sections describe in detail how to set up a voice over LTE call. We use the default scenario, a standard SISO LTE cell. And we use the default RF connector, RF 1 COM.

The following sections are based on each other. Please execute them in the given order:

- Connecting the UE and initializing the R&S CMW
- Configuring and starting the IMS server of the R&S CMW
- Configuring and switching on the LTE cell
- Attaching the UE to the cell and registering it to the IMS server
- Initiating a voice over LTE call

Connecting the UE and initializing the R&S CMW

The instrument is already running. The UE is switched off.

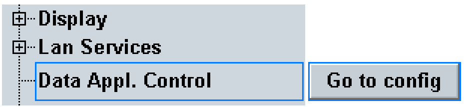
1. Connect your UE to the RF 1 COM port of the instrument.
2. Press RESET and perform a global preset.
3. Enable the applications:

a) Press SIGNAL GEN.
   The "Generator/Signaling Controller" dialog box opens.
b) Enable "LTE Signaling 1".
c) Press MEASURE.
   The "Measurement Controller" dialog box opens.
d) Enable "Audio Measurements 1".
e) Enable "Data Appl. Measurement 1".
   If this entry is not available, you can skip this step. The presence of the entry depends on the presence of option R&S CMW-KM050.

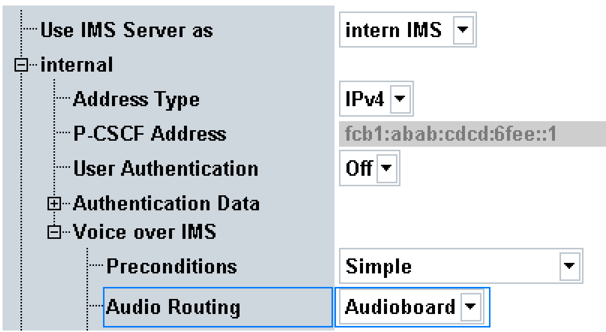
The task bar at the bottom contains now hotkeys for access to the LTE signaling application, the audio measurements and - optionally - to the data application measurements. To show or hide the task bar, press TASKS.

Configuring and starting the IMS server

1. Open the "Data Application Control" dialog box.
   a) Alternative 1, with R&S CMW-KM050:
      On the task bar, press "Data Meas 1". The "Data Application Measurement" view opens.
      Press the "Configure Services" softkey.
   b) Alternative 2, without R&S CMW-KM050:
      Press SETUP. The "Setup" dialog box opens.
      In the "System" section > "Data Appl. Control", press the "Go to config" button.



   The "Data Application Control" dialog box opens.
2. Select the "IMS" tab.
3. Press the "Config" hotkey.
   The IMS configuration dialog box opens.
4. Set "internal" > "Voice over IMS" > "Audio Routing" to "Audioboard"



5. Configure the remaining settings compatible to your UE:
   - "Address Type"

- "User Authentication", for "On" also the "Authentication Data"
- "Preconditions"

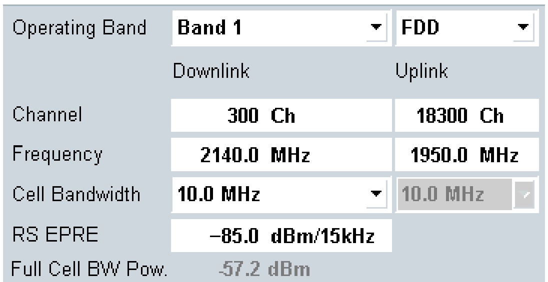
6. Press "OK" to close the dialog box.
7. Press ON | OFF.
   The IMS service is started. Wait until the "IMS" softkey displays the state "ON" and the displayed IMS status equals "running".

Configuring and switching on the LTE cell

1. On the task bar, press "LTE Signaling 1".

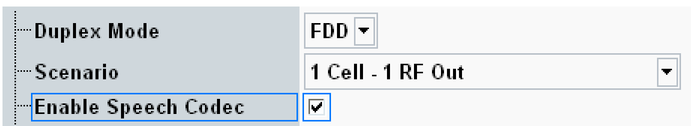
   The "LTE Signaling" view opens.
2. Adjust the RF settings to the capabilities of your UE.

   Configure especially the duplex mode (FDD / TDD), the band, the channel number and the cell bandwidth. The "RS EPRE" must be sufficient so that the UE can receive the DL signal.

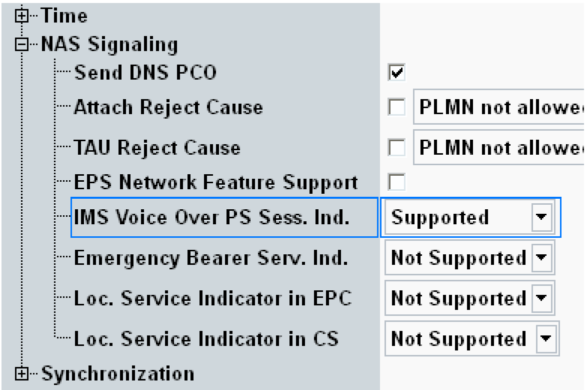


3. Press the "Config" hotkey.

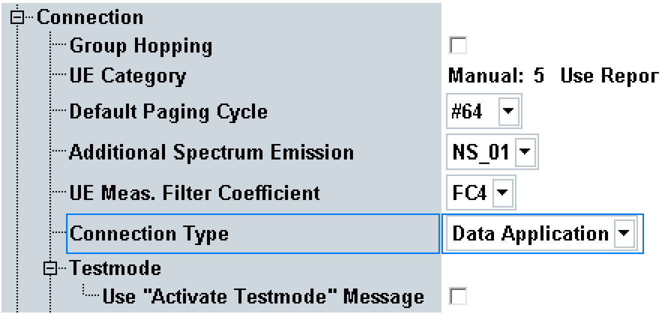
   The LTE signaling configuration dialog box opens.
4. Activate "Enable Speech Codec".



5. In section "Network" > "NAS Signaling", set "IMS Voice Over PS Sess. Ind." to "Supported".

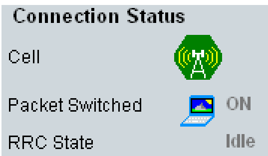


6. Configure the remaining "Network" settings compatible to your UE, especially the sections "NAS Signaling", "Identity" and "Security Settings".
7. In section "Connection", set "Connection Type" to "Data Application".
8. Disable "Use 'Activate Testmode' Message"



9. Close the dialog box.
10. Press ON | OFF.

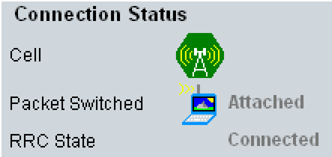
    The LTE cell signal is switched on. This may take some seconds. Note the displayed connection states and wait until the process is complete.



Attaching and registering the UE

1. Switch on the UE.

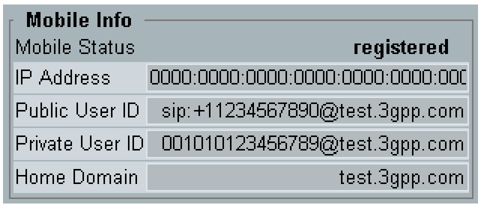
    The UE synchronizes to the LTE cell signal and attaches. A default bearer is established.
    Note the displayed connection states and wait until the attach procedure is complete and the RRC connection is established.



2. Open the "Data Application Control" dialog box.
   a) Task bar > "Data Meas 1" > "Configure Services" softkey, or
   b) SETUP > "Go to config" button

   The "Data Application Control" dialog box opens.
3. After attaching to the LTE cell, the UE registers to the IMS server.

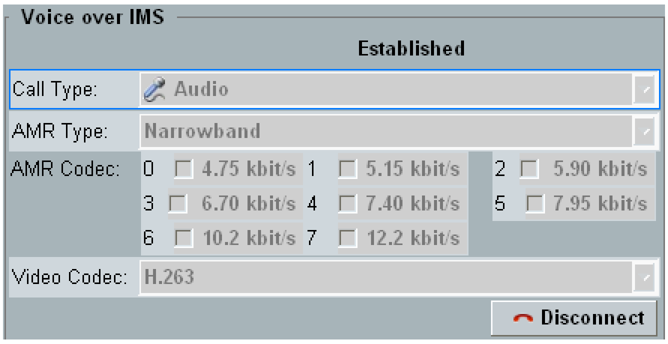
   Note the mobile status displayed on the "IMS" tab and wait until the registration is complete.



Initiating a VoLTE call

1. To initiate a mobile originating call, dial an arbitrary number at the UE.

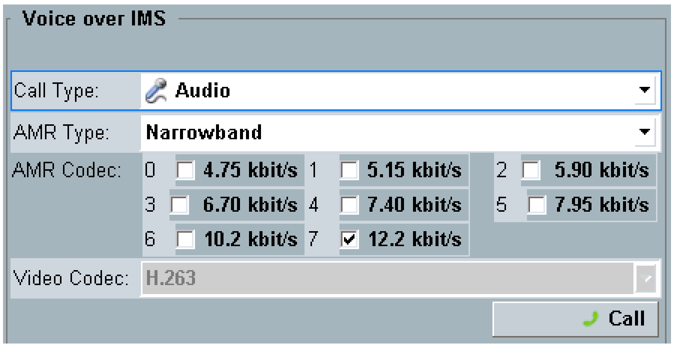
   The IMS server accepts the voice call.
   The "Voice over IMS" dialog box opens and displays the state "Established".



   The "Info" area indicates the successful call setup.

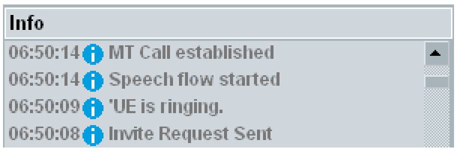
2. Alternatively, initiate a mobile terminating call as follows:
   a) Press the softkey "Voice over IMS".
      The "Voice over IMS" dialog box opens.

b) For "Call Type", use the default value "Audio".
Configure the "AMR Type" and the "AMR Codec" compatible to your UE.



c) Press the "Call" button to initiate the call.
The state "Calling" is displayed, followed by the state "Ringing".

d) Accept the call at the UE.
The state "Established" is displayed.
The "Info" area indicates the successful call setup.



2.3.3.3 Checking the Audio Transmission

This section describes a simple functional check of the audio transmission in uplink and downlink direction. You need the handset R&S CMW-Z50 for this check.

1. Connect the handset to AF 1 IN and AF 1 OUT.
2. Open the "Audio Measurement 1" view:
   On the task bar, press "Audio Measurement 1".
3. At the top, select the scenario "External Analog Speech Analysis".
4. Press the "Input Level" hotkey and enter 0.05 V.
5. Press the "Output Level" hotkey and enter 1 V.
6. To check the downlink direction, speak into the handset microphone and listen to the UE speaker. The speech should be audible at the UE speaker after a small delay.
7. To check the uplink direction, speak into the UE microphone and listen to the handset speaker. The speech should be audible at the handset speaker after a small delay.
8. Disconnect the handset.

2.3.3.4 Performing Basic Audio Tests

This section describes how to perform audio tests for an established VoLTE connection. As audio test signal, a single tone is used. The tests analyze mainly the harmonic distortions and noise of an audio signal.

The tests are performed in two steps. The first step is a speaker test, the second step a microphone test. You can perform speaker- and microphone tests with a stand-alone R&S CMW. No additional test instruments are required.

Performing a speaker test

The digital generator of the audio board feeds a 1000 Hz audio tone to the speech encoder. The tone is transmitted to the UE via the already established VoLTE connection. The UE demodulates and decodes the signal and feeds the resulting audio signal to its speaker.

The analog measurement of the audio board analyzes the audio signal of the speaker.

If the UE has a speaker jack, headphones jack or headset jack, connect it directly to the AF 1 IN port. Alternatively, you can use a microphone and connect it to AF 1 IN. You could for example use the microphone of an artificial head, designed for this purpose.

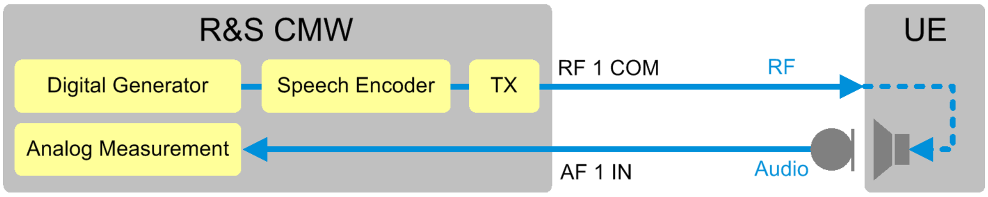


Fig. 2-30: Test setup for a speaker test

To prepare and execute the speaker test, proceed as follows:

1. Open the "Audio Measurement 1" view:
   On the task bar, press "Audio Measurement 1".
2. At the top, select the scenario "Microphone- and Speakertest".
3. Connect the UE speaker to AF 1 IN.
4. Select the "Digital Generator" softkey and press ON | OFF.
   The generator is started. Wait until the softkey indicates the "ON" state.
   A 1000 Hz tone is generated, fed to the speech encoder and transmitted to the UE via the VoLTE connection.
5. Select the "Analog Meas" softkey and press ON | OFF.
   The measurement is started. Wait until the softkey indicates the "RUN" state.
6. Evaluate the measurement results, for example the Total Harmonic Distortion (THD) and the Signal to Noise Ratio (SNR) of the audio signal.

Analog Measurement

	CUR	AVG	EXT	STD
THD [%]	0.1121	0.1095	0.1371	0.0037
THD [dB]	-59.01	-59.21	-57.26	0.28
THD + N [%]	0.4402	0.4465	0.4639	0.0051
SINAD [dB]	47.13	47.00	46.67	0.10
SNR [dB]	47.42	47.27	46.97	0.11
DC Level [V]	0.000	0.000	0.000	0.000
Frequency [Hz]	1000.0	1003.3	1095.5	12.3
Weighted Level, RMS [V]	0.0872	0.0873	0.0880	0.0002
Bandpass Level, RMS [V]	0.0872	0.0873	0.0880	0.0002

7. Stop the generator and the measurement:
   a) Select the "Analog Meas" softkey and press ON | OFF.
   b) Select the "Digital Generator" softkey and press ON | OFF.

Performing a microphone test

In the following test, the analog generator of the audio board feeds a 1000 Hz audio tone to the microphone of the UE.

The UE encodes the audio signal and modulates the RF signal. It transmits the RF signal via the already established VoLTE connection to the R&S CMW.

The R&S CMW demodulates and decodes the signal. The digital audio measurement of the audio board analyzes the resulting audio signal.

If the UE has a microphone jack or a headset jack, connect it directly to the AF 1 OUT port. Alternatively, you can use a speaker and connect it to AF 1 OUT. You could for example use the speaker of an artificial head.

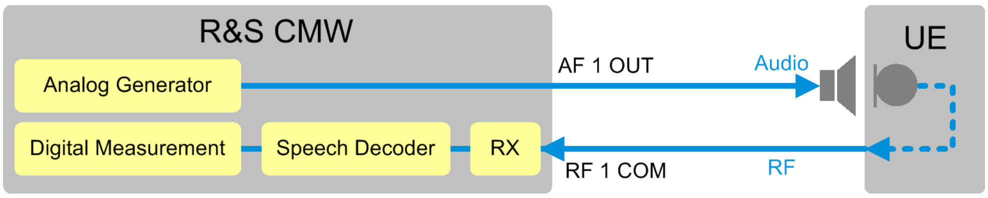


Fig. 2-31: Test setup for a microphone test

To prepare and execute the microphone test, proceed as follows:

1. Connect the UE microphone to AF 1 OUT.
2. Select the "Digital Meas" tab.
3. Press the "Analog Generator" softkey.
4. Press the "Level" hotkey and enter a value compatible to the microphone input of your UE, for example 100 mV.
5. Press ON | OFF.
   The generator is started. Wait until the softkey indicates the "ON" state.
   A 1000 Hz tone is generated and fed to the UE microphone.
6. Select the "Digital Meas" softkey and press ON | OFF.

The measurement is started. Wait until the softkey indicates the "RUN" state.

7. Evaluate the measurement results, for example the Total Harmonic Distortion (THD) and the Signal to Noise Ratio (SNR) of the audio signal.

Digital Measurement

	CUR	AVG	EXT	STD
THD [%]	0.2841	0.2956	25.6570	0.0588
THD [dB]	-50.92	-50.75	-11.82	1.76
THD + N [%]	2.5354	2.7075	24.9839	0.1183
SINAD [dB]	31.92	31.36	12.05	0.38
SNR [dB]	31.66	31.08	11.42	0.39
Weighted Level, RMS [FS]	0.0610	0.0595	1.0000	0.0024
Bandpass Level, RMS [FS]	0.0602	0.0586	0.9887	0.0025

8. Stop the generator and the measurement:
   a) Select the "Analog Meas" softkey and press ON | OFF.
   b) Select the "Digital Generator" softkey and press ON | OFF.

2.3.3.5 Testing the Speech Quality with an R&S UPV

To measure the speech quality of a VoLTE connection, add an audio analyzer to your test setup. The following example uses an R&S UPV.

The test setup shown in the following figure is similar to the combination of the microphone test setup and the speaker test setup. But the audio generators and measurements are now located in the R&S UPV, not in the R&S CMW. The RF connection / VoLTE connection is the same as for the preceding tests.

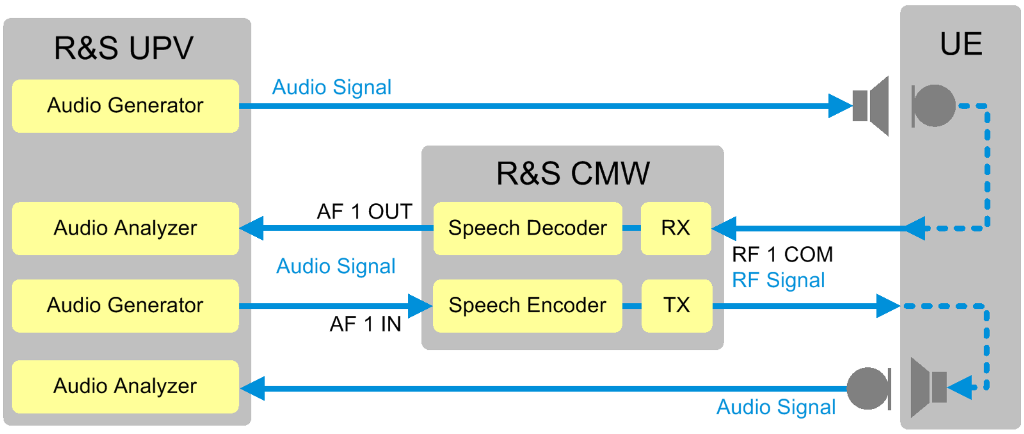


Fig. 2-32: Test setup for external speech analysis

A generator of the R&S UPV feeds an audio signal to the microphone of the UE. The UE encodes the audio signal and modulates the RF uplink signal. It transmits the RF signal via the VoLTE connection to the R&S CMW. The R&S CMW demodulates and decodes the signal. It routes the resulting audio signal via the AF 1 OUT port to an audio analyzer of the R&S UPV.

A generator of the R&S UPV feeds an audio signal via the AF 1 IN port to the speech encoder of the audio board. The test signal is transmitted via the VoLTE connection to the UE. The UE demodulates and decodes the signal and feeds the resulting audio signal to its speaker. An analyzer of the R&S UPV measures the audio signal of the speaker.

If the UE has microphone and speaker jacks or a headset jack, connect the UE via an audio cable to the R&S UPV. Alternatively, you can position a microphone at the UE speaker and a speaker at the UE microphone and connect them to the R&S UPV. Use a high quality microphone and speaker designed for that purpose, for example an artificial head.

Performing a speech quality test

The following sequence describes the configuration steps required at the R&S CMW. The R&S UPV configuration is out of the scope of this document.

1. Set up the VoLTE connection as described in the previous sections.
2. Set up the two audio connections between the R&S UPV and the UE and the two audio connections between the R&S UPV and the R&S CMW.
3. Configure the audio settings of the R&S CMW:
   a) At the top of the "Audio Measurement 1" view, select the scenario "External Analog Speech Analysis".
   b) Press the "Config" hotkey to open the audio configuration dialog box.
   c) Configure the input level compatible to the R&S UPV generator output.
   d) Configure the output level compatible to the R&S UPV analyzer input.
   A calibration procedure of the R&S UPV may require specific level settings.
4. Configure the R&S UPV. Calibrate it, if required.
5. Start the R&S UPV generators and analyzers.

For more information about speech quality tests with an R&S UPV, refer to the following documents:

- Application note "1MA204", "Voice over LTE (VoLTE) Speech Quality Measurements"
- Application note "1GA62", "Test Automation Tool for POLQA® and PESQ® Speech Quality Tests"

These documents are available for download at http://www.rohde-schwarz.com.

2.3.3.6 Possible Extensions

While you perform audio tests or speech quality tests, you can vary connection parameters and study the effect on the audio quality.

With option R&S CMW-KM050, you can use the data application unit to add network impairments to the downlink VoLTE connection. Thus you can simulate challenges of real IP networks and test the effect on the speech quality.

Configurable network impairments are for example:

- Packet delay, static or with jitter distribution

- Packet loss and packet corruption
- Reordering and duplication of packets

2.4 GUI Reference

The following sections provide detailed reference information on the parameters of the LTE signaling application. Most parameters can be configured via a single configuration dialog. Additional dialogs allow you to configure the measurements included in the signaling application.

Many of the signaling parameters are available in a subset of connection states only. Temporarily unavailable parameters are grayed out in the configuration dialogs; hotkeys appear and disappear dynamically, depending on the connection state.

The screenshots in this chapter show the GUI with all available options installed. Depending on the installed options some parameters are not configurable (display the default value) or are not visible at all. This is indicated in the parameter description.

The GUI reference is structured as follows.

2.4.1 Signaling View

The signaling view shows status information and information derived from the uplink signal to the left and the most important settings to the right. All settings in this view can also be accessed via the configuration dialog.

For a description of available hotkeys refer to chapter 2.4.2, "Signaling Control", on page 115.

For the shortcut softkeys refer to chapter 2.4.3, "Using the Shortcut Softkeys", on page 119.

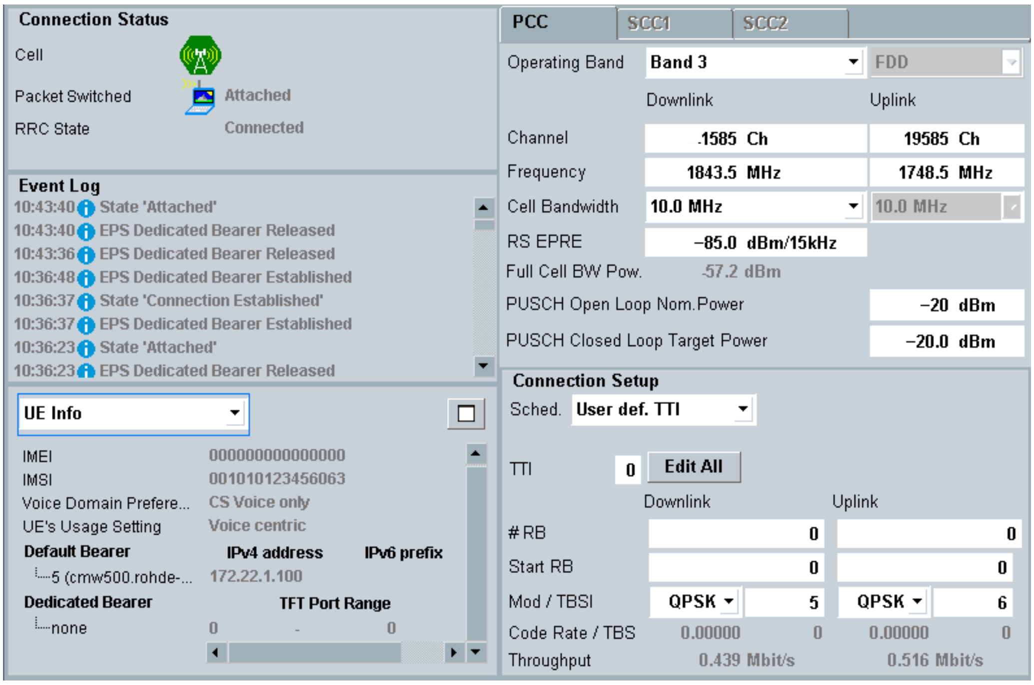


Fig. 2-33: LTE signaling view

For descriptions of the individual areas of the view, refer to the subsections.

2.4.1.1 Connection Status

The connection status area displays the following information.

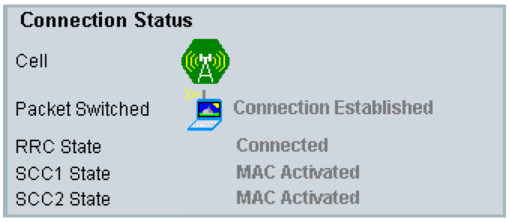


Fig. 2-34: Connection Status area of the main view

For background information about the displayed states, see chapter 2.2.8, "Connection States", on page 25.

For control of the states, see chapter 2.4.2, "Signaling Control", on page 115.

Cell

Displays the current state (or state transition) of the downlink signal generator.

Remote command:

`SOURce:LTE:SIGN<i>:CELL:STATe`

Packet Switched

Displays the current state or state transition of the primary packet switched connection (uplink and PCC downlink).

Remote command:

`FETCh:LTE:SIGN<i>:PSWitched:STATe?`

RRC State

Indicates whether a PCC RRC connection is established (Connected) or not (Idle).

Remote command:

`SENSe:LTE:SIGN<i>:RRCState?`

SCC<n> State

Displays the current state of the Secondary Component Carrier (SCC) number <n>. Only visible for carrier aggregation scenarios.

Remote command:

`FETCh:LTE:SIGN<i>:SCC<c>:STATe?`

2.4.1.2 Event Log

The event log area reports events and errors like PS connection state changes, RRC connection establishment/release, SCC state changes and authentication failure.

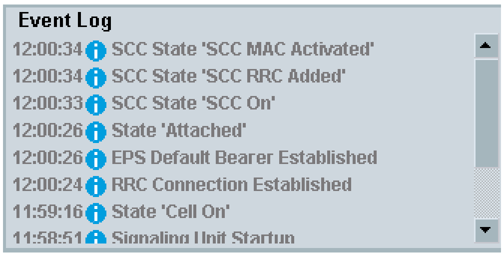


Fig. 2-35: Event Log area of the main view

Event log entries

Each entry consists of a timestamp, an icon indicating the category of the event and a short text describing the event.

Meaning of the category icons: = information, warning and error

Remote command:
SENSe:LTE:SIGN<i>:ELOG:LAST?
SENSe:LTE:SIGN<i>:ELOG:ALL?

2.4.1.3 UE Measurement Report

To display the measurement report information, select "UE Measurement Report" in the field below the event log area.

The displayed information is retrieved from "measurement reports" provided by the connected UE. The individual report values are defined in 3GPP TS 36.133.

To enable/disable measurement reports, use the checkbox.

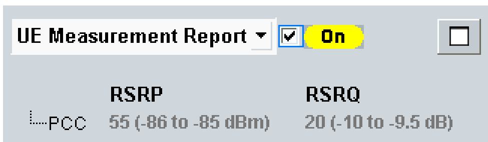


Fig. 2-36: Measurement report in the main view

The minimized default presentation shows all measurement report values for the serving LTE cell.

To show also neighbor cell measurement results, press the button to the right. This maximizes the area vertically.

To maximize the area also horizontally, press the button again.

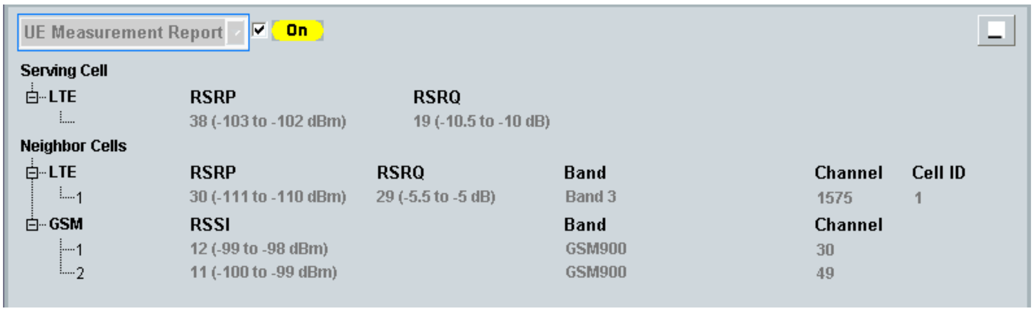


Fig. 2-37: Maximized report area

Neighbor cell measurements are by default disabled and can be enabled separately for each neighbor cell, see chapter 2.4.11.1, "Neighbor Cell Settings", on page 153. Option R&S CMW-KS510 is required.

The measurement results displayed in the maximized report area are described in the following. Additionally, configured neighbor cell settings are displayed (band, channel, ...).

LTE Serving Cell > RSRP

The Reference Signal Received Power (RSRP) denotes the average power of the resource elements carrying cell-specific reference signals.

The measurement report displays the reported dimensionless value and in brackets the corresponding measured value range. For carrier aggregation scenarios, the information is displayed per carrier.

Remote command:

```
SENSe:LTE:SIGN<i>:UEReport[:PCC]:RSRP?
SENSe:LTE:SIGN<i>:UEReport[:PCC]:RSRP:RANGe?
SENSe:LTE:SIGN<i>:UEReport[:PCC]:SCELl?
SENSe:LTE:SIGN<i>:UEReport[:PCC]:SCELl:RANGe?
SENSe:LTE:SIGN<i>:UEReport:SCC<c>:RSRP?
SENSe:LTE:SIGN<i>:UEReport:SCC<c>:RSRP:RANGe?
SENSe:LTE:SIGN<i>:UEReport:SCC<c>:SCELl?
SENSe:LTE:SIGN<i>:UEReport:SCC<c>:SCELl:RANGe?
```

LTE Serving Cell > RSRQ

The Reference Signal Received Quality (RSRQ) is calculated as *RSRQ = N×RSRP / (E-UTRA carrier RSSI)*. The "E-UTRA carrier RSSI" denotes the average of the total received power (including interferers and so on), observed in OFDM symbols containing reference symbols for antenna port 0 within the measurement bandwidth (N resource blocks).

The measurement report displays the reported dimensionless value and in brackets the corresponding measured value range. For carrier aggregation scenarios, the information is displayed per carrier.

Remote command:
SENSe:LTE:SIGN<i>:UEReport[:PCC]:RSRQ?
SENSe:LTE:SIGN<i>:UEReport[:PCC]:RSRQ:RANGe?
SENSe:LTE:SIGN<i>:UEReport[:PCC]:SCELl?
SENSe:LTE:SIGN<i>:UEReport[:PCC]:SCELl:RANGe?
SENSe:LTE:SIGN<i>:UEReport:SCC<c>:RSRQ?
SENSe:LTE:SIGN<i>:UEReport:SCC<c>:RSRQ:RANGe?
SENSe:LTE:SIGN<i>:UEReport:SCC<c>:SCELl?
SENSe:LTE:SIGN<i>:UEReport:SCC<c>:SCELl:RANGe?

LTE Neighbor Cells > RSRP, RSRQ

The RSRP and RSRQ reported for LTE neighbor cells is displayed in the same way as the values for the serving cell.

Remote command:
SENSe:LTE:SIGN<i>:UEReport:NCELl:LTE:CELL<no>?
SENSe:LTE:SIGN<i>:UEReport:NCELl:LTE:CELL<no>:RANGe?

GSM > RSSI

The Received Signal Strength Indicator (RSSI) denotes the received wideband power within the GSM channel bandwidth, measured on a GSM BCCH carrier.

The measurement report displays the reported dimensionless value and in brackets the corresponding measured value range.

Remote command:
SENSe:LTE:SIGN<i>:UEReport:NCELl:GSM:CELL<no>?
SENSe:LTE:SIGN<i>:UEReport:NCELl:GSM:CELL<no>:RANGe?

WCDMA > RSCP, EcNO

The Received Signal Code Power (RSCP) denotes the received power on one code, measured on the primary CPICH of the neighbor WCDMA cell.

The Ec/No denotes the ratio of the received energy per PN chip for the primary CPICH to the total received power spectral density in the WCDMA band.

The measurement report displays the reported dimensionless values and in brackets the corresponding measured value range.

Remote command:
SENSe:LTE:SIGN<i>:UEReport:NCELl:WCDMa:CELL<no>?
SENSe:LTE:SIGN<i>:UEReport:NCELl:WCDMa:CELL<no>:RANGe?

CDMA2000 / 1xEV-DO > pilot Pn Phase, pilot Strength

The pilot PN phase indicates the arrival time of a pilot, measured relative to the time reference of the UE in units of PN chips. For details refer to 3GPP2 C.S0005, section 2.6.6.2.4.

The pilot strength denotes the ratio of the received pilot energy per chip to the total received power spectral density in the signal bandwidth of the forward channel.

For reporting, the ratio is converted into a dB value, multiplied with -2 and truncated, so that a positive integer value is reported (0 to 63):

*Reported pilot strength value = INT (-2 * 10 $\log_{10}$(pilot energy / total power))*

For more details refer to 3GPP2 C.S0005, section 2.6.6.2.2 and section 2.7.2.3.2.5.

Remote command:
SENSe:LTE:SIGN<i>:UEReport:NCELl:CDMA:CELL<no>?
SENSe:LTE:SIGN<i>:UEReport:NCELl:EVDO:CELL<no>?

TD-SCDMA > RSCP

The Received Signal Code Power (RSCP) denotes the received power, measured on the P-CCPCH of the neighbor TD-SCDMA cell.

The measurement report displays the reported dimensionless values and in brackets the corresponding measured value range.

Remote command:
SENSe:LTE:SIGN<i>:UEReport:NCELl:TDSCdma:CELL<no>?
SENSe:LTE:SIGN<i>:UEReport:NCELl:TDSCdma:CELL<no>:RANGe?

2.4.1.4 UE Capabilities

To display the most important UE capabilities, select "UE Capabilities" in the field below the event log area.

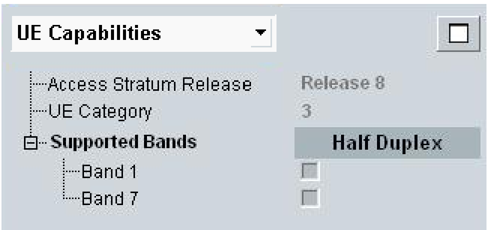


Fig. 2-38: UE capabilities in the main view

The displayed information comprises the following extracts from the UE capability report:

- General UE capability information
- RF UE capabilities

To maximize the UE capabilities area and display all capability information, press the button to the right.

The UE capabilities characterize the radio access capabilities of the UE. This information is received from the UE during registration. The radio access capabilities are specified in 3GPP TS 36.331.

For a description of the provided capability information, see chapter 2.4.20, "Annex: UE Capabilities", on page 203.

2.4.1.5 UE Info

To display UE-related information for an attached UE, select "UE Info" in the field below the event log area.

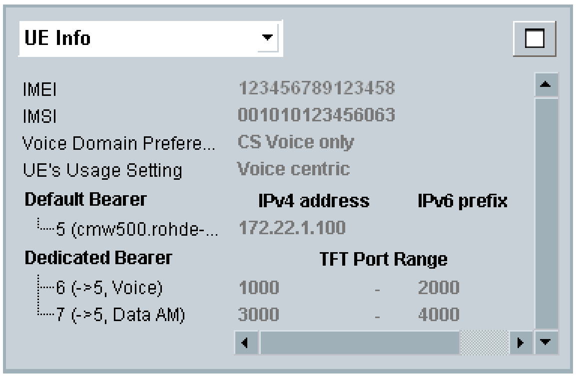


Fig. 2-39: UE info area of the main view

IMEI

International Mobile Equipment Identity (IMEI) received from the UE. The IMEI is only known if NAS security is enabled.

Remote command:
`SENSe:LTE:SIGN<i>:UESinfo:IMEI?`

IMSI

International Mobile Subscriber Identity (IMSI) received from the UE.

Remote command:
`SENSe:LTE:SIGN<i>:UESinfo:IMSI?`

Voice Domain Preference

The voice domain preference received from the UE indicates whether the UE uses the CS domain or the IMS for voice calls.

CS domain means that a circuit-switched fallback is performed and the voice call is established via GERAN or UTRAN.

IMS means that the voice call is established as voice over IMS call, via E-UTRAN.

The following preference values are possible:
- "CS voice only"
- "IMS PS voice only"
- "CS voice preferred, IMS PS voice as secondary"
- "IMS PS voice preferred, CS voice as secondary"

Remote command:
`SENSe:LTE:SIGN<i>:UESinfo:VDPReference?`

UE's Usage Setting

The usage setting received from the UE determines the behavior of the UE, if voice services are not possible in the current E-UTRAN cell.

Example: The UE has the voice domain preference "IMS PS Voice only", but the cell does not offer IMS services.

"Voice centric" The UE leaves the cell to ensure the support of voice services. It disables the E-UTRAN capability and performs a reselection to GERAN or UTRAN.

"Data centric" The UE stays in the cell even if voice services are not possible.

Remote command:
SENSe:LTE:SIGN<i>:UESinfo:UEUSage?

Default Bearer
List of all established default bearers, one line per bearer.

Each line contains the following information:
- Default bearer ID, composed as follows: *<EPS default bearer ID> (<APN>)*
  Example: "5 (cmw500.rohde.schwarz.com)" means default bearer 5, with access point name "cmw500.rohde.schwarz.com"
- IPv4 address assigned to the UE for this bearer
- IPv6 prefix assigned to the UE for this bearer

Remote command:
SENSe:LTE:SIGN<i>:UESinfo:UEADdress:IPV<n>?

Dedicated Bearer
List of all established dedicated bearers, one line per bearer.

Each line contains the following information:
- Dedicated bearer ID, composed as follows:
  <EPS dedicated bearer ID> (-> <EPS default bearer ID>, <profile>)
  Example: "6 (->5, Voice)" means dedicated bearer 6, mapped to default bearer 5, using dedicated bearer profile "Voice"
- TFT port range assigned to the dedicated bearer

Remote command:
SENSe:LTE:SIGN<i>:UESinfo:UEADdress:DEDBearer?

2.4.1.6 Settings

The main view provides the most important settings for fast access.

For carrier aggregation scenarios, the settings for the individual component carriers are provided on separate tabs.

Fig. 2-40: Settings in the main view, PCC and SCC1

Upper Part

The upper part contains the following settings:

- Duplex mode
  See chapter 2.4.4, "General Settings", on page 120
- RF frequency settings
  See chapter 2.4.6.2, "RF Frequency", on page 130
- Cell bandwidths
  See chapter 2.4.10, "Physical Cell Setup", on page 147
- Most important DL power parameters (RS EPRE, full cell BW power)
  See chapter 2.4.8, "Downlink Power Levels", on page 139
- Most important UL power parameters (PCC tab only)
  See chapter 2.4.9, "Uplink Power Control", on page 142

Swap (Button) ← Upper Part

The "Swap" button is only available on SCC tabs. It exchanges PCC DL settings with the settings of one SCC.

The following settings are exchanged:

- Operating band, channel number and frequency
- Cell bandwidth
- Active scheduling with all related settings (RB configuration, modulation etc.)
  Only the active scheduling settings for the active cell bandwidth are written to the other carrier. The settings related to inactive scheduling types or inactive cell bandwidths are not swapped.

If the swap changes the PCC scheduling type or the PCC cell bandwidth, the related inactive UL settings are activated.

Example 1 – operating band and channel number:

- Before swap
  – PCC: band 3, channel DL 1500 / UL 19500
  – SCC1: band 20, channel 6300
- After swap
  – PCC: band 20, channel DL 6300 / UL 24300
  – SCC1: band 3, channel 1500

Example 2 – cell BW, scheduling type and #RB:

- Before swap
  – PCC: 10 MHz, RMC, DL 50 RB, UL 40 RB
  – SCC1: 5 MHz, user-defined channel, 22 RB
  – PCC inactive settings for 5 MHz, user-defined channel: DL 15 RB, UL 18 RB
- After swap
  – PCC: 5 MHz, user-defined channel, DL 22 RB, UL 18 RB
  – SCC1: 10 MHz, RMC, 50 RB
  – PCC inactive settings for 10 MHz, RMC: DL 50 RB, UL 40 RB
  – SCC1 inactive settings for 5 MHz, user-defined channel: 22 RB

If you perform a swap for an established connection, all connection states after the swap equal the states before the swap. Either redirection or blind handover is used for the swap, see "Operating Band Change, Frequency Change" on page 178.

Remote command:
`CONFigure:LTE:SIGN<i>:CONNection:SCC<c>:SEXecute`

Connection Setup

Contains scheduling type-specific settings:

- RMC:
  The settings are the same as in the configuration tree, see chapter 2.4.12.5, "RMC Connection Settings", on page 183
- User-defined Channels:
  The settings are the same as in the configuration tree, see chapter 2.4.12.6, "User-Defined Channel Configuration", on page 186
- User-defined TTI-Based / Fixed CQI:
  You can configure the settings of a selected subframe (TTI) directly. Alternatively, press the button "Edit All" to open a dialog box where you can edit the settings of all subframes.
  For a parameter description, see chapter 2.4.1.7, "TTI-Based Channel Configuration", on page 108.
- Follow WB CQI / PMI / CQI-RI / CQI-PMI-RI:
  You can configure the settings of a selected uplink subframe directly. The downlink settings apply to all subframes.
  For additional settings, press the button "Edit All". It opens a dialog box where you can edit the settings of all uplink and downlink subframes.
  For a parameter description, see chapter 2.4.1.7, "TTI-Based Channel Configuration", on page 108.
- SPS:
  See chapter 2.4.1.8, "SPS Configuration", on page 113

If a transmission scheme using several data streams is active, the parameter "MIMO DL Stream" allows you to switch between the settings of the downlink streams. The parameter is disabled if all streams use the same set of settings.

Copy (Button) ← Connection Setup
The "Copy" button is only available on SCC tabs. It copies PCC DL settings to an SCC.

The following settings are copied:
- Cell bandwidth
- Active scheduling with all related settings (RB configuration, modulation etc.)

The copy operation is only possible, if the PCC settings and the SCC settings are compatible. Examples for incompatibilities:
- The active scenario is not symmetric for the carriers. Example: The scenario allows MIMO for the PCC but not for the SCC.
- The PCC scheduling type is not supported for the SCC (for example SPS).
- The resource allocation type is two for the PCC and zero for the SCC.
- The PCC scheduling type equals RMC. The PCC uses transmission mode 1 and the SCC uses another transmission mode (or vice versa).

Remote command:
`CONFigure:LTE:SIGN<i>:CONNection:SCC<c>:CEXecute`

2.4.1.7 TTI-Based Channel Configuration

Before you start channel configuration, configure the duplex mode and the cell bandwidth in the main view.

Then select the scheduling type and press the button "Edit All" in the "Connection Setup" section of the main view. A dialog box for TTI-based channel configuration is opened.

The button and the dialog box are available for the scheduling type "User-defined TTI-Based" and all "CQI-PMI-RI" scheduling types ("Fixed CQI" and "Follow ...").

The dialog box contains several tabs, which are active or inactive, depending mainly on the scheduling type and the scenario.

The tabs contain settings at the top and a graphical presentation of the resulting resource block configuration at the bottom.

For valid parameter combinations and background information, refer to the following sections:
- chapter 2.2.13, "User-Defined Channels", on page 54
- chapter 2.2.14, "CQI Channels", on page 56

DL Stream Tabs and UL Tab

The DL stream tabs and the UL tab contain usually one column of settings for each subframe of a radio frame. For some transmission schemes, the DL stream tab contains only one column, applicable to all subframes.

For TDD, the UL tab presents only the UL subframes of a radio frame, while the DL tabs present both DL and special subframes. The special subframe settings configure the DwPTS field for data transfer in downlink direction. To modify the uplink-downlink configuration of the radio frame, see "Uplink Downlink Configuration" on page 150. For UL-DL configuration 0, all UL subframes have the same settings.

The subframe number (0 to 9) and the subframe type are indicated in the column header. All columns must be configured top down (first # RB, then Start RB, then ...).

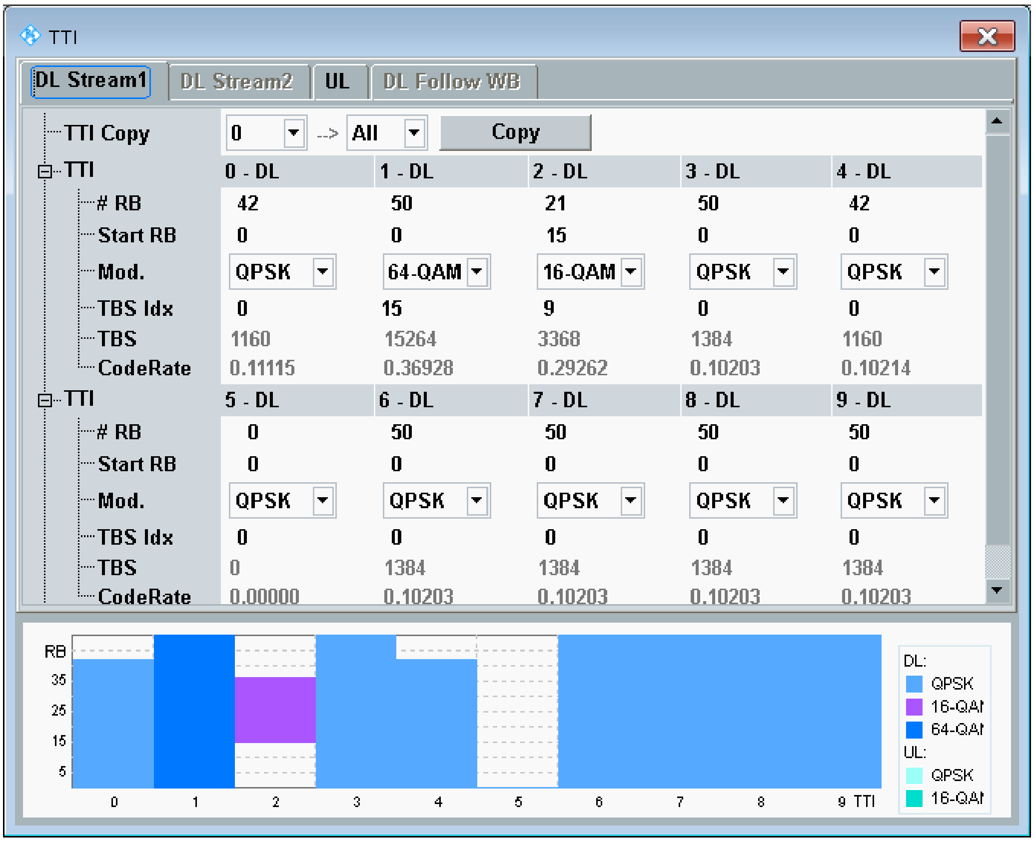


Fig. 2-41: User-defined TTI-Based configuration (PCC)

If the selected scenario involves several downlink streams, some DL parameters can be configured individually per stream. Other parameters are configurable for stream 1 only and are applied automatically to stream 2. If you enable parameter "Equal" in the main view, all stream 1 settings are also applied to stream 2 and the stream 2 tab is disabled.

For carrier aggregation scenarios, you can configure the downlink settings per component carrier. The dialog box for PCC configuration contains UL and DL tabs, the dialog box for SCC configuration only DL tabs.

All parameters of the tabs are explained in the following.

TTI Copy
Allows you to copy the settings of a selected subframe to other subframes. The source and target subframes of the copy operation are identified via their number.

To perform a copy operation, select the number of the subframe to be copied, select the target subframes and press the "Copy" button.

#RB
Selects the number of allocated resource blocks.

Start RB
Specifies the number of the first allocated resource block. This parameter allows you to shift the allocated RBs within the cell bandwidth.

CQI Idx.
Selects the CQI index for a downlink subframe for scheduling type "Fixed CQI".

Mod.
Selects or displays the modulation type.

TBS Idx
Selects the transport block size index.

UL Configuration Commands
The following commands configure the uplink parameters "#RB", "Start RB", "Mod." and "TBS Idx".

The settings apply to all scheduling types with TTI-based uplink configuration.

Remote command:
`CONFigure:LTE:SIGN<i>:CONNection[:PCC]:UDTTibased:UL`
`CONFigure:LTE:SIGN<i>:CONNection[:PCC]:UDTTibased:UL:ALL`

DL Configuration Commands
For downlink configuration, there are different commands per scheduling type and for PCC and SCC.

User-Defined TTI-Based ← DL Configuration Commands
The following commands configure the settings for the scheduling type "User-Defined TTI-Based".

Remote command:
`CONFigure:LTE:SIGN<i>:CONNection[:PCC]:UDTTibased:DL<s>`
`CONFigure:LTE:SIGN<i>:CONNection[:PCC]:UDTTibased:DL<s>:ALL`
`CONFigure:LTE:SIGN<i>:CONNection:SCC<c>:UDTTibased:DL<s>`
`CONFigure:LTE:SIGN<i>:CONNection:SCC<c>:UDTTibased:DL<s>:ALL`

Fixed CQI ← DL Configuration Commands
The following commands configure the settings for the scheduling type "Fixed CQI".

Remote command:
`CONFigure:LTE:SIGN<i>:CONNection[:PCC]:FCTTibased:DL<s>`
`CONFigure:LTE:SIGN<i>:CONNection[:PCC]:FCTTibased:DL<s>:ALL`
`CONFigure:LTE:SIGN<i>:CONNection:SCC<c>:FCTTibased:DL<s>`
`CONFigure:LTE:SIGN<i>:CONNection:SCC<c>:FCTTibased:DL<s>:ALL`

Follow WB PMI ← DL Configuration Commands
The following commands configure the settings for the scheduling type "Follow WB PMI".

Remote command:
`CONFigure:LTE:SIGN<i>:CONNection[:PCC]:FPMI:DL`
`CONFigure:LTE:SIGN<i>:CONNection:SCC:FPMI:DL`

TBS
Displays the transport block size in bits.

Remote command:
n/a

Code Rate
Displays the effective channel code rate, i.e. the number of information bits (including CRC bits) divided by the number of physical channel bits on PDSCH/PUSCH.

Remote command:
`SENSe:LTE:SIGN<i>:CONNection[:PCC]:UDTTibased:UL:CRATe:ALL?`
`SENSe:LTE:SIGN<i>:CONNection[:PCC]:UDTTibased:DL<s>:CRATe:ALL?`
`SENSe:LTE:SIGN<i>:CONNection:SCC<c>:UDTTibased:DL<s>:CRATe:ALL?`

Throughput
Displays the expected maximum throughput in Mbit/s (averaged over one frame). The value is calculated per downlink and uplink stream.

Remote command:
`SENSe:LTE:SIGN<i>:CONNection:ETHRoughput:UL?`
`SENSe:LTE:SIGN<i>:CONNection:ETHRoughput:DL[:PCC]:STReam<s>?`
`SENSe:LTE:SIGN<i>:CONNection:ETHRoughput:DL:SCC<c>:STReam<s>?`

DL Follow WB Tab

This tab is only active for the scheduling types "Follow WB CQI", "Follow WB CQI-RI" and "Follow WB CQI-PMI-RI". The settings are not configurable per TTI. They apply to all downlink subframes of the carrier.

For carrier aggregation scenarios, you can configure the downlink settings per component carrier.

The expected maximum throughput displayed for example in the main view is calculated using the maximum MCS index value of the mapping table.

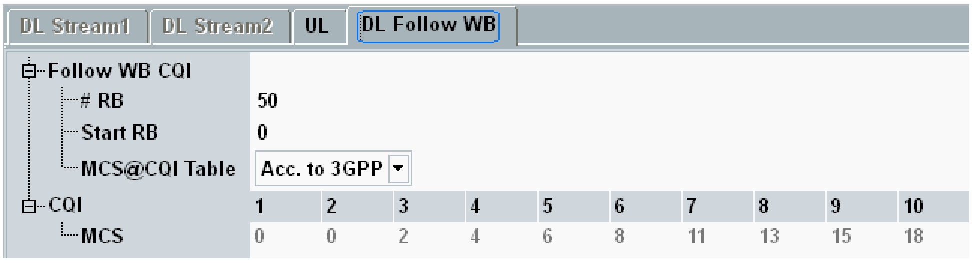


Fig. 2-42: Follow WB CQI DL settings

#RB
Selects the number of allocated resource blocks.

Start RB
Specifies the number of the first allocated resource block. This parameter allows you to shift the allocated RBs within the cell bandwidth.

MCS@CQI Table / CQI / MCS
The mapping table assigns an MCS index value (0 to 28) to each possible reported wideband CQI index value (1 to 15). The MCS index value used for the downlink is dynamically determined according to this table, using the previous wideband CQI value reported by the UE.

You can either use an automatic table configuration or a user-defined mapping:
- **Acc. to 3GPP**: The mapping is defined automatically based on the tables in 3GPP TS 36.521, Annex A.4. The used mapping is displayed for information.
- **User-Defined**: You can configure the mapping table manually.

DL Configuration Commands
There are different commands per scheduling type and for PCC and SCC.

Follow WB CQI ← DL Configuration Commands
The following commands configure the settings for the scheduling type "Follow WB CQI".

Remote command:
CONFigure:LTE:SIGN<i>:CONNection[:PCC]:FWBCqi:DL
CONFigure:LTE:SIGN<i>:CONNection[:PCC]:FWBCqi:DL:MCSTable:UDEFined
SENSe:LTE:SIGN<i>:CONNection[:PCC]:FWBCqi:DL:MCSTable:DETermined?
CONFigure:LTE:SIGN<i>:CONNection:SCC<c>:FWBCqi:DL
CONFigure:LTE:SIGN<i>:CONNection:SCC<c>:FWBCqi:DL:MCSTable:UDEFined
SENSe:LTE:SIGN<i>:CONNection:SCC<c>:FWBCqi:DL:MCSTable:DETermined?

Follow WB CQI-RI ← DL Configuration Commands
The following commands configure the settings for the scheduling type "Follow WB CQI-RI".

Remote command:
CONFigure:LTE:SIGN<i>:CONNection[:PCC]:FCRI:DL
CONFigure:LTE:SIGN<i>:CONNection[:PCC]:FCRI:DL:MCSTable:UDEFined
SENSe:LTE:SIGN<i>:CONNection[:PCC]:FCRI:DL:MCSTable:DETermined?
CONFigure:LTE:SIGN<i>:CONNection:SCC:FCRI:DL
CONFigure:LTE:SIGN<i>:CONNection:SCC:FCRI:DL:MCSTable:UDEFined
SENSe:LTE:SIGN<i>:CONNection:SCC:FCRI:DL:MCSTable:DETermined?

Follow WB CQI-PMI-RI ← DL Configuration Commands
The following commands configure the settings for the scheduling type "Follow WB CQI-PMI-RI".

Remote command:
CONFigure:LTE:SIGN<i>:CONNection[:PCC]:FCPRi:DL
CONFigure:LTE:SIGN<i>:CONNection[:PCC]:FCPRi:DL:MCSTable:UDEFined
SENSe:LTE:SIGN<i>:CONNection[:PCC]:FCPRi:DL:MCSTable:DETermined?
CONFigure:LTE:SIGN<i>:CONNection:SCC<c>:FCPRi:DL
CONFigure:LTE:SIGN<i>:CONNection:SCC<c>:FCPRi:DL:MCSTable:UDEFined
SENSe:LTE:SIGN<i>:CONNection:SCC<c>:FCPRi:DL:MCSTable:DETermined?

2.4.1.8 SPS Configuration

Most semi-persistent scheduling settings are configurable in the main view.

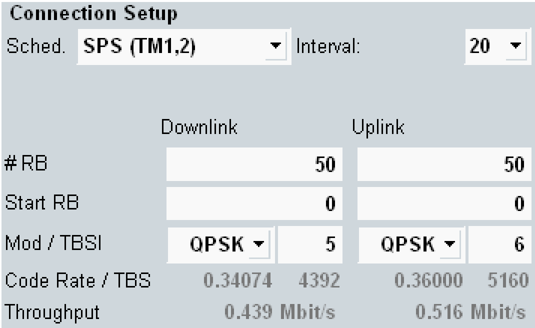


Fig. 2-43: SPS settings

To configure SPS, proceed as follows:

1. Select the duplex mode and the cell bandwidth in the upper part of the main view.
2. Select the scheduling type SPS.
3. Select the subframe interval.
4. Select the number of allocated resource blocks (RB), the position of the first RB and the modulation type.
5. Select the transport block size index.

For valid parameter combinations and background information, see chapter 2.2.15, "Semi-Persistent Scheduling (SPS)", on page 58.

The channel settings can be changed in all main connection states including "Connection Established".

The parameters are described in the following. Option R&S CMW-KS510 is required.

Sched.

Selects the scheduling type, see "Scheduling Type" on page 174.

Interval

Configures the subframe periodicity n. The UE is granted the configured RB allocation in every n^{th} subframe.

For TDD, only multiples of radio frames are allowed. For that reason, the selected value is internally rounded down to a multiple of 10. Example: 128 selected means 120.

Remote command:

CONFigure:LTE:SIGN<i>:CONNection[:PCC]:SPS:SINTerval

 # RB ... TBSI /TBS

"# RB" selects the number of allocated resource blocks.

"Start RB" specifies the number of the first allocated resource block. This parameter allows you to shift the allocated RBs within the cell bandwidth.

"Mod" selects the modulation type. The setting influences the allowed transport block size indices.

"TBSI" selects the transport block size index. "TBS" displays the resulting transport block size in bits.

Remote command:
CONFigure:LTE:SIGN<i>:CONNection[:PCC]:SPS:DL
CONFigure:LTE:SIGN<i>:CONNection[:PCC]:SPS:UL

Code Rate

Effective channel code rate, i.e. the number of information bits (including CRC bits) divided by the number of physical channel bits on PDSCH/PUSCH.

Remote command:
SENSe:LTE:SIGN<i>:CONNection[:PCC]:SPS:DL<s>:CRATe:ALL?
SENSe:LTE:SIGN<i>:CONNection[:PCC]:SPS:UL:CRATe:ALL?

Throughput

Expected maximum throughput in Mbit/s (averaged over one frame).

Remote command:
SENSe:LTE:SIGN<i>:CONNection:ETHRoughput:DL[:PCC]:STReam<s>?
SENSe:LTE:SIGN<i>:CONNection:ETHRoughput:UL?

2.4.2 Signaling Control

The individual connection states are controlled via the ON | OFF key, via hotkeys and via the UE.

The available hotkeys depend on the current connection state. All possible hotkeys are described in the following.

For background information, refer to chapter 2.2.8, "Connection States", on page 25.

ON | OFF (key) / LTE Signaling (softkey)

The ON | OFF key is used to turn the DL signal transmission on or off. The current state is shown by the softkey. The signal transmission can be switched off any time, independent of the current connection state. A yellow hour glass symbol indicates that the signaling generator is currently turned on or off.

The state "RDY" means that the signaling application is ready to receive an inter-RAT handover from another signaling application (e.g. from WCDMA). This state is initiated by the application acting as source of the handover.

Remote command:
`SOURce:LTE:SIGN<i>:CELL:STATe`
`SOURce:LTE:SIGN<i>:CELL:STATe:ALL?`

Connection control hotkeys
Any interaction with a UE requires an LTE downlink signal (cell). As soon as the signal is available (state ON, no hour glass), connection control hotkeys may appear in the hotkey bar.

The available hotkeys depend on the current packet switched state, RRC state, SCC state, connection type and selected component carrier tab. For SCC activation, there are several possible modes, influencing the available SCC hotkeys, see "SCC Activation Mode" on page 124.

To access hotkeys for a specific component carrier, select the corresponding tab. Example: For hotkey "SCC2 On" select the tab "SCC2". Via the "PCC" tab, you can access hotkeys for the PCC and for the SCC1.

The possible hotkeys are listed in the following table.

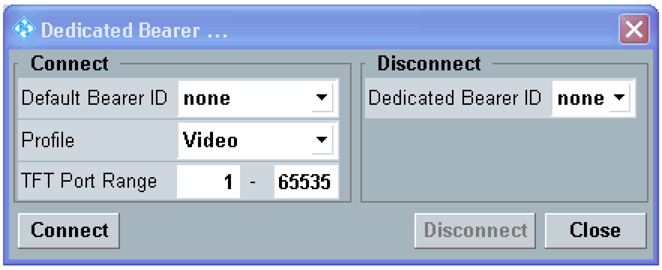
Hotkey	Description
"Connect"	See "Connect (hotkey)" on page 116
"Disconnect"	Release a dedicated bearer connection in test mode.
"Detach"	Send a detach request to the UE and detach the UE (independent of UE reaction to the request).
"Send SMS"	Send an SMS message to the UE.
"Inter/Intra-RAT"	See "Inter/Intra-RAT (hotkey)" on page 118
"SCC<n> On"	Switch on the SCC<n> DL signal.
"SCC<n> Off"	Switch off the SCC<n> DL signal.
"SCC<n> add RRC" "SCC<n> delete RRC"	Add/delete SCC<n> RRC connection.
"SCC<n> activate MAC" "SCC<n> deactivate MAC"	Activate/deactivate MAC for the SCC<n>.

Remote command:
`CALL:LTE:SIGN<i>:PSWitched:ACTion`
`FETCh:LTE:SIGN<i>:PSWitched:STATe?`
`CALL:LTE:SIGN<i>:SCC<c>:ACTion`
`FETCh:LTE:SIGN<i>:SCC<c>:STATe?`

Connect (hotkey)
The UE must attach to make the "Connect" hotkey available.

The effect of the hotkey depends on the parameter Connection Type:

- "Testmode": The hotkey sets up a single dedicated bearer with predefined default settings.
- "Data Application": The hotkey opens a dialog box for configuration, connection and release of multiple dedicated bearers.
  Option R&S CMW-KS510 is required. Without this option, a single dedicated bearer with predefined default settings is set up.



The dialog box is described in the following.

Connect ← Connect (hotkey)
Use the "Connect" section of the dialog box to configure a dedicated bearer. Then press the "Connect" button to establish the bearer with the configured settings.

"Default Bearer ID" selects the default bearer, to which the dedicated bearer shall be mapped. For more details about the ID, see "Default Bearer" on page 105.

"Profile" selects a dedicated bearer profile. The profiles contain optimum bearer settings for voice calls, video calls and data connections with high throughput in RLC acknowledged or unacknowledged mode. The most important bearer settings are listed in table 2-20.

"TFT Port Range" selects the destination ports for which traffic shall be routed to the dedicated bearer. The configured port range is used for the uplink and for the downlink. If you set up several dedicated bearers, the port ranges of the bearers must not overlap.

In total, up to eight bearers can be established in parallel (default plus dedicated bearers).

Table 2-20: Bearer settings depending on the "Profile"

	Voice	Video	Data AM	Data UM
QCI	1	2	6	6
PDCP discard timer	50ms	50ms	infinity	infinity
PDCP SN Size (RLC UM)	len7bits	len7bits	-	len12bits
RLC mode (RLC AM/UM)	UM	UM	AM	UM
RLC sn-FieldLength (RLC UM)	size5	size5	-	size10
T-Reordering (RLC UM, AM)	10ms	10ms	20ms	20ms
T-StatusProhibit (RLC AM)	-	-	5ms	-
T-PollRetransmit (RLC AM)	-	-	60ms	-
pollPDU (RLC AM)	-	-	p32	-

	Voice	Video	Data AM	Data UM
pollByte (RLC AM)	-	-	250kB	-
maxRetxThreshold (RLC AM)	-	-	t16	-

Remote command:
CATalog:LTE:SIGN<i>:CONNection:DEFBearer?
PREPare:LTE:SIGN<i>:CONNection:DEDBearer
CALL:LTE:SIGN<i>:PSWitched:ACTion

Disconnect ← Connect (hotkey)
Use the "Disconnect" section of the dialog box to release an established dedicated bearer.

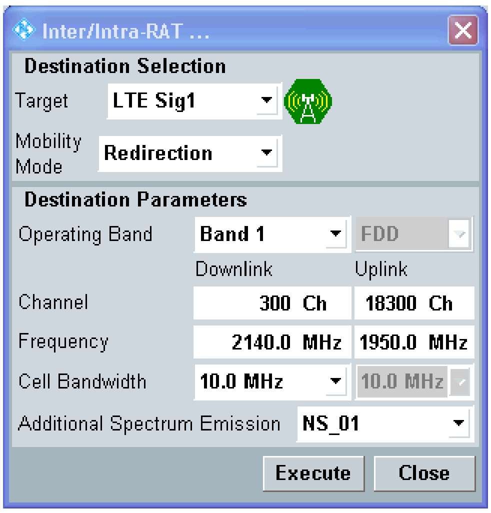
Select the bearer via the "Dedicated Bearer ID" list. Then press the "Disconnect" button.

For more details about the ID, see "Dedicated Bearer" on page 105.

Remote command:
CATalog:LTE:SIGN<i>:CONNection:DEDBearer?
CONFigure:LTE:SIGN<i>:CONNection:DEDBearer
CALL:LTE:SIGN<i>:PSWitched:ACTion

Inter/Intra-RAT (hotkey)
The hotkey opens a dialog for selection and configuration of the handover destination and initiation of the handover.

The LTE signaling application supports a handover within the signaling application, e.g. to another operating band, as well as a handover to another instrument or to another signaling application. The two signaling applications must use different RF paths. If they use the same RF path, an error message is displayed, indicating that blind handover is not supported.



The parameter "Target" selects the handover destination. The cell icon indicates the cell state of the currently selected destination. When you select another signaling application, e.g. "WCDMA Sig1", the destination cell is switched on automatically and the target cell state changes to RDY (ready for handover). For a handover to another instrument select "No Connection" as target.

The parameter "Mobility Mode" selects the mechanism to be used for handover to another signaling application, for example to GSM or WCDMA. Either redirection or circuit switched fallback ("MT CS Fallback") can be used. Circuit switched fallback requires option R&S CMW-KS510. The parameter is irrelevant for a handover within the signaling application.

The "Destination Parameters" display current settings of the selected signaling application target, typically operating band and channels. You can modify these settings before starting the handover. To configure the settings via remote control commands, use the commands provided by the signaling application target. There are no special handover commands for this purpose.

For a handover to another instrument, the "External Destination Parameters" are displayed instead (radio access technology and typically operating band and channel). Configure them according to the actual configuration of the other instrument. There is no communication between the two instruments, so the settings at both instruments must match.

To initiate a handover, press the "Execute" button.

For a detailed step-by-step description of a handover, see chapter 2.2.9, "Handover", on page 28.

Remote command:
PREPare:LTE:SIGN<i>:HANDover
PREPare:LTE:SIGN<i>:HANDover:DESTination
PREPare:LTE:SIGN<i>:HANDover:MMODe
PREPare:LTE:SIGN<i>:HANDover:CATalog:DESTination?
PREPare:LTE:SIGN<i>:HANDover:EXTernal:DESTination
PREPare:LTE:SIGN<i>:HANDover:EXTernal:CDMA
PREPare:LTE:SIGN<i>:HANDover:EXTernal:EVDO
PREPare:LTE:SIGN<i>:HANDover:EXTernal:GSM
PREPare:LTE:SIGN<i>:HANDover:EXTernal:LTE
PREPare:LTE:SIGN<i>:HANDover:EXTernal:TDSCdma
PREPare:LTE:SIGN<i>:HANDover:EXTernal:WCDMa
CALL:LTE:SIGN<i>:PSWitched:ACTion

2.4.3 Using the Shortcut Softkeys

When using the LTE signaling application and an LTE measurement in parallel, use a shortcut softkey to switch to the measurement.

Using one of these softkeys ensures that the measurement is configured compatible to the settings of the signaling application. When you use the softkey to switch to a TX measurement, the combined signal path scenario is activated automatically in the measurement.

Consequences:

- The measurement and the signaling application can be used in parallel, i.e. both DL signal transmission and measurement can be switched on.
- The signaling RF settings are also used for the measurement.
- Some measurement control settings are configured compatible with the signaling settings.
- A suitable trigger signal provided by the signaling application is selected as trigger source for the measurement.

If the softkey label equals "Go to...", the softkey opens a dialog box with a list of all available measurements. If the softkey label indicates a measurement name instead of "Go to...", this measurement has been assigned to the softkey as fixed target, see chapter 2.4.16, "Shortcut Configuration", on page 195.

Three shortcut softkeys are available and can be set to different fixed targets.

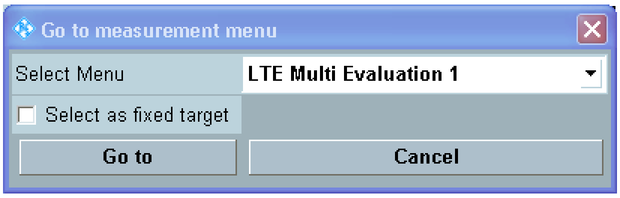


Fig. 2-44: Dialog box opened by "Go to..." softkey

Select Menu
Selects the target measurement you want to switch to.

Select as fixed target
Sets the selected measurement as fixed target of the softkey. The softkey label indicates the measurement name and switches directly to the selected target without opening the dialog box.

When the dialog box has been disabled, you can still change the target measurement or re-enable the dialog box using the configuration menu, see chapter 2.4.16, "Shortcut Configuration", on page 195.

Go to / Cancel
Press "Go to" to switch to the selected measurement or "Cancel" to abort.

2.4.4 General Settings

The general settings are located at the top of the configuration dialog. Configure them according to your test scenario, before configuring any other settings.

The general settings reflect basic decisions: FDD or TDD signal, use MIMO / fading / carrier aggregation or not.

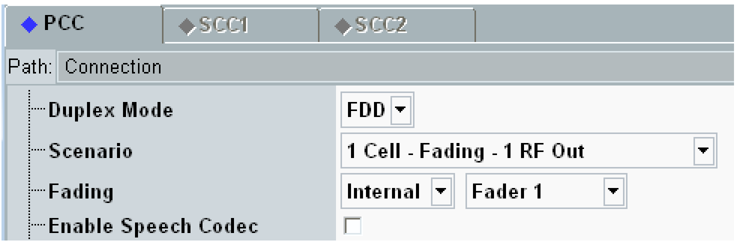


Fig. 2-45: Top of configuration dialog (PCC)

The configuration dialog contains one tab per component carrier:

- "PCC" tab: This tab is always active, independent of the selected scenario. The settings are either PCC-specific (marked by), or they apply to the PCC and to the SCCs (if SCC tabs are active).
- "SCC<n>" tab: The tabs are active or inactive depending on the selected scenario. The settings are either SCC-specific (marked by), or they apply to the PCC and to the SCC. In the latter case, changing the setting on one tab changes it also on the other tab. Most settings marked by are configurable per SCC. So different values can be set on the individual SCC tabs.

If a setting is individually configurable for PCC and SCC, two remote control commands are listed for the setting: one `[:PCC]` command and one `:SCC` command. If the SCC command has a suffix (`:SCC<c>`), the setting is individually configurable for each SCC.

The SCC tab contains a subset of the settings present on the PCC tab. For that reason, most screenshots in the following sections show the settings on the PCC tab.

The general section on the SCC tab contains an additional parameter that is not present on the PCC tab:

Fig. 2-46: Additional setting on SCC tab

The general settings are described in the following.

Duplex Mode

Selects the duplex mode of the LTE signal: FDD or TDD.

Option R&S CMW-KS500 required for FDD, R&S CMW-KS550 required for TDD.

Remote command:

`CONFigure:LTE:SIGN<i>:DMODe`

Scenario, Fading

Different test scenarios require different sets of parameters. Selecting a scenario hides/shows parts of the GUI as required by the scenario.

- **1 Cell - 1 RF Out**:
  Basic LTE cell (no MIMO, no fading, no carrier aggregation)
- **1 Cell - 2 RF Out**:
  DL MIMO / SIMO nx2 (no fading, no carrier aggregation)
- **1 Cell - 4 RF Out**:
  DL MIMO 4x2 and external RF fading (no I/Q fading, no carrier aggregation)
- **2CC CA - 2 RF Out**:
  DL carrier aggregation (CA) with two carriers (one PCC path and one SCC path, no MIMO, no fading)
- **2CC CA - 4 RF Out**:
  DL CA with two carriers and DL MIMO / SIMO nx2 (two PCC paths and two SCC paths, no fading)
- **3CC CA - 3 RF Out**:
  DL CA with three carriers (one PCC path, one SCC1 path, one SCC2 path, no MIMO, no fading)
- **3CC CA - PCC MIMO - 4 RF Out**:
  DL CA with three carriers and PCC DL MIMO / SIMO nx2 (two PCC paths, one SCC1 path, one SCC2 path, no fading)
- **3CC CA - SCC1 MIMO - 4 RF Out**:
  DL CA with three carriers and SCC1 DL MIMO / SIMO nx2 (one PCC path, two SCC1 paths, one SCC2 path, no fading)
- **... - Fading - ...**:
  For the following scenarios, there is a variant with fading and/or AWGN insertion:
  – "1 Cell - 1 RF Out"
  – "2CC CA - 2 RF Out"
  – "2CC CA - 4 RF Out"

  For "1 Cell - 2 RF Out", there are two variants:
  – "1 Cell - Fading - 2 RF Out" for MIMO 2x2, SIMO 1x2 and beamforming
  – "1 Cell - Fading - MIMO4x2 - 2 RF Out" for MIMO 4x2

  For the fading scenarios, the additional parameter "Fading" is displayed. It selects between external fading via a connected R&S AMU200A and internal fading via an internal fader I/Q board.
  For internal fading with a single I/Q board, the I/Q board to be used can be selected in order to avoid resource conflicts (two signaling applications try to use the same I/Q board in parallel).
- **1 Cell - IQ Out, RF In**:
  RF uplink as for "1 Cell - 1 RF Out", baseband downlink via the I/Q board.
  Allows you for example to insert an R&S SMU200A into the downlink path.

For further reference:

- chapter 2.2.1, "Test Setups", on page 13
- chapter 2.2.3, "Carrier Aggregation", on page 20
- chapter 2.2.4, "External Fading", on page 22
- chapter 2.2.5, "Internal Fading", on page 23
- chapter 2.2.11, "MIMO and Beamforming", on page 34

The individual scenarios are only offered for selection if the required software and hardware options are available, as listed in the following table.

Table 2-21: Required hardware and software options

	SUW	TX	I/Q Board	Software Options
"1 Cell - 1 RF Out"	1	1	-	-
"1 Cell - 2 RF Out"	1	2	-	KS520
"1 Cell - 4 RF Out"	2	4	-	KS520, KS521
"2CC CA - 2 RF Out"	2	2	-	KS502 (FDD) / KS552 (TDD)
"2CC CA - 4 RF Out"	2	4	-	KS502 (FDD) / KS552 (TDD), KS520
"3CC CA - 3 RF Out"	3	3	-	KS502 (FDD) / KS552 (TDD), KS512
"3CC CA - PCC MIMO - 4 RF Out"	3	4	-	KS502 (FDD) / KS552 (TDD), KS512, KS520
"3CC CA - SCC1 MIMO - 4 RF Out"	3	4	-	KS502 (FDD) / KS552 (TDD), KS512, KS520
"1 Cell - Fading - 1 RF Out, External"	1	1	B510x or B520x	KS510
"1 Cell - Fading - 1 RF Out, Internal"	1	1	B510F or B520F	KS510, KE100, KE500
"1 Cell - Fading - 2 RF Out, External"	1	2	B510x or B520x	KS510, KS520
"1 Cell - Fading - 2 RF Out, Internal"	1	2	B510F or B520F	KS510, KS520, KE100, KE500
"1 Cell - Fading - MIMO4x2 - 2 RF Out, Ext."	2	2	B510x plus B520x	KS510, KS520, KS521
"1 Cell - Fading - MIMO4x2 - 2 RF Out, Int."	2	2	B510F plus B520F	KS510, KS520, KS521, KE100, KE500, KE501
"2CC CA - Fading - 2 RF Out, External"	2	2	B510x plus B520x	KS502 (FDD) / KS552 (TDD), KS512
"2CC CA - Fading - 2 RF Out, Internal"	2	2	B510F plus B520F	KS502 (FDD) / KS552 (TDD), KS512, KE100, KE500
"2CC CA - Fading - 4 RF Out, External"	2	4	B510x plus B520x	KS502 (FDD) / KS552 (TDD), KS512, KS520
"2CC CA - Fading - 4 RF Out, Internal"	2	4	B510F plus B520F	KS502 (FDD) / KS552 (TDD), KS512, KE100, KE500, KS520
"1 Cell - IQ Out, RF In"	1	-	B510x or B520x	-
All listed options are R&S CMW-... options. Example: B510F means R&S CMW-B510F All scenarios require KS500 for FDD and KS550 for TDD in addition to the listed options.				

Remote command:
ROUTe:LTE:SIGN<i>:SCENario:SCELl
ROUTe:LTE:SIGN<i>:SCENario:TRO
ROUTe:LTE:SIGN<i>:SCENario:FRO
ROUTe:LTE:SIGN<i>:SCENario:CATRfout
ROUTe:LTE:SIGN<i>:SCENario:CAFRfout
ROUTe:LTE:SIGN<i>:SCENario:CCTHree:RFTHree
ROUTe:LTE:SIGN<i>:SCENario:CCTHree:PMIMo:RFFour
ROUTe:LTE:SIGN<i>:SCENario:CCTHree:SMIMo:RFFour
ROUTe:LTE:SIGN<i>:SCENario:SCFading[:EXTernal]
ROUTe:LTE:SIGN<i>:SCENario:SCFading:INTernal
ROUTe:LTE:SIGN<i>:SCENario:SCFading:INTernal:FFADer
ROUTe:LTE:SIGN<i>:SCENario:TROFading[:EXTernal]
ROUTe:LTE:SIGN<i>:SCENario:TROFading:INTernal
ROUTe:LTE:SIGN<i>:SCENario:TROFading:INTernal:FFADer
ROUTe:LTE:SIGN<i>:SCENario:MTFading[:EXTernal]
ROUTe:LTE:SIGN<i>:SCENario:MTFading:INTernal
ROUTe:LTE:SIGN<i>:SCENario:CATF[:EXTernal]
ROUTe:LTE:SIGN<i>:SCENario:CATF:INTernal
ROUTe:LTE:SIGN<i>:SCENario:CAFF[:EXTernal]
ROUTe:LTE:SIGN<i>:SCENario:CAFF:INTernal
ROUTe:LTE:SIGN<i>:SCENario:IORI
ROUTe:LTE:SIGN<i>:SCENario?
ROUTe:LTE:SIGN<i>?

SCC Activation Mode
This setting is only displayed on the SCC tabs. It configures the activation mode of the SCCs for carrier aggregation scenarios. The setting applies to all SCCs (same value on all SCC tabs).

Option R&S CMW-KS512 is required for the modes "Manual" and "Semiautomatic".

See also chapter 2.2.8.2, "SCC States", on page 27.

"Auto"
The SCC is activated automatically at UE attach, so that the state "MAC Activated" is reached.
Prerequisite for this mode: The PCC RRC connection must be kept after attach (Keep RRC Connection must be enabled). Otherwise the "Auto" mode is identical to the "Semiautomatic" mode.

"Semiautomatic"
The SCC activation must be initiated manually once. As a result, all state transitions required to reach the state "MAC Activated" are performed.
This mode is useful if you want to establish first a PCC connection and add the SCC connection later on after some tests.

"Manual" Each state transition step must be initiated separately. You must trigger three state transition steps to reach the state "MAC Activated" from the state "SCC Off" (via "SCC On" and "RRC Added").
This mode is useful for debugging of the UE. From each state you can go back to the previous state or continue to the next state. For example from state "RRC Added" you can go to "MAC Activated" or to "SCC On".

Remote command:
`CONFigure:LTE:SIGN<i>:SCC:AMODe`

Enable Speech Codec
If this parameter is enabled, the LTE signaling application is connected to the speech codec of the audio board when the cell is switched on.

Only one signaling application can be connected to the audio board at a time. The parameter is only configurable while the cell is switched off.

Option R&S CMW-KS510 is required. The audio board and a speech codec must be installed (R&S CMW-B400B and R&S CMW-B405A).

For background information, see chapter 2.2.7, "Audio Tests and Speech Quality Tests", on page 25.

Remote command:
`CONFigure:LTE:SIGN<i>:ESCode`

2.4.5 I/Q Settings

The parameters in this section configure the I/Q output paths and/or the I/Q input paths. This is relevant for external fading scenarios and for the "I/Q out - RF in" scenario. Only for these scenarios, the section is present.

Depending on the scenario, the section configures only one I/Q output path or one, two or four pairs of input and output paths. Typically an R&S AMU200A is connected. For carrier aggregation scenarios, you can configure the settings per component carrier.

If you use the "I/Q out - RF in" scenario, specify the external delay of the test setup in the setup dialog. This allows the "LTE Signaling" application to compensate a time delay in the output path.

See also: "Digital IQ" in the R&S CMW user manual, chapter "Basic Instrument Functions"

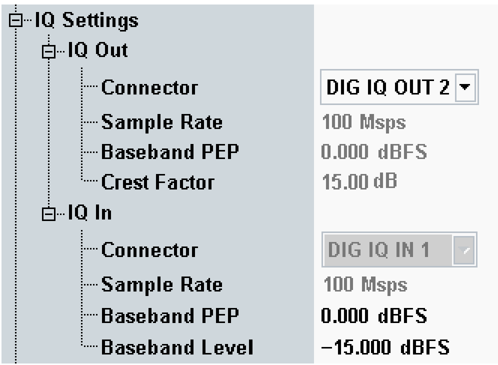


Fig. 2-47: I/Q settings (1 Cell - Fading - 1 RF Out, external fading)

Connector (Out / In)

Select the output connector. The input connector depends on the output connector and is displayed for information.

The DIG IQ connectors are located at the rear panel (if an I/Q board is installed).

Remote command:
`ROUTe:LTE:SIGN<i>:SCENario:IORI`
`ROUTe:LTE:SIGN<i>:SCENario:SCFading[:EXTernal]`
`ROUTe:LTE:SIGN<i>:SCENario:TROFading[:EXTernal]`
`ROUTe:LTE:SIGN<i>:SCENario:MTFading[:EXTernal]`
`ROUTe:LTE:SIGN<i>:SCENario:CATF[:EXTernal]`
`ROUTe:LTE:SIGN<i>:SCENario:CAFF[:EXTernal]`

Sample Rate (Out / In)

The used sample rate is displayed for information. The value is fixed.

Configure the connected instrument accordingly (baseband input settings and digital I/Q output settings).

Remote command:
`SENSe:LTE:SIGN<i>:IQOut[:PCC]:PATH<n>?`
`SENSe:LTE:SIGN<i>:IQOut:SCC:PATH<n>?`

Baseband PEP (Out / In)

Indicates the peak envelope power of the baseband signal as dB value relative to full scale. "Full scale" in this case corresponds to the maximum representable amplitude of the I/Q samples.

Use the displayed output PEP value to configure the baseband input of the connected instrument.

Configure the input PEP so that it matches the baseband output of the connected instrument.

Remote command:
SENSe:LTE:SIGN<i>:IQOut[:PCC]:PATH<n>?
CONFigure:LTE:SIGN<i>:IQIN[:PCC]:PATH<n>
SENSe:LTE:SIGN<i>:IQOut:SCC:PATH<n>?
CONFigure:LTE:SIGN<i>:IQIN:SCC:PATH<n>

Crest Factor (Out)
Indicates the crest factor of the baseband signal, i.e. the ratio of peak to average baseband power. The average power is calculated for time intervals with active downlink traffic channel timeslots only.

Use the displayed crest factor value to configure the baseband input of the connected instrument.

Remote command:
SENSe:LTE:SIGN<i>:IQOut[:PCC]:PATH<n>?
SENSe:LTE:SIGN<i>:IQOut:SCC:PATH<n>?

Baseband Level (In)
Indicates the nominal RMS level of the baseband signal during a call (connection established).

Configure the baseband level so that it matches the baseband output of the connected instrument.

Remote command:
CONFigure:LTE:SIGN<i>:IQIN[:PCC]:PATH<n>
CONFigure:LTE:SIGN<i>:IQIN:SCC:PATH<n>

2.4.6 RF Settings

The parameters in this section configure the RF input and output paths.

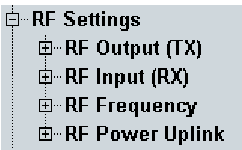


Fig. 2-48: RF settings (1 Cell - 1 RF Out)

For descriptions of the parameters, refer to the subsections.

2.4.6.1 RF Signal Routing

Depending on the selected scenario, this section configures only the RF input path, or one input and one output path, or one input and two output paths. Most parameters are configurable per path.

For carrier aggregation scenarios, you can configure the downlink settings per component carrier (except "External Delay Compensation").

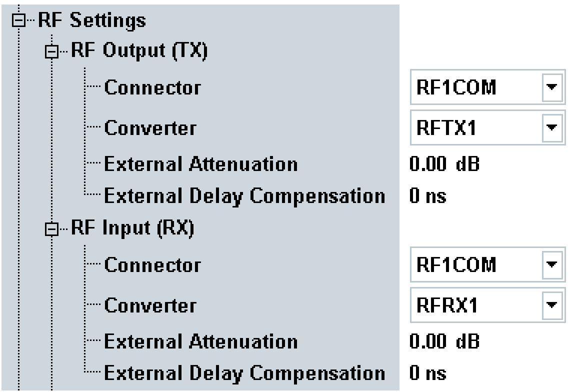


Fig. 2-49: RF path settings (1 Cell - 1 RF Out)

RF Output (TX)
The following parameters configure the RF output paths of the R&S CMW.

Connector, Converter ← RF Output (TX)
Selects the output paths for the generated RF signals, that means the output connector and the TX module for each downlink path.

Depending on your hardware configuration, there are dependencies between both parameters.

Remote command:
Depends on the scenario, see chapter 2.6.8.1, "Signal Routding", on page 308
Example: ROUTe:LTE:SIGN<i>:SCENario:SCELl

External Attenuation ← RF Output (TX)
Defines the value of an external attenuation (or gain, if the value is negative) in the output path. With an external attenuation of x dB, the power of the generated signal is increased by x dB. The actual generated levels are equal to the displayed values plus the external attenuation.

If a correction table for frequency-dependent attenuation is active for the chosen connector, the table name and a button are displayed. Press the button to display the table entries.

You can configure the external attenuation per output path.

Remote command:
CONFigure:LTE:SIGN<i>:RFSettings[:PCC]:EATTenuation:OUTPut<n>
CONFigure:LTE:SIGN<i>:RFSettings:SCC<c>:EATTenuation:OUTPut<n>

External Delay Compensation ← RF Output (TX)
Defines the value of an external time delay in the output path, for example caused by a very long optical fiber cable or by an additional instrument in the output path.

As a result, the downlink signal is sent earlier, so that the downlink signal arrives at the UE without delay.

Remote command:
CONFigure:LTE:SIGN<i>:RFSettings:EDC:OUTPut

RF Input (RX)
The following parameters configure the RF input path of the R&S CMW.

Connector, Converter ← RF Input (RX)
Selects the input path for the measured RF signal, i.e. the input connector and the RX module to be used.

Depending on your hardware configuration there may be dependencies between both parameters. Select the RF connector first. The "Converter" parameter offers only values compatible with the selected RF connector.

Remote command:
Depends on the scenario, see chapter 2.6.8.1, "Signal Routing", on page 308
Example: ROUTe:LTE:SIGN<i>:SCENario:SCELl

External Attenuation ← RF Input (RX)
Defines the value of an external attenuation (or gain, if the value is negative) in the input path. The power readings of the R&S CMW are corrected by the external attenuation value.

The external attenuation value is also used in the calculation of the maximum input power that the R&S CMW can measure.

If a correction table for frequency-dependent attenuation is active for the chosen connector, then the table name and a button are displayed. Press the button to display the table entries.

Remote command:
CONFigure:LTE:SIGN<i>:RFSettings[:PCC]:EATTenuation:INPut

External Delay Compensation ← RF Input (RX)
Defines the value of an external time delay in the input path, for example caused by a very long optical fiber cable.

The signaling application uses this information to compensate for the delay and to synchronize the uplink and the downlink in spite of the delay.

Remote command:
CONFigure:LTE:SIGN<i>:RFSettings:EDC:INPut

2.4.6.2 RF Frequency

This section configures the operating band and the channel/frequency for uplink and downlink.

The uplink settings configure the center frequency of the RF analyzer. The downlink settings configure the carrier center frequency of the generated LTE signal.

If option R&S CMW-KS525 is available, a user-defined band can be specified and used.

For carrier aggregation scenarios, you can configure the downlink settings per component carrier.

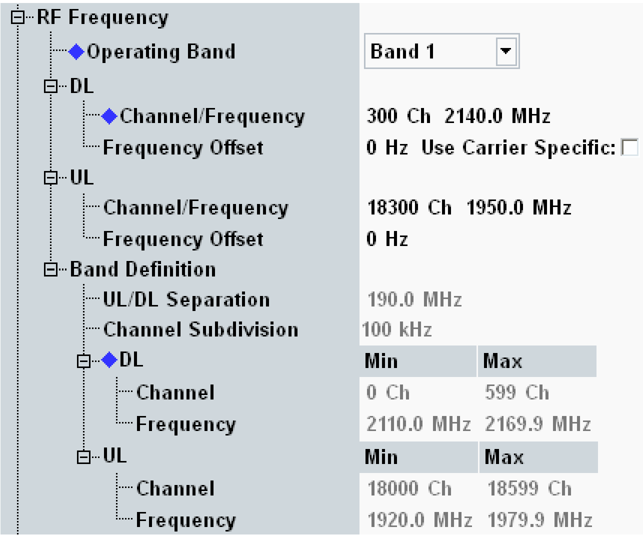


Fig. 2-50: Frequency settings

Operating Band, Channel, Frequency

To specify the DL and UL frequencies, select an operating band first, then enter a valid channel number or frequency for UL or DL. The related frequency or channel number and the parameters for the other direction are calculated automatically.

For carrier aggregation, select different DL channels for the carriers. The channels must not overlap and can be located in the same band or in different bands.

The relation between operating band, carrier frequencies and channel numbers is defined by 3GPP (see chapter 2.2.16, "Operating Bands", on page 59). You can define an additional band if option R&S CMW-KS525 is available, see "Band Definition" on page 131.

You can change the operating band and the channels in all main connection states. In state "Connection Established" you can either change one parameter directly or you can perform a handover to reconfigure several parameters, see chapter 2.2.9, "Handover", on page 28.

Remote command:
`CONFigure:LTE:SIGN<i>[:PCC]:BAND`
`CONFigure:LTE:SIGN<i>:RFSettings[:PCC]:CHANnel:DL`
`CONFigure:LTE:SIGN<i>:RFSettings[:PCC]:CHANnel:UL`
`CONFigure:LTE:SIGN<i>:SCC<c>:BAND`
`CONFigure:LTE:SIGN<i>:RFSettings:SCC:CHANnel:DL`
`CONFigure:LTE:SIGN<i>:RFSettings:SCC:CHANnel:DL:SCC2`
`CONFigure:LTE:SIGN<i>:RFSettings:ALL:BWCHannel`

Frequency Offset
You can specify positive or negative offsets to be added to the carrier center frequencies. This is useful for example if the UE has a frequency offset relative to the channels defined by 3GPP.

To configure different PCC and SCC downlink settings for carrier aggregation scenarios, enable "Use Carrier Specific".

Remote command:
`CONFigure:LTE:SIGN<i>:RFSettings[:PCC]:FOFFset:DL`
`CONFigure:LTE:SIGN<i>:RFSettings:SCC<c>:FOFFset:DL`
`CONFigure:LTE:SIGN<i>:RFSettings[:PCC]:FOFFset:DL:UCSPecific`
`CONFigure:LTE:SIGN<i>:RFSettings[:PCC]:FOFFset:UL`

Band Definition
Displays the definition of the selected operating band. Operating band "User-Defined" can be edited.

Option R&S CMW-KS525 is required for user-defined bands.

UL/DL Separation ← Band Definition
F_{DL} - F_{UL}, for TDD usually the same frequency is used in UL and DL, but different frequencies can be configured for user-defined bands.

Remote command:
`CONFigure:LTE:SIGN<i>:RFSettings[:PCC]:UDEFined:UDSeparation`

Channel Subdivision ← Band Definition
Displays the spacing between center frequencies of two adjacent channels, always 100 kHz - also for user-defined bands.

Band Indicator ← Band Definition
Frequency band indicator identifying a user-defined band in signaling messages. The value is sent to the UE via broadcast in system information block 1. It is also used in handover messages.

Remote command:
`CONFigure:LTE:SIGN<i>:RFSettings[:PCC]:UDEFined:BINDicator`
`CONFigure:LTE:SIGN<i>:RFSettings:SCC<c>:UDEFined:BINDicator`

DL Channel, Frequency ← Band Definition
For user-defined PCC or SCC channels, you can edit the minimum DL channel number, the maximum DL channel number and the minimum DL center frequency.

The maximum DL center frequency is calculated automatically according to the "Channel Subdivision".

Remote command:
`CONFigure:LTE:SIGN<i>:RFSettings[:PCC]:UDEFined:CHANnel:DL:MINimum`
`CONFigure:LTE:SIGN<i>:RFSettings[:PCC]:UDEFined:CHANnel:DL:MAXimum`
`CONFigure:LTE:SIGN<i>:RFSettings[:PCC]:UDEFined:FREQuency:DL:MINimum`
`CONFigure:LTE:SIGN<i>:RFSettings[:PCC]:UDEFined:FREQuency:DL:MAXimum?`
`CONFigure:LTE:SIGN<i>:RFSettings:SCC:UDEFined:CHANnel:DL:MINimum`
`CONFigure:LTE:SIGN<i>:RFSettings:SCC:UDEFined:CHANnel:DL:MAXimum`
`CONFigure:LTE:SIGN<i>:RFSettings:SCC:UDEFined:FREQuency:DL:MINimum`
`CONFigure:LTE:SIGN<i>:RFSettings:SCC:UDEFined:FREQuency:DL:MAXimum?`
`CONFigure:LTE:SIGN<i>:RFSettings:SCC:UDEFined:CHANnel:DL:MAXimum:SCC<c>`
`CONFigure:LTE:SIGN<i>:RFSettings:SCC:UDEFined:CHANnel:DL:MINimum:SCC<c>`
`CONFigure:LTE:SIGN<i>:RFSettings:SCC:UDEFined:FREQuency:DL:MAXimum:SCC<c>?`
`CONFigure:LTE:SIGN<i>:RFSettings:SCC:UDEFined:FREQuency:DL:MINimum:SCC<c>`

UL Channel, Frequency ← Band Definition
For user-defined PCC channels, you can edit the minimum UL channel number and thus the relation between DL and UL channel numbers.

The other UL settings are calculated automatically according to the DL settings and the "UL/DL Separation".

Remote command:

`CONFigure:LTE:SIGN<i>:RFSettings[:PCC]:UDEFined:CHANnel:UL:MINimum`

`CONFigure:LTE:SIGN<i>:RFSettings[:PCC]:UDEFined:CHANnel:UL:MAXimum?`

`CONFigure:LTE:SIGN<i>:RFSettings[:PCC]:UDEFined:FREQuency:UL:MINimum?`

`CONFigure:LTE:SIGN<i>:RFSettings[:PCC]:UDEFined:FREQuency:UL:MAXimum?`

2.4.6.3 Expected Uplink Power

The following parameters configure the expected uplink power.

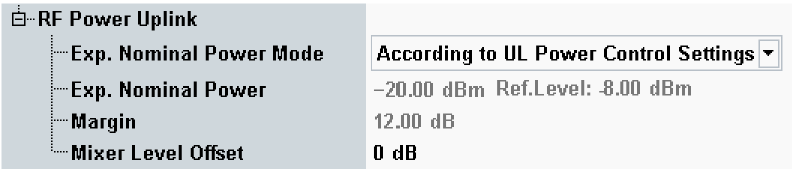


Fig. 2-51: RF uplink power settings

Exp. Nominal Power..., Margin

These parameters configure the expected UL power. Two modes are available:

- **According to UL Power Control Settings**
  The UL power is calculated automatically from the UL power control settings. The resulting expected nominal power is displayed for information. The displayed reference level is calculated as:
  Reference Level = Expected Nominal Power + 12 dB Margin
  For UL power control settings see chapter 2.4.9, "Uplink Power Control", on page 142.
- **Manual**
  In manual mode the expected nominal power and a margin can be defined manually. The displayed reference level is calculated as:
  Reference Level = Expected Nominal Power + Margin

The margin is used to account for the known variations (crest factor) of the RF input signal power.

Note: The actual input power at the connectors must be within the level range of the selected RF input connector; refer to the data sheet. If all power settings are configured correctly, the actual power equals the "Reference Level" minus the "External Attenuation (Input)" value.

The parameters can be changed in all main connection states including "Connection Established".

Remote command:
CONFigure:LTE:SIGN<i>:RFSettings:ENPMode
CONFigure:LTE:SIGN<i>:RFSettings:ENPower
CONFigure:LTE:SIGN<i>:RFSettings:UMARgin

Mixer Level Offset
Varies the input level of the mixer in the analyzer path. A negative offset reduces the mixer input level, a positive offset increases it. Optimize the mixer input level according to the properties of the uplink signal.

Mixer Level Offset	Advantages	Possible Shortcomings
< 0 dB	Suppression of distortion (e.g. of the intermodulation products generated in the mixer)	Lower dynamic range (due to smaller signal-to-noise ratio)
> 0 dB	High signal-to-noise ratio, higher dynamic range	Risk of intermodulation, smaller overdrive reserve

Remote command:
CONFigure:LTE:SIGN<i>:RFSettings:MLOFfset

2.4.7 Internal Fading

This branch of the configuration tree is only visible, if a fading scenario is selected and the fading source is set to "Internal".

For general prerequisites/required options and background information, see chapter 2.2.5, "Internal Fading", on page 23.

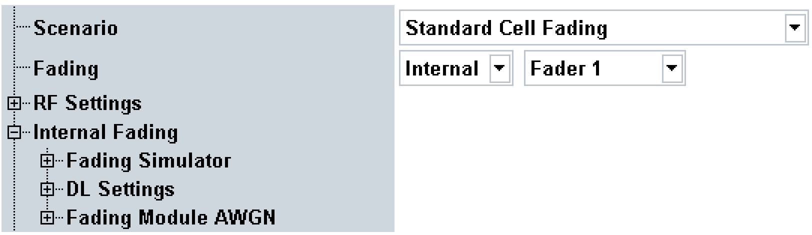


Fig. 2-52: Internal fading settings

2.4.7.1 Fading Simulator

The following parameters enable and set up the fading simulator. For background information, see chapter 2.2.5.1, "Fading Simulator", on page 23.

For carrier aggregation scenarios, you can configure the settings per component carrier.

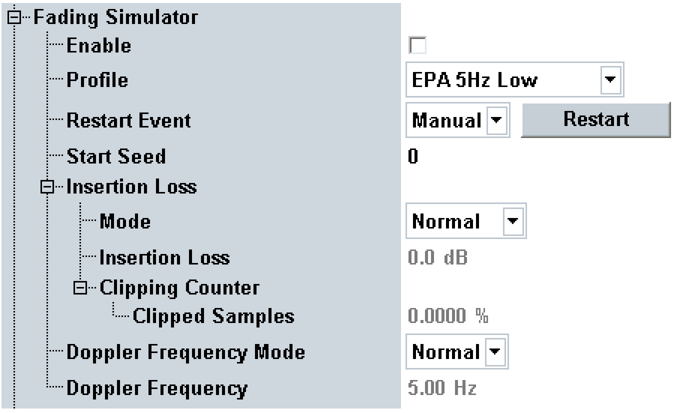


Fig. 2-53: Fading simulator settings

Enable

Enables/disables the fading simulator.

Remote command:
CONFigure:LTE:SIGN<i>:FADing[:PCC]:FSIMulator:ENABle
CONFigure:LTE:SIGN<i>:FADing:SCC:FSIMulator:ENABle

Profile

Selects a propagation condition profile. The following profiles are available:

- Delay profiles for low, medium and high delay spread environments:
  – Extended Pedestrian A model (EPA), maximum Doppler frequency 5 Hz
  – Extended Vehicular A model (EVA), maximum Doppler frequency 5 Hz or 70 Hz
  – Extended Typical Urban model (ETU), maximum Doppler frequency 30 Hz, 70 Hz or 300 Hz

  All profiles are available with low, medium and high correlation level, relevant for MIMO scenarios.
  The delay profiles are defined in 3GPP TS 36.101, Annex B.2.
- High Speed Train (HST) scenario defined in 3GPP TS 36.101, Annex B.3
- Multi-path profile used for CQI tests with parameter specifications of 3GPP TS 36.521-1, section 9.3 "CQI Reporting under fading conditions"

Remote command:
CONFigure:LTE:SIGN<i>:FADing[:PCC]:FSIMulator:STANdard
CONFigure:LTE:SIGN<i>:FADing:SCC:FSIMulator:STANdard

Restart Event

The scenario "1 Cell - Fading - MIMO4x2 - 2 RF Out" supports only the mode "Trigger". The other scenarios support only the modes "Auto" and "Manual".

"Auto" Fading starts automatically with the downlink signal.

"Manual" Fading is started and restarted manually. A "Restart" button is displayed.

"Trigger" Fading starts automatically. The two I/Q boards are synchronized via an internal trigger signal.

Remote command:
CONFigure:LTE:SIGN<i>:FADing[:PCC]:FSIMulator:RESTart:MODE
CONFigure:LTE:SIGN<i>:FADing[:PCC]:FSIMulator:RESTart
CONFigure:LTE:SIGN<i>:FADing:SCC:FSIMulator:RESTart:MODE
CONFigure:LTE:SIGN<i>:FADing:SCC:FSIMulator:RESTart

Start Seed

Sets the start seed for the pseudo-random fading algorithm. This enables reproducible fading conditions.

Remote command:
CONFigure:LTE:SIGN<i>:FADing[:PCC]:FSIMulator:GLOBal:SEED
CONFigure:LTE:SIGN<i>:FADing:SCC:FSIMulator:GLOBal:SEED

Insertion Loss

The insertion loss is the attenuation at the fader input. It can be calculated automatically or you can define it manually.

"Normal" The insertion loss is calculated automatically, based on the currently selected Profile.

"User" Specify the insertion loss value. A lower insertion loss allows for a higher downlink power but may result in clipping.
You can use the displayed information "Clipped Samples" to find the lowest insertion loss value for which no clipping occurs. For scenarios with several output paths, the information is displayed per path.

Remote command:
CONFigure:LTE:SIGN<i>:FADing[:PCC]:FSIMulator:ILOSs:MODE
CONFigure:LTE:SIGN<i>:FADing[:PCC]:FSIMulator:ILOSs:LOSS
SENSe:LTE:SIGN<i>:FADing[:PCC]:FSIMulator:ILOSs:CSAMples<path>?
CONFigure:LTE:SIGN<i>:FADing:SCC:FSIMulator:ILOSs:MODE
CONFigure:LTE:SIGN<i>:FADing:SCC:FSIMulator:ILOSs:LOSS
SENSe:LTE:SIGN<i>:FADing:SCC:FSIMulator:ILOSs:CSAMples<n>?

Doppler Frequency Mode, Doppler Frequency

The maximum Doppler frequency can be calculated automatically or you can define it manually.

"Normal" The maximum Doppler frequency is calculated automatically, based on the currently selected Profile.

"User" Specify the maximum Doppler frequency.

Remote command:
CONFigure:LTE:SIGN<i>:FADing[:PCC]:FSIMulator:DSHift:MODE
CONFigure:LTE:SIGN<i>:FADing[:PCC]:FSIMulator:DSHift
CONFigure:LTE:SIGN<i>:FADing:SCC:FSIMulator:DSHift:MODE
CONFigure:LTE:SIGN<i>:FADing:SCC:FSIMulator:DSHift

2.4.7.2 DL Settings

This branch displays noise power values, calculated from the downlink power, the cell bandwidth and the fading module AWGN settings.

For carrier aggregation scenarios, this information is available per component carrier.

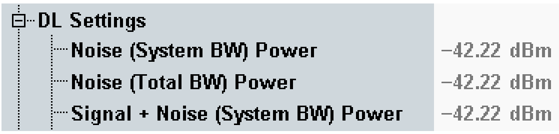


Fig. 2-54: Noise information

Noise (System BW) Power
Displays the noise power on the downlink channel, i.e. within the cell bandwidth.

Remote command:
CONFigure:LTE:SIGN<i>:FADing[:PCC]:POWer:NOISe?
CONFigure:LTE:SIGN<i>:FADing:SCC:POWer:NOISe?

Noise (Total BW) Power
Displays the total noise power, within and outside of the cell bandwidth.

The total noise power is irrelevant for 3GPP test cases. They specify the SNR or the noise power within the cell bandwidth. The total noise power is only displayed for compatibility reasons with other Rohde & Schwarz instruments, for example the R&S AMU200A.

Remote command:
CONFigure:LTE:SIGN<i>:FADing[:PCC]:POWer:NOISe:TOTal?
CONFigure:LTE:SIGN<i>:FADing:SCC:POWer:NOISe:TOTal?

Signal + Noise (System BW) Power
Displays the total power (signal + noise) on the downlink channel, i.e. within the cell bandwidth.

Remote command:
CONFigure:LTE:SIGN<i>:FADing[:PCC]:POWer:SUM?
CONFigure:LTE:SIGN<i>:FADing:SCC:POWer:SUM?

2.4.7.3 Fading Module AWGN

The following parameters enable and configure the AWGN insertion on the fading module. For background information, see chapter 2.2.5.2, "AWGN Generator", on page 24.

For carrier aggregation scenarios, you can configure the settings per component carrier.

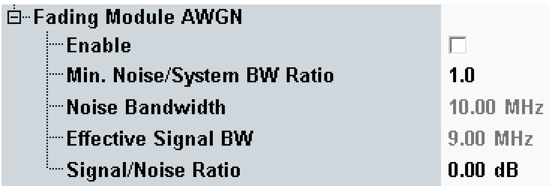


Fig. 2-55: AWGN settings

Enable

Enables/disables AWGN insertion via the fading module.

Remote command:

```
CONFigure:LTE:SIGN<i>:FADing[:PCC]:AWGN:ENABle
CONFigure:LTE:SIGN<i>:FADing:SCC:AWGN:ENABle
```

Min. Noise/System BW Ratio

Configures the minimum ratio between the noise bandwidth and the cell bandwidth.

Remote command:

```
CONFigure:LTE:SIGN<i>:FADing[:PCC]:AWGN:BWIDth:RATio
CONFigure:LTE:SIGN<i>:FADing:SCC:AWGN:BWIDth:RATio
```

Noise Bandwidth

Displays the actual noise bandwidth, resulting from the "Min. Noise/System BW Ratio" and the cell bandwidth.

Remote command:

```
CONFigure:LTE:SIGN<i>:FADing[:PCC]:AWGN:BWIDth:NOISe?
CONFigure:LTE:SIGN<i>:FADing:SCC:AWGN:BWIDth:NOISe?
```

Effective Signal BW

Displays the part of the cell bandwidth that is dedicated to the downlink subcarriers.

Signal/Noise Ratio

Specifies the signal to noise ratio.

Remote command:

```
CONFigure:LTE:SIGN<i>:FADing[:PCC]:AWGN:SNRatio
CONFigure:LTE:SIGN<i>:FADing:SCC:AWGN:SNRatio
```

2.4.8 Downlink Power Levels

This section defines power levels of physical downlink channels and physical downlink signals.

The parameters in this section except the power offset PA can be changed in all main connection states including "Connection Established".

For carrier aggregation scenarios, you can configure the settings per component carrier.

For background information, see also chapter 2.2.10, "Physical DL Channels and Signals", on page 30.

Fig. 2-56: DL power levels

RS EPRE

Defines the Energy Per Resource Element (EPRE) of the Reference Signal (RS). The RS EPRE corresponds to the DL power averaged over all resource elements carrying cell-specific reference signals within one subcarrier (15 kHz).

Additionally the "Full Cell BW Power" resulting from the RS EPRE is displayed. It is calculated assuming that the full DL cell bandwidth is used (all subcarriers) and all power offsets equal 0 dB.

Remote command:
`CONFigure:LTE:SIGN<i>:DL[:PCC]:RSEPre:LEVel`
`SENSe:LTE:SIGN<i>:DL[:PCC]:FCPower?`
`CONFigure:LTE:SIGN<i>:DL:SCC<c>:RSEPre:LEVel`
`SENSe:LTE:SIGN<i>:DL:SCC<c>:FCPower?`

PSS Power Offset
Power level of a Primary Synchronization Signal (PSS) resource element relative to the RS EPRE.

Remote command:
`CONFigure:LTE:SIGN<i>:DL[:PCC]:PSS:POFFset`
`CONFigure:LTE:SIGN<i>:DL:SCC<c>:PSS:POFFset`

SSS Power Offset
Power level of a Secondary Synchronization Signal (SSS) resource element relative to the RS EPRE.

Remote command:
`CONFigure:LTE:SIGN<i>:DL[:PCC]:SSS:POFFset`
`CONFigure:LTE:SIGN<i>:DL:SCC<c>:SSS:POFFset`

PBCH Power Offset
Power level of a Physical Broadcast Channel (PBCH) resource element relative to the RS EPRE.

Remote command:
`CONFigure:LTE:SIGN<i>:DL[:PCC]:PBCH:POFFset`
`CONFigure:LTE:SIGN<i>:DL:SCC<c>:PBCH:POFFset`

PCFICH Power Offset
Power level of a Physical Control Format Indicator Channel (PCFICH) resource element relative to the RS EPRE.

Remote command:
`CONFigure:LTE:SIGN<i>:DL[:PCC]:PCFich:POFFset`
`CONFigure:LTE:SIGN<i>:DL:SCC<c>:PCFich:POFFset`

PHICH Power Offset
Power level of a Physical Hybrid ARQ Indicator Channel (PHICH) resource element relative to the RS EPRE.

Remote command:
`CONFigure:LTE:SIGN<i>:DL[:PCC]:PHICh:POFFset`
`CONFigure:LTE:SIGN<i>:DL:SCC<c>:PHICh:POFFset`

PDCCH Power Offset
Power level of a Physical Downlink Control Channel (PDCCH) resource element relative to the RS EPRE.

Remote command:
CONFigure:LTE:SIGN<i>:DL[:PCC]:PDCCh:POFFset
CONFigure:LTE:SIGN<i>:DL:SCC<c>:PDCCh:POFFset

OCNG
Enables or disables the OFDMA Channel Noise Generator (OCNG).

When the OCNG is enabled it uses all not allocated Resource Blocks (RB) of the cell bandwidth, so that the full cell bandwidth is used. Example: if for a bandwidth of 10 MHz only 16 RBs are used by the RMC, the remaining 34 RBs are used by the OCNG.

The power level of the OCNG is chosen automatically so that the displayed "Full Cell BW Power" is reached. Thus the overall DL power is constant in each transmission time interval.

Remote command:
CONFigure:LTE:SIGN<i>:DL[:PCC]:OCNG
CONFigure:LTE:SIGN<i>:DL:SCC<c>:OCNG

PDSCH
These parameters define the power level of the Physical Downlink Shared Channel (PDSCH).

According to 3GPP TS 36.213 the power level of a PDSCH resource element relative to the RS EPRE is denoted by:
- ρ_A (rhoA) if no RS resource elements are transmitted simultaneously on other subcarriers
- ρ_B (rhoB) if RS resource elements are transmitted simultaneously on other subcarriers

The power offset P_A and the power ratio index P_B are related to these ratios as follows:
- $P_A = \rho_A$
- P_B = 0, 1, 2, 3 corresponds to ρ_B/ρ_A =
  - 1, 4/5, 3/5, 2/5 for single TX antenna configurations;
  - 5/4, 1, 3/4, 1/2 for multiple TX antenna configurations.

The displayed ratios "rhoA" and "rhoB" are calculated from the parameters "PA" and "PB".

Remote command:
CONFigure:LTE:SIGN<i>:DL[:PCC]:PDSCh:PA
CONFigure:LTE:SIGN<i>:DL[:PCC]:PDSCh:RINDex
CONFigure:LTE:SIGN<i>:DL:SCC<c>:PDSCh:PA
CONFigure:LTE:SIGN<i>:DL:SCC<c>:PDSCh:RINDex

AWGN
Total level of the Additional White Gaussian Noise (AWGN) interferer in dBm/15 kHz (the spectral density integrated across one subcarrier). If enabled, the AWGN signal is added to the DL LTE signal for the entire cell bandwidth.

For fading scenarios this parameter is disabled, so that AWGN cannot be added by the signaling unit. Instead AWGN can be added by the fader (external or internal).

Option R&S CMW-KS510 required.

Remote command:
CONFigure:LTE:SIGN<i>:DL[:PCC]:AWGN
CONFigure:LTE:SIGN<i>:DL:SCC<c>:AWGN

2.4.9 Uplink Power Control

This section defines parameters related to the control of the UE uplink power by the instrument. The PRACH and initial PUSCH power are relevant during connection setup. During an established connection the power is controlled via TPC commands.

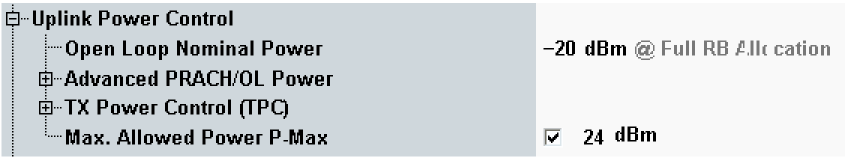


Fig. 2-57: UL power control

2.4.9.1 PRACH and Initial PUSCH Power

The following parameters configure the PRACH power and the initial PUSCH power.

By default the basic settings apply (see figure 2-58). Only the "Open Loop Nominal Power" is configurable. The advanced settings are not configurable and the grayed out values indicate the used basic settings.

If you enable the advanced settings, the grayed out values become configurable. Instead the "Open Loop Nominal Power" parameter is disabled.

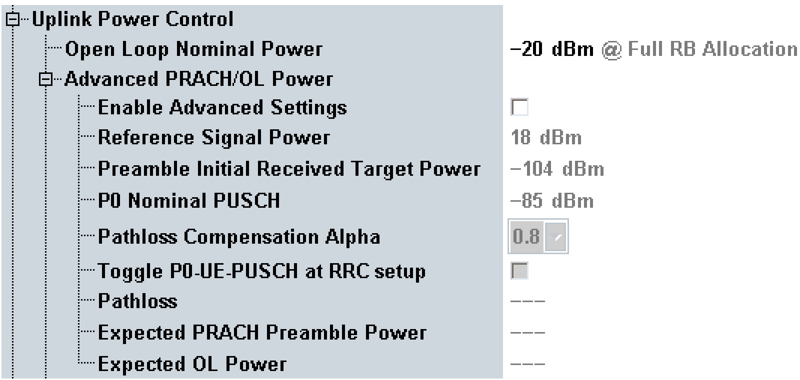


Fig. 2-58: OL and PRACH power control

Open Loop Nominal Power

Defines a cell-specific nominal power value for full resource block allocation in the UL (entire channel bandwidth used). From this value the cell-specific nominal power value related to one resource block is determined and sent to all UEs via broadcast.

The UE uses this value for calculation of the average power of an SC-FDMA symbol in which the PUSCH is transmitted. The calculation is described in 3GPP TS 36.213 (see $P_{O\_NOMINAL\_PUSCH}$).

This power control procedure is performed during connection setup. Afterwards the power remains constant until changed by TPC commands.

The parameter is only relevant and configurable if the "Advanced PRACH/OL Power" settings are disabled.

Remote command:
`CONFigure:LTE:SIGN<i>:UL:OLNPower`

Enable Advanced Settings

Enables configuration of the advanced parameters.

If disabled, the following parameters are grayed out and display the used basic settings.

Remote command:
`CONFigure:LTE:SIGN<i>:UL:APPower:EASettings`

Reference Signal Power

Specifies the parameter "referenceSignalPower", signaled to the UE as PDSCH configuration parameter (see 3GPP TS 36.331, section 6.3.2).

The value is used by the UE to determine the pathloss, see 3GPP TS 36.213 section 5.1.1.1.

Remote command:
`CONFigure:LTE:SIGN<i>:UL:APPower:RSPower:ADVanced`
`SENSe:LTE:SIGN<i>:UL:APPower:RSPower:BASic?`

Preamble Initial Received Target Power

Specifies the parameter "preambleInitialReceivedTargetPower", signaled to the UE as common RACH parameter (see 3GPP TS 36.331, section 6.3.2).

In 3GPP TS 36.213, section 5.1.1.1 this parameter is called P_{O_PRE}.

The value is used by the UE for example to calculate the power of the first preamble.

Remote command:
`CONFigure:LTE:SIGN<i>:UL:APPower:PIRPower:ADVanced`
`SENSe:LTE:SIGN<i>:UL:APPower:PIRPower:BASic?`

P0 Nominal PUSCH

Specifies the parameter "p0-NominalPUSCH", signaled to the UE as uplink power control parameter (see 3GPP TS 36.331, section 6.3.2).

In 3GPP TS 36.213, section 5.1.1.1 this parameter is called $P_{O\_NOMINAL\_PUSCH}$.

Remote command:
CONFigure:LTE:SIGN<i>:UL:APPower:PNPusch:ADVanced
SENSe:LTE:SIGN<i>:UL:APPower:PNPusch:BASic?

Pathloss Compensation Alpha

Specifies the parameter "alpha", signaled to the UE as uplink power control parameter (see 3GPP TS 36.331, section 6.3.2).

In 3GPP TS 36.213, section 5.1.1.1 this parameter is called α.

Remote command:
CONFigure:LTE:SIGN<i>:UL:APPower:PCALpha:ADVanced
SENSe:LTE:SIGN<i>:UL:APPower:PCALpha:BASic?

Toggle P0-UE-PUSCH at RRC Setup

With enabled toggling, the following P0-UE-PUSCH values are set during RRC connection setup:

- RRC Connection Setup message (SRB1): P0-UE-PUSCH = 1 dB
- RRC Connection Reconfiguration message (SRB2+DRB): P0-UE-PUSCH = 0 dB

P0-UE-PUSCH toggling is required for some 3GPP conformance tests, for example 3GPP TS 36.521, section 6.3.5.1 "Power Control Absolute power tolerance", table 6.3.5.1.4.3-4.

The toggling initiates a "TPC accumulation reset" at the UE ($f_c(i)$ is set to 0, see 3GPP TS 36.213, section 5.1.1.1).

Note: Toggling deletes a PRACH ramp-up procedure. Disable toggling if a PRACH ramp-up procedure is required for decoding of the UE signal. Otherwise the RRC connection setup will fail.

Note: Use toggling only if the external attenuation is compensated accurately. Do not use toggling if this cannot be ensured, for example for over the air tests with fluctuating external attenuation.

Remote command:
CONFigure:LTE:SIGN<i>:UL:APPower:TPRRcsetup:ADVanced
SENSe:LTE:SIGN<i>:UL:APPower:TPRRcsetup:BASic?

Pathloss

Displays the pathloss resulting from the "Reference Signal Power" on page 143 and the "RS EPRE" on page 139.

Remote command:
SENSe:LTE:SIGN<i>:UL:APPower:PATHloss?

Expected PRACH Preamble Power

Displays the expected power of the first preamble.

The value depends on the "preambleInitialReceivedTargetPower" ("Preamble Initial Received Target Power" on page 143) and on the preamble format resulting from the configuration index ("Configuration Index" on page 152).

For details see 3GPP TS 36.321 section 5.1.

Remote command:
`SENSe:LTE:SIGN<i>:UL:APPower:EPPPower?`

Expected OL Power
Displays the expected initial PUSCH power. Most of the advanced power settings influence this value.

You can use the displayed values to verify your configuration: With a correct configuration, the expected PRACH power is not larger than the expected OL power. It is also not very much lower. Otherwise the PRACH cannot be detected and the attach procedure fails.

Remote command:
`SENSe:LTE:SIGN<i>:UL:APPower:EOPower?`

2.4.9.2 TX Power Control (TPC)

This section configures settings for UL power control via TPC commands.

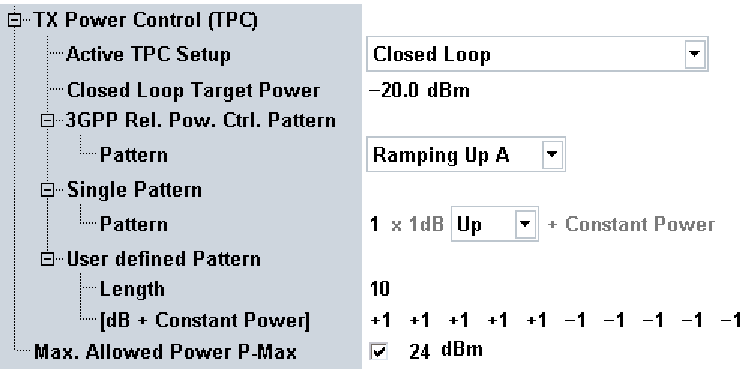


Fig. 2-59: TPC power control

Active TPC Setup
Selects the TPC setup to be executed. All setups use relative (accumulative) TPC commands and are only executed when a connection has been established. During connection setup 0-dB commands are sent.

The string "Adjusted" behind a node of settings indicates that the currently selected setup is further configured by this node.

- **Min Power, Max Power, Constant Power**

The UE is commanded to maximum power, to minimum power or is ordered to keep the UL power constant.
If one of these setups is selected, it is executed automatically without additional user action.

- **3GPP Relative Power Control**
  Ramping up or down test pattern according to 3GPP TS 36.521, section 6.3.5.2.
  Select the test pattern via "3GPP Rel. Pow. Ctrl. Pattern" and start the pattern via the "Execute" button.
  For details about the test pattern, see Relative Power Control Tests.
- **Single Pattern, User-defined Single Pattern**
  A configurable TPC pattern is sent to the UE when the "Execute" button is pressed.
  Before and after execution of the pattern, the power is kept constant.
  A single pattern contains only one type of TPC command while a user-defined single pattern allows you to combine different TPC commands.
- **User-defined Continuous Pattern**
  A configurable user-defined TPC pattern is sent to the UE continuously. If this setup is selected, it is executed automatically without additional user action.
  While this setup is selected, the relevant parameter for pattern configuration is marked by the string "Adjusted".
- **Alternating +1, -1, ...**
  An alternating TPC pattern of plus and minus 1-dB commands is sent to the UE continuously. If this setup is selected, it is executed automatically without additional user action.
- **Closed Loop**
  The UE is commanded to the configured target power. This is done by sending plus or minus 1-dB commands until the difference between the measured UL power and the target power is less than 1 dB. Afterwards the power is kept constant (0-dB commands).
  This setup is executed automatically without additional user action. Even the measurement of the uplink power is performed automatically in the background. No additional measurement application is needed.

Depending on the current configuration, some values are grayed out. The reason is displayed in that case, for example active PUCCH scheduling (number of RBs = 0) or active HARQ. TPC setups for which skipping a bit is no problem, are always available (for example max power or closed loop, in contrast to single or alternating pattern).

If you change the configuration so that the currently active setup is no longer allowed (for example activate HARQ), the TPC setup is corrected automatically and a notice is displayed.

Remote command:
CONFigure:LTE:SIGN<i>:UL:PUSCh:TPC:SET
CONFigure:LTE:SIGN<i>:UL:PUSCh:TPC:PEXecute

3GPP Rel. Pow. Ctrl. Pattern
Selects the pattern to be executed for the TPC setup "3GPP Relative Power Control".
The available up and down patterns are defined in 3GPP TS 36.521, section 6.3.5.2.
See also Relative Power Control Tests.

Remote command:
CONFigure:LTE:SIGN<i>:UL:PUSCh:TPC:RPControl

Closed Loop Target Power
Defines the target power for the TPC setup "Closed Loop". The target power applies to PUCCH and PUSCH.

Remote command:
`CONFigure:LTE:SIGN<i>:UL:PUSCh:TPC:CLTPower`

Single Pattern
Defines a pattern for the TPC setup "Single Pattern". The pattern consists of up to 35 up (+1 dB) or down (-1 dB) commands.

Remote command:
`CONFigure:LTE:SIGN<i>:UL:PUSCh:TPC:SINGle`

User-Defined Pattern
Defines a pattern for the TPC setups "User-defined Single Pattern" and "User-defined Continuous Pattern". The pattern consists of up to 20 TPC commands (-1 / 0 / +1 / +3 dB).

Remote command:
`CONFigure:LTE:SIGN<i>:UL:PUSCh:TPC:UDPattern`

2.4.9.3 General Power Control Parameters

The following parameter defines an upper power limit applicable to all power control mechanisms.

Max. allowed Power P-Max
Specifies the maximum allowed output power for the UE in the cell. The UE output power must neither exceed this value nor the maximum power value resulting from the UE power class.

If the checkbox is enabled, the configured value is signaled to the UE within the system information. If it is disabled, the parameter has no effect.

Remote command:
`CONFigure:LTE:SIGN<i>:UL:PMAX`

2.4.10 Physical Cell Setup

This section defines physical layer attributes of the simulated cell.

For background information, see also chapter 2.2.10, "Physical DL Channels and Signals", on page 30.

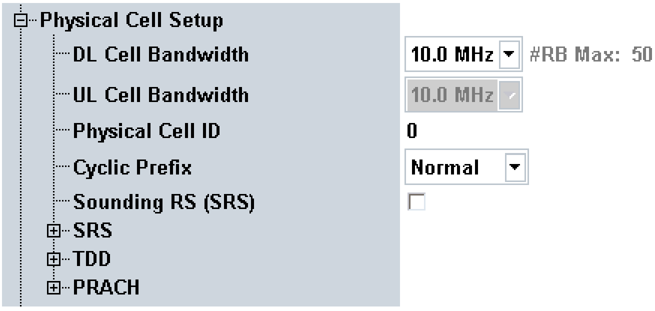


Fig. 2-60: Cell setup parameters

DL / UL Cell Bandwidth

Define the DL and UL cell bandwidths, also called channel bandwidth by 3GPP. In the current release, the two values are identical.

The resulting maximum number of DL resource blocks is indicated for information. It is smaller than the DL bandwidth divided by 180 kHz, because some space at the channel borders must not be occupied by resource blocks. 3GPP defines the relation as follows:

Channel Bandwidth [MHz]	1.4	3	5	10	15	20
Maximum no of RBs	6	15	25	50	75	100

You can change the cell bandwidth in all main connection states. In state "Connection Established" you can either change it directly or you can perform a handover to reconfigure several parameters, see chapter 2.2.9, "Handover", on page 28.

For carrier aggregation scenarios, you can configure different DL cell bandwidths for the carriers.

Remote command:
CONFigure:LTE:SIGN<i>:CELL:BANDwidth[:PCC]:DL
CONFigure:LTE:SIGN<i>:CELL:BANDwidth:SCC<c>:DL
CONFigure:LTE:SIGN<i>:RFSettings:ALL:BWCHannel

Physical Cell ID

The cell ID is used for generation of the physical synchronization signals. During cell search the UE determines the cell ID from the primary and secondary synchronization signal.

The physical cell ID can be set independent of the E-UTRAN cell identifier sent to the UE via broadcast (see "E-UTRAN Cell Identifier" on page 157).

If you use carrier aggregation, configure different values for the component carriers.

Remote command:
CONFigure:LTE:SIGN<i>:CELL[:PCC]:PCID
CONFigure:LTE:SIGN<i>:CELL:SCC<c>:PCID

Cyclic Prefix

Defines whether a normal or extended Cyclic Prefix (CP) is used.

An extended cyclic prefix cannot be combined with the transmission mode 8 (combination not foreseen by 3GPP).

Option R&S CMW-KS510 is required for extended CP.

Remote command:
CONFigure:LTE:SIGN<i>:CELL:CPRefix

Sounding RS (SRS)

Enables support of SRS. The information that the cell supports SRS is then broadcasted to the UE. During connection setup, the UE is requested to send a sounding reference signal.

Uplink SRS signals can be measured using the "LTE SRS" measurement included in option R&S CMW-KM500/-KM550.

Remote command:
CONFigure:LTE:SIGN<i>:CELL:SRS:ENABle

SRS

The parameters "srs-SubframeConfig" and "srs-ConfigIndex" are signaled to the UE. Their values can be set automatically or manually via the following parameters.

These parameters determine the SRS timing. In subframes with SRS transmission, only a single UE in the cell sends an SRS symbol. All other UE in the cell send a "blank SRS symbol".

The timing is configured via a cell-specific setting and a UE-specific setting:

- At time instances with configured UE-specific SRS, the UE sends an SRS symbol. All other UE send a "blank SRS symbol".
- At time instances with cell-specific SRS but without UE-specific SRS, the UE sends a "blank SRS symbol" (and another UE sends an SRS symbol).

Option R&S CMW-KS510 is required.

Manual Configuration ← SRS
With disabled "Manual Configuration", the parameter "srs-SubframeConfig" is set to 3 for FDD and to 0 for TDD. The parameter "srs-ConfigIndex" is set to 7 for FDD and to 0 for TDD. These values are specified in 3GPP TS 36.521 for example for SRS time mask tests.

With enabled "Manual Configuration", the signaled values are configured manually via the parameters "Subframe Configuration" and "Configuration Index".

Remote command:
`CONFigure:LTE:SIGN<i>:CELL:SRS:MCENable`

Subframe Configuration ← SRS
Configures the parameter "srs-SubframeConfig" manually. This is only possible if "Manual Configuration" is enabled.

The value determines the cell-specific SRS timing. The meaning of the individual values is specified in 3GPP TS 36.211, section 5.5.3.3.

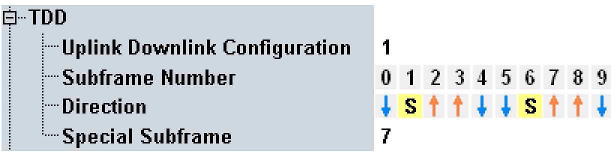
Remote command:
`CONFigure:LTE:SIGN<i>:CELL:SRS:SFConfig`

Configuration Index ← SRS
Configures the parameter "srs-ConfigIndex" manually. This is only possible if "Manual Configuration" is enabled.

The value determines the UE-specific SRS timing. The meaning of the individual values is specified in 3GPP TS 36.213, section 8.2.

Remote command:
`CONFigure:LTE:SIGN<i>:CELL:SRS:SCINdex:FDD`
`CONFigure:LTE:SIGN<i>:CELL:SRS:SCINdex:TDD`

TDD
The following parameters configure TDD-specific settings, not relevant for FDD.



Uplink Downlink Configuration ← TDD
Selects the uplink-downlink configuration of a TDD signal, see table 2-1. Each configuration defines a combination of uplink subframes, downlink subframes and special subframes within a radio frame.

If duplex mode TDD is active, the radio frame structure is displayed for information (lines "Subframe Number" and "Direction").

Option R&S CMW-KS510 is required for configuration of the parameter.

Option R&S CMW-KS550 is required for configuration and display of the parameter.

Remote command:
`CONFigure:LTE:SIGN<i>:CELL:ULDL`

Special Subframe ← TDD

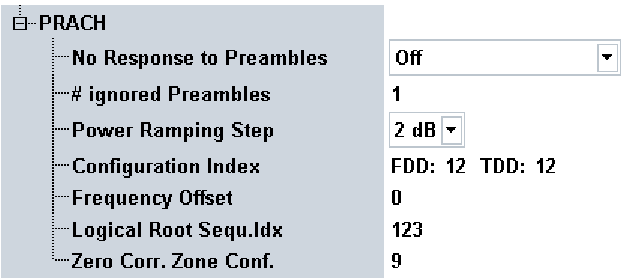
Configuration of the special subframes of a TDD signal, as defined in 3GPP TS 36.211, chapter 4, "Frame Structure". Each configuration defines the inner structure of a special subframe, i.e. the lengths of DwPTS, GP and UpPTS.

Option R&S CMW-KS550 required.

Remote command:
`CONFigure:LTE:SIGN<i>:CELL:SSUBframe`

PRACH

The following parameters configure settings related to the random access procedure.



No Response to Preambles, # Ignored Preambles ← PRACH

By default the signaling application responds to received preambles, so that the UE can perform an attach. Alternatively received preambles can be ignored (no response), so that the UE continues to send preambles and PRACH measurements can be performed (included in R&S CMW-KM500/-KM550).

"Off"	The signaling application responds to received preambles.
"On"	Any received preambles are ignored by the signaling application (no response).
"# Ignored Preambles"	The number of preambles to be ignored by the signaling application is configured via parameter "# Ignored Preambles". Subsequent preambles are answered. This value can only be selected if parameter "Power Ramping Step" is set to 0 dB.

Remote command:
`CONFigure:LTE:SIGN<i>:CELL:PRACh:NRPReambles`
`CONFigure:LTE:SIGN<i>:CELL:PRACh:NIPRach`

Power Ramping Step ← PRACH

Specifies the transmit power difference between two consecutive preambles. This value is broadcasted to the UE.

If you set the step size to 0 dB, the preamble power is kept constant by the UE. This allows you to use a constant expected nominal power setting during a PRACH measurement.

Remote command:
`CONFigure:LTE:SIGN<i>:CELL:PRACh:PRSTep`

Configuration Index ← PRACH
Sets the PRACH configuration index. It defines the preamble format and other PRACH signal properties, e.g. which resources in the time domain are allowed for transmission of preambles. This value is broadcasted to the UE.

There are separate settings for FDD and TDD (if both R&S CMW-KS500 and R&S CMW-KS550 are available). The values allowed for TDD depend on the UL-DL configuration as listed in the command description.

For details see 3GPP TS 36.211, section 5.7.1 "Time and frequency structure".

Remote command:
`CONFigure:LTE:SIGN<i>:CELL:PRACh:PCINdex:FDD`
`CONFigure:LTE:SIGN<i>:CELL:PRACh:PCINdex:TDD`

Frequency Offset ← PRACH
The frequency offset is used by the UE to calculate the location of the six preamble Resource Blocks (RB) within the channel bandwidth. The value is broadcasted to the UE.

For details see "prach-FrequencyOffset" in 3GPP TS 36.211, section 5.7.1 "Time and frequency structure".

Remote command:
`CONFigure:LTE:SIGN<i>:CELL:PRACh:PFOFfset`

Logical Root Sequ.Idx ← PRACH
Specifies the logical root sequence index to be used by the UE for generation of the preamble sequence. The value is broadcasted to the UE as RACH_ROOT_SEQUENCE.

For details see 3GPP TS 36.211, section 5.7.2 "Preamble sequence generation".

Remote command:
`CONFigure:LTE:SIGN<i>:CELL:PRACh:LRSindex`

Zero Corr. Zone Conf. ← PRACH
The zero correlation zone config determines which N_{CS} value of an N_{CS} set has to be used by the UE for generation of the preamble sequence. The value is broadcasted to the UE.

For details see "zeroCorrelationZoneConfig" in 3GPP TS 36.211, section 5.7.2 "Preamble sequence generation".

Remote command:
`CONFigure:LTE:SIGN<i>:CELL:PRACh:ZCZConfig`

2.4.11 Network Settings

The "Network" settings configure parameters of the simulated radio network.

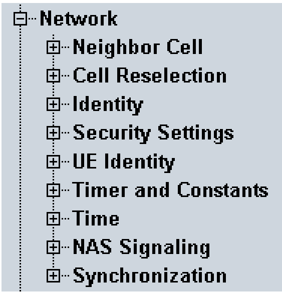


Fig. 2-61: Network settings

For parameter descriptions, refer to the subsections.

2.4.11.1 Neighbor Cell Settings

This section defines neighbor cell information to be broadcasted to the UE. For each radio access technology you can define a reselection threshold and several neighbor cell entries. The signaling messages for broadcast of neighbor cell information are defined in 3GPP TS 36.331.

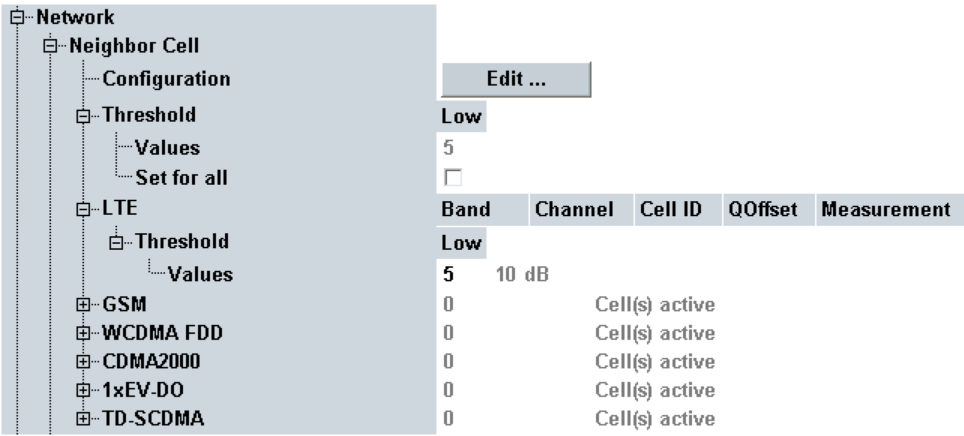


Fig. 2-62: Neighbor cell settings

To configure the neighbor cell entries, press the "Edit" button. The configuration dialog contains one tab per technology.

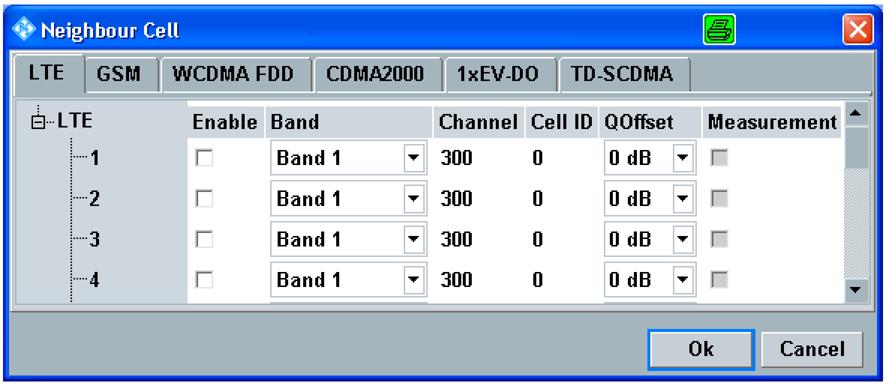


Fig. 2-63: Neighbor cell list configuration dialog

Only the enabled entries are broadcasted.

The column "Measurement" is only configurable for enabled entries. It specifies whether measurement reports for the neighbor cell are requested from the UE. Received reports are displayed in the main view, see chapter 2.4.1.3, "UE Measurement Report", on page 100. Option R&S CMW-KS510 is required for neighbor cell measurements.

The individual neighbor cell settings are described in the following.

Threshold

The configured "Low" reselection threshold value is written into the system information block element "threshX-Low" defined in 3GPP TS 36.331. It corresponds to the parameter "Thresh$_{X, LowP}$" in 3GPP TS 36.304. The resulting threshold value in dB is displayed for information.

You can define an individual threshold per technology or a common threshold applicable to all technologies. To apply common thresholds, enable "Threshold > Set for all". To apply the individual thresholds, disable the parameter.

Remote command:

`CONFigure:LTE:SIGN<i>:NCELl:ALL:THResholds:LOW`
`CONFigure:LTE:SIGN<i>:NCELl:LTE:THResholds:LOW`
`CONFigure:LTE:SIGN<i>:NCELl:GSM:THResholds:LOW`
`CONFigure:LTE:SIGN<i>:NCELl:WCDMa:THResholds:LOW`
`CONFigure:LTE:SIGN<i>:NCELl:CDMA:THResholds:LOW`
`CONFigure:LTE:SIGN<i>:NCELl:EVDO:THResholds:LOW`
`CONFigure:LTE:SIGN<i>:NCELl:TDSCdma:THResholds:LOW`

LTE
For an LTE (E-UTRA) neighbor cell entry you can specify the operating band and downlink channel number, the physical layer cell ID and the "QOffset".

Parameter "QOffset" corresponds to the value "q-OffsetCell" in 3GPP TS 36.331, which equals "$\text{Qoffset}_{s,n}$" in 3GPP TS 36.304. It is used by the UE when evaluating candidates for cell reselection or triggering conditions for measurement reporting.

If the channel number of an entry and the currently used channel number are identical, the parameters are written into system information block 4 (intra-frequency cell reselection). Otherwise they are written into system information block 5 (inter-frequency cell reselection).

Reselection thresholds defined for LTE are only relevant for system information block 5.

The list supports up to 16 active neighbor cell entries. The active entries can use up to five different channel numbers. Active entries with the same channel number must have different cell IDs.

Remote command:
`CONFigure:LTE:SIGN<i>:NCELl:LTE:CELL<n>`

GSM
For a GSM (GERAN) neighbor cell entry you can specify the operating band and the channel number used for the Broadcast Control Channel (BCCH).

This information and the GSM reselection thresholds are written into system information block 7.

Remote command:
`CONFigure:LTE:SIGN<i>:NCELl:GSM:CELL<n>`

WCDMA FDD
For a WCDMA (UTRA FDD) neighbor cell entry you can specify the operating band, the downlink channel number and the primary scrambling code of the cell.

The channel number and the WCDMA reselection thresholds are written into system information block 6.

Remote command:
`CONFigure:LTE:SIGN<i>:NCELl:WCDMa:CELL<n>`

CDMA2000, 1xEV-DO
For a CDMA2000 (1xRTT) or 1xEV-DO (HRPD) neighbor cell entry you can specify the band class, the channel number and the physical cell ID which identifies the PN offset.

This information and the reselection thresholds, are written into system information block 8 - the CDMA2000 parameters into element "parameters1XRTT", the 1xEV-DO parameters into element "parametersHRPD".

Remote command:
`CONFigure:LTE:SIGN<i>:NCELl:CDMA:CELL<n>`
`CONFigure:LTE:SIGN<i>:NCELl:EVDO:CELL<n>`

TD-SCDMA
For a TD-SCDMA (UTRA TDD) neighbor cell entry you can specify the operating band, the channel number and the cell parameter ID.

The channel number and the TD-SCDMA reselection thresholds are written into system information block 6.

Remote command:
`CONFigure:LTE:SIGN<i>:NCELl:TDSCdma:CELL<n>`

2.4.11.2 Cell Reselection

The parameters in this section define cell reselection information to be transmitted in the system information blocks SIB1 and SIB3. For detailed information refer to 3GPP TS 36.304 and 3GPP TS 36.331.

The section is only visible if R&S CMW-KS510 is available.

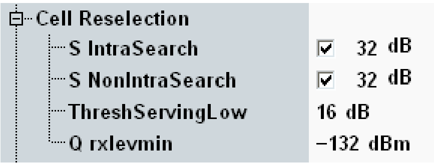


Fig. 2-64: Settings for cell reselection

S IntraSearch
Threshold $S_{IntraSearch}$ for intra-frequency measurements.

The threshold is configured in dB. System information block 3 contains the configured value divided by 2. If the checkbox is disabled, the information element is omitted in SIB 3.

Option R&S CMW-KS510 is required.

Remote command:
`CONFigure:LTE:SIGN<i>:CELL:RESelection:SEARch:INTRasearch`

S NonIntraSearch
Threshold $S_{nonIntraSearch}$ for inter-frequency and inter-RAT measurements.

The threshold is configured in dB. System information block 3 contains the configured value divided by 2. If the checkbox is disabled, the information element is omitted in SIB 3.

Option R&S CMW-KS510 is required.

Remote command:
`CONFigure:LTE:SIGN<i>:CELL:RESelection:SEARch:NINTrasearch`

ThreshServingLow
Parameter $Thresh_{Serving,Low}$, used by the UE for reselection towards a lower priority RAT/ frequency.

The threshold is configured in dB. System information block 3 contains the configured value divided by 2.

Option R&S CMW-KS510 is required.

Remote command:
CONFigure:LTE:SIGN<i>:CELL:RESelection:TSLow

Q rxlevmin
Minimum required received RSRP level in the cell in dBm ($Q_{rxlevmin}$).

The level is configured in dBm. System information block 1 contains the configured value divided by 2.

Option R&S CMW-KS510 is required.

Remote command:
CONFigure:LTE:SIGN<i>:CELL:RESelection:QUALity:RXLevmin

2.4.11.3 Identity Settings

This section configures identities of the simulated radio network. The values are transferred to the UE under test via broadcast.

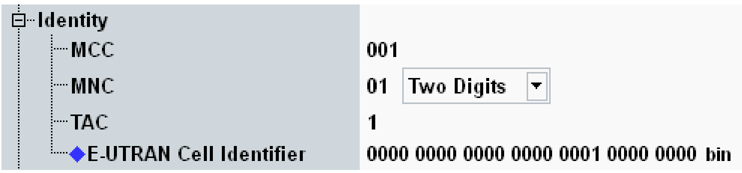


Fig. 2-65: Network identity settings

MCC
Specifies the 3-digit Mobile Country Code (MCC).

Remote command:
CONFigure:LTE:SIGN<i>:CELL:MCC

MNC
Specifies the Mobile Network Code (MNC). A two or three-digit MNC can be set.

Remote command:
CONFigure:LTE:SIGN<i>:CELL:MNC
CONFigure:LTE:SIGN<i>:CELL:MNC:DIGits

TAC
Specifies the Tracking Area Code (TAC).

Remote command:
CONFigure:LTE:SIGN<i>:CELL:TAC

E-UTRAN Cell Identifier
Specifies the E-UTRAN cell identifier, unique within a PLMN. It is sent to the UE via broadcast and can be set independent of the physical cell ID (see "Physical Cell ID" on page 149).

If you use carrier aggregation, configure different values for the carriers.

Remote command:

CONFigure:LTE:SIGN<i>:CELL[:PCC]:CID:EUTRan
CONFigure:LTE:SIGN<i>:CELL:SCC<c>:CID:EUTRan

2.4.11.4 Security Settings

The "Security Settings" configure parameters related to the authentication procedure and other security procedures.

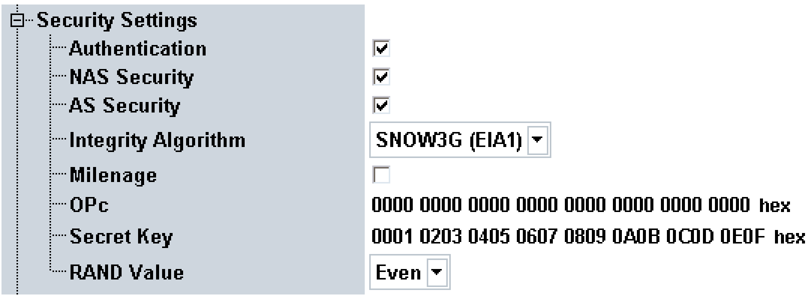


Fig. 2-66: Security settings

Authentication

Enables or disables authentication, to be performed during the attach procedure. Authentication requires a test USIM. An appropriate 3GPP USIM can be obtained from Rohde & Schwarz (R&S CMW-Z04, stock no. 1207.9901.02).

Remote command:

CONFigure:LTE:SIGN<i>:CELL:SECurity:AUTHenticat

NAS Security

Enables or disables Non-Access Stratum (NAS) security. With enabled NAS security the UE performs integrity protection of NAS signaling. This setting is only relevant if authentication is enabled.

Remote command:

CONFigure:LTE:SIGN<i>:CELL:SECurity:NAS

AS Security
Enables or disables Access Stratum (AS) security. With enabled AS security the UE performs integrity protection of RRC signaling. This setting is only relevant if authentication is enabled.

Remote command:
`CONFigure:LTE:SIGN<i>:CELL:SECurity:AS`

Integrity Algorithm
Selects an algorithm for integrity protection. NULL means that integrity protection is disabled. Use this setting for UEs which do not support the SNOW3G (EIA1) algorithm.

Remote command:
`CONFigure:LTE:SIGN<i>:CELL:SECurity:IALGorithm`

Milenage
Enable this parameter to use a USIM with MILENAGE algorithm set.

Remote command:
`CONFigure:LTE:SIGN<i>:CELL:SECurity:MILenage`

OPc
The key OP_c is used for authentication and integrity check procedures with the MILENAGE algorithm set (parameter "Milenage" enabled). The value is entered as 32-digit hexadecimal number.

Remote command:
`CONFigure:LTE:SIGN<i>:CELL:SECurity:OPC`

Secret Key
The secret key K is used for the authentication procedure (including a possible integrity check). The value is entered as 32-digit hexadecimal number.

The integrity check fails unless the secret key is equal to the value stored on the test USIM of the UE. The test USIM R&S CMW-Z04 is compatible with the default setting of this parameter.

If authentication is switched off, the secret key is ignored.

Remote command:
`CONFigure:LTE:SIGN<i>:CELL:SECurity:SKEY`

RAND Value
The random number RAND is used for the authentication procedure (including a possible integrity check). This parameter selects whether an odd or even RAND value is used.

Remote command:
`CONFigure:LTE:SIGN<i>:CELL:SECurity:RVALue`

2.4.11.5 UE Identity

The "UE Identity" settings configure the default IMSI.

Fig. 2-67: UE identity settings

Default IMSI

15-digit International Mobile Subscriber Identity (IMSI)

Remote command:

CONFigure:LTE:SIGN<i>:CELL:UEIDentity:IMSI

2.4.11.6 Timer and Constants

The parameters in this section configure timers and counters.

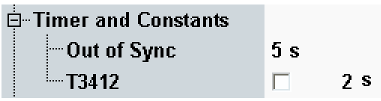


Fig. 2-68: Timer settings

Out of Sync

The "Out of Sync" timer specifies the time after which the instrument, having waited for a signal from the connected UE, releases the connection. The timer is started when an uplink grant message is sent to the UE.

Remote command:

CONFigure:LTE:SIGN<i>:CELL:TOUT:OSYNch

T3412

Timer "T3412" controls the initiation of a periodic tracking area update by the UE.

If the timer is disabled, no periodic tracking area update is required.

Remote command:

CONFigure:LTE:SIGN<i>:CELL:TOUT:T<no>

2.4.11.7 Time

The "Time" section allows you to send configurable date and time information to the UE. Thus you can update the date and time displayed by the mobile. In a real network this service is typically used to send the current local time to the UE.

The section is only visible if R&S CMW-KS510 is available.

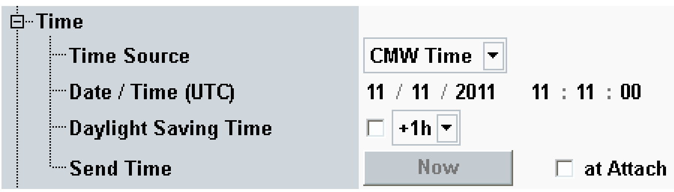


Fig. 2-69: Time settings

Time Source

This parameter selects the date and time source.

- **CMW Time**
  Selects the current CMW (Windows) date and time as source. The Windows settings determine the UTC date, the UTC time, the current daylight saving time offset and the time zone offset.
- **Date / Time**
  Selects the parameters "Date / Time (UTC)" and "Daylight Saving Time" as source. The time zone offset is set to 0.

Option R&S CMW-KS510 is required.

Remote command:
`CONFigure:LTE:SIGN<i>:CELL:TIME:TSOurce`

Date / Time (UTC)

Defines the UTC date and time to be used if "Time Source" is set to "Date / Time".

Option R&S CMW-KS510 is required.

Remote command:
`CONFigure:LTE:SIGN<i>:CELL:TIME:DATE`
`CONFigure:LTE:SIGN<i>:CELL:TIME:TIME`

Daylight Saving Time

Specifies a Daylight Saving Time (DST) offset to be used if "Time Source" is set to "Date / Time".

You can disable DST or enable it with an offset of +1 hour or +2 hours.

Option R&S CMW-KS510 is required.

Remote command:
`CONFigure:LTE:SIGN<i>:CELL:TIME:DSTime`

Send Time

Press "Now" to send the date and time information to the UE. This is only possible if an RRC connection has been established.

"at Attach" selects whether the date and time information is sent to the UE during the attach procedure or not.

Option R&S CMW-KS510 is required.

Remote command:
`CONFigure:LTE:SIGN<i>:CELL:TIME:SNOW`
`CONFigure:LTE:SIGN<i>:CELL:TIME:SATTach`

2.4.11.8 NAS Signaling Settings

The parameters in this section configure settings related to NAS signaling messages, to be sent to the UE.

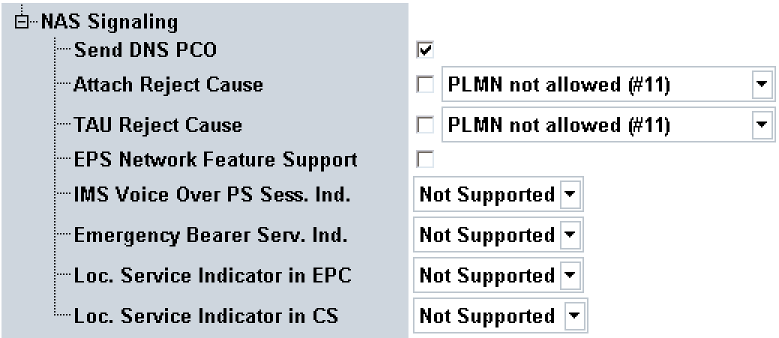


Fig. 2-70: Reject cause settings

Send DNS PCO

Enables or disables sending of a DNS IP address to the UE.

Remote command:

`CONFigure:LTE:SIGN<i>:CONNection:SDNSpco`

Attach Reject Cause, TAU Reject Cause

If the checkboxes are enabled, the application rejects attach requests / Tracking Area Update (TAU) requests from the UE. The reject message contains the selected reject cause.

The rejection causes are defined in 3GPP TS 24.301, section 9.9.3.9. The purpose of rejecting UE requests is to test the reaction of the UE: does it repeat the request at all and if so, in which time intervals.

Remote command:

`CONFigure:LTE:SIGN<i>:CELL:RCAuse:ATTach`
`CONFigure:LTE:SIGN<i>:CELL:RCAuse:TAU`

EPS Network Feature Support

Enables or disables sending of the information element "EPS Network Feature Support" to the UE in the "attach accept" message.

The information element indicates the support of specific features by the network (see 3GPP TS 24.301, section 9.9.3.12A). The individual feature flags are configured via the following parameters.

Option R&S CMW-KS510 is required.

Remote command:

`CONFigure:LTE:SIGN<i>:CELL:NAS:EPSNetwork`

IMS Voice Over PS Session Indicator

Configures bit 1 of the information element "EPS Network Feature Support".

The flag indicates whether voice over LTE (VoLTE) is supported, or a Circuit Switched Fallback (CSFB) is required for voice calls.

Option R&S CMW-KS510 is required.

Remote command:
CONFigure:LTE:SIGN<i>:CELL:NAS:IMSVops

Emergency Bearer Services Indicator

Configures bit 2 of the information element "EPS Network Feature Support".

The flag indicates whether emergency bearer services are supported. Such bearers have a higher priority than ordinary bearers.

Option R&S CMW-KS510 is required.

Remote command:
CONFigure:LTE:SIGN<i>:CELL:NAS:EMCBs

Location Service Indicator in EPC

Configures bit 3 of the information element "EPS Network Feature Support".

The flag indicates whether location services are supported by the LTE network (evolved packet core network).

Option R&S CMW-KS510 is required.

Remote command:
CONFigure:LTE:SIGN<i>:CELL:NAS:EPCLcs

Location Service Indicator in CS

Configures bit 4 and 5 of the information element "EPS Network Feature Support".

The flag indicates whether location services are supported by the CS domain or not or no information is available.

Option R&S CMW-KS510 is required.

Remote command:
CONFigure:LTE:SIGN<i>:CELL:NAS:CSLCs

2.4.11.9 Synchronization

The parameters in this section configure the synchronization to other signaling applications and the synchronization of PCC and SCC.

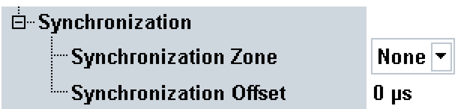


Fig. 2-71: Synchronization settings

Synchronization Zone
Select the same synchronization zone in all signaling applications that you want to synchronize. "None" means that the application is not synchronized to other signaling applications.

The PCC and SCC of an LTE signaling application are always synchronized to each other, independent of this setting.

Synchronizing signaling applications means synchronizing the used system time. This is useful for example for evaluation of message logs, because the time stamps in the logs are synchronized.

Synchronizing two LTE signaling applications means also synchronizing the used system frame numbers.

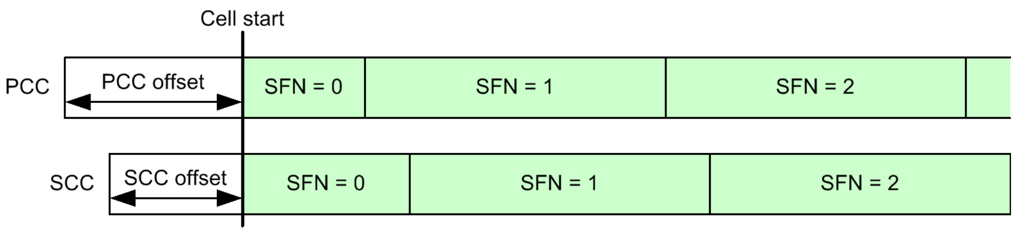
Remote command:
`CONFigure:LTE:SIGN<i>:CELL[:PCC]:SYNC:ZONE`

Synchronization Offset
Configures the timing offset at cell start, relative to the time zone.

Without offset, the cell signal starts with system frame number 0 and a system time according to the time zone. With an offset, the cell starts with system frame number 0 plus the offset and a system time according to the time zone plus the offset.

Option R&S CMW-KS510 is required for the PCC setting. Option R&S CMW-KS512 is required for the SCC setting.

Setting different offsets for component carriers is required for example for performance requirement tests with carrier aggregation, see 3GPP TS 36.521 section "8.2.1.1.1_A".



Remote command:
`CONFigure:LTE:SIGN<i>:CELL[:PCC]:SYNC:OFFSet`
`CONFigure:LTE:SIGN<i>:CELL:SCC<c>:SYNC:OFFSet`

2.4.12 Connection Configuration

This section defines parameters for the connection, for example the resource configuration to be allocated to the UE. Most parameters can be reconfigured for an established connection.

For parameter descriptions, refer to the subsections.

2.4.12.1 Miscellaneous Connection Settings Part 1

This section describes the following "Connection" settings.

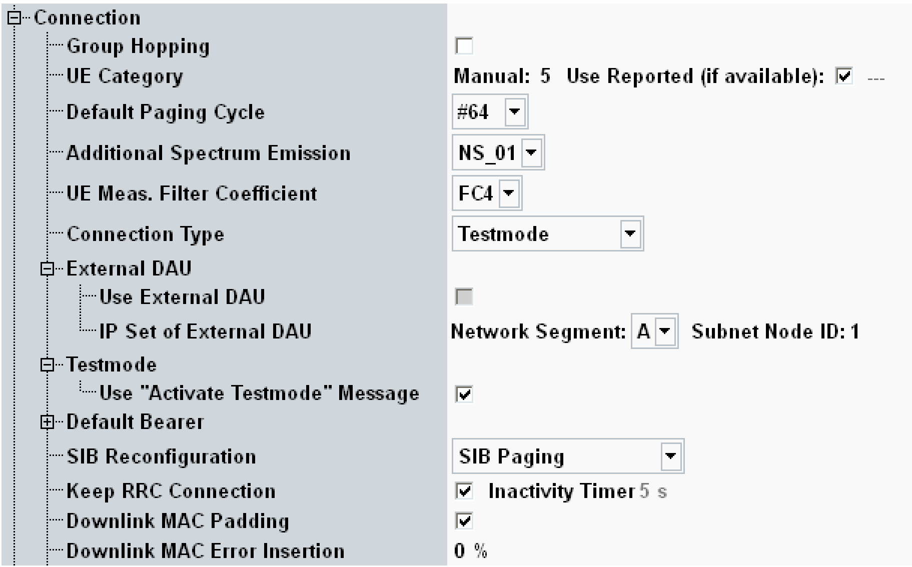


Fig. 2-72: Connection configuration settings part 1

Group Hopping

Enables or disables group hopping, specified in 3GPP TS 36.211.

Option R&S CMW-KS510 is required.

Remote command:
`CONFigure:LTE:SIGN<i>:CONNection:GHOPping`

UE Category

The UE category to be used by the R&S CMW can be set manually. Alternatively, it can be set automatically according to the UE category reported by the UE in the capability report.

- "Manual":
  If you want to set the category of your UE manually, enter it here. A value not reflecting the capabilities of the UE will result in problems when trying to reach high data rates.
- "Use Reported (if available)":
  If no reported value is available, the manually configured value is used.
  If a reported value is available, it is displayed for information. If the checkbox is enabled, the reported value is used. Otherwise the manually configured value is used.

Remote command:
`CONFigure:LTE:SIGN<i>:CONNection:UECategory:MANual`
`CONFigure:LTE:SIGN<i>:CONNection:UECategory:REPorted`

Default Paging Cycle

Selects the cell-specific default paging cycle (32, 64, 128 or 256 radio frames). The value is signaled to the UE as "defaultPagingCycle" and used by the UE as input for the calculation of paging radio frame and subframe positions.

The R&S CMW considers the setting when sending paging messages.

Remote command:
`CONFigure:LTE:SIGN<i>:CONNection:DPCYcle`

Additional Spectrum Emission

The selected value is signaled to the UE within a system information block. It determines which additional ACLR and spectrum emission requirements have to be met and whether Additional Maximum Power Reduction (A-MPR) is allowed. For details see 3GPP TS 36.521-1.

Remote command:
`CONFigure:LTE:SIGN<i>:CONNection:ASEMission`

UE Meas. Filter Coefficient

Some RRC messages to be sent to the UE for conformance tests contain an information element "filterCoefficient" = "fc4" or "fc8". This parameter selects the value to be sent.

The relevant value depends on the conformance test to be performed, see 3GPP TS 36.521 and 3GPP TS 36.508.

The "filterCoefficient" is used for uplink power control. Do not confuse it with "filterCoefficientRSRP" and "filterCoefficientRSRQ" for UE measurement reports, see "Filter Coefficient RSRP/RSRQ" on page 192.

Remote command:
`CONFigure:LTE:SIGN<i>:CONNection:FCOefficient`

Connection Type
Configures the connection type to be applied at the R&S CMW.

- "Testmode":
  The test mode uses only layer 1 and 2 of the protocol stack. Layer 3 is not used. This mode is suitable for any signaling tests not involving the Data Application Unit (DAU).
- "Data Application":
  The data application mode supports also layer 3, required for IP-based services. Select this mode if you want to perform data application measurements using the DAU. See also chapter 2.2.6, "Data Tests and Voice Over LTE", on page 24 and chapter 2.3.2, "LTE IP-Based Data Tests", on page 82.
  This value requires an installed DAU with option R&S CMW-KM050, or an external DAU.

Remote command:
`CONFigure:LTE:SIGN<i>:CONNection:CTYPe`

External DAU
Usually, the DAU is installed on the same R&S CMW as the LTE signaling application. If all expansion slots of this R&S CMW are occupied by other hardware options, a DAU installed on another R&S CMW can be used instead (external DAU).

Using an external DAU is only possible if the instrument where the LTE signaling application is running fulfills the following prerequisites:
- No DAU is installed
- Option R&S CMW-KA120 is available
- An ethernet switch is installed (option R&S CMW-B660A plus -B661A)

Use external DAU ← External DAU
Enable the checkbox if you want to use an external DAU.

The two instruments must be connected via LAN. For details, refer to the DAU documentation.

Remote command:
`CONFigure:LTE:SIGN<i>:CONNection:EDAU:ENABle`

Network Segment, Subnet Node ID ← External DAU
Select the values of the instrument where the external DAU is installed. You can check the values in the "Setup" dialog > "Misc" > "IP Subnet Config".

The two instruments must use the same network segment and must have different node IDs.

Remote command:
`CONFigure:LTE:SIGN<i>:CONNection:EDAU:NSEGment`
`CONFigure:LTE:SIGN<i>:CONNection:EDAU:NID`

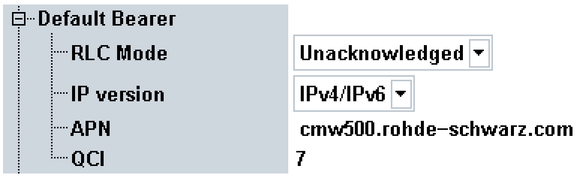
Testmode > Use "Activate Testmode" Message
When enabled, an "ACTIVATE TEST MODE" message is sent to the UE. No loop mode is requested. Test modes are specified in 3GPP TS 36.509 and 36.508.

Remote command:
CONFigure:LTE:SIGN<i>:CONNection:TMODe

Default Bearer
For connection type "Testmode", the default bearer settings are fixed.

For connection type "Data Application", the default bearer settings are configurable. Option R&S CMW-KS510 is required.

The default bearer settings are applied to all default bearers.



RLC Mode ← Default Bearer
Selects the RLC mode for downlink transmissions: Unacknowledged Mode (UM) or Acknowledged Mode (AM), see 3GPP TS 36.322.

"UM"	There are no ARQ retransmissions on the RLC layer.
"AM"	There are ARQ retransmissions on the RLC layer.

Remote command:
CONFigure:LTE:SIGN<i>:CONNection:RLCMode

IP Version ← Default Bearer
Allowed IP versions. With "IPv4 only" for example, IPv6 is not used, even if requested by the UE.

Remote command:
CONFigure:LTE:SIGN<i>:CONNection:IPVersion

APN ← Default Bearer
Default Access Point Name (APN), used if no APN is provided by the UE.

Remote command:
CONFigure:LTE:SIGN<i>:CONNection:APN

QCI ← Default Bearer
Quality of service class identifier signaled to the UE. The values are specified in 3GPP TS 23.203.

Remote command:
CONFigure:LTE:SIGN<i>:CONNection:QCI

SIB Reconfiguration
Selects a method for information of an attached UE about changes in the system information, resulting from modified parameters.

- "RRC Reconfiguration":

An RRC reconfiguration message is sent to the UE, containing the system information values in a mobility control information element. This method is only used if an RRC connection is established. Without RRC connection SIB paging is used.

- "SIB Paging":
  The UE is paged. This triggers the UE to evaluate the broadcasted system information.

The UE is for example informed about changes of the following parameters: maximum allowed uplink power P-Max, neighbor cell information, PUSCH open loop nominal power, SRS enable/disable, PRACH configuration index and default paging cycle.

Remote command:
`CONFigure:LTE:SIGN<i>:CONNection:SIBReconfig`

Keep RRC Connection
Selects whether the RRC connection is kept or released after attach.

- "Enabled":
  The RRC connection established during attach is kept when the attach procedure is completed.
  For a subsequent connection setup the already established RRC connection is used. This speeds up the connection setup. When the dedicated bearer is released via a disconnect, the RRC connection is still kept.
- "Disabled":
  – For "Connection Type" = "Testmode", the RRC connection established during attach is released immediately when the attach procedure is completed.
  – For "Connection Type" = "Data Application" there is an additional setting "Inactivity Timer". The RRC connection established during attach is released when the attach procedure is completed and there has been no activity on the connection (no traffic) for the configured time.
    The inactivity timer requires option R&S CMW-KS510. Without this option, the RRC connection is released immediately when the attach procedure is completed.

Remote command:
`CONFigure:LTE:SIGN<i>:CONNection:KRRC`
`CONFigure:LTE:SIGN<i>:CONNection:RITimer`

Downlink MAC Padding
Activates or deactivates downlink padding at the MAC layer.

When no data (signaling or user data) is available from higher layers, an allocated channel can be filled with padding bits (DL padding on). This scenario is foreseen in many conformance tests.

Switching off DL padding is useful e.g. if the UE has problems to attach because the DL signal contains padding bits.

If UL dynamic scheduling is enabled, MAC padding is disabled and grayed out.

Remote command:
`CONFigure:LTE:SIGN<i>:CONNection:DLPadding`

Downlink MAC Error Insertion

Configures the rate of transport block errors to be inserted into the downlink data. This is useful when performing a BLER measurement.

The parameter can be changed in all main connection states including "Connection Established".

Remote command:

`CONFigure:LTE:SIGN<i>:CONNection:DLEinsertion`

2.4.12.2 MIMO Connection Settings

This section describes the MIMO connection settings.

For background information, see chapter 2.2.11, "MIMO and Beamforming", on page 34.

For carrier aggregation scenarios, you can configure the MIMO settings per component carrier.

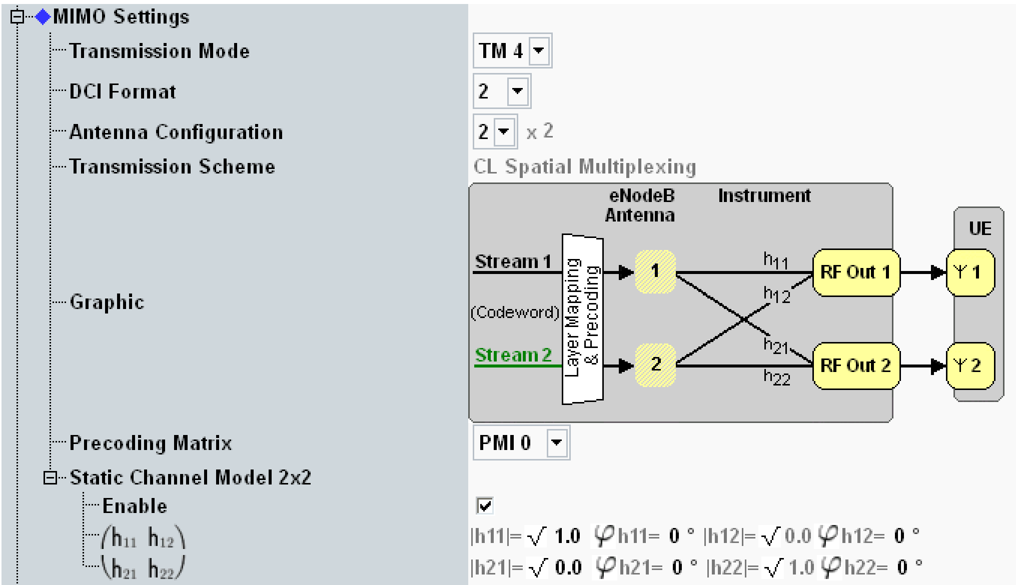


Fig. 2-73: MIMO settings

Transmission Mode
Selects the LTE transmission mode. The available values depend on the active scenario, see table 2-2.

In the state "Connection Established", the parameter can be changed within the following groups: Mode 1/7, Mode 2/3/4/6/8.

The following combinations are not foreseen by 3GPP and are not allowed:
- Transmission mode 7 plus normal cyclic prefix, plus "number of PDCCH symbols" = 4
- Transmission mode 8 plus extended cyclic prefix

Remote command:
`CONFigure:LTE:SIGN<i>:CONNection[:PCC]:TRANsmission`
`CONFigure:LTE:SIGN<i>:CONNection:SCC<c>:TRANsmission`

DCI Format
Selects the Downlink Control Information (DCI) format. The available values depend on the transmission mode. For most transmission modes, the DCI format is fixed.

For scheduling type "Follow WB CQI-RI", only DCI format 2A is supported. Changing the format to 1A modifies the scheduling type.

Remote command:
`CONFigure:LTE:SIGN<i>:CONNection[:PCC]:DCIFormat`
`CONFigure:LTE:SIGN<i>:CONNection:SCC<c>:DCIFormat`

Antenna Configuration
Selects the number of downlink TX antennas. The allowed values depend on the selected scenario and transmission mode.

The number of downlink RX antennas depends on the selected scenario and is displayed for information.

For MIMO 4x2, option R&S CMW-KS521 is required.

For transmission mode 7 and 8, the parameter is irrelevant and hidden.

Remote command:
`CONFigure:LTE:SIGN<i>:CONNection[:PCC]:NENBantennas`
`CONFigure:LTE:SIGN<i>:CONNection:SCC<c>:NENBantennas`

Transmission Scheme
Displays the PDSCH transmission scheme resulting from the settings.

The displayed value does not reflect transmission scheme changes due to reported rank indicator values. TM4 combined with follow RI and RI=1 results in transmit diversity.

Remote command:
`SENSe:LTE:SIGN<i>:CONNection[:PCC]:TSCHeme?`
`SENSe:LTE:SIGN<i>:CONNection:SCC<c>:TSCHeme?`

Graphic

The graphic shows the logical signal path of the data streams via the virtual eNodeB antennas and the RF output connectors to the antenna connectors of the UE.

Remote command:
n/a

Precoding Matrix

Selects the precoding matrix for closed loop spatial multiplexing (transmission mode 4 or 6).

Depending on the scheduling type, the downlink signal follows the reported PMI value. In that case, the configured PMI value is used as initial value until a PMI report has been received.

The meaning of the PMI values is defined in 3GPP TS 36.213, section 7.2.4.

Option R&S CMW-KS510 is required.

Remote command:
CONFigure:LTE:SIGN<i>:CONNection[:PCC]:PMATrix
CONFigure:LTE:SIGN<i>:CONNection:SCC<c>:PMATrix

Static Channel Model

This section is displayed for transmit diversity and spatial multiplexing, if supported by the scenario.

The matrix defines the radio channel coefficients, see chapter 2.2.11.1, "Radio Channel Coefficients for MIMO", on page 36.

Each element of the matrix is a complex number, defined via its phase and its magnitude.

- 2x2 channel model:
  You can configure the phase of each number and the square of the magnitude of h_{11} and h_{21}. The other magnitudes are adapted automatically.
  If the model is disabled, there is no coupling between the signals of the eNodeB antennas. So each UE antenna receives only the signal of one eNodeB antenna.
- 4x2 channel model:
  You can configure the phase and the square of the magnitude of all coefficients. The sum of all magnitude squares within each line of the matrix must equal 1.
  The sum is checked automatically. A correct sum is indicated by ☺, a wrong sum by ☹, followed by the sum. Configure all values of a line so that the sum equals 1, then press the "Apply" button.

Remote command:
CONFigure:LTE:SIGN<i>:CONNection[:PCC]:SCHModel:ENABle
CONFigure:LTE:SIGN<i>:CONNection[:PCC]:SCHModel
CONFigure:LTE:SIGN<i>:CONNection[:PCC]:SCHModel:MIMO<Mimo>
CONFigure:LTE:SIGN<i>:CONNection:SCC<c>:SCHModel:ENABle
CONFigure:LTE:SIGN<i>:CONNection:SCC<c>:SCHModel
CONFigure:LTE:SIGN<i>:CONNection:SCC<c>:SCHModel:MIMO<Mimo>

Beamforming Model

This section configures beamforming. It is displayed for transmission mode 7 and 8.

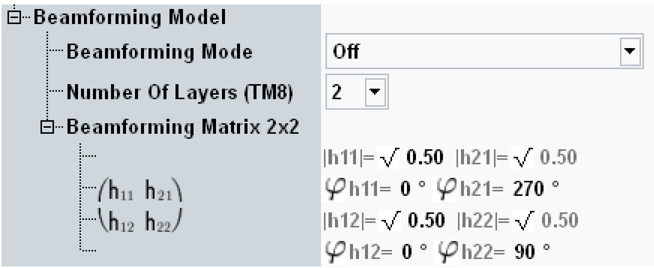


Fig. 2-74: Beamforming settings for TM8, 2 layers

Beamforming Mode ← Beamforming Model
Enables or disables beamforming.

- **Off**: Beamforming is disabled
- **On**: Beamforming is enabled. The configured beamforming matrix is used.
- **TS 36.521 Beamforming Mode**:
  Beamforming is enabled. The beamforming matrix is selected randomly as defined in 3GPP TS 36.521, Annex B.4.1 and B.4.2.
  This value is not allowed for 1x1 beamforming matrices.

Remote command:
`CONFigure:LTE:SIGN<i>:CONNection[:PCC]:BEAMforming:MODE`
`CONFigure:LTE:SIGN<i>:CONNection:SCC<c>:BEAMforming:MODE`

Number of Layers ← Beamforming Model
Transmission mode 7 uses only a single transmission layer. For transmission mode 8, you can select between one layer (single-layer beamforming) and two layers (dual-layer beamforming).

Remote command:
`CONFigure:LTE:SIGN<i>:CONNection[:PCC]:BEAMforming:NOLayers`
`CONFigure:LTE:SIGN<i>:CONNection:SCC<c>:BEAMforming:NOLayers`

Beamforming Matrix ← Beamforming Model
This section defines the beamforming matrix for the beamforming mode "On".

The matrix characterizes the mapping of the UE-specific antenna ports 5, 7 and 8 to the transmit antennas, see chapter 2.2.11.2, "Beamforming Matrix", on page 38.

Each element of the matrix is a complex number, defined via its phase and its magnitude. The size of the matrix depends on the scenario, the transmission mode and the number of layers.

- 1x1 matrix (h_{11}):
  You can configure the phase of the coefficient.
- 1x2 matrix (h_{11} and h_{21}):
  You can configure the phase of both coefficients.
- 2x2 matrix (h_{11} to h_{22}):

You can configure the phase of each coefficient and the square of the magnitude of h_{11} and h_{12}. The other magnitudes are adapted automatically.

Remote command:
CONFigure:LTE:SIGN<i>:CONNection[:PCC]:BEAMforming:MATRix
CONFigure:LTE:SIGN<i>:CONNection:SCC<c>:BEAMforming:MATRix

2.4.12.3 Miscellaneous Connection Settings Part 2

This section describes the following "Connection" settings.

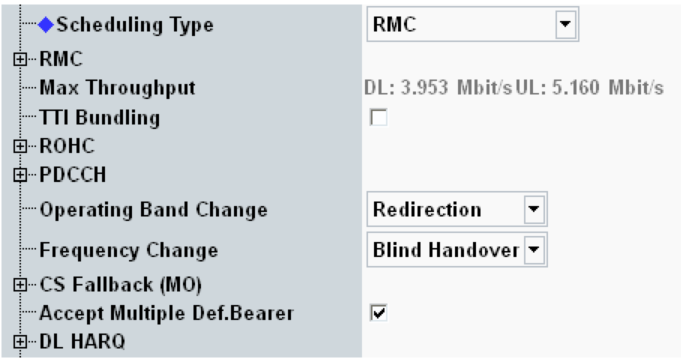


Fig. 2-75: Connection configuration settings part 2

Scheduling Type
Selects the channel type to be scheduled for the UE.

For carrier aggregation scenarios, you can configure this setting per component carrier.

- **RMC**
  The instrument allocates a 3GPP compliant reference measurement channel.
  For configuration, see chapter 2.4.12.5, "RMC Connection Settings", on page 183.

- **User-defined Channels**
  3GPP compliant RMCs allow only specific combinations of cell bandwidth, number of allocated RBs, RB position and modulation type. User-defined channels provide more flexibility concerning the allowed combinations.
  For configuration, see chapter 2.4.12.6, "User-Defined Channel Configuration", on page 186.
  Option R&S CMW-KS510 is required.
- **User-defined TTI-Based**
  Like "User-defined Channels", but settings can be configured individually per TTI (subframe).
  For configuration, see chapter 2.4.1.7, "TTI-Based Channel Configuration", on page 108.
  Option R&S CMW-KS510 is required.
- **Fixed CQI**
  Provides a downlink signal with CQI index and RB allocation configurable individually per TTI. The uplink signal is the same as for "User-defined TTI-Based".
  For configuration, see chapter 2.4.1.7, "TTI-Based Channel Configuration", on page 108.
  Option R&S CMW-KS510 is required.
- **Follow WB CQI / PMI / CQI-RI / CQI-PMI-RI**
  The "Follow..." scheduling types provide a downlink signal configured according to the values reported by the UE. The scheduling types are available depending on the transmission mode:
  – Follow CQI (TM 1 to 7)
  – Follow PMI (TM 4 and 6)
  – Follow CQI and RI (TM 3)
  – Follow CQI, PMI and RI (TM 4)

  The uplink signal is the same as for "User-defined TTI-Based".
  For configuration, see chapter 2.4.1.7, "TTI-Based Channel Configuration", on page 108.
  Selecting these scheduling types also enables CQI reporting.
  The "Follow..." scheduling types can only work correctly, if the UE sends the corresponding reports. For carrier aggregation, configure the CQI reporting settings, so that reports for the individual carriers arrive in different subframes. Otherwise, the "follow" mechanism will not work. See also chapter 2.4.13, "CQI Reporting", on page 188.
  Option R&S CMW-KS510/-KS512 is required (without CA/with CA).
- **SPS**
  Semi-persistent scheduling (PCC only). A configured RB allocation is granted to the UE every n^{th} subframe.
  Selecting this value disables HARQ and UL dynamic scheduling for connected DRX.
  For configuration, see chapter 2.4.1.8, "SPS Configuration", on page 113.

Remote command:
`CONFigure:LTE:SIGN<i>:CONNection[:PCC]:STYPe`
`CONFigure:LTE:SIGN<i>:CONNection:SCC<c>:STYPe`

SPS TwoIntervalsConfig TDD

Configures the parameter "twoIntervalsConfig", signaled to the UE for scheduling type SPS in TDD mode. The parameter is specified in 3GPP TS 36.321.

Remote command:

CONFigure:LTE:SIGN<i>:CONNection[:PCC]:SPS:TIConfig

Max Throughput

Displays the expected maximum throughput in Mbit/s (averaged over one frame). For the downlink, the value refers to the sum of all streams of a component carrier.

Remote command:

SENSe:LTE:SIGN<i>:CONNection:ETHRoughput:DL[:PCC]?
SENSe:LTE:SIGN<i>:CONNection:ETHRoughput:DL:SCC<c>?
SENSe:LTE:SIGN<i>:CONNection:ETHRoughput:UL?

TTI Bundling

Enables or disables TTI bundling for the uplink.

With TTI bundling, the UE sends the same data with different redundancy versions in four subsequent TTIs. TTI bundling is faster than HARQ. So TTI bundling makes sense if the channel quality is bad and the application is delay-sensitive, for example voice over LTE.

The following restrictions apply for TTI bundling:

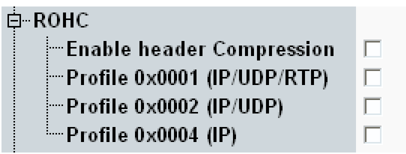
- UL RB configuration:
  - Number of RB ≤ 3
  - Modulation type QPSK
- TDD:
  - UL/DL configuration = 0, 1 or 6
  - User-defined scheduling (global, not TTI-based)
- FDD:
  - User-defined scheduling (global, not TTI-based) or SPS

Option R&S CMW-KS510 is required.

Remote command:

CONFigure:LTE:SIGN<i>:CONNection:TTIBundling

ROHC



This node configures robust header compression (ROHC).

Header compression is relevant for the continuous transfer of small packets, for example for voice over LTE. Here, the uncompressed header is typically bigger than the payload. Header compression reduces the radio resources required for a voice call.

ROHC is specified in 3GPP TS 36.323 and the references stated therein.

Option R&S CMW-KS510 is required.

Enable Header Compression ← ROHC

Enables or disables ROHC. ROHC is only performed for dedicated bearers with bearer profile "Voice" or "Video", not for data connections.

Remote command:
CONFigure:LTE:SIGN<i>:CONNection:ROHC:ENABle

Profile ... ← ROHC

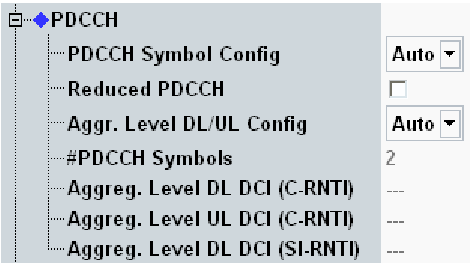
Enables up to two header compression profiles. If more than one enabled profile is compatible to the used protocols, the most specific profile is used. If no profile is compatible, no compression is performed.

Example - profile 1 (IP/UDP/RTP) and 2 (IP/UDP) enabled:

- IP/UDP/RTP traffic: profile 1 used
- IP/UDP/SIP traffic: profile 2 used
- IP/TDP/... traffic: no compression

Remote command:
CONFigure:LTE:SIGN<i>:CONNection:ROHC:PROFiles

PDCCH



This node configures the used PDCCH configuration. For carrier aggregation scenarios, the settings can be configured per component carrier.

PDCCH Symbol Config, #PDCCH Symbols ← PDCCH

Configures and displays the number of OFDM symbols used for the PDCCH per normal subframe.

The available values depend on the cell bandwidth as follows:

- 1.4 MHz: 4 symbols
- 3 and 5 MHz: 2 or 3 symbols
- 10, 15 and 20 MHz: 1, 2, 3 symbols or "Auto"
  "Auto" configures 2 or 3 symbols, depending on the scheduling type.

With enabled "Reduced PDCCH", the lowest allowed value is set automatically.

"#PDCCH Symbols" displays the number of OFDM symbols resulting from the settings.

Remote command:
CONFigure:LTE:SIGN<i>:CONNection[:PCC]:PDCCh:SYMBol
CONFigure:LTE:SIGN<i>:CONNection:SCC<c>:PDCCh:SYMBol
SENSe:LTE:SIGN<i>:CONNection[:PCC]:PDCCh:PSYMbols?
SENSe:LTE:SIGN<i>:CONNection:SCC<c>:PDCCh:PSYMbols?

Aggr. Level DL/UL Config, Aggreg. Level ... ← PDCCH
There are three aggregation levels, for different types of DCI messages: DCI messages for DL with C-RNTI, for UL with C-RNTI and for DL with SI-RNTI.

The aggregation levels are displayed as numbers of Control Channel Elements (CCE), see 3GPP TS 36.211, section 6.8.1.

"Aggr. Level DL/UL Config" configures the C-RNTI aggregation levels. The available values depend on the cell bandwidth as follows:

- 1.4 MHz: "Auto", 4/2, 1/1
- 3 MHz: "Auto", 4/4, 4/2
- 5 MHz: "Auto", 8/4, 4/4
- 10, 15 and 20 MHz: "Auto"

Value <a>/<b> means <a> CCE for DL and <b> CCE for UL. The listed values depend only on the cell bandwidth. Which values are really possible depends also on other scheduling settings. If the selected value is not possible, a lower value is used automatically.

"Auto" configures the aggregation levels automatically, depending on the scheduling settings.

The "Aggreg. Level..." parameters display the actually used aggregation levels, resulting from the settings. Switch the cell signal on to see the values.

Remote command:
`CONFigure:LTE:SIGN<i>:CONNection[:PCC]:PDCCh:ALEVel`
`SENSe:LTE:SIGN<i>:CONNection[:PCC]:PDCCh:ALEVel?`
`CONFigure:LTE:SIGN<i>:CONNection:SCC<c>:PDCCh:ALEVel`
`SENSe:LTE:SIGN<i>:CONNection:SCC<c>:PDCCh:ALEVel?`

Reduced PDCCH ← PDCCH
Enable "Reduced PDCCH" in order to reduce the resources used for the PDCCH and increase the resources available for the PDSCH. Thus you can influence the used coding rates and the PDSCH data rate.

This is a comfort function. You can achieve the same effect by setting low values for "PDCCH Symbol Config".

Remote command:
`CONFigure:LTE:SIGN<i>:CONNection[:PCC]:PDCCh:RPDCch`
`CONFigure:LTE:SIGN<i>:CONNection:SCC<c>:PDCCh:RPDCch`

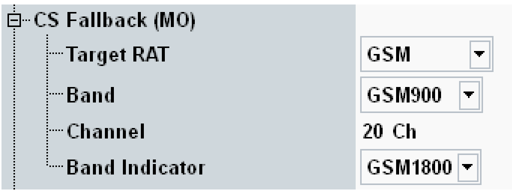
Operating Band Change, Frequency Change
Select the mechanism to be used for inter-band handover and inter-frequency handover within the LTE signaling application.

Either blind handover or redirection can be used, see chapter 2.2.9, "Handover", on page 28.

The selected mechanism is also relevant for a swap of SCC and PCC settings during an established connection. If the cell bandwidth is changed by the swap, redirection is used. If the cell bandwidth is not changed but the band is changed, the setting "Operating Band Change" is used. If also the band is not changed but the frequency is changed, the setting "Frequency Change" is used.

Remote command:
CONFigure:LTE:SIGN<i>:CONNection:OBCHange
CONFigure:LTE:SIGN<i>:CONNection:FCHange

CS Fallback (MO)
The following settings configure the feature Circuit Switched Fallback (CSFB) for mobile originating calls.



A fallback for a mobile originating voice call can be performed to a WCDMA cell or to a GSM cell. In both cases, specify the target band and channel. For GSM, you can additionally set the band indicator for distinction of GSM 1800 and GSM 1900 bands.

Option R&S CMW-KS510 is required.

Remote command:
CONFigure:LTE:SIGN<i>:CONNection:CSFB:DESTination
CONFigure:LTE:SIGN<i>:CONNection:CSFB:GSM
CONFigure:LTE:SIGN<i>:CONNection:CSFB:WCDMa

Accept Multiple Default Bearer
Enables/disables accepting multiple default bearer requests.

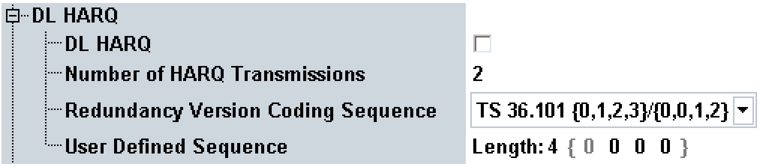
- Disabled: Only the first default bearer request of a UE is accepted. Additional requests are rejected.
- Enabled: If the UE sends several default bearer requests, several bearers are established. For each bearer a different IP address is assigned to the UE.

During the establishment of additional default bearers you must not modify any settings. So do not change parameters when the UE sends a default bearer request, until the event log indicates that the requested bearer has been established.

Remote command:
CONFigure:LTE:SIGN<i>:CONNection:AMDBearer

DL HARQ
The following parameters configure the HARQ procedure for downlink transmissions.

For scenarios without carrier aggregation, option R&S CMW-KS510 is required. For scenarios with carrier aggregation, R&S CMW-KS512 is required.



DL HARQ ← DL HARQ

Enables or disables HARQ for downlink transmissions.

HARQ is disabled for scheduling type SPS.

Remote command:

CONFigure:LTE:SIGN<i>:CONNection:HARQ:DL:ENABle

Number of HARQ Transmissions ← DL HARQ

Specifies the maximum number of downlink transmissions, including initial transmissions and retransmissions.

Remote command:

CONFigure:LTE:SIGN<i>:CONNection:HARQ:DL:NHT

Redundancy Version Coding Sequence, User-Defined Sequence ← DL HARQ

The coding sequence defines the redundancy versions for repeated transmissions of a packet. The first value of the sequence is used for initial transmissions, the second value for the first retransmission and so on.

If the sequence is shorter than the maximum allowed number of transmissions, it is used several times. Example: Four transmissions allowed and sequence {0,2} results in used sequence {0,2,0,2}.

If the sequence is longer than the maximum allowed number of transmissions, the surplus values have no effect. Example: Two transmissions allowed and sequence {0,1,2,3} results in used sequence {0,1}.

You can configure a user-defined sequence or use a sequence defined by 3GPP:

- **TS 36.101**: Depending on the modulation scheme, either the sequence {0,1,2,3} or {0,0,1,2} is used, as defined in 3GPP TS 36.101.
- **TS 36.104**: The sequence {0,2,3,1} is used, as defined in 3GPP TS 36.104.
- **User-Defined**: The user-defined sequence is used. Define first the length of the sequence, then the sequence itself.

For details about the meaning of the individual redundancy versions, see "redundancy version number" in 3GPP TS 36.212.

Remote command:

CONFigure:LTE:SIGN<i>:CONNection:HARQ:DL:RVCSequence
CONFigure:LTE:SIGN<i>:CONNection:HARQ:DL:UDSequence:LENGth
CONFigure:LTE:SIGN<i>:CONNection:HARQ:DL:UDSequence

2.4.12.4 Connected DRX Connection Settings

This section describes settings for Discontinuous Reception (DRX) of the UE during an established connection. If DRX is enabled, the UE monitors the PDCCH discontinuously and thus reduces battery consumption. The related signaling parameters are configurable and specified in 3GPP TS 36.321, section 5.7.

There are two types of DRX cycles. Long DRX cycles are mandatory while short DRX cycles are optional. Both types have a fixed length and start with a fixed "On" time during which the UE receiver is active. After the "On" time there is an opportunity for DRX.

The following figure shows a typical example including short and long DRX cycles. The example starts with reception of a PDCCH during a long DRX cycle "On" time of two subframes. Due to this reception, the inactivity timer set to 40 subframes is started and the receiver stays on until the timer expires. In this example no further PDCCH is received, so that the timer is not restarted.

After the timer is expired, four short DRX cycles are executed (short DRX cycle = 10 subframes, short cycle timer = 4 cycles). Finally, long DRX cycles are executed (long DRX cycle = 20 subframes).

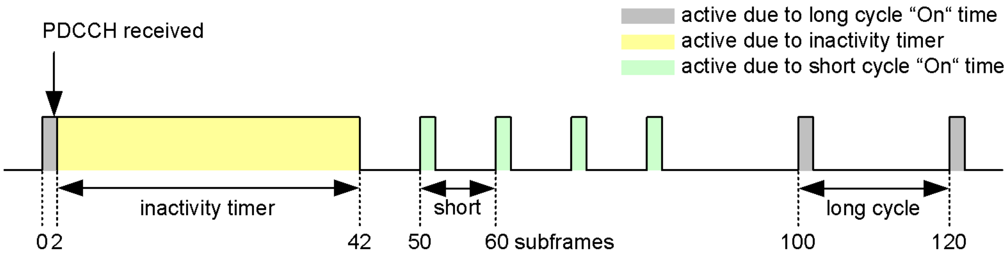


Fig. 2-76: Example, short and long cycles after inactivity

Active MAC padding and uplink RB allocation cause PDCCH traffic and prevent DRX, see also "UL Dynamic Scheduling" on page 183.

The following settings are available (option R&S CMW-KS510 is required).

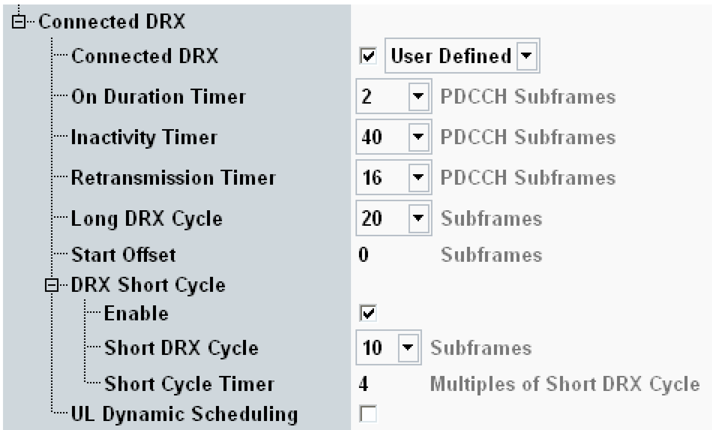


Fig. 2-77: Connected DRX settings (values used in example)

The unit "PDCCH subframe" used in this context refers to subframes with PDCCH. For FDD this is any subframe. For TDD only DL subframes and subframes with DwPTS are counted.

Connected DRX

Enables or disables DRX and selects a set of DRX settings.

If CQI reporting is enabled, connected DRX is not possible (disabled and grayed out).

Option R&S CMW-KS510 is required.

"DRX_S"	Settings according to 3GPP TS 36.521-3, table H.3.6-1.
"DRX_L"	Settings according to 3GPP TS 36.521-3, table H.3.6-2.
"User-Defined"	You can configure all DRX settings.

Remote command:
`CONFigure:LTE:SIGN<i>:CONNection:CDRX:ENABle`

On Duration Timer

"On" time at the beginning of each short or long DRX cycle (onDurationTimer).

Remote command:
`CONFigure:LTE:SIGN<i>:CONNection:CDRX:ODTimer`

Inactivity Timer

"On" time after reception and decoding of a PDCCH for this UE ("drx-InactivityTimer").

Remote command:
`CONFigure:LTE:SIGN<i>:CONNection:CDRX:ITIMer`

Retransmission Timer

"On" time if the UE expects a DL retransmission ("drx-RetransmissionTimer"). The timer expires early when the retransmission is received.

Remote command:
`CONFigure:LTE:SIGN<i>:CONNection:CDRX:RTIMer`

Long DRX Cycle

Duration of one long DRX cycle (longDRX-Cycle).

If short DRX cycles are enabled, the long DRX cycle duration is always a multiple of the short DRX cycle duration. Enabling short DRX cycles or modifying the short DRX cycle duration modifies also the long DRX cycle duration, so that it is compatible.

Remote command:
`CONFigure:LTE:SIGN<i>:CONNection:CDRX:LDCYcle`

Start Offset

Offset shifting all short and long DRX cycles (drxStartOffset).

Remote command:
`CONFigure:LTE:SIGN<i>:CONNection:CDRX:SOFFset`

DRX Short Cycle
The following settings configure optional short DRX cycles.

Enable ← DRX Short Cycle
Enables short DRX cycles.

Remote command:
`CONFigure:LTE:SIGN<i>:CONNection:CDRX:SCENable`

Short DRX Cycle ← DRX Short Cycle
Duration of one short DRX cycle (shortDRX-Cycle).

The long DRX cycle duration is always a multiple of the short DRX cycle duration and adapted automatically to this setting (if short cycles are enabled).

Remote command:
`CONFigure:LTE:SIGN<i>:CONNection:CDRX:SDCYcle`

Short Cycle Timer ← DRX Short Cycle
Number of short DRX cycles to be processed (drxShortCycleTimer), for example after the inactivity timer has expired.

Remote command:
`CONFigure:LTE:SIGN<i>:CONNection:CDRX:SCTimer`

UL Dynamic Scheduling
With uplink dynamic scheduling, the UE gets uplink grants only upon request. Furthermore, MAC padding is disabled automatically.

Enable dynamic scheduling to force DRX, but allow the UE to get an UL grant upon request.

If you want to force DRX without allowing any uplink grants, disable dynamic scheduling, set the number of UL RBs to zero and disable MAC padding.

If connected DRX is disabled, the "UL Dynamic Scheduling" parameter has no effect. For scheduling type SPS, "UL Dynamic Scheduling" is disabled.

Remote command:
`CONFigure:LTE:SIGN<i>:CONNection:CDRX:UDSCheduling`

2.4.12.5 RMC Connection Settings

The parameters in this section configure a 3GPP conform reference measurement channel (RMC). The settings apply if Scheduling Type = "RMC".

To configure the RMC, proceed as follows (for UL and DL):

1. Select the cell bandwidth (see chapter 2.4.10, "Physical Cell Setup", on page 147).
2. Select the number and position of allocated Resource Blocks (RB).
3. Select the modulation type.
4. If the transport block size index is configurable, select it (possible for very few RMCs)

For valid parameter combinations and background information see chapter 2.2.12, "Scheduling Type RMC", on page 39.

The RMC settings can be changed in all main connection states including "Connection Established".

For carrier aggregation scenarios, you can configure the downlink settings per component carrier.

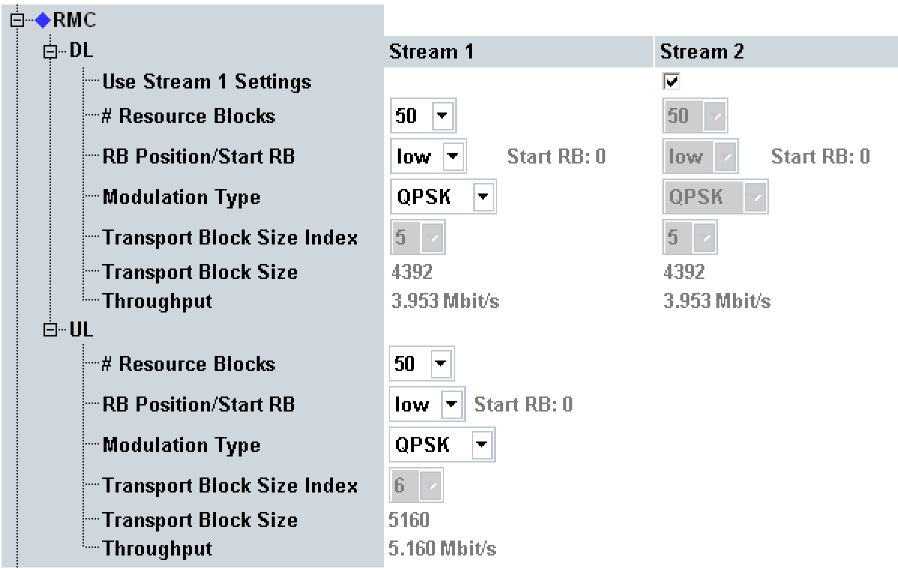


Fig. 2-78: RMC connection settings

Use Stream 1 Settings

This parameter is visible if the selected transmission scheme involves several downlink streams.

If you enable this parameter, all stream 1 settings are also applied to stream 2.

If you disable this parameter, you can configure some DL parameters individually per stream. Other parameters are configurable for stream 1 only and are applied automatically to stream 2.

Remote command:

`CONFigure:LTE:SIGN<i>:CONNection[:PCC]:DLEQual`
`CONFigure:LTE:SIGN<i>:CONNection:SCC<c>:DLEQual`

 # Resource Blocks
Selects the number of allocated resource blocks. This parameter influences the allowed modulation types.

Remote command:
`CONFigure:LTE:SIGN<i>:CONNection[:PCC]:RMC:DL<s>`
`CONFigure:LTE:SIGN<i>:CONNection:SCC<c>:RMC:DL<s>`
`CONFigure:LTE:SIGN<i>:CONNection[:PCC]:RMC:UL`

Version
Some TDD RMCs defined by 3GPP have the same channel bandwidth, number of RBs, modulation type and transport block size index. The parameter "Version" is introduced to distinguish between these RMCs.

For the meaning of the version values, see chapter 2.2.12.3, "DL RMCs, Multiple TX Antennas (TM 2 to 6)", on page 50.

Remote command:
`CONFigure:LTE:SIGN<i>:CONNection[:PCC]:RMC:VERSion:DL<s>`
`CONFigure:LTE:SIGN<i>:CONNection:SCC<c>:RMC:VERSion:DL<s>`

RB Position/Start RB
The RBs can be allocated at the lower or upper end of the cell bandwidth. The resulting number of the first allocated RB is displayed for information.

Remote command:
`CONFigure:LTE:SIGN<i>:CONNection[:PCC]:RMC:RBPosition:DL<s>`
`CONFigure:LTE:SIGN<i>:CONNection:SCC<c>:RMC:RBPosition:DL<s>`
`CONFigure:LTE:SIGN<i>:CONNection[:PCC]:RMC:RBPosition:UL`

Modulation Type
Selects the modulation type. This parameter influences the transport block size index.

Remote command:
`CONFigure:LTE:SIGN<i>:CONNection[:PCC]:RMC:DL<s>`
`CONFigure:LTE:SIGN<i>:CONNection:SCC<c>:RMC:DL<s>`
`CONFigure:LTE:SIGN<i>:CONNection[:PCC]:RMC:UL`

Transport Block Size Index
Displays or selects the transport block size index, depending on the modulation type.

For most RMCs, the TBS index can be determined from the other settings and is displayed for information.

Only for very few RMCs, the combination of the other settings is ambiguous and you can additionally select a TBS index.

Remote command:
`CONFigure:LTE:SIGN<i>:CONNection[:PCC]:RMC:DL<s>`
`CONFigure:LTE:SIGN<i>:CONNection:SCC<c>:RMC:DL<s>`
`CONFigure:LTE:SIGN<i>:CONNection[:PCC]:RMC:UL`

Transport Block Size
Displays the transport block size in bits.

Remote command:
n/a

Throughput
Displays the expected maximum throughput in Mbit/s (averaged over one frame). The value is calculated per downlink and uplink stream.

Remote command:
`SENSe:LTE:SIGN<i>:CONNection:ETHRoughput:DL[:PCC]:STReam<s>?`
`SENSe:LTE:SIGN<i>:CONNection:ETHRoughput:DL:SCC<c>:STReam<s>?`
`SENSe:LTE:SIGN<i>:CONNection:ETHRoughput:UL?`

2.4.12.6 User-Defined Channel Configuration

The parameters in this section configure the resource block configuration, modulation type and transport block size for DL and UL channels. The allowed combinations are more flexible than for 3GPP compliant RMCs. Option R&S CMW-KS510 is required.

The settings apply if Scheduling Type = "User-Defined Channels".

To configure the channels, proceed as follows (for UL and DL):

1. Select the cell bandwidth (see chapter 2.4.10, "Physical Cell Setup", on page 147).
2. Select the number of allocated Resource Blocks (RB), the position of the first RB and the modulation type.
3. Select the transport block size index.

For valid parameter combinations and background information see chapter 2.2.13, "User-Defined Channels", on page 54.

The channel settings can be changed in all main connection states including "Connection Established".

For carrier aggregation scenarios, you can configure the downlink settings per component carrier.

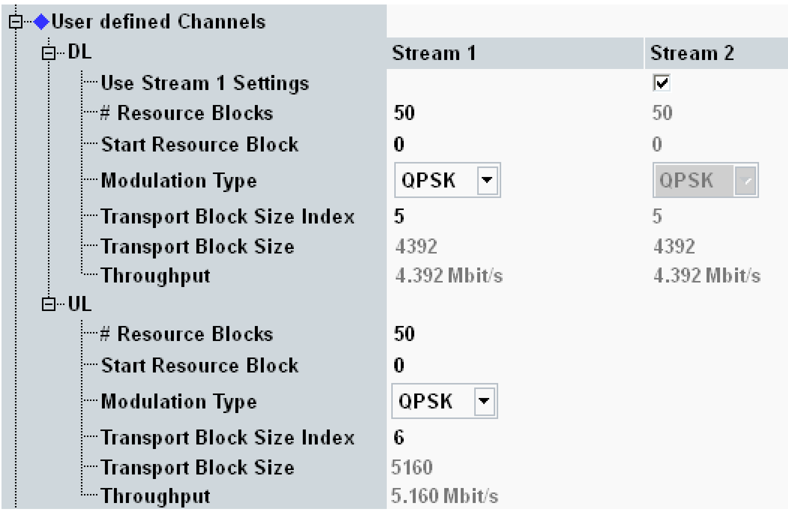


Fig. 2-79: User-defined channel settings

Use Stream 1 Settings

This parameter is visible if the selected transmission scheme involves several downlink streams.

If you enable this parameter, all stream 1 settings are also applied to stream 2.

If you disable this parameter, you can configure some DL parameters individually per stream. Other parameters are configurable for stream 1 only and are applied automatically to stream 2.

Remote command:

CONFigure:LTE:SIGN<i>:CONNection[:PCC]:DLEQual
CONFigure:LTE:SIGN<i>:CONNection:SCC<c>:DLEQual

 # Resource Blocks ... Transport Block Size

"# Resource Blocks" selects the number of allocated resource blocks.

"Start Resource Block" specifies the number of the first allocated resource block. This parameter allows you to shift the allocated RBs within the cell bandwidth.

"Modulation Type" selects the modulation type and influences the allowed transport block size indices.

"Transport Block Size Index" selects TBS index. The resulting "Transport Block Size" in bits is displayed

Remote command:

CONFigure:LTE:SIGN<i>:CONNection[:PCC]:UDCHannels:DL<s>
CONFigure:LTE:SIGN<i>:CONNection:SCC<c>:UDCHannels:DL<s>
CONFigure:LTE:SIGN<i>:CONNection[:PCC]:UDCHannels:UL

Throughput
Displays the expected maximum throughput in Mbit/s (averaged over one frame). The value is calculated per downlink and uplink stream.

Remote command:
`SENSe:LTE:SIGN<i>:CONNection:ETHRoughput:DL[:PCC]:STReam<s>?`
`SENSe:LTE:SIGN<i>:CONNection:ETHRoughput:DL:SCC<c>:STReam<s>?`
`SENSe:LTE:SIGN<i>:CONNection:ETHRoughput:UL?`

Code Rate
Only displayed in the main view: Effective channel code rate, i.e. the number of information bits (including CRC bits) divided by the number of physical channel bits on PDSCH/PUSCH.

Remote command:
`SENSe:LTE:SIGN<i>:CONNection[:PCC]:UDCHannels:DL<s>:CRATe:ALL?`
`SENSe:LTE:SIGN<i>:CONNection:SCC<c>:UDCHannels:DL<s>:CRATe:ALL?`
`SENSe:LTE:SIGN<i>:CONNection[:PCC]:UDCHannels:UL:CRATe:ALL?`

2.4.12.7 User-Defined TTI-Based Channel Configuration

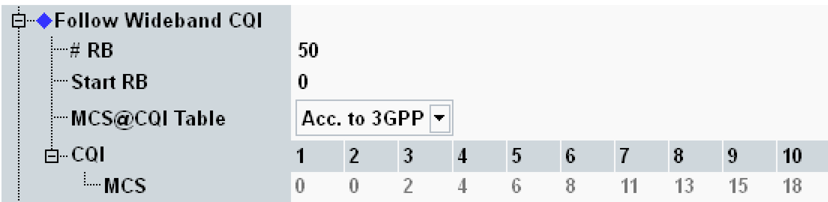
Parameters specific for scheduling type "User-defined TTI-Based" can only be configured from the main view, not from the configuration tree.

See chapter 2.4.1.7, "TTI-Based Channel Configuration", on page 108

2.4.12.8 CQI Channel Configuration

The configuration depends on the CQI scheduling type.

- "Fixed CQI" and "Follow WB PMI":
  Uplink and downlink settings for these scheduling types can only be configured from the main view, not from the configuration tree.
- "Follow WB CQI", "Follow WB CQI-RI" and "Follow WB CQI-PMI-RI":
  The uplink settings can only be configured from the main view, not from the configuration tree. The downlink settings are also contained in the configuration tree:



For a description of all parameters, see chapter 2.4.1.7, "TTI-Based Channel Configuration", on page 108.

2.4.13 CQI Reporting

The following parameters configure Channel Quality Indication (CQI) reporting. The reporting procedures are specified in 3GPP TS 36.213, section 7.2.

For scenarios without carrier aggregation, option R&S CMW-KS510 is required. For scenarios with carrier aggregation, R&S CMW-KS512 is required.

Which reports are sent by the UE depends on the transmission mode. If you want to see CQI, PMI and RI reports, you can use for example transmission mode 4.

Fig. 2-80: CQI reporting settings

Enable CQI Reporting

Enables periodic CQI reporting (Periodic) or disables CQI reporting completely (Off).

For the scheduling types "Follow...", periodic CQI reporting is enabled automatically.

If connected DRX is enabled, CQI reporting is not possible (disabled and grayed out).

Periodic CQI reporting is described in 3GPP TS 36.213, section 7.2.2.

Remote command:
CONFigure:LTE:SIGN<i>:CQIReporting:ENABle

Format Indicator

The current software version supports only wideband CQI reporting. Subband CQI reporting is not supported.

Remote command:
n/a

Enable PMI/RI Reporting (TM8)

In transmission mode 8, PMI and RI reports must be explicitly requested from the UE.

If you activate only "Enable CQI Reporting", you will only get CQI values. If you also want PMI and RI values, you must additionally enable this parameter.

Remote command:
CONFigure:LTE:SIGN<i>:CQIReporting:PRIReporting:ENABle

CQI/PMI Config Index

Specifies the "cqi-pmi-ConfigIndex" ($I_{CQI/PMI}$) for FDD and TDD.

If you want to evaluate reports for several component carriers, you must configure compatible values, so that the carriers use different subframes for reporting. See "Configuration Hints" on page 190.

Remote command:
`CONFigure:LTE:SIGN<i>:CQIReporting[:PCC]:CINDex[:FDD]`
`CONFigure:LTE:SIGN<i>:CQIReporting[:PCC]:CINDex:TDD`
`CONFigure:LTE:SIGN<i>:CQIReporting:SCC<c>:CINDex[:FDD]`
`CONFigure:LTE:SIGN<i>:CQIReporting:SCC<c>:CINDex:TDD`

CQI/PMI Reporting Period / Offset

The displayed reporting period N_p and the reporting offset $N_{OFFSET,CQI}$ result from the configured "cqi-pmi-ConfigIndex" and the duplex mode. They are derived using the mapping tables 7.2.2-1A and 7.2.2-1C in 3GPP TS 36.213.

For carrier aggregation scenarios, the information is available per component carrier.

Remote command:
`SENSe:LTE:SIGN<i>:CQIReporting[:PCC]:RPERiod?`
`SENSe:LTE:SIGN<i>:CQIReporting[:PCC]:ROFFset?`
`SENSe:LTE:SIGN<i>:CQIReporting:SCC<c>:RPERiod?`
`SENSe:LTE:SIGN<i>:CQIReporting:SCC<c>:ROFFset?`

Configuration Hints

The eNodeB determines which subframes the UE can use for CQI, PMI and RI reporting. This is specified in 3GPP TS 36.213, section 7.2.2.

The subframes for CQI and PMI reporting are determined by the parameter "cqi-pmi-ConfigIndex". This parameter is configurable. Via a mapping table, the "cqi-pmi-ConfigIndex" determines the reporting period N_p and the reporting offset $N_{OFFSET,CQI}$.

The subframes for RI reporting are determined by the parameters "M_{RI}" and "$N_{OFFSET,RI}$". The LTE signaling application uses "M_{RI}" = 1 and "$N_{OFFSET,RI}$" = -1.

This means, that the subframes for RI reporting are located immediately before the subframes for CQI/PMI reporting.

If you want to evaluate reports for several component carriers, the carriers must use different subframes for reporting. The carrier configurations must not overlap. This is also important for scheduling types with a DL configuration that reacts to the reports, for example "Follow WB CQI".

Example, dual-carrier FDD, wrong configuration:

PCC: "cqi-pmi-ConfigIndex" = 3 means offset = 1, period = 5

SCC: "cqi-pmi-ConfigIndex" = 9 means offset = 2, period = 10

The following table shows the resulting configuration for two frames. There is a collision in subframe number 1, with CQI/PMI reporting for the PCC and RI reporting for the SCC.

Subframe no.	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9
PCC	R	C				R	C				R	C				R	C			

SCC		R	C									R	C							
C = CQI/PMI reporting, R = RI reporting																				

Example, dual-carrier FDD, correct configuration:

PCC: "cqi-pmi-ConfigIndex" = 3 means offset = 1, period = 5

SCC: "cqi-pmi-ConfigIndex" = 5 means offset = 3, period = 5

The following table shows the resulting configuration. There is no collision.

Subframe no.	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9
PCC	R	C				R	C				R	C				R	C			
SCC			R	C				R	C				R	C				R	C	
C = CQI/PMI reporting, R = RI reporting																				

2.4.14 UE Measurement Report Settings

This section configures the UE measurement report. The report is shown in the main signaling view, see chapter 2.4.1.3, "UE Measurement Report", on page 100.

For enabling of neighbor cell measurements, see chapter 2.4.11.1, "Neighbor Cell Settings", on page 153.

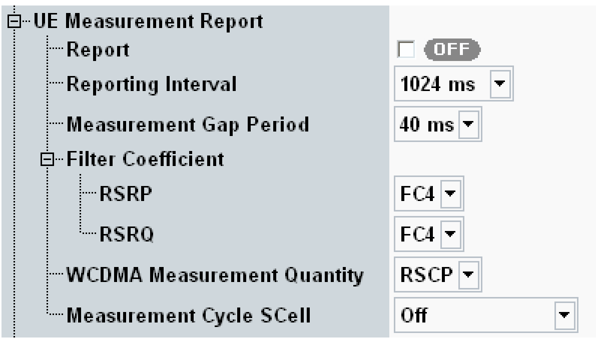


Fig. 2-81: UE measurement report settings

Report

Enables or disables the UE measurement report.

Configure the other settings before enabling this parameter.

Remote command:

`CONFigure:LTE:SIGN<i>:UEReport:ENABle`

Reporting Interval

Sets the interval between two consecutive measurement reports. Reduce the interval to check whether the UE can cope with a high repetition rate.

Remote command:

`CONFigure:LTE:SIGN<i>:UEReport:RINTerval`

Measurement Gap Period
Specifies the periodicity of transmission gaps that can be used by the UE to perform neighbor cell measurements. A measurement gap of 6 ms occurs either every 40 ms or every 80 ms.

Measurement gaps occur only if at least one neighbor cell measurement is active.

Option R&S CMW-KS510 is required for neighbor cell measurements.

Remote command:
CONFigure:LTE:SIGN<i>:UEReport:MGPeriod

Filter Coefficient RSRP/RSRQ
Selects the filter coefficients used by the UE to measure the Reference Signal Received Power (RSRP) and the Reference Signal Received Quality (RSRQ).

The values are signaled to the UE via the information elements "filterCoefficientRSRP" and "filterCoefficientRSRQ". Do not confuse these elements with the "filterCoefficient" for uplink power control, see "UE Meas. Filter Coefficient" on page 166.

Remote command:
CONFigure:LTE:SIGN<i>:UEReport:FCOefficient:RSRP
CONFigure:LTE:SIGN<i>:UEReport:FCOefficient:RSRQ

WCDMA Measurement Quantity
Selects whether the UE shall determine the RSCP or the Ec/No during WCDMA neighbor cell measurements. The setting is signaled to the UE.

Option R&S CMW-KS510 is required for neighbor cell measurements.

Remote command:
CONFigure:LTE:SIGN<i>:UEReport:WMQuantity

Measurement Cycle SCell
Specifies how often the UE shall perform measurements on the SCC in SCC state "RRC Added". The setting is signaled to the UE as "measCycleSCell". The measurement period is calculated from the configured value. For details see 3GPP TS 36.133, section 8.3.3.2.

"Off" means that parameter "measCycleSCell" is not signaled to the UE.

The setting is only visible for carrier aggregation scenarios.

Remote command:
CONFigure:LTE:SIGN<i>:UEReport:MCSCell

2.4.15 Messaging (SMS) Parameters

The "Messaging (SMS)" section configures parameters of the Short Message Service (SMS). Sending an SMS message to the UE is triggered via hotkey, see "Connection control hotkeys" on page 116.

Fig. 2-82: SMS parameters

2.4.15.1 Outgoing SMS

This section configures outgoing mobile terminating short messages.

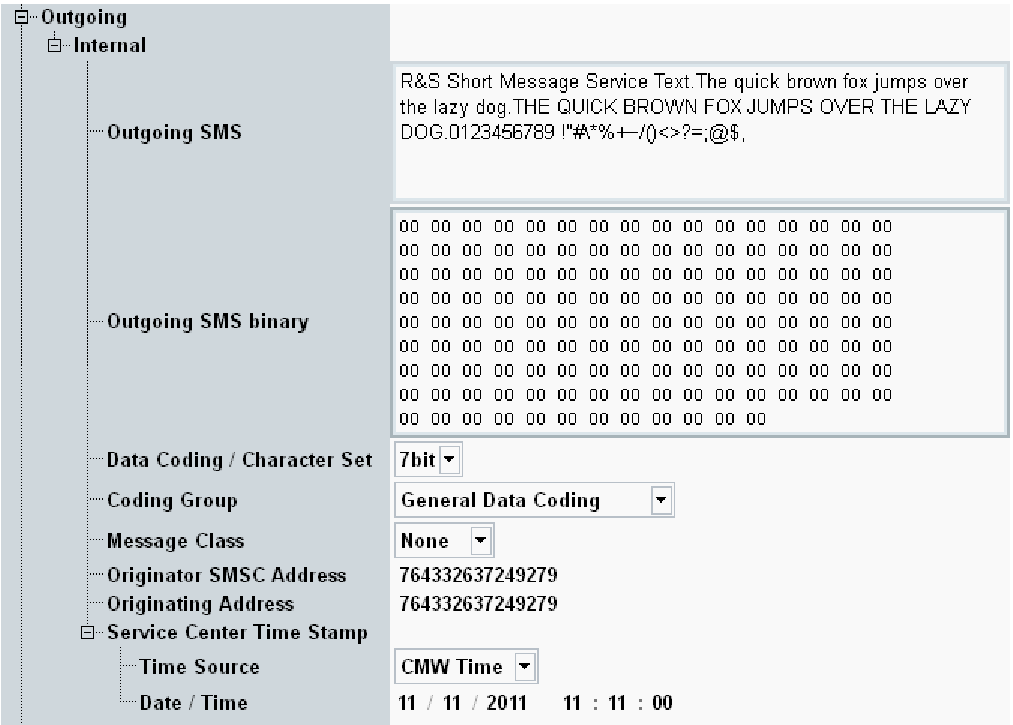


Fig. 2-83: Outgoing SMS parameters

Outgoing SMS

Defines the message contents for outgoing 7-bit ASCII messages. Up to 160 characters are allowed.

Remote command:

`CONFigure:LTE:SIGN<i>:SMS:OUTGoing:INTernal`

Outgoing SMS binary
Defines the message contents for outgoing 8-bit binary messages. The contents are entered as hexadecimal numbers. Up to 280 digits are allowed.

Remote command:
`CONFigure:LTE:SIGN<i>:SMS:OUTGoing:BINary`

Data Coding / Character Set
Selects whether a 7-bit ASCII or 8-bit binary message shall be sent.

Remote command:
`CONFigure:LTE:SIGN<i>:SMS:OUTGoing:DCODing`

Coding Group
Selects the coding group to be indicated to the message recipient in the TP-Data-Coding-Scheme field. See also 3GPP TS 23.038.

Remote command:
`CONFigure:LTE:SIGN<i>:SMS:OUTGoing:CGRoup`

Message Class
Selects the message class to be indicated to the message recipient in the TP-Data-Coding-Scheme field. See also 3GPP TS 23.038.

"None" means that no message class is sent.

Remote command:
`CONFigure:LTE:SIGN<i>:SMS:OUTGoing:MCLass`

Originator SMSC Address
Short message service center address, to be sent to the recipient.

Remote command:
`CONFigure:LTE:SIGN<i>:SMS:OUTGoing:OSADdress`

Originating Address
Address of the originator of the SMS, to be sent to the recipient.

Remote command:
`CONFigure:LTE:SIGN<i>:SMS:OUTGoing:OADDress`

Service Center Time Stamp
Service center time stamp, to be sent to the recipient.

You can configure the time stamp in two ways:
- Select the time source "CMW Time".
  This sets the time stamp according to the current date and time of the operation system.
- Select the time source "Date / Time" and configure the time stamp value via the parameter "Date / Time".

Option R&S CMW-KS510 is required.

Remote command:
CONFigure:LTE:SIGN<i>:SMS:OUTGoing:SCTStamp:TSOurce
CONFigure:LTE:SIGN<i>:SMS:OUTGoing:SCTStamp:DATE
CONFigure:LTE:SIGN<i>:SMS:OUTGoing:SCTStamp:TIME

2.4.15.2 Incoming SMS

This section displays information about incoming mobile originating short messages.

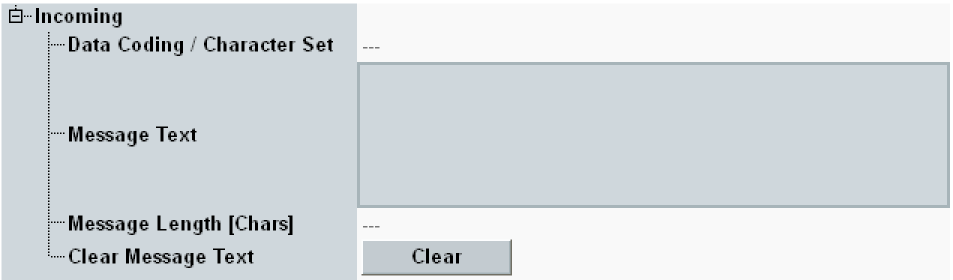


Fig. 2-84: Incoming SMS parameters

Data Coding / Character Set
Indicates whether the last received message is a 7-bit ASCII message or an 8-bit binary message.

Remote command:
SENSe:LTE:SIGN<i>:SMS:INComing:INFO:DCODing?

Message Text / Message Length
Show the text and length of the last received SMS message.

Remote command:
SENSe:LTE:SIGN<i>:SMS:INComing:INFO:MTEXt?
SENSe:LTE:SIGN<i>:SMS:INComing:INFO:MLENgth?

Clear Message Text
The button resets all parameters related to a received message.

The message information is deleted. The "message read" flag is set to true.

Remote command:
SENSe:LTE:SIGN<i>:SMS:INFO:LRMessage:RFLag?
CLEan:LTE:SIGN<i>:SMS:INComing:INFO:MTEXt

2.4.16 Shortcut Configuration

This section configures the three shortcut softkeys that provide a fast way to switch to selectable measurements.

See also chapter 2.4.3, "Using the Shortcut Softkeys", on page 119

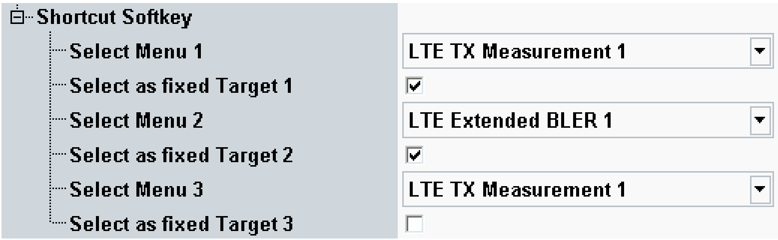


Fig. 2-85: Shortcut configuration

Select Menu

Selects a measurement. The corresponding shortcut softkey opens a dialog presenting this measurement as default target or uses the measurement as fixed target.

Select as fixed Target

Configures and renames the corresponding shortcut softkey.

- **Enabled**: The softkey directly opens the measurement selected via Select Menu.
- **Disabled**: The softkey opens a dialog box for selection of the target measurement.

2.4.17 Message Monitoring Settings

Messages exchanged between the LTE signaling application and the UE can be monitored. For this purpose the messages are sent to an external PC.

See also: "Logging" in the R&S CMW user manual, chapter "Basic Instrument Functions"

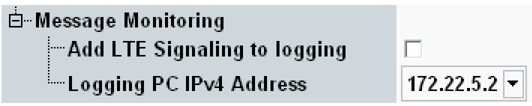


Fig. 2-86: Message Monitoring Settings

Add LTE Signaling to logging

Enables or disables message monitoring for the LTE signaling application.

Remote command:

`CONFigure:LTE:SIGN<i>:MMONitor:ENABle`

Logging PC IPv4 Address

Selects the IP address to which the messages are sent for monitoring.

The address pool is configured globally, see "Setup" dialog, section "Logging".

Remote command:

`CONFigure:LTE:SIGN<i>:MMONitor:IPADdress`

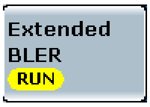
2.4.18 BLER Measurement Configuration

The "Extended BLER" measurement is included in the "LTE signaling" application. To access the measurement, press the softkey "LTE RX Meas" in the LTE signaling main view. Then select the tab "Extended BLER". The views and configuration dialogs of the tab are described in this section.

2.4.18.1 Measurement Control

The measurement is turned on or off using the ON | OFF or RESTART | STOP keys.

See also: "Measurement Control" in the R&S CMW user manual, chapter "System Overview"



Extended BLER (Softkey)
The softkey shows the current measurement state. Additional measurement substates can be retrieved via remote control.

Remote command:
INITiate:LTE:SIGN<i>:EBLer
STOP:LTE:SIGN<i>:EBLer
ABORt:LTE:SIGN<i>:EBLer
FETCh:LTE:SIGN<i>:EBLer:STATe?
FETCh:LTE:SIGN<i>:EBLer:STATe:ALL?

2.4.18.2 Measurement Views

The measurement provides BLER, throughput, HARQ and reported CQI results in several views. The BLER view shows also common settings of the "LTE signaling" application. Additional settings of the "LTE signaling" application can be accessed via the "Signaling Parameters" softkey and the related hotkeys.

To switch to the signaling application, press the "LTE Signaling" softkey two times.

The "Config" hotkey opens either the configuration dialog of the measurement or the configuration dialog of the signaling application, depending on which softkey is active.

The following figure shows the result overview, providing access to the individual detailed result views.

Fig. 2-87: Extended BLER result overview

Results

For a detailed description of the individual views and results, see chapter 2.2.19, "Extended BLER Measurement", on page 66.

For result retrieval commands, see chapter 2.6.19.3, "Measurement Results", on page 455.

2.4.18.3 Settings

The "Extended BLER" parameters configure the scope of the measurement.

If you want to insert block errors into the downlink signal, see "Downlink MAC Error Insertion" on page 170.

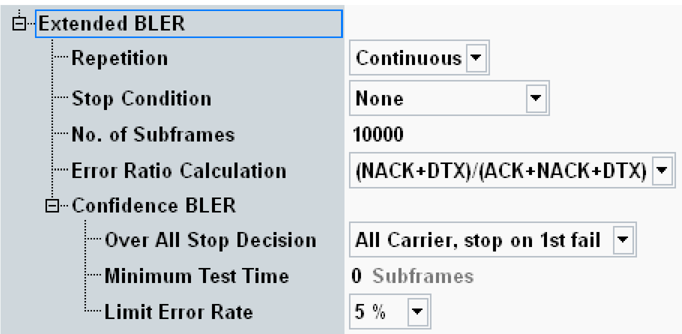


Fig. 2-88: Extended BLER settings

Repetition

Defines how often the measurement is repeated.

"Continuous" The measurement is continued until it is explicitly terminated. The results are periodically updated.

"Single-Shot" The measurement stops automatically, depending on the configured "Stop Condition" either when the configured "No. of Subframes" has been processed or when a confidence BLER measurement result is available.

Remote command:
`CONFigure:LTE:SIGN<i>:EBLer:REPetition`

Stop Condition

Selects whether a BLER measurement without stop condition or a confidence BLER measurement with early decision concept is performed.

"None" The measurement is performed according to its "Repetition" mode and the specified "No. of Subframes". No confidence BLER result is determined.

"Confidence Level" A confidence BLER measurement is performed. The measurement stops when the configured "Minimum Test Time" has passed and a pass/fail decision has been made, so that a confidence BLER result (e.g. "Early Pass") is available. The "Repetition" is automatically set to "Single-Shot".
Option R&S CMW-KS510/-KS512 (without CA/with CA) is required.

Remote command:
`CONFigure:LTE:SIGN<i>:EBLer:SCONdition`

No. of Subframes

For measurements without stop condition, this parameter defines the number of subframes to be processed per measurement cycle (a single-shot measurement covers one measurement cycle).

For confidence BLER measurements, this parameter specifies only the length of the throughput result trace. It does not influence the duration of the measurement.

For FDD, all scheduled and unscheduled downlink subframes are considered. For TDD, all downlink, uplink and special subframes are considered.

A scheduled downlink subframe that is sent via several downlink streams in parallel is counted as one subframe.

For examples, see chapter 2.2.19.8, "Common View Elements", on page 75.

Remote command:
`CONFigure:LTE:SIGN<i>:EBLer:SFRames`

Error Ratio Calculation
Selects the formula to be used for calculation of the BLER from the number of ACK, NACK and DTX. PDSCH decoding errors result in NACK while PDCCH decoding errors result in DTX.

3GPP TS 36.521 specifies which formula must be used for a certain performance test or CQI test.

The following formulae are available:
- *BLER = (NACK + DTX) / (ACK + NACK + DTX)*
- *BLER = DTX / (ACK + NACK + DTX)*
- *BLER = NACK / (ACK + NACK + DTX)*
- *BLER = NACK / (ACK + NACK)*

Remote command:
`CONFigure:LTE:SIGN<i>:EBLer:ERCalc`

Confidence BLER
The following parameters configure parameters only relevant for confidence BLER measurements.

Over All Stop Decision ← Confidence BLER
This setting configures the stop decision and the overall confidence BLER result calculation for measurements with carrier aggregation.

Depending on the selection, the measurement stops when the following condition is fulfilled:
- "PCC only": A result is available for the PCC.
- "SCC<n> only": A result is available for SCC number <n>.
- "All Carrier, stop on 1st fail":
  – Results are available for all component carriers, OR
  – At least one result equals "Fail" or "Early Fail".
- "All Carrier, wait for all CCs": Results are available for all component carriers.

Depending on the selection, the overall confidence BLER result is calculated as follows:
- "PCC only": Overall result = PCC result
- "SCC<n> only": Overall result = SCC<n> result
- "All Carrier, ...":
  – If at least one result = "Early Fail": Overall result = "Early Fail"
  – Else, if at least one result = "Fail": Overall result = "Fail"
  – Else, if all results = "Early Pass": Overall result = "Early Pass"
  – Else: Overall result = "Pass"

Remote command:
`CONFigure:LTE:SIGN<i>:EBLer:CONFidence:OASCondition`

Minimum Test Time ← Confidence BLER
Specifies the minimum test time of a confidence BLER measurement as number of processed subframes. During this time no pass/fail decision is allowed.

Minimum test times are for example specified in 3GPP TS 36.521 Annex G.4. They are necessary if the test conditions introduce fluctuations disturbing the statistical independence of the single bit error events (e.g. multipath fading). A minimum test time ensures that the fluctuations are averaged out.

For FDD, all scheduled and unscheduled downlink subframes are considered. For TDD, all downlink, uplink and special subframes are considered.

Remote command:
CONFigure:LTE:SIGN<i>:EBLer:CONFidence:MTTime

Limit Error Rate ← Confidence BLER
Selects the limit error ratio for a confidence BLER measurement. The selection determines for example the used pass/fail decision rules.

The minimum test time and the error ratio calculation formula are independent of this selection, so configure also these parameters as desired.

"0.1%, 1%"	Pass/fail decision according to 3GPP TS 36.521 Annex G.4
"5%"	Pass/fail decision according to 3GPP TS 36.521 Annex G.2

Remote command:
CONFigure:LTE:SIGN<i>:EBLer:CONFidence:LERate

2.4.19 RLC Throughput Measurement Configuration

The "Extended BLER" measurement is included in the "LTE signaling" application. To access the measurement, press the softkey "LTE RX Meas" in the LTE signaling main view. Then select the tab "RLC Throughput". The tab is described in this section.

2.4.19.1 Measurement Control

The measurement is turned on or off using the ON | OFF or RESTART | STOP keys.

See also: "Measurement Control" in the R&S CMW user manual, chapter "System Overview"

RLC Throughput (Softkey)
The softkey shows the current measurement state. Additional measurement substates can be retrieved via remote control.

Remote command:
INITiate:LTE:SIGN<i>:THRoughput
STOP:LTE:SIGN<i>:THRoughput
ABORt:LTE:SIGN<i>:THRoughput
FETCh:LTE:SIGN<i>:THRoughput:STATe?
FETCh:LTE:SIGN<i>:THRoughput:STATe:ALL?

2.4.19.2 RLC Throughput Tab

The tab shows the measurement results in a diagram and a table. The connection status information displayed at the bottom is the same as in the LTE signaling main view.

The most important settings of the "LTE signaling" application can be accessed via the "Signaling Parameters" softkey and the related hotkeys.

To switch to the signaling application, press the "LTE Signaling" softkey two times.

The "Config" hotkey opens either the configuration dialog of the measurement or the configuration dialog of the signaling application, depending on which softkey is active.

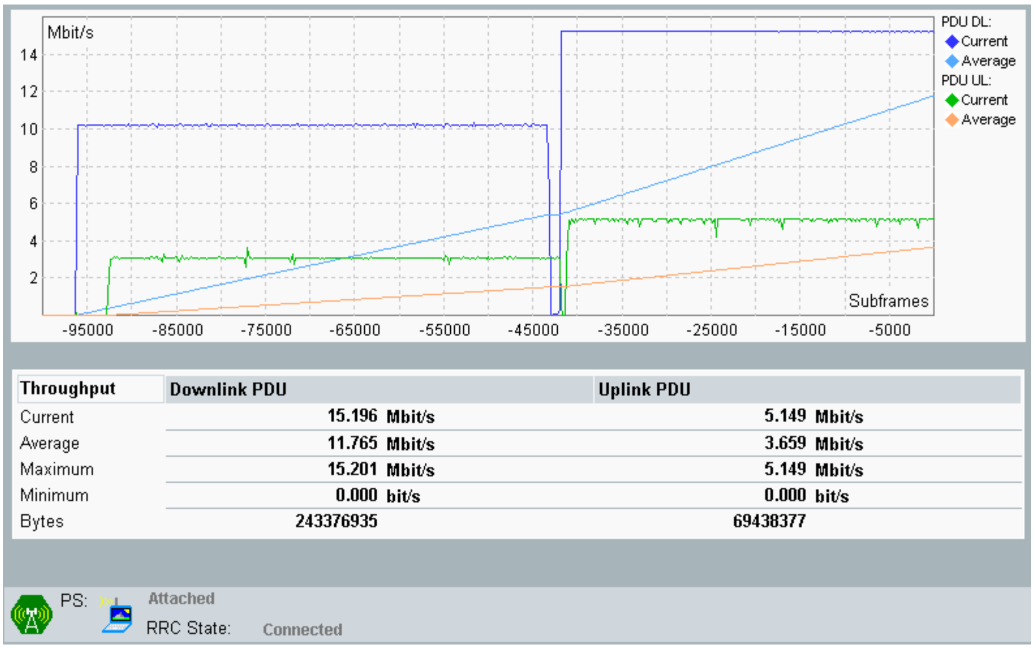


Fig. 2-89: RLC throughput tab

Results
For a detailed description of the results, see chapter 2.2.20.2, "Measurement Results", on page 77.

Remote command:
`FETCh:LTE:SIGN<i>:THRoughput?` etc.
`FETCh:LTE:SIGN<i>:THRoughput:TRACe:UL:PDU:CURRent?` etc.
`FETCh:LTE:SIGN<i>:THRoughput:TRACe:DL:PDU:CURRent?` etc.

2.4.19.3 Settings

The "RLC Throughput" parameters configure the scope of the measurement.

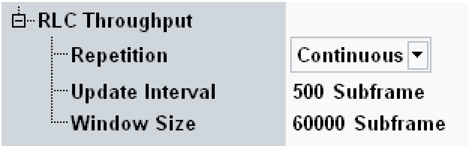


Fig. 2-90: RLC throughput settings

Repetition

Defines how often the measurement is repeated.

"Continuous" The measurement is continued until it is explicitly terminated. The results are periodically updated.

"Single-Shot" The measurement stops automatically when the configured "Window Size" has been processed.

Remote command:

CONFigure:LTE:SIGN<i>:THRoughput:REPetition

Update Interval

Number of subframes used to derive a single throughput result (multiple of 100 subframes).

Remote command:

CONFigure:LTE:SIGN<i>:THRoughput:UPDate

Window Size

Number of subframes on the X-axis of the throughput diagram.

The number of results in the diagram equals the window size divided by the update interval rounded down to the next integer value, plus one:

number of results = integer (<Window Size> / <Update Interval>) + 1

The window size cannot be smaller than the update interval.

Remote command:

CONFigure:LTE:SIGN<i>:THRoughput:WINDow

2.4.20 Annex: UE Capabilities

This section describes the UE capability information displayed in the main view, if the UE capabilities area is maximized. See also chapter 2.4.1.4, "UE Capabilities", on page 103.

All capability information is transmitted by the UE in the information element *UE-EUTRA-Capability* described in 3GPP TS 36.331.

For some parameters described in the following sections, three remote control commands are listed:

- First command:

Queries the parameter in the upper part of the capability report. Features indicated as "supported" are supported for FDD and TDD.

- Command with additional `:FAUeeutra:` mnemonic:
  Queries the parameter in section "fdd Add UE-EUTRA Capabilities". Features indicated as "supported" are supported only for FDD, not for TDD.
- Command with additional `:TAUeeutra:` mnemonic:
  Queries the parameter in section "tdd Add UE-EUTRA Capabilities". Features indicated as "supported" are supported only for TDD, not for FDD.

2.4.20.1 General UE Capability Information

At the highest level, the report lists the following information.

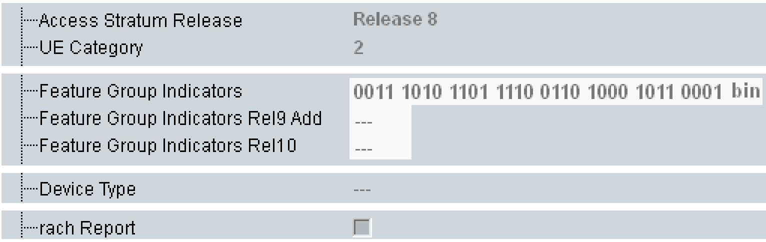


Fig. 2-91: General UE capability information

Access Stratum Release

Supported release of the E-UTRA layer 1, 2 and 3 specifications

Remote command:

`SENSe:LTE:SIGN<i>:UECapability:ASRelease?`

UE Category

UE category of the UE, defining several transport channel and physical channel parameters for UL and DL (for details see 3GPP TS 36.306)

Remote command:

`SENSe:LTE:SIGN<i>:UECapability:UECategory?`

Feature Group Indicators

32-bit value, containing one bit per feature group ("1" = supported, "0" = not supported)

The features assigned to the individual bits are listed in the annex of 3GPP TS 36.331, table B.1-1.

Remote command:
`SENSe:LTE:SIGN<i>:UECapability:FGINdicators?`
`SENSe:LTE:SIGN<i>:UECapability:FAUeeutra:FGINdicators?`
`SENSe:LTE:SIGN<i>:UECapability:TAUeeutra:FGINdicators?`

Feature Group Indicators Rel9 Add
32-bit value, containing one bit per feature group ("1" = supported, "0" = not supported)

The features assigned to the individual bits are listed in the annex of 3GPP TS 36.331, table B.1-1a.

Remote command:
`SENSe:LTE:SIGN<i>:UECapability:FGINdicators:RNADd?`
`SENSe:LTE:SIGN<i>:UECapability:FAUeeutra:FGINdicators:RNADd?`
`SENSe:LTE:SIGN<i>:UECapability:TAUeeutra:FGINdicators:RNADd?`

Feature Group Indicators Rel 10
32-bit value, containing one bit per feature group ("1" = supported, "0" = not supported)

The features assigned to the individual bits are listed in the annex of 3GPP TS 36.331, table C.1-1.

Remote command:
`SENSe:LTE:SIGN<i>:UECapability:FGINdicators:RTEN?`
`SENSe:LTE:SIGN<i>:UECapability:FAUeeutra:FGINdicators:RTEN?`
`SENSe:LTE:SIGN<i>:UECapability:TAUeeutra:FGINdicators:RTEN?`

Device Type
Indicates whether the UE benefits from NW-based battery consumption optimization:
- "noBenFromBatConsumpOpt" means that the UE does not benefit from the optimization.
- An empty field means that the UE does benefit from the optimization.

Remote command:
`SENSe:LTE:SIGN<i>:UECapability:DTYPe?`

rach Report
Support of RACH report delivery

Remote command:
`SENSe:LTE:SIGN<i>:UECapability:RREPort?`

2.4.20.2 PDCP UE Capabilities

The following UE capability information indicates in which way the UE supports the Packet Data Convergence Protocol (PDCP) described in 3GPP TS 36.323.

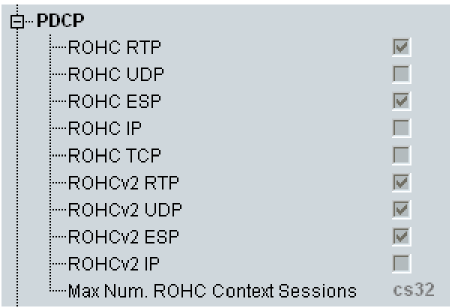


Fig. 2-92: PDCP UE capabilities

ROHC RTP to ROHCv2 IP

Support of the robust header compression profiles with the profile identifiers 0x0001 to 0x0004, 0x0006, 0x0101 to 0x0104

Remote command:

`SENSe:LTE:SIGN<i>:UECapability:PDCP:SRPRofiles?`

Max Num ROHC Context Sessions

Maximum number of header compression context sessions supported by the UE

Remote command:

`SENSe:LTE:SIGN<i>:UECapability:PDCP:MRCSessions?`

2.4.20.3 Physical Layer UE Capabilities

This section indicates physical layer capabilities of the UE.

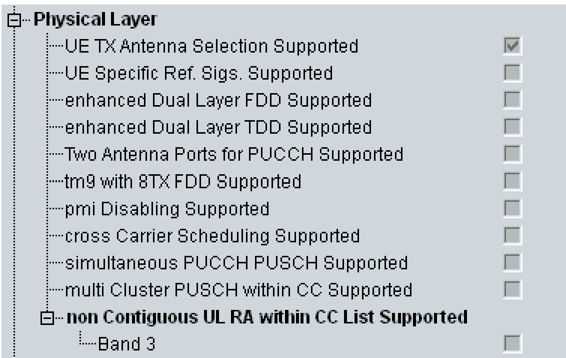


Fig. 2-93: Physical Layer UE capabilities

UE TX Antenna Selection Supported

Support of transmit antenna selection, see 3GPP TS 36.213

Remote command:

`SENSe:LTE:SIGN<i>:UECapability:PLAYer:UTASupported?`
`SENSe:LTE:SIGN<i>:UECapability:FAUeeutra:PLAYer:UTASupported?`
`SENSe:LTE:SIGN<i>:UECapability:TAUeeutra:PLAYer:UTASupported?`

UE-Specific Ref. Sigs. Supported

Support of PDSCH TM7 for FDD

Remote command:

`SENSe:LTE:SIGN<i>:UECapability:PLAYer:USRSsupport?`
`SENSe:LTE:SIGN<i>:UECapability:FAUeeutra:PLAYer:USRSsupport?`
`SENSe:LTE:SIGN<i>:UECapability:TAUeeutra:PLAYer:USRSsupport?`

enhanced Dual layer FDD/TDD Supported

Support of enhanced dual layer (PDSCH TM8) for FDD/TDD

Remote command:

`SENSe:LTE:SIGN<i>:UECapability:PLAYer:EDLFsupport?`
`SENSe:LTE:SIGN<i>:UECapability:PLAYer:EDLTsupport?`

Two Antenna Ports for PUCCH Supported

Support of transmit diversity for PUCCH formats 1/1a/1b/2/2a/2b and support of PUCCH format 3 / transmit diversity for PUCCH format 3

Remote command:

`SENSe:LTE:SIGN<i>:UECapability:PLAYer:TAPPsupport?`
`SENSe:LTE:SIGN<i>:UECapability:FAUeeutra:PLAYer:TAPPsupport?`
`SENSe:LTE:SIGN<i>:UECapability:TAUeeutra:PLAYer:TAPPsupport?`

tm9 with 8TX FDD Supported

Support of PDSCH TM9 with 8 CSI reference signal ports for FDD

Remote command:

`SENSe:LTE:SIGN<i>:UECapability:PLAYer:TWEFsupport?`
`SENSe:LTE:SIGN<i>:UECapability:FAUeeutra:PLAYer:TWEFsupport?`
`SENSe:LTE:SIGN<i>:UECapability:TAUeeutra:PLAYer:TWEFsupport?`

pmi Disabling Supported

Support of PMI disabling

Remote command:

`SENSe:LTE:SIGN<i>:UECapability:PLAYer:PDSupport?`
`SENSe:LTE:SIGN<i>:UECapability:FAUeeutra:PLAYer:PDSupport?`
`SENSe:LTE:SIGN<i>:UECapability:TAUeeutra:PLAYer:PDSupport?`

cross Carrier Scheduling Supported
Support of cross-carrier scheduling for CA

Remote command:
SENSe:LTE:SIGN<i>:UECapability:PLAYer:CCSSupport?
SENSe:LTE:SIGN<i>:UECapability:FAUeeutra:PLAYer:CCSSupport?
SENSe:LTE:SIGN<i>:UECapability:TAUeeutra:PLAYer:CCSSupport?

simultaneous PUCCH PUSCH Supported
UE baseband supports simultaneous transmission of PUCCH and PUSCH and is band agnostic

Remote command:
SENSe:LTE:SIGN<i>:UECapability:PLAYer:SPPSupport?
SENSe:LTE:SIGN<i>:UECapability:FAUeeutra:PLAYer:SPPSupport?
SENSe:LTE:SIGN<i>:UECapability:TAUeeutra:PLAYer:SPPSupport?

multi Cluster PUSCH within CC Supported
UE baseband supports multi-cluster PUSCH transmission within a component carrier (CC), and is band agnostic

Remote command:
SENSe:LTE:SIGN<i>:UECapability:PLAYer:MCPCsupport?
SENSe:LTE:SIGN<i>:UECapability:FAUeeutra:PLAYer:MCPCsupport?
SENSe:LTE:SIGN<i>:UECapability:TAUeeutra:PLAYer:MCPCsupport?

non Contiguous UL RA within CC List Supported
For each supported E-UTRA band: UE RF supports non-contiguous UL resource allocations within a CC

Remote command:
SENSe:LTE:SIGN<i>:UECapability:PLAYer:NURClist?
SENSe:LTE:SIGN<i>:UECapability:FAUeeutra:PLAYer:NURClist?
SENSe:LTE:SIGN<i>:UECapability:TAUeeutra:PLAYer:NURClist?

2.4.20.4 RF UE Capabilities

This section indicates the supported E-UTRA operating bands. For carrier aggregation, it indicates the supported operating band combinations.

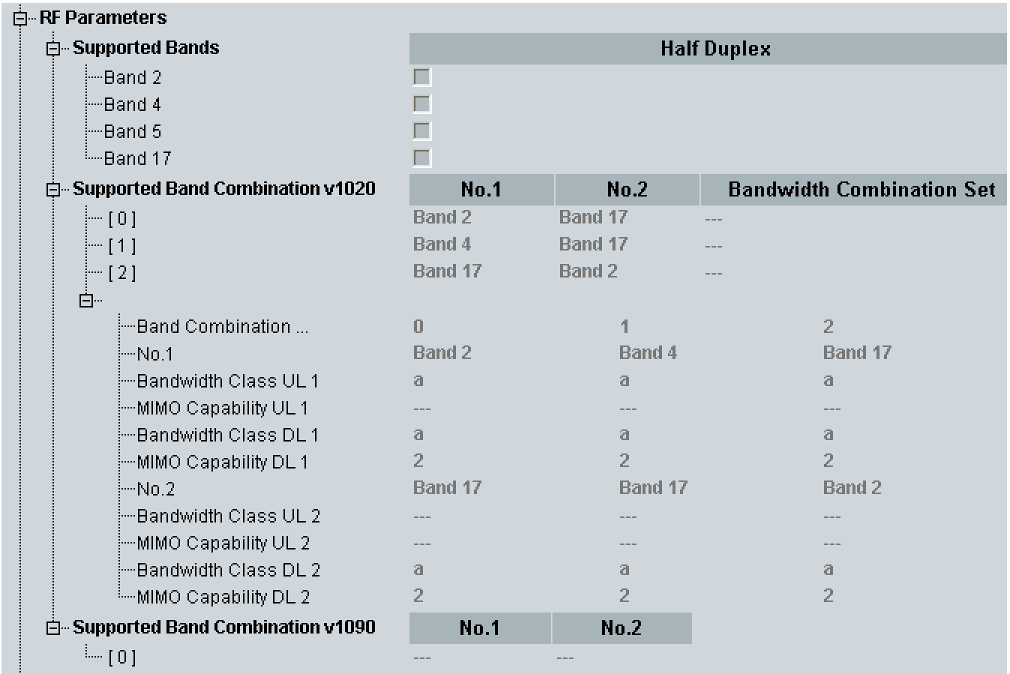


Fig. 2-94: RF UE capabilities

Supported Bands

The UE supports all listed operating bands.

Column "Half Duplex" indicates whether the UE supports only half duplex operation for the band.

Remote command:

`SENSe:LTE:SIGN<i>:UECapability:RF:SUPPorted?`

`SENSe:LTE:SIGN<i>:UECapability:RF:HDUPlex?`

Supported Band Combination v1020

Lists information contained in the information element "RF-Parameters-v1020".

For carrier aggregation, the UE supports the listed band combinations. The band combinations are numbered from [0] to [n]. Each row shows one supported combination.

Column "Bandwidth Combination Set" indicates which bandwidth combination sets are supported for a band combination. The leftmost bit corresponds to set 0, the next bit to set 1 and so on. "0" means that the set is not supported. "1" means that the set is supported. The sets are specified in 3GPP TS 36.101, section 5.6A.1.

The lower table contains one column per band combination. The rows indicate for each band of the combination:

- Supported bandwidth classes for UL and DL
  The bandwidth classes are defined in 3GPP TS 36.101, section 5.6A.
- MIMO capability for each supported bandwidth class, UL and DL
  Indicates the number of supported layers for spatial multiplexing

Example: bandwidth class = "abc", MIMO capability = "244" means 2 layers for class a, 4 layers for class b and c

Remote command:
`SENSe:LTE:SIGN<i>:UECapability:RF:BCOMbination:V<Number>:BCSet?`
`SENSe:LTE:SIGN<i>:UECapability:RF:BCOMbination:V<Number>:EUTRa<BandNr>?`
`SENSe:LTE:SIGN<i>:UECapability:RF:BCOMbination:V<Number>:EUTRa<BandNr>:BCLass:UL?`
`SENSe:LTE:SIGN<i>:UECapability:RF:BCOMbination:V<Number>:EUTRa<BandNr>:BCLass:DL?`
`SENSe:LTE:SIGN<i>:UECapability:RF:BCOMbination:V<Number>:EUTRa<BandNr>:MCAPability:UL?`
`SENSe:LTE:SIGN<i>:UECapability:RF:BCOMbination:V<Number>:EUTRa<BandNr>:MCAPability:DL?`

Supported Band Combination v1090
Lists information contained in the information element "RF-Parameters-v1090".

For carrier aggregation, the UE supports the listed band combinations. The combinations are numbered from [0] to [n].

Remote command:
`SENSe:LTE:SIGN<i>:UECapability:RF:BCOMbination:V<Number>:EUTRa<BandNr>?`

2.4.20.5 Measurement UE Capabilities

This section indicates whether the UE needs measurement gaps for measurements on other operating bands or on other Radio Access Technologies (RAT).

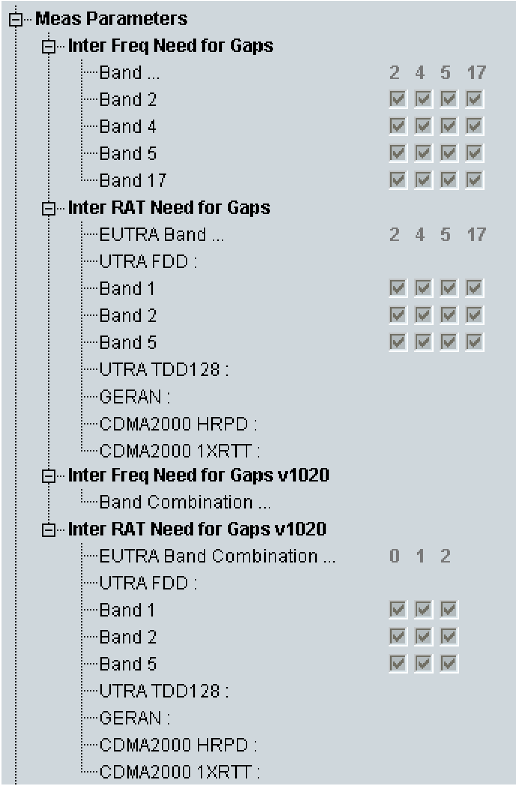


Fig. 2-95: Measurement UE capabilities

Inter-Freq Need for Gaps

Indicates the need for downlink measurement gaps when using a certain E-UTRA band and measuring a certain E-UTRA band. Each column corresponds to a specific used E-UTRA band, each row to a specific measured E-UTRA band.

Remote command:

SENSe:LTE:SIGN<i>:UECapability:MEAS:IFNGaps?

Inter-RAT Need for Gaps

Indicates the need for downlink measurement gaps when using a certain E-UTRA band and measuring on a supported band of another RAT. Each column corresponds to a specific used E-UTRA band, each row to a specific measured band of another RAT.

Remote command:

SENSe:LTE:SIGN<i>:UECapability:MEAS:IRNGaps:UFDD?
SENSe:LTE:SIGN<i>:UECapability:MEAS:IRNGaps:UTDD<n>?
SENSe:LTE:SIGN<i>:UECapability:MEAS:IRNGaps:GERan?
SENSe:LTE:SIGN<i>:UECapability:MEAS:IRNGaps:CHRPd?
SENSe:LTE:SIGN<i>:UECapability:MEAS:IRNGaps:CXRTt?

Inter-Freq Need for Gaps v1020
Indicates the need for downlink measurement gaps when using a certain E-UTRA band combination for carrier aggregation and measuring a certain E-UTRA band. Each column corresponds to a specific used band combination, each row to a specific measured E-UTRA band.

Remote command:
SENSe:LTE:SIGN<i>:UECapability:MEAS:IFNGaps:V<number>?

Inter-RAT Need for Gaps v1020
Indicates the need for downlink measurement gaps when using a certain E-UTRA band combination for carrier aggregation and measuring on a supported band of another RAT. Each column corresponds to a specific used band combination, each row to a specific measured band of another RAT.

Remote command:
SENSe:LTE:SIGN<i>:UECapability:MEAS:IRNGaps:V<number>:UFDD?
SENSe:LTE:SIGN<i>:UECapability:MEAS:IRNGaps:V<number>:UTDD<n>?
SENSe:LTE:SIGN<i>:UECapability:MEAS:IRNGaps:V<number>:GERan?
SENSe:LTE:SIGN<i>:UECapability:MEAS:IRNGaps:V<number>:CHRPd?
SENSe:LTE:SIGN<i>:UECapability:MEAS:IRNGaps:V<number>:CXRTt?

2.4.20.6 Inter-RAT UE Capabilities

This section indicates the inter-RAT handover capabilities of the UE.

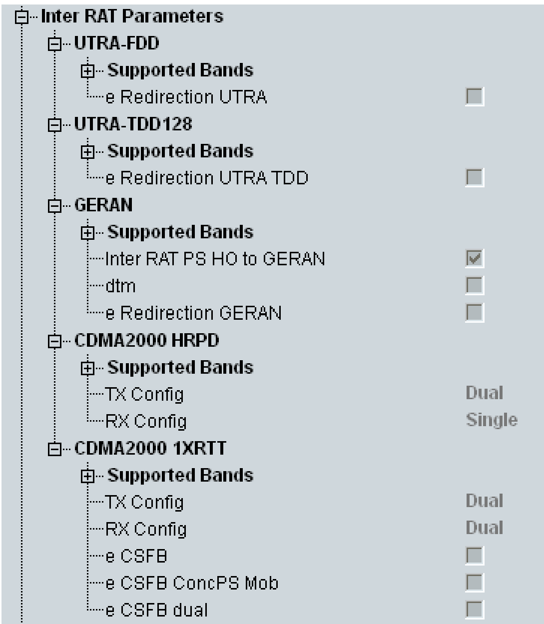


Fig. 2-96: Inter-RAT handover UE capabilities

UTRA-FDD

This node contains capability information for handover to UTRA FDD.

Supported Bands ← UTRA-FDD

Lists the supported UTRA FDD operating bands. Handover to these bands is supported by the UE.

Remote command:

`SENSe:LTE:SIGN<i>:UECapability:IRAT:UFDD:SUPPorted?`

e Redirection UTRA ← UTRA-FDD

Support of enhanced redirection to UTRA FDD, using system information provided upon redirection

Remote command:

`SENSe:LTE:SIGN<i>:UECapability:IRAT:UFDD:EREDirection:UTRA?`
`SENSe:LTE:SIGN<i>:UECapability:FAUeeutra:IRAT:EREDirection:UTRA?`
`SENSe:LTE:SIGN<i>:UECapability:TAUeeutra:IRAT:EREDirection:UTRA?`

UTRA-TDD128

This node contains capability information for handover to UTRA TDD with a chip rate of 1.28 Mcps.

Supported Bands ← UTRA-TDD128

Lists the supported UTRA TDD operating bands. Handover to these bands is supported by the UE.

Remote command:

`SENSe:LTE:SIGN<i>:UECapability:IRAT:UTDD128:SUPPorted?`

e Redirection UTRA TDD ← UTRA-TDD128
Support of enhanced redirection to UTRA TDD, using system information provided upon redirection.

Remote command:
`SENSe:LTE:SIGN<i>:UECapability:IRAT:UTDD128:EREDirection:UTDD?`
`SENSe:LTE:SIGN<i>:UECapability:FAUeeutra:IRAT:EREDirection:UTDD?`
`SENSe:LTE:SIGN<i>:UECapability:TAUeeutra:IRAT:EREDirection:UTDD?`

GERAN
This node contains capability information for handover to GERAN

Supported Bands ← GERAN
Lists the supported GERAN operating bands

Remote command:
`SENSe:LTE:SIGN<i>:UECapability:IRAT:GERan:SUPPorted?`
`SENSe:LTE:SIGN<i>:UECapability:FAUeeutra:IRAT:GERan:SUPPorted?`
`SENSe:LTE:SIGN<i>:UECapability:TAUeeutra:IRAT:GERan:SUPPorted?`

Inter-RAT PS HO to GERAN ← GERAN
Support of a handover to GERAN

Remote command:
`SENSe:LTE:SIGN<i>:UECapability:IRAT:GERan:PHGeran?`
`SENSe:LTE:SIGN<i>:UECapability:FAUeeutra:IRAT:GERan:PHGeran?`
`SENSe:LTE:SIGN<i>:UECapability:TAUeeutra:IRAT:GERan:PHGeran?`

dtm ← GERAN
Support of the Dual Transfer Mode (DTM) in GERAN

Remote command:
`SENSe:LTE:SIGN<i>:UECapability:IRAT:GERan:DTM?`

e Redirection GERAN ← GERAN
Support of an enhanced redirection to GERAN, using system information provided upon redirection

Remote command:
`SENSe:LTE:SIGN<i>:UECapability:IRAT:GERan:EREDirection?`

CDMA2000 HRPD
This node contains capability information for handover to CDMA2000 HRPD.

Supported Bands ← CDMA2000 HRPD
Lists the supported HRPD band classes

Remote command:
`SENSe:LTE:SIGN<i>:UECapability:IRAT:CHRPd:SUPPorted?`

TX Config ← CDMA2000 HRPD
Support of single/dual transmitter. Dual transmitter allows the UE to transmit simultaneously on E-UTRAN and HRPD.

Remote command:
SENSe:LTE:SIGN<i>:UECapability:IRAT:CHRPd:TCONfig?

RX Config ← CDMA2000 HRPD
Support of single/dual receiver. Dual receiver allows the UE to receive simultaneously on E-UTRAN and HRPD.

Remote command:
SENSe:LTE:SIGN<i>:UECapability:IRAT:CHRPd:RCONfig?

CDMA2000 1xRTT
This node contains capability information for handover to CDMA2000 1xRTT.

Supported Bands ← CDMA2000 1xRTT
Lists the supported 1xRTT band classes

Remote command:
SENSe:LTE:SIGN<i>:UECapability:IRAT:CXRTt:SUPPorted?

TX Config ← CDMA2000 1xRTT
Support of single/dual transmitter. Dual transmitter allows the UE to transmit simultaneously on E-UTRAN and 1xRTT.

Remote command:
SENSe:LTE:SIGN<i>:UECapability:IRAT:CXRTt:TCONfig?

RX Config ← CDMA2000 1xRTT
Support of single/dual receiver. Dual receiver allows the UE to receive simultaneously on E-UTRAN and 1xRTT.

Remote command:
SENSe:LTE:SIGN<i>:UECapability:IRAT:CXRTt:RCONfig?

e CSFB ← CDMA2000 1xRTT
Support of enhanced CS fallback to CDMA2000 1xRTT

Remote command:
SENSe:LTE:SIGN<i>:UECapability:IRAT:CXRTt:ECSFb?
SENSe:LTE:SIGN<i>:UECapability:FAUeeutra:IRAT:CXRTt:ECSFb?
SENSe:LTE:SIGN<i>:UECapability:TAUeeutra:IRAT:CXRTt:ECSFb?

e CSFB ConcPS Mob ← CDMA2000 1xRTT
Support of concurrent enhanced CS fallback to CDMA2000 1xRTT and handover/redirection to CDMA2000 HRPD

Remote command:
SENSe:LTE:SIGN<i>:UECapability:IRAT:CXRTt:ECCMob?
SENSe:LTE:SIGN<i>:UECapability:FAUeeutra:IRAT:CXRTt:ECCMob?
SENSe:LTE:SIGN<i>:UECapability:TAUeeutra:IRAT:CXRTt:ECCMob?

e CSFB dual ← CDMA2000 1xRTT

Support of enhanced CS fallback to CDMA2000 1xRTT for dual Rx/Tx configuration

Remote command:

SENSe:LTE:SIGN<i>:UECapability:IRAT:CXRTt:ECDual?
SENSe:LTE:SIGN<i>:UECapability:FAUeeutra:IRAT:CXRTt:ECDual?
SENSe:LTE:SIGN<i>:UECapability:TAUeeutra:IRAT:CXRTt:ECDual?

2.4.20.7 CSG Proximity Indication Capabilities

This section indicates the support of proximity indications by the UE.

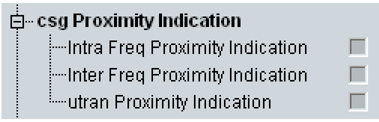


Fig. 2-97: Proximity Indication capabilities

Intra Freq Proximity Indication

Support of proximity indications for intra-frequency E-UTRAN CSG member cells

Remote command:

SENSe:LTE:SIGN<i>:UECapability:CPINdication:FREQuency:INTRa?

Inter Freq Proximity Indication

Support of proximity indications for inter-frequency E-UTRAN CSG member cells

Remote command:

SENSe:LTE:SIGN<i>:UECapability:CPINdication:FREQuency:INTer?

utran Proximity Indication

Support of proximity indications for UTRAN CSG member cells

Remote command:

SENSe:LTE:SIGN<i>:UECapability:CPINdication:UTRan?

2.4.20.8 Neighbor Cell SI-Acquisition Capabilities

This section indicates whether the UE supports system information requests for handover. When the UE receives such a request, it shall use autonomous gaps to read and report the system information of neighbor cells.

Fig. 2-98: SI-Acquisition capabilities

Intra Freq SI-Acquisition for HO

Support of system information acquisition for intra-frequency neighbor cells

Remote command:

SENSe:LTE:SIGN<i>:UECapability:NCSacq:FREQuency:INTRa?
SENSe:LTE:SIGN<i>:UECapability:FAUeeutra:NCSacq:FREQuency:INTRa?
SENSe:LTE:SIGN<i>:UECapability:TAUeeutra:NCSacq:FREQuency:INTRa?

Inter Freq SI-Acquisition for HO

Support of system information acquisition for inter-frequency neighbor cells

Remote command:

SENSe:LTE:SIGN<i>:UECapability:NCSacq:FREQuency:INTer?
SENSe:LTE:SIGN<i>:UECapability:FAUeeutra:NCSacq:FREQuency:INTer?
SENSe:LTE:SIGN<i>:UECapability:TAUeeutra:NCSacq:FREQuency:INTer?

utran SI-Acquisition for HO

Support of system information acquisition for UMTS neighbor cells

Remote command:

SENSe:LTE:SIGN<i>:UECapability:NCSacq:UTRan?
SENSe:LTE:SIGN<i>:UECapability:FAUeeutra:NCSacq:UTRan?
SENSe:LTE:SIGN<i>:UECapability:TAUeeutra:NCSacq:UTRan?

2.4.20.9 UE Based Network Performance Measurement Capabilities

This section indicates UE capabilities for UE-based network performance measurements.

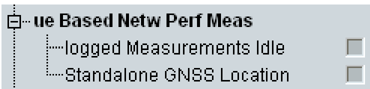


Fig. 2-99: Network Performance Measurement capabilities

logged Measurements Idle

Support of logged measurements in idle mode

Remote command:

SENSe:LTE:SIGN<i>:UECapability:UBNPmeas:LMIDle?

Standalone GNSS Location

Indicates whether the UE is equipped with a GNSS receiver or not

Remote command:

SENSe:LTE:SIGN<i>:UECapability:UBNPmeas:SGLocation?

2.4.20.10 FDD/TDD Additional E-UTRA Capabilities

The capability report sections "fdd-Add-UE-EUTRA-Capabilities" and "tdd-Add-UE-EUTRA-Capabilities" are only relevant for UEs that support both FDD and TDD.

In that case, the previous sections contain information that applies to FDD and TDD. Features that are indicated as supported are supported in both modes.

The additional section "fdd-Add-UE-EUTRA-Capabilities" contains a subset of the parameters described in the previous sections. If a feature is listed as supported, it means that this feature is only supported for FDD but not for TDD.

The additional section "tdd-Add-UE-EUTRA-Capabilities" contains the same subset of parameters. If a feature is listed as supported, it means that this feature is only supported for TDD but not for FDD.

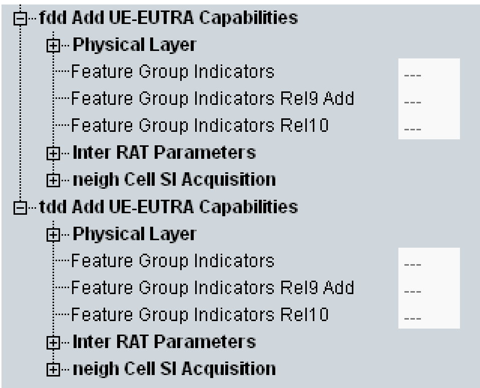


Fig. 2-100: Additional FDD/TDD-only capabilities

For the description of the individual parameters, refer to the previous sections. The remote control commands for the additional sections are also referenced there.

2.5 Programming

The following sections provide programming examples for the LTE signaling application.

The examples contain SCPI commands supported by the R&S CMW and the following symbolic scripting commands:

- // <comment>:
  A <comment> ignored by the used programming tool
- WHILE <query> <> <value>:
  Waits until the <query> returns a certain <value>, e.g. a specific state is reached.
- WAITKEY <message>:
  Displays a dialog box with a <message> and waits until the box is closed by the user.

See also: "Remote Control" in the R&S CMW user manual

2.5.1 General Configuration

The LTE signaling application is programmed as follows:

- The application is controlled by SCPI commands with the following syntax: `...:LTE:SIGN:...`
- After a `*RST`, the DL signal is switched off.
  To activate the DL signal, use `SOURce:LTE:SIGN:CELL:STATe ON`.
  Query the cell state using `SOURce:LTE:SIGN:CELL:STATe:ALL?`. The result `ON,ADJ` indicates that the DL signal is available.
- To initiate a connection setup, use `CALL:LTE:SIGN:PSWitched:ACTion CONNect`.
  To query the connection state, use `FETCh:LTE:SIGN:PSWitched:STATe?`.

2.5.1.1 Initialization

```
// *****************************************************************************
// System-Reset
// *****************************************************************************
*RST; *OPC?
*CLS; *OPC?
```

2.5.1.2 Selecting a Scenario

Each scenario is activated via a different `ROUTe` command. Some examples are given in this section.

Each of the following command blocks activates a scenario, selects the related signal paths and configures the related external attenuations. Execute only one command block.

```
// *****************************************************************************
// SISO, no CA, no fading
// *****************************************************************************
ROUTe:LTE:SIGN:SCENario:SCELl RF2C,RX1,RF2C,TX1
CONFigure:LTE:SIGN:RFSettings:EATTenuation:OUTPut 2
CONFigure:LTE:SIGN:RFSettings:EATTenuation:INPut 2

// *****************************************************************************
// MIMO 4x2, no CA, internal fading
// *****************************************************************************
ROUTe:LTE:SIGN:SCENario:MTFading:INTernal RF1C,RX1,RF1C,TX1,RF3C,TX2
CONFigure:LTE:SIGN:RFSettings:EATTenuation:OUTPut1 2
CONFigure:LTE:SIGN:RFSettings:EATTenuation:OUTPut2 2
CONFigure:LTE:SIGN:RFSettings:EATTenuation:INPut 2
```

```
// *****************************************************************************
// SISO, DL CA, two carriers, external fading
// *****************************************************************************
ROUTe:LTE:SIGN:SCENario:CATF RF1C,RX1,RF1C,TX1,IQ2O,RF3C,TX2,IQ4O
CONFigure:LTE:SIGN:RFSettings:PCC:EATTenuation:OUTPut 2
CONFigure:LTE:SIGN:RFSettings:SCC:EATTenuation:OUTPut 2
CONFigure:LTE:SIGN:RFSettings:PCC:EATTenuation:INPut 2

// *****************************************************************************
// MIMO nx2, DL CA, two carriers, internal fading
// *****************************************************************************
ROUTe:LTE:SIGN:SCENario:CAFF:INT RF1C,RX1,RF1C,TX1,RF2C,TX3,RF3C,TX2,RF4C,TX4
CONFigure:LTE:SIGN:RFSettings:PCC:EATTenuation:OUTPut1 2
CONFigure:LTE:SIGN:RFSettings:PCC:EATTenuation:OUTPut2 2
CONFigure:LTE:SIGN:RFSettings:SCC:EATTenuation:OUTPut1 2
CONFigure:LTE:SIGN:RFSettings:SCC:EATTenuation:OUTPut2 2
CONFigure:LTE:SIGN:RFSettings:PCC:EATTenuation:INPut 2

// *****************************************************************************
// DL CA, three carriers, SCC1 MIMO nx2, PCC/SCC2 SISO, no fading
// *****************************************************************************
ROUTe:LTE:SIGN:SCENario:CCTHree:SMIMo:RFFour
    RF2C,RX3,RF2C,TX3,RF1C,TX1,RF3C,TX2,RF4C,TX4
CONFigure:LTE:SIGN:RFSettings:PCC:EATTenuation:OUTPut1 2
CONFigure:LTE:SIGN:RFSettings:SCC1:EATTenuation:OUTPut1 2
CONFigure:LTE:SIGN:RFSettings:SCC1:EATTenuation:OUTPut2 2
CONFigure:LTE:SIGN:RFSettings:SCC2:EATTenuation:OUTPut1 2
CONFigure:LTE:SIGN:RFSettings:PCC:EATTenuation:INPut 2
```

2.5.1.3 Specifying General Settings

```
// *****************************************************************************
// Select duplex mode FDD, automatic SCC activation mode and disable audio tests
// *****************************************************************************
CONFigure:LTE:SIGN:DMODe FDD
CONFigure:LTE:SIGN:SCC:AMODe AUTO
CONFigure:LTE:SIGN:ESCode OFF

// *****************************************************************************
// Define time delay to be compensated in output and input paths.
// *****************************************************************************
CONFigure:LTE:SIGN:RFSettings:EDC:OUTPut 5E-9
CONFigure:LTE:SIGN:RFSettings:EDC:INPut 5E-9

// *****************************************************************************
// Specify PCC operating band plus DL channel number and query the
// automatically calculated UL channel number and the UL frequency in Hz.
// Configure PCC frequency offsets for DL and UL.
```

```
// Configure SCC1 band, channel and frequency offset.
// ****************************************************************************
CONFigure:LTE:SIGN:PCC:BAND OB7
CONFigure:LTE:SIGN:RFSettings:PCC:CHANnel:DL 3000 ;UL?
CONFigure:LTE:SIGN:RFSettings:PCC:CHANnel:UL? Hz
CONFigure:LTE:SIGN:RFSettings:PCC:FOFFset:DL 100
CONFigure:LTE:SIGN:RFSettings:PCC:FOFFset:UL -200
CONFigure:LTE:SIGN:SCC:BAND OB7
CONFigure:LTE:SIGN:RFSettings:SCC:CHANnel:DL 3100
CONFigure:LTE:SIGN:RFSettings:PCC:FOFFset:DL:UCSPecific ON
CONFigure:LTE:SIGN:RFSettings:SCC:FOFFset:DL 200

// ****************************************************************************
// Configure the PCC user-defined band: UL/DL separation, band indicator,
// minimum and maximum DL and UL channel numbers
// and carrier center frequencies corresponding to these channel numbers.
// Configure the SCC1 user-defined band.
// ****************************************************************************
CONFigure:LTE:SIGN:RFSettings:PCC:UDEFined:UDSeparation 200E+6
CONFigure:LTE:SIGN:RFSettings:PCC:UDEFined:BINDicator 3
CONFigure:LTE:SIGN:RFSettings:PCC:UDEFined:CHANnel:DL:MINimum 1200
CONFigure:LTE:SIGN:RFSettings:PCC:UDEFined:CHANnel:DL:MAXimum 2000
CONFigure:LTE:SIGN:RFSettings:PCC:UDEFined:CHANnel:UL:MINimum 17000
CONFigure:LTE:SIGN:RFSettings:PCC:UDEFined:CHANnel:UL:MAXimum?
CONFigure:LTE:SIGN:RFSettings:PCC:UDEFined:FREQuency:DL:MINimum 1E+9
CONFigure:LTE:SIGN:RFSettings:PCC:UDEFined:FREQuency:DL:MAXimum?
CONFigure:LTE:SIGN:RFSettings:PCC:UDEFined:FREQuency:UL:MINimum?
CONFigure:LTE:SIGN:RFSettings:PCC:UDEFined:FREQuency:UL:MAXimum?

CONFigure:LTE:SIGN:RFSettings:SCC:UDEFined:BINDicator 4
CONFigure:LTE:SIGN:RFSettings:SCC:UDEFined:CHANnel:DL:MINimum 1900
CONFigure:LTE:SIGN:RFSettings:SCC:UDEFined:CHANnel:DL:MAXimum 2400
CONFigure:LTE:SIGN:RFSettings:SCC:UDEFined:FREQuency:DL:MINimum 1E+9
CONFigure:LTE:SIGN:RFSettings:SCC:UDEFined:FREQuency:DL:MAXimum?

// ****************************************************************************
// Select manual expected nominal power mode and specify the expected power,
// the user margin and the mixer level offset.
// ****************************************************************************
CONFigure:LTE:SIGN:RFSettings:ENPMode MANual
CONFigure:LTE:SIGN:RFSettings:ENPower -25
CONFigure:LTE:SIGN:RFSettings:UMARgin 3
CONFigure:LTE:SIGN:RFSettings:MLOFfset 1
```

2.5.1.4 Configuring Internal Fading

```
// ****************************************************************************
// Configure the fading simulator for the PCC downlink:
// Enable it, select a fading profile, start fading automatically,
```

```
// set start seed, calculate insertion loss automatically,
// specify max Doppler frequency.
// Configure the SCC1 downlink.
// ****************************************************************************
CONFigure:LTE:SIGN:FADing:PCC:FSIMulator:ENABle ON
CONFigure:LTE:SIGN:FADing:PCC:FSIMulator:STANdard EP5Low
CONFigure:LTE:SIGN:FADing:PCC:FSIMulator:RESTart:MODE AUTO
CONFigure:LTE:SIGN:FADing:PCC:FSIMulator:GLOBal:SEED 0
CONFigure:LTE:SIGN:FADing:PCC:FSIMulator:ILOSs:MODE NORMal
CONFigure:LTE:SIGN:FADing:PCC:FSIMulator:DSHift:MODE USER
CONFigure:LTE:SIGN:FADing:PCC:FSIMulator:DSHift 6

CONFigure:LTE:SIGN:FADing:SCC:FSIMulator:ENABle ON
CONFigure:LTE:SIGN:FADing:SCC:FSIMulator:STANdard EP5Low
CONFigure:LTE:SIGN:FADing:SCC:FSIMulator:RESTart:MODE AUTO
CONFigure:LTE:SIGN:FADing:SCC:FSIMulator:GLOBal:SEED 0
CONFigure:LTE:SIGN:FADing:SCC:FSIMulator:ILOSs:MODE NORMal
CONFigure:LTE:SIGN:FADing:SCC:FSIMulator:DSHift:MODE USER
CONFigure:LTE:SIGN:FADing:SCC:FSIMulator:DSHift 6

// ****************************************************************************
// Configure AWGN insertion for the PCC downlink:
// Enable AWGN, set min noise/system BW ratio, set signal to noise ratio
// and query calculated noise power.
// Configure the SCC1 downlink.
// ****************************************************************************
CONFigure:LTE:SIGN:FADing:PCC:AWGN:ENABle ON
CONFigure:LTE:SIGN:FADing:PCC:AWGN:BWIDth:RATio 1
CONFigure:LTE:SIGN:FADing:PCC:AWGN:SNRatio 1
CONFigure:LTE:SIGN:FADing:PCC:POWer:NOISe?

CONFigure:LTE:SIGN:FADing:SCC:AWGN:ENABle ON
CONFigure:LTE:SIGN:FADing:SCC:AWGN:BWIDth:RATio 1
CONFigure:LTE:SIGN:FADing:SCC:AWGN:SNRatio 1
CONFigure:LTE:SIGN:FADing:SCC:POWer:NOISe?
```

2.5.1.5 Configuring DL Power Levels

The following commands configure the PCC. To configure the SCC number <n>, substitute `:PCC:` by `:SCC<n>:` (`:SSC1:`, `:SCC2:`, ...).

```
// ****************************************************************************
// Define the RS EPRE level and the power of the DL channels and signals
// relative to the RS EPRE level. Query full cell BW power.
// ****************************************************************************
CONFigure:LTE:SIGN:DL:PCC:RSEPre:LEVel -80
CONFigure:LTE:SIGN:DL:PCC:PSS:POFFset -3
CONFigure:LTE:SIGN:DL:PCC:SSS:POFFset -3
CONFigure:LTE:SIGN:DL:PCC:PBCH:POFFset 0
CONFigure:LTE:SIGN:DL:PCC:PCFich:POFFset 0
```

```
CONFigure:LTE:SIGN:DL:PCC:PHICh:POFFset 0
CONFigure:LTE:SIGN:DL:PCC:PDCCh:POFFset -3
SENSe:LTE:SIGN:DL:PCC:FCPower?

// *****************************************************************************
// Enable the OFDMA channel noise generator.
// *****************************************************************************
CONFigure:LTE:SIGN:DL:PCC:OCNG ON

// *****************************************************************************
// Define power offset and power ratio index
// for calculation of the PDSCH power level.
// *****************************************************************************
CONFigure:LTE:SIGN:DL:PCC:PDSCh:PA ZERO
CONFigure:LTE:SIGN:DL:PCC:PDSCh:RINDex 1

// *****************************************************************************
// Define the AWGN power level (also activates the AWGN interferer).
// *****************************************************************************
CONFigure:LTE:SIGN:DL:PCC:AWGN -100
```

2.5.1.6 Configuring UL Power Control for Call Setup

```
// *****************************************************************************
// Define the open loop nominal power directly (basic UL power configuration).
// Query the resulting parameter values signaled to the UE.
// *****************************************************************************
CONFigure:LTE:SIGN:UL:OLNPower -30
SENSe:LTE:SIGN:UL:APPower:RSPower:BASic?
SENSe:LTE:SIGN:UL:APPower:PIRPower:BASic?
SENSe:LTE:SIGN:UL:APPower:PNPusch:BASic?
SENSe:LTE:SIGN:UL:APPower:PCALpha:BASic?
SENSe:LTE:SIGN:UL:APPower:TPRRcsetup:BASic?

// *****************************************************************************
// Alternatively enable advanced UL power configuration,
// define the parameter values to be signaled to the UE and
// query values calculated from the parameters.
// *****************************************************************************
CONFigure:LTE:SIGN:UL:APPower:EASettings ON
CONFigure:LTE:SIGN:UL:APPower:RSPower:ADVanced 15
CONFigure:LTE:SIGN:UL:APPower:PIRPower:ADVanced -100
CONFigure:LTE:SIGN:UL:APPower:PNPusch:ADVanced -81
CONFigure:LTE:SIGN:UL:APPower:PCALpha:ADVanced DOT7
CONFigure:LTE:SIGN:UL:APPower:TPRRcsetup:ADVanced OFF
SENSe:LTE:SIGN:UL:APPower:PATHloss?
SENSe:LTE:SIGN:UL:APPower:EPPPower?
SENSe:LTE:SIGN:UL:APPower:EOPower?
```

```
// ****************************************************************************
// Define maximum allowed UE power.
// ****************************************************************************
CONFigure:LTE:SIGN:UL:PMAX 3
```

2.5.1.7 Configuring Physical Cell Setup

```
// ****************************************************************************
// Define channel bandwidth and physical cell ID for PCC and SCC1.
// Select cyclic prefix and configure normal uplink signal (not SRS).
// Configure srs-SubframeConfig and srs-ConfigIndex manually.
// Use UL/DL configuration 1 and special subframe configuration 5.
// ****************************************************************************
CONFigure:LTE:SIGN:CELL:BANDwidth:PCC:DL B100
CONFigure:LTE:SIGN:CELL:BANDwidth:SCC:DL B100
CONFigure:LTE:SIGN:CELL:PCC:PCID 10
CONFigure:LTE:SIGN:CELL:SCC:PCID 15
CONFigure:LTE:SIGN:CELL:CPRefix NORM
CONFigure:LTE:SIGN:CELL:SRS:ENABle OFF
CONFigure:LTE:SIGN:CELL:SRS:MCENable ON
CONFigure:LTE:SIGN:CELL:SRS:SFConfig 3
CONFigure:LTE:SIGN:CELL:SRS:SCINdex:TDD 0
CONFigure:LTE:SIGN:CELL:SRS:SCINdex:FDD 7
CONFigure:LTE:SIGN:CELL:ULDL 1
CONFigure:LTE:SIGN:CELL:SSUBframe 5

// ****************************************************************************
// PRACH settings: answer preambles, set power step size,
// PRACH configuration index, frequency offset,
// logical root sequence index and zero correlation zone config.
// ****************************************************************************
CONFigure:LTE:SIGN:CELL:PRACh:NRPReambles OFF
CONFigure:LTE:SIGN:CELL:PRACh:PRSTep P4DB
CONFigure:LTE:SIGN:CELL:PRACh:PCINdex:FDD 15
CONFigure:LTE:SIGN:CELL:PRACh:PCINdex:TDD 15
CONFigure:LTE:SIGN:CELL:PRACh:PFOFfset 10
CONFigure:LTE:SIGN:CELL:PRACh:LRSindex 120
CONFigure:LTE:SIGN:CELL:PRACh:ZCZConfig 5
```

2.5.1.8 Configuring Network Settings

```
// ****************************************************************************
// Specify 2 neighbor cell entries for LTE, GSM, WCDMA, CDMA2000,
// 1xEV-DO and TD-SCDMA.
// ****************************************************************************
CONFigure:LTE:SIGN:NCELl:LTE:CELL1 ON, OB1, 10, 1, ZERO, ON
CONFigure:LTE:SIGN:NCELl:LTE:CELL2 ON, OB2, 700, 3, P1, OFF
CONFigure:LTE:SIGN:NCELl:GSM:CELL1 ON, G09, 0, ON
CONFigure:LTE:SIGN:NCELl:GSM:CELL2 ON, G09, 124, OFF
```

```
CONFigure:LTE:SIGN:NCELl:WCDMa:CELL1 ON, OB1, 10562, #H10A, ON
CONFigure:LTE:SIGN:NCELl:WCDMa:CELL2 ON, OB2, 412, #H10B, OFF
CONFigure:LTE:SIGN:NCELl:CDMA:CELL1 ON, USC, 1, 5, ON
CONFigure:LTE:SIGN:NCELl:CDMA:CELL2 ON, USC, 799, 6, OFF
CONFigure:LTE:SIGN:NCELl:EVDO:CELL1 ON, USC, 1, 5, ON
CONFigure:LTE:SIGN:NCELl:EVDO:CELL2 ON, USC, 799, 6, OFF
CONFigure:LTE:SIGN:NCELl:TDSCdma:CELL1 ON, OB1, 9500, #H1, ON
CONFigure:LTE:SIGN:NCELl:TDSCdma:CELL2 ON, OB2, 10100, #H2, ON

// *****************************************************************************
// Specify neighbor cell reselection thresholds per technology.
// *****************************************************************************
CONFigure:LTE:SIGN:NCELl:LTE:THResholds:LOW 5
CONFigure:LTE:SIGN:NCELl:GSM:THResholds:LOW 5
CONFigure:LTE:SIGN:NCELl:WCDMa:THResholds:LOW 5
CONFigure:LTE:SIGN:NCELl:CDMA:THResholds:LOW 10
CONFigure:LTE:SIGN:NCELl:EVDO:THResholds:LOW 10
CONFigure:LTE:SIGN:NCELl:TDSCdma:THResholds:LOW 5

// *****************************************************************************
// Specify general reselection parameters for the cell.
// *****************************************************************************
CONFigure:LTE:SIGN:CELL:RESelection:SEARch:INTRasearch OFF
CONFigure:LTE:SIGN:CELL:RESelection:SEARch:NINTrasearch OFF
CONFigure:LTE:SIGN:CELL:RESelection:TSLow 14
CONFigure:LTE:SIGN:CELL:RESelection:QUALity:RXLevmin -130

// *****************************************************************************
// Specify MCC, 2-digit MNC and tracking area code.
// Configure E-UTRAN cell ID for PCC and SCC1.
// *****************************************************************************
CONFigure:LTE:SIGN:CELL:MCC 262
CONFigure:LTE:SIGN:CELL:MNC 30
CONFigure:LTE:SIGN:CELL:MNC:DIGits TWO
CONFigure:LTE:SIGN:CELL:TAC 1384
CONFigure:LTE:SIGN:CELL:PCC:CID:EUTRan #B10000010001000
CONFigure:LTE:SIGN:CELL:SCC:CID:EUTRan #B10000010001001

// *****************************************************************************
// Enable authentication, NAS security, AS security and milenage.
// Define integrity algorithm, OPc, secret key and RAND mode.
// *****************************************************************************
CONFigure:LTE:SIGN:CELL:SECurity:AUTHenticat ON
CONFigure:LTE:SIGN:CELL:SECurity:NAS ON
CONFigure:LTE:SIGN:CELL:SECurity:AS ON
CONFigure:LTE:SIGN:CELL:SECurity:MILenage ON
CONFigure:LTE:SIGN:CELL:SECurity:IALGorithm S3G
CONFigure:LTE:SIGN:CELL:SECurity:OPC #H000010B00091006000F00000A0005000
CONFigure:LTE:SIGN:CELL:SECurity:SKEY #H000102030405060708090A0B0C0D0E0F
CONFigure:LTE:SIGN:CELL:SECurity:RVALue EVEN
```

```
// ****************************************************************************
// Configure timers.
// ****************************************************************************
CONFigure:LTE:SIGN:CELL:TOUT:OSYNch 40
CONFigure:LTE:SIGN:CELL:TOUT:T3412 180

// ****************************************************************************
// Configure NAS signaling settings:
// Disable sending of a DNS IP address to the UE, configure reject causes,
// enable IE "EPS Network Feature Support" and configure its contents.
// ****************************************************************************
CONFigure:LTE:SIGN:CONNection:SDNSpco OFF
CONFigure:LTE:SIGN:CELL:RCAuse:ATTach CONG22
CONFigure:LTE:SIGN:CELL:RCAuse:TAU TANA12
CONFigure:LTE:SIGN:CELL:NAS:EPSNetwork ON
CONFigure:LTE:SIGN:CELL:NAS:IMSVops NSUP
CONFigure:LTE:SIGN:CELL:NAS:EMCBs SUPP
CONFigure:LTE:SIGN:CELL:NAS:EPCLcs NSUP
CONFigure:LTE:SIGN:CELL:NAS:CSLCs NINF

// ****************************************************************************
// Synchronize the signaling application and the PCC to zone 1.
// Apply an offset of 30 µs to the SCC1.
// ****************************************************************************
CONFigure:LTE:SIGN:CELL:SYNC:ZONE 1
CONFigure:LTE:SIGN:CELL:PCC:SYNC:OFFSet 0
CONFigure:LTE:SIGN:CELL:SCC:SYNC:OFFSet 30E-6
```

2.5.1.9 Configuring General Connection Settings

```
// ****************************************************************************
// Enable group hopping and configure UE category manually.
// Select default paging cycle, additional spectrum emission requirements and
// filter coefficient.
// ****************************************************************************
CONFigure:LTE:SIGN:CONNection:GHOPping ON
CONFigure:LTE:SIGN:CONNection:UECategory:MANual 5
CONFigure:LTE:SIGN:CONNection:UECategory:REPorted OFF
CONFigure:LTE:SIGN:CONNection:DPCYcle P128
CONFigure:LTE:SIGN:CONNection:ASEMission NS02
CONFigure:LTE:SIGN:CONNection:FCOefficient FC4

// ****************************************************************************
// Set connection type and request test mode.
// Query default bearer RLC mode, allowed IP versions, APN and QCI.
// Configure SIB reconfiguration. Disable keeping the RRC connection with a
// timeout of 20 s.
// ****************************************************************************
```

```
CONFigure:LTE:SIGN:CONNection:CTYPe TEST
CONFigure:LTE:SIGN:CONNection:TMODe ON
CONFigure:LTE:SIGN:CONNection:RLCMode?
CONFigure:LTE:SIGN:CONNection:IPVersion?
CONFigure:LTE:SIGN:CONNection:APN?
CONFigure:LTE:SIGN:CONNection:QCI?
CONFigure:LTE:SIGN:CONNection:SIBReconfig RRCReconfig
CONFigure:LTE:SIGN:CONNection:KRRC OFF
CONFigure:LTE:SIGN:CONNection:RITimer 20

// *****************************************************************************
// Enable usage of external DAU and specify network segment and network ID
// of instrument with external DAU.
// *****************************************************************************
CONFigure:LTE:SIGN:CONNection:EDAU:ENABle ON
CONFigure:LTE:SIGN:CONNection:EDAU:NSEGment A
CONFigure:LTE:SIGN:CONNection:EDAU:NID 5

// *****************************************************************************
// Activate DL padding, insert 10% transport block errors,
// use redirection for intra-LTE handover,
// do not accept multiple default bearer requests, disable TTI bundling.
// *****************************************************************************
CONFigure:LTE:SIGN:CONNection:DLPadding ON
CONFigure:LTE:SIGN:CONNection:DLEinsertion 10
CONFigure:LTE:SIGN:CONNection:OBCHange REDirection
CONFigure:LTE:SIGN:CONNection:FCHange REDirection
CONFigure:LTE:SIGN:CONNection:AMDBearer OFF
CONFigure:LTE:SIGN:CONNection:TTIBundling OFF

// *****************************************************************************
// Enable header compression with profile 2 and 4.
// *****************************************************************************
CONFigure:LTE:SIGN:CONNection:ROHC:ENABle ON
CONFigure:LTE:SIGN:CONNection:ROHC:PROFiles OFF, ON, ON

// *****************************************************************************
// Set and query number of PDCCH symbols.
// Set PDCCH C-RNTI aggregation levels. Query all used aggregation levels.
// For PCC and SCC1.
// *****************************************************************************
CONFigure:LTE:SIGN:CONNection:PCC:PDCCh:SYMBol P3
SENSe:LTE:SIGN:CONNection:PCC:PDCCh:PSYMbols?
CONFigure:LTE:SIGN:CONNection:PCC:PDCCh:ALEVel AUTO
SENSe:LTE:SIGN:CONNection:PCC:PDCCh:ALEVel?

CONFigure:LTE:SIGN:CONNection:SCC:PDCCh:SYMBol P3
SENSe:LTE:SIGN:CONNection:SCC:PDCCh:PSYMbols?
CONFigure:LTE:SIGN:CONNection:SCC:PDCCh:ALEVel AUTO
SENSe:LTE:SIGN:CONNection:SCC:PDCCh:ALEVel?
```

```
// *****************************************************************************
// Configure GSM and WCDMA target for MO CSFB.
// Activate the GSM target.
// *****************************************************************************
CONFigure:LTE:SIGN:CONNection:CSFB:GSM G09, 1000, G18
CONFigure:LTE:SIGN:CONNection:CSFB:WCDMa OB1, 10600
CONFigure:LTE:SIGN:CONNection:CSFB:DESTination GSM

// *****************************************************************************
// Configure HARQ for the downlink: enable HARQ, allow 4 transmissions and
// specify user-defined redundancy version sequence.
// *****************************************************************************
CONFigure:LTE:SIGN:CONNection:HARQ:DL:ENABle ON
CONFigure:LTE:SIGN:CONNection:HARQ:DL:NHT 4
CONFigure:LTE:SIGN:CONNection:HARQ:DL:RVCSequence UDEF
CONFigure:LTE:SIGN:CONNection:HARQ:DL:UDSequence:LENGth 4
CONFigure:LTE:SIGN:CONNection:HARQ:DL:UDSequence 0,0,2,3

// *****************************************************************************
// Configure MIMO settings for PCC:
// Select mode 4 (closed loop spatial multiplexing), DCI format 2 and
// two transmit antennas (MIMO 2x2). Query resulting transmission scheme.
// Select precoding matrix.
// Enable and specify static channel model for MIMO 2x2.
// Specify static channel model for MIMO 4x2.
// Enable beamforming, configure dual-layer beamforming for TM 8 and configure
// the beamforming matrix.
// Configure the same settings for SCC1.
// *****************************************************************************
CONFigure:LTE:SIGN:CONNection:PCC:TRANsmission TM4
CONFigure:LTE:SIGN:CONNection:PCC:DCIFormat D2
CONFigure:LTE:SIGN:CONNection:PCC:NENBantennas TWO
SENSe:LTE:SIGN:CONNection:PCC:TSCHeme?
CONFigure:LTE:SIGN:CONNection:PCC:PMATrix PMI1
CONFigure:LTE:SIGN:CONNection:PCC:SCHModel:ENABle ON
CONFigure:LTE:SIGN:CONNection:PCC:SCHModel 0.9,0,45,0.1,45,0
CONFigure:LTE:SIGN:CONNection:PCC:SCHModel:MIMO42 0.1,0,0.2,0,0.3,0,0.4,270,
    0.4,270,0.3,90,0.2,90,0.1,180
CONFigure:LTE:SIGN:CONNection:PCC:BEAMforming:MODE ON
CONFigure:LTE:SIGN:CONNection:PCC:BEAMforming:NOLayers L2
CONFigure:LTE:SIGN:CONNection:PCC:BEAMforming:MATRix 0,0,0.4,0.6,270,15

CONFigure:LTE:SIGN:CONNection:SCC:TRANsmission TM4
CONFigure:LTE:SIGN:CONNection:SCC:DCIFormat D2
CONFigure:LTE:SIGN:CONNection:SCC:NENBantennas TWO
SENSe:LTE:SIGN:CONNection:SCC:TSCHeme?
CONFigure:LTE:SIGN:CONNection:SCC:PMATrix PMI1
CONFigure:LTE:SIGN:CONNection:SCC:SCHModel:ENABle ON
CONFigure:LTE:SIGN:CONNection:SCC:SCHModel 0.9,0,45,0.1,45,0
```

```
CONFigure:LTE:SIGN:CONNection:SCC:SCHModel:MIMO42 0.1,0,0.2,0,0.3,0,0.4,270,
    0.4,270,0.3,90,0.2,90,0.1,180
CONFigure:LTE:SIGN:CONNection:SCC:BEAMforming:MODE ON
CONFigure:LTE:SIGN:CONNection:SCC:BEAMforming:NOLayers L2
CONFigure:LTE:SIGN:CONNection:SCC:BEAMforming:MATRix 0,0,0.4,0.6,270,15

// *****************************************************************************
// Select user-defined channels as scheduling type for PCC and SCC1.
// *****************************************************************************
CONFigure:LTE:SIGN:CONNection:PCC:STYPe UDCH
CONFigure:LTE:SIGN:CONNection:SCC:STYPe UDCH
```

2.5.1.10 Configuring Connected DRX

```
// *****************************************************************************
// Enable connected DRX with user-defined settings and configure all settings.
// *****************************************************************************
CONFigure:LTE:SIGN:CONNection:CDRX:ENABle UDEF
CONFigure:LTE:SIGN:CONNection:CDRX:ODTimer PSF3
CONFigure:LTE:SIGN:CONNection:CDRX:ITIMer PSF80
CONFigure:LTE:SIGN:CONNection:CDRX:RTIMer PSF8
CONFigure:LTE:SIGN:CONNection:CDRX:LDCYcle SF80
CONFigure:LTE:SIGN:CONNection:CDRX:SOFFset 10
CONFigure:LTE:SIGN:CONNection:CDRX:SCENable ON
CONFigure:LTE:SIGN:CONNection:CDRX:SDCYcle SF5
CONFigure:LTE:SIGN:CONNection:CDRX:SCTimer 5
CONFigure:LTE:SIGN:CONNection:CDRX:UDSCheduling ON
```

2.5.1.11 Configuring RMCs

```
// *****************************************************************************
// Define 3GPP compliant RMCs: Select scheduling type,
// configure DL PCC RMC with 50 RBs and 16-QAM modulation,
// UL RMC with 12 RBs and QPSK modulation. The transport block size index
// is selected automatically.
// Configure the upper end of the channel bandwidth as RB position (not really
// relevant for DL - the 50 RBs use the entire bandwidth).
// Select version 1 of ambiguous RMCs.
// *****************************************************************************
CONFigure:LTE:SIGN:CONNection:PCC:STYPe RMC
CONFigure:LTE:SIGN:CONNection:PCC:RMC:DL N50,Q16,KEEP
CONFigure:LTE:SIGN:CONNection:PCC:RMC:RBPosition:DL HIGH
CONFigure:LTE:SIGN:CONNection:RMC:UL N12,QPSK,KEEP
CONFigure:LTE:SIGN:CONNection:RMC:RBPosition:UL HIGH
CONFigure:LTE:SIGN:CONNection:PCC:RMC:VERSion:DL 1

// *****************************************************************************
// Define the same RMC for the second MIMO downlink stream.
// *****************************************************************************
```

```
CONFigure:LTE:SIGN:CONNection:PCC:RMC:DL2 N50,Q16,KEEP
CONFigure:LTE:SIGN:CONNection:PCC:RMC:RBPosition:DL2 HIGH
CONFigure:LTE:SIGN:CONNection:PCC:RMC:VERSion:DL2 1

// *****************************************************************************
// Configure the same settings for the SCC1.
// *****************************************************************************
CONFigure:LTE:SIGN:CONNection:SCC:STYPe RMC
CONFigure:LTE:SIGN:CONNection:SCC:RMC:DL N50,Q16,KEEP
CONFigure:LTE:SIGN:CONNection:SCC:RMC:RBPosition:DL HIGH
CONFigure:LTE:SIGN:CONNection:SCC:RMC:VERSion:DL 1
CONFigure:LTE:SIGN:CONNection:SCC:RMC:DL2 N50,Q16,KEEP
CONFigure:LTE:SIGN:CONNection:SCC:RMC:RBPosition:DL2 HIGH
CONFigure:LTE:SIGN:CONNection:SCC:RMC:VERSion:DL2 1

// *****************************************************************************
// Instead of configuring the same settings for stream 1 and stream 2, you can
// apply the stream 1 settings to all streams and skip the "DL2" commands.
// *****************************************************************************
CONFigure:LTE:SIGN:CONNection:PCC:DLEQual ON
CONFigure:LTE:SIGN:CONNection:SCC:DLEQual ON
```

2.5.1.12 Configuring User-Defined Channels

```
// *****************************************************************************
// Specify user-defined channels: Select scheduling type,
// configure DL PCC channel with 15 RBs starting with RB number 12,
// 64-QAM modulation, TBS index 26. UL channel with 12 RBs starting with
// RB number 21, QPSK modulation, TBS index 19.
// Query the resulting maximum expected throughput and the code rate.
// *****************************************************************************
CONFigure:LTE:SIGN:CONNection:PCC:STYPe UDCHannels
CONFigure:LTE:SIGN:CONNection:PCC:UDCHannels:DL1 15,12,Q64,26
CONFigure:LTE:SIGN:CONNection:UDCHannels:UL 12,21,QPSK,9
SENSe:LTE:SIGN:CONNection:ETHRoughput:UL?
SENSe:LTE:SIGN:CONNection:ETHRoughput:DL:PCC:STReam1?
SENSe:LTE:SIGN:CONNection:UDCHannels:UL:CRATe:ALL?
SENSe:LTE:SIGN:CONNection:PCC:UDCHannels:DL1:CRATe:ALL?

// *****************************************************************************
// Define the same user-defined channel for the second MIMO downlink stream.
// Query the resulting maximum expected throughput for that stream and for
// both PCC downlink streams together. Query the code rate.
// *****************************************************************************
CONFigure:LTE:SIGN:CONNection:PCC:UDCHannels:DL2 15,12,Q64,26
SENSe:LTE:SIGN:CONNection:ETHRoughput:DL:PCC:STReam2?
SENSe:LTE:SIGN:CONNection:ETHRoughput:DL:PCC?
SENSe:LTE:SIGN:CONNection:PCC:UDCHannels:DL2:CRATe:ALL?
```

```
// *****************************************************************************
// Configure the same user-defined channel for the SCC1.
// Query the code rates for the streams.
// Query the maximum expected throughput for each SCC1 stream, for the sum of
// the SCC1 streams and for the sum of all PCC and SCC streams.
// *****************************************************************************
CONFigure:LTE:SIGN:CONNection:SCC:STYPe UDCHannels
CONFigure:LTE:SIGN:CONNection:SCC:UDCHannels:DL1 15,12,Q64,26
CONFigure:LTE:SIGN:CONNection:SCC:UDCHannels:DL2 15,12,Q64,26
SENSe:LTE:SIGN:CONNection:SCC:UDCHannels:DL1:CRATe:ALL?
SENSe:LTE:SIGN:CONNection:SCC:UDCHannels:DL2:CRATe:ALL?
SENSe:LTE:SIGN:CONNection:ETHRoughput:DL:SCC:STReam1?
SENSe:LTE:SIGN:CONNection:ETHRoughput:DL:SCC:STReam2?
SENSe:LTE:SIGN:CONNection:ETHRoughput:DL:SCC?
SENSe:LTE:SIGN:CONNection:ETHRoughput:DL:ALL?

// *****************************************************************************
// Instead of configuring the same settings for stream 1 and stream 2, you can
// apply the stream 1 settings to all streams and skip the "DL2" commands.
// *****************************************************************************
CONFigure:LTE:SIGN:CONNection:PCC:DLEQual ON
CONFigure:LTE:SIGN:CONNection:SCC:DLEQual ON
```

2.5.1.13 Configuring TTI-Based User-Defined Channels

```
// *****************************************************************************
// TTI-based user-defined channels: Select scheduling type,
// configure subframe number 3 and 4, UL and both PCC DL streams.
// *****************************************************************************
CONFigure:LTE:SIGN:CONNection:PCC:STYPe UDTTibased
CONFigure:LTE:SIGN:CONNection:UDTTibased:UL 3,12,21,QPSK,9
CONFigure:LTE:SIGN:CONNection:UDTTibased:UL 4,12,21,QPSK,9
CONFigure:LTE:SIGN:CONNection:PCC:UDTTibased:DL1 3,15,12,Q64,26
CONFigure:LTE:SIGN:CONNection:PCC:UDTTibased:DL1 4,15,12,Q64,26
CONFigure:LTE:SIGN:CONNection:PCC:UDTTibased:DL2 3,15,12,Q64,26
CONFigure:LTE:SIGN:CONNection:PCC:UDTTibased:DL2 4,15,12,Q64,26

// *****************************************************************************
// TTI-based user-defined channels: configure all subframes for PCC DL stream 1
// decreasing number of RBs (50 to 3 for subframe 0 to 9),
// position approximately in middle of bandwidth (start RB = 0 to 24),
// all subframes use 64-QAM and TBS index 26.
// Configure the same settings for DL stream 2.
// Configure also the UL.
// Query the resulting code rates.
// *****************************************************************************
CONF:LTE:SIGN:CONN:PCC:UDTT:DL1:ALL 50,48,45,39,33,27,21,15,9,3,0,0,3,6,9,12,15,
18,21,24,Q64,Q64,Q64,Q64,Q64,Q64,Q64,Q64,Q64,Q64,26,26,26,26,26,26,26,26,26,26
CONF:LTE:SIGN:CONN:PCC:UDTT:DL2:ALL 50,48,45,39,33,27,21,15,9,3,0,0,3,6,9,12,15,
```

```
18,21,24,Q64,Q64,Q64,Q64,Q64,Q64,Q64,Q64,Q64,Q64,26,26,26,26,26,26,26,26,26,26
CONF:LTE:SIGN:CONN:UDTT:UL:ALL 50,45,40,36,30,24,18,12,8,3,0,2,5,7,10,13,16,19,
    21,24,Q16,Q16,Q16,Q16,Q16,Q16,Q16,Q16,Q16,Q16,19,19,19,19,19,19,19,19,19,19
SENSe:LTE:SIGN:CONNection:PCC:UDTTibased:DL1:CRATe:ALL?
SENSe:LTE:SIGN:CONNection:PCC:UDTTibased:DL2:CRATe:ALL?
SENSe:LTE:SIGN:CONNection:UDTTibased:UL:CRATe:ALL?

// *****************************************************************************
// Configure the same settings for the SCC1 and query the resulting code rates.
// *****************************************************************************
CONFigure:LTE:SIGN:CONNection:SCC:STYPe UDTTibased
CONFigure:LTE:SIGN:CONNection:SCC:UDTTibased:DL1 3,15,12,Q64,26
CONFigure:LTE:SIGN:CONNection:SCC:UDTTibased:DL1 4,15,12,Q64,26
CONFigure:LTE:SIGN:CONNection:SCC:UDTTibased:DL2 3,15,12,Q64,26
CONFigure:LTE:SIGN:CONNection:SCC:UDTTibased:DL2 4,15,12,Q64,26
CONF:LTE:SIGN:CONN:SCC:UDTT:DL1:ALL 50,48,45,39,33,27,21,15,9,3,0,0,3,6,9,12,15,
18,21,24,Q64,Q64,Q64,Q64,Q64,Q64,Q64,Q64,Q64,Q64,26,26,26,26,26,26,26,26,26,26
CONF:LTE:SIGN:CONN:SCC:UDTT:DL2:ALL 50,48,45,39,33,27,21,15,9,3,0,0,3,6,9,12,15,
18,21,24,Q64,Q64,Q64,Q64,Q64,Q64,Q64,Q64,Q64,Q64,26,26,26,26,26,26,26,26,26,26
SENSe:LTE:SIGN:CONNection:SCC:UDTTibased:DL1:CRATe:ALL?
SENSe:LTE:SIGN:CONNection:SCC:UDTTibased:DL2:CRATe:ALL?

// *****************************************************************************
// Instead of configuring the same settings for stream 1 and stream 2, you can
// apply the stream 1 settings to all streams and skip the "DL2" commands.
// *****************************************************************************
CONFigure:LTE:SIGN:CONNection:PCC:DLEQual ON
CONFigure:LTE:SIGN:CONNection:SCC:DLEQual ON
```

2.5.1.14 Configuring CQI DL Channels

The following commands configure the PCC. To configure the SCC number <n>, substitute `:PCC:` by `:SCC<n>:`.

```
// *****************************************************************************
// Fixed CQI downlink channels: Select scheduling type.
// Configure subframe number 3 and 4, both PCC DL streams.
// For uplink see TTI-based user-defined channels.
// *****************************************************************************
CONFigure:LTE:SIGN:CONNection:PCC:STYPe CQI, TTIBased
CONFigure:LTE:SIGN:CONNection:PCC:FCTTibased:DL1 3,15,12,10
CONFigure:LTE:SIGN:CONNection:PCC:FCTTibased:DL1 4,15,12,10
CONFigure:LTE:SIGN:CONNection:PCC:FCTTibased:DL2 3,15,12,10
CONFigure:LTE:SIGN:CONNection:PCC:FCTTibased:DL2 4,15,12,10

// *****************************************************************************
// Fixed CQI downlink channels - configure all subframes for PCC DL stream 1:
// decreasing number of RBs (50 to 3 for subframe 0 to 9),
// position approximately in middle of bandwidth (start RB = 0 to 24),
// CQI index from 15 to 6.
```

```
// Configure the same settings for DL stream 2.
// ******************************************************************************
CONF:LTE:SIGN:CONN:PCC:FCTT:DL1:ALL 50,48,45,39,33,27,21,15,9,3,0,0,3,6,9,12,15,
    18,21,24,15,14,13,12,11,10,9,8,7,6
CONF:LTE:SIGN:CONN:PCC:FCTT:DL2:ALL 50,48,45,39,33,27,21,15,9,3,0,0,3,6,9,12,15,
    18,21,24,15,14,13,12,11,10,9,8,7,6

// ******************************************************************************
// Instead of configuring the same settings for stream 1 and stream 2, you can
// apply the stream 1 settings to all streams and skip the "DL2" commands.
// ******************************************************************************
CONFigure:LTE:SIGN:CONNection:PCC:DLEQual ON

// ******************************************************************************
// Follow WB CQI PCC downlink channels: Select scheduling type.
// Configure the global settings, including a user-defined mapping table.
// ******************************************************************************
CONFigure:LTE:SIGN:CONNection:PCC:STYPe CQI,FWB
CONFigure:LTE:SIGN:CONNection:PCC:FWBCqi:DL 50,0,UDEF
CONF:LTE:SIGN:CONN:PCC:FWBC:DL:MCST:UDEF 0,1,2,3,6,7,9,13,14,16,19,22,24,27,28

// ******************************************************************************
// Follow WB PMI PCC downlink channels: Select scheduling type.
// Configure the RB allocation.
// ******************************************************************************
CONFigure:LTE:SIGN:CONNection:PCC:STYPe CQI,FPMI
CONFigure:LTE:SIGN:CONNection:PCC:FPMI:DL 50,0,Q16,11

// ******************************************************************************
// Follow WB CQI-RI PCC downlink channels: Select scheduling type.
// Configure the global settings, including a user-defined mapping table.
// ******************************************************************************
CONFigure:LTE:SIGN:CONNection:PCC:STYPe CQI,FCRI
CONFigure:LTE:SIGN:CONNection:PCC:FCPRi:DL 50,0,UDEF
CONF:LTE:SIGN:CONN:PCC:FCPR:DL:MCST:UDEF 0,1,2,3,6,7,9,13,14,16,19,22,24,27,28

// ******************************************************************************
// Follow WB CQI-PMI-RI PCC downlink channels: Select scheduling type.
// Configure the global settings, including a user-defined mapping table.
// ******************************************************************************
CONFigure:LTE:SIGN:CONNection:PCC:STYPe CQI,FCPRi
CONFigure:LTE:SIGN:CONNection:PCC:FCRI:DL 50,0,UDEF
CONF:LTE:SIGN:CONN:PCC:FCRI:DL:MCST:UDEF 0,1,2,3,6,7,9,13,14,16,19,22,24,27,28
```

2.5.1.15 Configuring SPS

```
// ******************************************************************************
// Select the scheduling type and configure twoIntervalsConfig for TDD.
// Configure the periodicity, DL RB allocation and UL RB allocation.
```

```
// Query the resulting code rates and expected throughput.
// ******************************************************************************
CONFigure:LTE:SIGN:CONNection:PCC:STYPe SPS
CONFigure:LTE:SIGN:CONNection:PCC:SPS:TIConfig ON
CONFigure:LTE:SIGN:CONNection:PCC:SPS:SINTerval S20
CONFigure:LTE:SIGN:CONNection:PCC:SPS:DL 10,20,QPSK,9
CONFigure:LTE:SIGN:CONNection:PCC:SPS:UL 10,20,QPSK,9
SENSe:LTE:SIGN:CONNection:PCC:SPS:DL:CRATe:ALL?
SENSe:LTE:SIGN:CONNection:PCC:SPS:UL:CRATe:ALL?
SENSe:LTE:SIGN:CONNection:ETHRoughput:DL:ALL?
SENSe:LTE:SIGN:CONNection:ETHRoughput:UL?
```

2.5.1.16 Configuring CQI Reporting

```
// ******************************************************************************
// Enable periodic CQI reporting and set the cqi-pmi-ConfigIndex for PCC
// and SCC1, FDD and TDD. Query the reporting period and reporting offset
// resulting for the active duplex mode.
// ******************************************************************************
CONFigure:LTE:SIGN:CQIReporting:ENABle PER
CONFigure:LTE:SIGN:CQIReporting:PRIReporting:ENABle ON
CONFigure:LTE:SIGN:CQIReporting:PCC:CINDex:FDD 17
CONFigure:LTE:SIGN:CQIReporting:SCC:CINDex:FDD 13
CONFigure:LTE:SIGN:CQIReporting:PCC:CINDex:TDD 17
CONFigure:LTE:SIGN:CQIReporting:SCC:CINDex:TDD 13
SENSe:LTE:SIGN:CQIReporting:PCC:RPERiod?
SENSe:LTE:SIGN:CQIReporting:PCC:ROFFset?
SENSe:LTE:SIGN:CQIReporting:SCC:RPERiod?
SENSe:LTE:SIGN:CQIReporting:SCC:ROFFset?
```

2.5.1.17 Configuring Measurement Reports

```
// ******************************************************************************
// Set reporting interval, measurement gap period, filter coefficient RSRP,
// filter coefficient RSRQ, WCDMA measurement quantity
// and SCell measurement cycle. Enable measurement reports.
// ******************************************************************************
CONFigure:LTE:SIGN:UEReport:RINTerval I640
CONFigure:LTE:SIGN:UEReport:MGPeriod G080
CONFigure:LTE:SIGN:UEReport:FCOefficient:RSRP FC4
CONFigure:LTE:SIGN:UEReport:FCOefficient:RSRQ FC4
CONFigure:LTE:SIGN:UEReport:WMQuantity ECNO
CONFigure:LTE:SIGN:UEReport:MCSCell SF640
CONFigure:LTE:SIGN:UEReport:ENABle ON
```

2.5.1.18 Configuring Message Monitoring

```
// *****************************************************************************
// Enable message monitoring for LTE, select address number 2 from the global
// logging PC address pool and query the corresponding IP address string.
// *****************************************************************************
CONFigure:LTE:SIGN:MMONitor:ENABle ON
CONFigure:LTE:SIGN:MMONitor:IPADdress IP2
CONFigure:LTE:SIGN:MMONitor:IPADdress?
```

2.5.1.19 Attaching the UE and Activating SCCs

```
// *****************************************************************************
// Connect the UE (switched off). Switch on the DL signal. Query the cell
// state until it equals ON,ADJ (DL signal available at RF connector).
// *****************************************************************************
WAITKEY >Ensure that the UE is connected to the instrument and switched off<
SOURce:LTE:SIGN:CELL:STATe ON
WHILE SOURce:LTE:SIGN:CELL:STATe:ALL? <> "ON,ADJ"

// *****************************************************************************
// Switch on the UE and wait until it is attached (connection state = ATT).
// *****************************************************************************
WAITKEY >Switch on the UE<
WHILE FETCh:LTE:SIGN:PSWitched:STATe? <> "ATT"

// *****************************************************************************
// Query the RRC connection state.
// *****************************************************************************
SENSe:LTE:SIGN:RRCState?

// *****************************************************************************
// Query the SCC1 state. The SCC connection is set up automatically after attach
// if: a carrier aggregation scenario is active, the SCC activation mode is
// "AUTO" and keep RRC connection is enabled.
// *****************************************************************************
FETCh:LTE:SIGN:SCC1:STATe?
```

2.5.1.20 Configuring the I/Q Settings

```
// *****************************************************************************
// Query the properties of the outgoing baseband signal, required to configure
// the baseband input of the connected instrument. Configure the baseband input
// according to the baseband output of the connected instrument.
// Configure also the SCC1.
// *****************************************************************************
SENSe:LTE:SIGN:IQOut:PCC:PATH1?
SENSe:LTE:SIGN:IQOut:PCC:PATH2?
CONFigure:LTE:SIGN:IQIN:PCC:PATH1 -30, -20
```

```
CONFigure:LTE:SIGN:IQIN:PCC:PATH2 -30, -20

SENSe:LTE:SIGN:IQOut:SCC:PATH1?
SENSe:LTE:SIGN:IQOut:SCC:PATH2?
CONFigure:LTE:SIGN:IQIN:SCC:PATH1 -30, -20
CONFigure:LTE:SIGN:IQIN:SCC:PATH2 -30, -20
```

2.5.1.21 Setting up a Test Mode Connection

This section is only relevant for test mode connections, not for data application tests.

```
// *****************************************************************************
// Set up a mobile terminated test mode connection.
// Query the connection state until it equals CEST (connection established).
// Query the IPv4 addresses assigned to the UE.
// *****************************************************************************
CALL:LTE:SIGN:PSWitched:ACTion CONNect
WHILE FETCh:LTE:SIGN:PSWitched:STATe? <> "CEST"
SENSe:LTE:SIGN:UESinfo:UEADdress:IPV4?
```

After the connection has been established you can e.g.:

- perform an LTE multi-evaluation measurement (option R&S CMW-KM500/-KM550)
- perform a BLER measurement, see chapter 2.5.2, "BLER Tests", on page 244
- modify parameters, see chapter 2.5.1.31, "Modifying Parameters for an Established Connection", on page 242

2.5.1.22 Connecting/Releasing Dedicated Bearers

This section is only relevant for data application tests, not for test mode connections.

```
// *****************************************************************************
// Query a list of established default bearers.
// Configure a dedicated bearer.
// Establish the dedicated bearer.
// *****************************************************************************
CATalog:LTE:SIGN:CONNection:DEFBearer?
PREPare:LTE:SIGN:CONN:DEDBearer "5 (cmw500.rohde-schwarz.com)", DRAM, 10, 20
CALL:LTE:SIGN:PSWitched:ACTion CONNect

// *****************************************************************************
// Query a list of established dedicated bearers.
// Select a dedicated bearer.
// Release the selected dedicated bearer.
// *****************************************************************************
CATalog:LTE:SIGN:CONNection:DEDBearer?
CONFigure:LTE:SIGN:CONNection:DEDBearer "6 (->5, DRAM)"
CALL:LTE:SIGN:PSWitched:ACTion DISConnect
```

2.5.1.23 Querying UE Measurement Report Contents

```
// *****************************************************************************
// Query UE measurement report values for the serving LTE cell and
// for the first neighbor cell of each technology, PCC and SCC1.
// *****************************************************************************
SENSe:LTE:SIGN:UEReport:PCC:SCELl?
SENSe:LTE:SIGN:UEReport:SCC:SCELl?
SENSe:LTE:SIGN:UEReport:PCC:SCELl:RANGe?
SENSe:LTE:SIGN:UEReport:SCC:SCELl:RANGe?
SENSe:LTE:SIGN:UEReport:NCELl:LTE:CELL1?
SENSe:LTE:SIGN:UEReport:NCELl:LTE:CELL1:RANGe?
SENSe:LTE:SIGN:UEReport:NCELl:GSM:CELL1?
SENSe:LTE:SIGN:UEReport:NCELl:GSM:CELL1:RANGe?
SENSe:LTE:SIGN:UEReport:NCELl:WCDMa:CELL1?
SENSe:LTE:SIGN:UEReport:NCELl:WCDMa:CELL1:RANGe?
SENSe:LTE:SIGN:UEReport:NCELl:CDMA:CELL1?
SENSe:LTE:SIGN:UEReport:NCELl:EVDO:CELL1?
SENSe:LTE:SIGN:UEReport:NCELl:TDSCdma:CELL1?
SENSe:LTE:SIGN:UEReport:NCELl:TDSCdma:CELL1:RANGe?
```

2.5.1.24 Querying UE Information

```
// *****************************************************************************
// Query all UE information results.
// *****************************************************************************
SENSe:LTE:SIGN:UESinfo:IMEI?
SENSe:LTE:SIGN:UESinfo:IMSI?
SENSe:LTE:SIGN:UESinfo:VDPReference?
SENSe:LTE:SIGN:UESinfo:UEUSage?
SENSe:LTE:SIGN:UESinfo:UEADdress:IPV4?
SENSe:LTE:SIGN:UESinfo:UEADdress:IPV6?
SENSe:LTE:SIGN:UESinfo:UEADdress:DEDBearer?
```

2.5.1.25 Querying UE Capability Report Contents

```
// *****************************************************************************
// Query general UE capability information.
// *****************************************************************************
SENSe:LTE:SIGN:UECapability:ASRelease?
SENSe:LTE:SIGN:UECapability:UECategory?
SENSe:LTE:SIGN:UECapability:FGINdicators?
SENSe:LTE:SIGN:UECapability:FAUeeutra:FGINdicators?
SENSe:LTE:SIGN:UECapability:TAUeeutra:FGINdicators?
SENSe:LTE:SIGN:UECapability:FGINdicators:RNADd?
SENSe:LTE:SIGN:UECapability:FAUeeutra:FGINdicators:RNADd?
SENSe:LTE:SIGN:UECapability:TAUeeutra:FGINdicators:RNADd?
SENSe:LTE:SIGN:UECapability:FGINdicators:RTEN?
SENSe:LTE:SIGN:UECapability:FAUeeutra:FGINdicators:RTEN?
```

```
SENSe:LTE:SIGN:UECapability:TAUeeutra:FGINdicators:RTEN?
SENSe:LTE:SIGN:UECapability:DTYPe?
SENSe:LTE:SIGN:UECapability:RREPort?

// ******************************************************************************
// Query PDCP UE capabilities.
// ******************************************************************************
SENSe:LTE:SIGN:UECapability:PDCP:SRPRofiles?
SENSe:LTE:SIGN:UECapability:PDCP:MRCSessions?

// ******************************************************************************
// Query physical layer UE capabilities.
// ******************************************************************************
SENSe:LTE:SIGN:UECapability:PLAYer:UTASupported?
SENSe:LTE:SIGN:UECapability:FAUeeutra:PLAYer:UTASupported?
SENSe:LTE:SIGN:UECapability:TAUeeutra:PLAYer:UTASupported?
SENSe:LTE:SIGN:UECapability:PLAYer:USRSsupport?
SENSe:LTE:SIGN:UECapability:FAUeeutra:PLAYer:USRSsupport?
SENSe:LTE:SIGN:UECapability:TAUeeutra:PLAYer:USRSsupport?
SENSe:LTE:SIGN:UECapability:PLAYer:EDLFsupport?
SENSe:LTE:SIGN:UECapability:PLAYer:EDLTsupport?
SENSe:LTE:SIGN:UECapability:PLAYer:TAPPsupport?
SENSe:LTE:SIGN:UECapability:FAUeeutra:PLAYer:TAPPsupport?
SENSe:LTE:SIGN:UECapability:TAUeeutra:PLAYer:TAPPsupport?
SENSe:LTE:SIGN:UECapability:PLAYer:TWEFsupport?
SENSe:LTE:SIGN:UECapability:FAUeeutra:PLAYer:TWEFsupport?
SENSe:LTE:SIGN:UECapability:TAUeeutra:PLAYer:TWEFsupport?
SENSe:LTE:SIGN:UECapability:PLAYer:PDSupport?
SENSe:LTE:SIGN:UECapability:FAUeeutra:PLAYer:PDSupport?
SENSe:LTE:SIGN:UECapability:TAUeeutra:PLAYer:PDSupport?
SENSe:LTE:SIGN:UECapability:PLAYer:CCSSupport?
SENSe:LTE:SIGN:UECapability:FAUeeutra:PLAYer:CCSSupport?
SENSe:LTE:SIGN:UECapability:TAUeeutra:PLAYer:CCSSupport?
SENSe:LTE:SIGN:UECapability:PLAYer:SPPSupport?
SENSe:LTE:SIGN:UECapability:FAUeeutra:PLAYer:SPPSupport?
SENSe:LTE:SIGN:UECapability:TAUeeutra:PLAYer:SPPSupport?
SENSe:LTE:SIGN:UECapability:PLAYer:MCPCsupport?
SENSe:LTE:SIGN:UECapability:FAUeeutra:PLAYer:MCPCsupport?
SENSe:LTE:SIGN:UECapability:TAUeeutra:PLAYer:MCPCsupport?
SENSe:LTE:SIGN:UECapability:PLAYer:NURClist?
SENSe:LTE:SIGN:UECapability:FAUeeutra:PLAYer:NURClist?
SENSe:LTE:SIGN:UECapability:TAUeeutra:PLAYer:NURClist?

// ******************************************************************************
// Query RF UE capabilities.
// ******************************************************************************
SENSe:LTE:SIGN:UECapability:RF:SUPPorted?
SENSe:LTE:SIGN:UECapability:RF:HDUPlex?
SENSe:LTE:SIGN:UECapability:RF:BCOMbination:V1020:BCSet?
SENSe:LTE:SIGN:UECapability:RF:BCOMbination:V1020:EUTRa1?
```

```
SENSe:LTE:SIGN:UECapability:RF:BCOMbination:V1020:EUTRa2?
SENSe:LTE:SIGN:UECapability:RF:BCOMbination:V1020:EUTRa1:BCLass:UL?
SENSe:LTE:SIGN:UECapability:RF:BCOMbination:V1020:EUTRa2:BCLass:UL?
SENSe:LTE:SIGN:UECapability:RF:BCOMbination:V1020:EUTRa1:BCLass:DL?
SENSe:LTE:SIGN:UECapability:RF:BCOMbination:V1020:EUTRa2:BCLass:DL?
SENSe:LTE:SIGN:UECapability:RF:BCOMbination:V1020:EUTRa1:MCAPability:UL?
SENSe:LTE:SIGN:UECapability:RF:BCOMbination:V1020:EUTRa2:MCAPability:DL?
SENSe:LTE:SIGN:UECapability:RF:BCOMbination:V1020:EUTRa1:MCAPability:UL?
SENSe:LTE:SIGN:UECapability:RF:BCOMbination:V1020:EUTRa2:MCAPability:DL?
SENSe:LTE:SIGN:UECapability:RF:BCOMbination:V1090:EUTRa1?
SENSe:LTE:SIGN:UECapability:RF:BCOMbination:V1090:EUTRa2?

// *****************************************************************************
// Query measurement UE capabilities.
// *****************************************************************************
SENSe:LTE:SIGN:UECapability:MEAS:IFNGaps?
SENSe:LTE:SIGN:UECapability:MEAS:IRNGaps:UFDD?
SENSe:LTE:SIGN:UECapability:MEAS:IRNGaps:UTDD128?
SENSe:LTE:SIGN:UECapability:MEAS:IRNGaps:GERan?
SENSe:LTE:SIGN:UECapability:MEAS:IRNGaps:CHRPd?
SENSe:LTE:SIGN:UECapability:MEAS:IRNGaps:CXRTt?
SENSe:LTE:SIGN:UECapability:MEAS:IFNGaps:V1020?
SENSe:LTE:SIGN:UECapability:MEAS:IRNGaps:V1020:UFDD?
SENSe:LTE:SIGN:UECapability:MEAS:IRNGaps:V1020:UTDD128?
SENSe:LTE:SIGN:UECapability:MEAS:IRNGaps:V1020:GERan?
SENSe:LTE:SIGN:UECapability:MEAS:IRNGaps:V1020:CHRPd?
SENSe:LTE:SIGN:UECapability:MEAS:IRNGaps:V1020:CXRTt?

// *****************************************************************************
// Query inter-RAT UE capabilities.
// *****************************************************************************
SENSe:LTE:SIGN:UECapability:IRAT:UFDD:SUPPorted?
SENSe:LTE:SIGN:UECapability:IRAT:UFDD:EREDirection:UTRA?
SENSe:LTE:SIGN:UECapability:FAUeeutra:IRAT:EREDirection:UTRA?
SENSe:LTE:SIGN:UECapability:TAUeeutra:IRAT:EREDirection:UTRA?
SENSe:LTE:SIGN:UECapability:IRAT:UTDD128:SUPPorted?
SENSe:LTE:SIGN:UECapability:IRAT:UTDD128:EREDirection:UTDD?
SENSe:LTE:SIGN:UECapability:FAUeeutra:IRAT:EREDirection:UTDD?
SENSe:LTE:SIGN:UECapability:TAUeeutra:IRAT:EREDirection:UTDD?
SENSe:LTE:SIGN:UECapability:IRAT:GERan:SUPPorted?
SENSe:LTE:SIGN:UECapability:FAUeeutra:IRAT:GERan:SUPPorted?
SENSe:LTE:SIGN:UECapability:TAUeeutra:IRAT:GERan:SUPPorted?
SENSe:LTE:SIGN:UECapability:IRAT:GERan:PHGeran?
SENSe:LTE:SIGN:UECapability:FAUeeutra:IRAT:GERan:PHGeran?
SENSe:LTE:SIGN:UECapability:TAUeeutra:IRAT:GERan:PHGeran?
SENSe:LTE:SIGN:UECapability:IRAT:GERan:DTM?
SENSe:LTE:SIGN:UECapability:IRAT:GERan:EREDirection?
SENSe:LTE:SIGN:UECapability:IRAT:CHRPd:SUPPorted?
SENSe:LTE:SIGN:UECapability:IRAT:CHRPd:TCONfig?
SENSe:LTE:SIGN:UECapability:IRAT:CHRPd:RCONfig?
```

```
SENSe:LTE:SIGN:UECapability:IRAT:CXRTt:SUPPorted?
SENSe:LTE:SIGN:UECapability:IRAT:CXRTt:TCONfig?
SENSe:LTE:SIGN:UECapability:IRAT:CXRTt:RCONfig?
SENSe:LTE:SIGN:UECapability:IRAT:CXRTt:ECSFb?
SENSe:LTE:SIGN:UECapability:FAUeeutra:IRAT:CXRTt:ECSFb?
SENSe:LTE:SIGN:UECapability:TAUeeutra:IRAT:CXRTt:ECSFb?
SENSe:LTE:SIGN:UECapability:IRAT:CXRTt:ECCMob?
SENSe:LTE:SIGN:UECapability:FAUeeutra:IRAT:CXRTt:ECCMob?
SENSe:LTE:SIGN:UECapability:TAUeeutra:IRAT:CXRTt:ECCMob?
SENSe:LTE:SIGN:UECapability:IRAT:CXRTt:ECDual?
SENSe:LTE:SIGN:UECapability:FAUeeutra:IRAT:CXRTt:ECDual?
SENSe:LTE:SIGN:UECapability:TAUeeutra:IRAT:CXRTt:ECDual?

// *****************************************************************************
// Query CSG proximity indication UE capabilities.
// *****************************************************************************
SENSe:LTE:SIGN:UECapability:CPINdication:FREQuency:INTRa?
SENSe:LTE:SIGN:UECapability:CPINdication:FREQuency:INTer?
SENSe:LTE:SIGN:UECapability:CPINdication:UTRan?

// *****************************************************************************
// Query neighbor cell SI-acquisition UE capabilities.
// *****************************************************************************
SENSe:LTE:SIGN:UECapability:NCSacq:FREQuency:INTRa?
SENSe:LTE:SIGN:UECapability:FAUeeutra:NCSacq:FREQuency:INTRa?
SENSe:LTE:SIGN:UECapability:TAUeeutra:NCSacq:FREQuency:INTRa?
SENSe:LTE:SIGN:UECapability:NCSacq:FREQuency:INTer?
SENSe:LTE:SIGN:UECapability:FAUeeutra:NCSacq:FREQuency:INTer?
SENSe:LTE:SIGN:UECapability:TAUeeutra:NCSacq:FREQuency:INTer?
SENSe:LTE:SIGN:UECapability:NCSacq:UTRan?
SENSe:LTE:SIGN:UECapability:FAUeeutra:NCSacq:UTRan?
SENSe:LTE:SIGN:UECapability:TAUeeutra:NCSacq:UTRan?

// *****************************************************************************
// Query UE-based network performance measurement capabilities.
// *****************************************************************************
SENSe:LTE:SIGN:UECapability:UBNPmeas:LMIDle?
SENSe:LTE:SIGN:UECapability:UBNPmeas:SGLocation?
```

2.5.1.26 Performing an Intra-RAT Handover

```
// *****************************************************************************
// An intra-RAT handover is a handover within the LTE signaling application.
//
// Select the LTE signaling application as handover destination.
// Define the destination parameters: band 2, DL channel no. 910,
// 10 MHz cell bandwidth, additional requirement NS_03.
// Initiate the handover.
// *****************************************************************************
```

```
PREPare:LTE:SIGN:HANDover:DESTination "LTE Sig1"
PREPare:LTE:SIGN:HANDover OB2, 910, B100, NS03
CALL:LTE:SIGN:PSWitched:ACTion HANDover
```

2.5.1.27 Performing an Inter-RAT Handover

```
// ******************************************************************************
// An inter-RAT handover is a handover to another signaling application.
//
// Query a list of possible handover destinations (signaling applications).
// Select a handover destination from the list.
// Select the handover mechanism.
// Wait until the destination is ready to receive a handover.
// Initiate the handover.
//
// Destination parameters like operating band or channel can be changed using
// commands provided by the destination signaling application. Adjust these
// parameters before executing the following commands.
// ******************************************************************************
PREPare:LTE:SIGN:HANDover:CATalog:DESTination?
PREPare:LTE:SIGN:HANDover:DESTination "GSM Sig1"
PREPare:LTE:SIGN:HANDover:MMODe REDirection
WHILE SOURce:GSM:SIGN:CELL:STATe? <> "RFH"
CALL:LTE:SIGN:PSWitched:ACTion HANDover
```

2.5.1.28 Performing a Handover to another Instrument

```
// ******************************************************************************
// Select handover to other instrument ("No Connection").
// Select target RAT (WCDMA) and configure the other destination settings.
// Initiate the handover.
// Prepare also the settings for other target RATs.
// ******************************************************************************
PREPare:LTE:SIGN:HANDover:DESTination "No Connection"
PREPare:LTE:SIGN:HANDover:EXTernal:DESTination WCDMa
PREPare:LTE:SIGN:HANDover:EXTernal:WCDMa OB1, 10565
CALL:LTE:SIGN:PSWitched:ACTion HANDover

PREPare:LTE:SIGN:HANDover:EXTernal:CDMA USC, 500
PREPare:LTE:SIGN:HANDover:EXTernal:EVDO USC, 500
PREPare:LTE:SIGN:HANDover:EXTernal:GSM G09, 55, G18
PREPare:LTE:SIGN:HANDover:EXTernal:LTE OB1, 300
PREPare:LTE:SIGN:HANDover:EXTernal:TDSCdma OB1, 10565
```

2.5.1.29 Sending / Receiving a Short Message

```
// ******************************************************************************
// Configure outgoing messages: ASCII message text, binary message contents,
```

```
// data coding, coding group, message class, SC address, originating address,
// service center time stamp.
// Send the message.
// ****************************************************************************
CONFigure:LTE:SIGN:SMS:OUTGoing:INTernal "Testing SMS 012!.#\*%+-/()<>?=;@$,"
CONFigure:LTE:SIGN:SMS:OUTGoing:BINary #H0125498fa3bc8d348
CONFigure:LTE:SIGN:SMS:OUTGoing:DCODing BIT7
CONFigure:LTE:SIGN:SMS:OUTGoing:CGRoup GDCoding
CONFigure:LTE:SIGN:SMS:OUTGoing:MCLass CL2
CONFigure:LTE:SIGN:SMS:OUTGoing:OSADdress '543221'
CONFigure:LTE:SIGN:SMS:OUTGoing:OADDress '3526735'
CONFigure:LTE:SIGN:SMS:OUTGoing:SCTStamp:TSOurce DATE
CONFigure:LTE:SIGN:SMS:OUTGoing:SCTStamp:DATE 15,5,2014
CONFigure:LTE:SIGN:SMS:OUTGoing:SCTStamp:TIME 14,40,50
CALL:LTE:SIGN:PSWitched:ACTion SMS

// ****************************************************************************
// Reset parameters related to an already received short message.
// Wait until a message from the UE has been received.
// Query information about the received message: encoding, message content,
// message length, message segments.
// ****************************************************************************
CLEan:LTE:SIGN:SMS:INComing:INFO:MTEXt
WAITKEY >Send short message from UE<
WHILE SENSe:LTE:SIGN:SMS:INFO:LRMessage:RFLag? <> "OFF"
SENSe:LTE:SIGN:SMS:INComing:INFO:DCODing?
SENSe:LTE:SIGN:INComing:INFO:MTEXt?
SENSe:LTE:SIGN:SMS:INComing:INFO:MLENgth?
SENSe:LTE:SIGN:SMS:INComing:INFO:SEGMent?
```

2.5.1.30 Sending Date and Time Information to the UE

```
// ****************************************************************************
// Select a time source and configure date, time and DST +1h.
// Enable sending of the information during attach.
// Send the information to the UE now.
// ****************************************************************************
CONFigure:LTE:SIGN:CELL:TIME:TSOurce DATE
CONFigure:LTE:SIGN:CELL:TIME:DATE 24,10,2012
CONFigure:LTE:SIGN:CELL:TIME:TIME 12,40,30
CONFigure:LTE:SIGN:CELL:TIME:DSTime P1H
CONFigure:LTE:SIGN:CELL:TIME:SATTach ON
CONFigure:LTE:SIGN:CELL:TIME:SNOW
```

2.5.1.31 Modifying Parameters for an Established Connection

```
// ****************************************************************************
// Modify inserted transport block errors and additional spectrum emission
// requirements. Set PCC scheduling type to 3GPP compliant RMC.
```

```
// *****************************************************************************
CONFigure:LTE:SIGN:CONNection:DLEinsertion 20
CONFigure:LTE:SIGN:CONNection:ASEMission NS03
CONFigure:LTE:SIGN:CONNection:PCC:STYPe RMC

// *****************************************************************************
// Redefine the PCC RMCs: DL RMC with 50 RBs, 64-QAM modulation and
// transport block size index 5. UL RMC with 50 RBs, QPSK modulation and
// block size index 6.
// Position the resource blocks at the lower end of the channel bandwidth.
// *****************************************************************************
CONFigure:LTE:SIGN:CONNection:PCC:RMC:DL N50,QPSK,T5
CONFigure:LTE:SIGN:CONNection:PCC:RMC:UL N50,QPSK,T6
CONFigure:LTE:SIGN:CONNection:PCC:RMC:RBPosition:DL LOW
CONFigure:LTE:SIGN:CONNection:PCC:RMC:RBPosition:UL LOW

// *****************************************************************************
// Modify the RS EPRE level for the PCC.
// *****************************************************************************
CONFigure:LTE:SIGN:DL:PCC:RSEPre:LEVel -83

// *****************************************************************************
// Command the UE to change the UL power by +3 dB:
// Select single pattern as active TPC setup, define a single pattern of
// 3 steps UP, execute the pattern.
// *****************************************************************************
CONFigure:LTE:SIGN:UL:PUSCh:TPC:SET SINGle
CONFigure:LTE:SIGN:UL:PUSCh:TPC:SINGle 3, UP
CONFigure:LTE:SIGN:UL:PUSCh:TPC:PEXecute

// *****************************************************************************
// Apply a continuous TPC command pattern of 5x -1 dB and 4x +1 dB:
// Define the pattern and select the active TPC setup.
// *****************************************************************************
CONFigure:LTE:SIGN:UL:PUSCh:TPC:UDPattern 9,-1,-1,-1,-1,-1,1,1,1,1
CONFigure:LTE:SIGN:UL:PUSCh:TPC:SET UDContinuous

// *****************************************************************************
// Command the UE to a target power of -10 dBm.
// *****************************************************************************
CONFigure:LTE:SIGN:UL:PUSCh:TPC:CLTPower -10
CONFigure:LTE:SIGN:UL:PUSCh:TPC:SET CLOop

// *****************************************************************************
// Execute ramping up pattern B for a 3GPP relative power control test.
// *****************************************************************************
CONFigure:LTE:SIGN:UL:PUSCh:TPC:SET RPControl
CONFigure:LTE:SIGN:UL:PUSCh:TPC:RPControl RUB
CONFigure:LTE:SIGN:UL:PUSCh:TPC:PEXecute
```

2.5.2 BLER Tests

The BLER measurement provided by the LTE signaling application is programmed as follows:

- The application is controlled by SCPI commands with the following syntax: `...:LTE:SIGN:EBLer:...`
- After a `*RST`, the measurement is switched off.
  You can start the measurement using `INIT:LTE:SIGN:EBLer` and retrieve the results using `FETCh` commands.

The examples in this section focus on commands directly related to the BLER measurement. For general configuration of the signaling application and setting up the connection, refer to chapter 2.5.1, "General Configuration", on page 219.

2.5.2.1 Configuring a BLER Measurement

```
// *****************************************************************************
// Activate DL padding.
// *****************************************************************************
CONFigure:LTE:SIGN:CONNection:DLPadding ON

// *****************************************************************************
// Configure a continuous BLER measurement without stop condition and
// 1000 subframes per measurement cycle. NACK and DTX contribute to the BLER.
// *****************************************************************************
CONFigure:LTE:SIGN:EBLer:SCONdition NONE
CONFigure:LTE:SIGN:EBLer:REPetition CONT
CONFigure:LTE:SIGN:EBLer:SFRames 1000
CONFigure:LTE:SIGN:EBLer:ERCalc ERC1

// *****************************************************************************
// Configure a confidence BLER measurement.
// The stop condition "Confidence Level" sets also the repetition.
// NACK and DTX contribute to the BLER, wait for all carriers,
// no minimum test time, ER limit 5%.
// *****************************************************************************
CONFigure:LTE:SIGN:EBLer:SCONdition CLEV
CONFigure:LTE:SIGN:EBLer:ERCalc ERC1
CONFigure:LTE:SIGN:EBLer:CONFidence:OASCondition ACWait
CONFigure:LTE:SIGN:EBLer:CONFidence:MTTime 0
CONFigure:LTE:SIGN:EBLer:CONFidence:LERate P050
```

2.5.2.2 Performing a Confidence BLER Measurement

```
// *****************************************************************************
// Start a confidence BLER measurement and return the pass/fail results
// for PCC and SCC1.
// *****************************************************************************
CONFigure:LTE:SIGN:EBLer:SCONdition CLEV
```

```
INIT:LTE:SIGN:EBLer
FETCh:LTE:SIGN:EBLer:PCC:CONFidence?
FETCh:LTE:SIGN:EBLer:SCC:CONFidence?
FETCh:LTE:SIGN:EBLer:ALL:CONFidence?
```

2.5.2.3 Performing a Continuous BLER Measurement

```
// ******************************************************************************
// Start a continuous BLER measurement.
// Wait until the measurement is really running.
// ******************************************************************************
CONFigure:LTE:SIGN:EBLer:REPetition CONT
CONFigure:LTE:SIGN:EBLer:SCONdition NONE
INIT:LTE:SIGN:EBLer
WHILE FETCh:LTE:SIGN:EBLer:STATe:ALL? <> "RUN","ADJ","ACT"

// ******************************************************************************
// Monitor intermediate BLER results for a SISO single carrier configuration,
// by sending the following commands periodically.
// ******************************************************************************
FETCh:INTermediate:LTE:SIGN:EBLer:PCC:ABSolute?
FETCh:INTermediate:LTE:SIGN:EBLer:PCC:RELative?

// ******************************************************************************
// Monitor intermediate BLER results for a MIMO configuration with carrier
// aggregation and two carriers, by sending the following commands periodically.
// ******************************************************************************
FETCh:INTermediate:LTE:SIGN:EBLer:PCC:ABSolute?
FETCh:INTermediate:LTE:SIGN:EBLer:PCC:RELative?
FETCh:INTermediate:LTE:SIGN:EBLer:PCC:STReam1:ABSolute?
FETCh:INTermediate:LTE:SIGN:EBLer:PCC:STReam2:ABSolute?
FETCh:INTermediate:LTE:SIGN:EBLer:PCC:STReam1:RELative?
FETCh:INTermediate:LTE:SIGN:EBLer:PCC:STReam2:RELative?

FETCh:INTermediate:LTE:SIGN:EBLer:SCC:ABSolute?
FETCh:INTermediate:LTE:SIGN:EBLer:SCC:RELative?
FETCh:INTermediate:LTE:SIGN:EBLer:SCC:STReam1:ABSolute?
FETCh:INTermediate:LTE:SIGN:EBLer:SCC:STReam2:ABSolute?
FETCh:INTermediate:LTE:SIGN:EBLer:SCC:STReam1:RELative?
FETCh:INTermediate:LTE:SIGN:EBLer:SCC:STReam2:RELative?

// ******************************************************************************
// Alternatively monitor the sum of all PCC and SCC streams.
// ******************************************************************************
FETCh:INTermediate:LTE:SIGN:EBLer:ALL:ABSolute?
FETCh:INTermediate:LTE:SIGN:EBLer:ALL:RELative?
```

2.5.2.4 Performing a Single-Shot BLER Measurement

```
// *****************************************************************************
// Start a single-shot BLER measurement (one measurement cycle).
// *****************************************************************************
CONFigure:LTE:SIGN:EBLer:REPetition SING
CONFigure:LTE:SIGN:EBLer:SCONdition NONE
INIT:LTE:SIGN:EBLer

// *****************************************************************************
// Return BLER and throughput single results for a SISO single carrier
// configuration.
// *****************************************************************************
FETCh:LTE:SIGN:EBLer:ABSolute?
FETCh:LTE:SIGN:EBLer:RELative?

// *****************************************************************************
// Return BLER and throughput single results for a MIMO single carrier
// configuration:
// Overall absolute and relative results, absolute results for stream 1 and
// stream 2, relative results for stream 1 and stream 2.
// *****************************************************************************
FETCh:LTE:SIGN:EBLer:PCC:ABSolute?
FETCh:LTE:SIGN:EBLer:PCC:RELative?
FETCh:LTE:SIGN:EBLer:PCC:STReam1:ABSolute?
FETCh:LTE:SIGN:EBLer:PCC:STReam2:ABSolute?
FETCh:LTE:SIGN:EBLer:PCC:STReam1:RELative?
FETCh:LTE:SIGN:EBLer:PCC:STReam2:RELative?

// *****************************************************************************
// Return throughput traces for a MIMO configuration with CA and two carriers:
// Sum of all PCC plus SCC streams, sum of all PCC streams,
// sum of all SCC streams, throughput per stream.
// *****************************************************************************
FETCh:LTE:SIGN:EBLer:TRACe:THRoughput:ALL?
FETCh:LTE:SIGN:EBLer:TRACe:THRoughput:PCC?
FETCh:LTE:SIGN:EBLer:TRACe:THRoughput:SCC?
FETCh:LTE:SIGN:EBLer:TRACe:THRoughput:PCC:STReam1?
FETCh:LTE:SIGN:EBLer:TRACe:THRoughput:PCC:STReam2?
FETCh:LTE:SIGN:EBLer:TRACe:THRoughput:SCC:STReam1?
FETCh:LTE:SIGN:EBLer:TRACe:THRoughput:SCC:STReam2?

// *****************************************************************************
// Return CQI single results for a MIMO configuration with PCC and SCC1.
// *****************************************************************************
FETCh:LTE:SIGN:EBLer:PCC:CQIReporting:STReam1?
FETCh:LTE:SIGN:EBLer:PCC:CQIReporting:STReam2?
FETCh:LTE:SIGN:EBLer:SCC:CQIReporting:STReam1?
FETCh:LTE:SIGN:EBLer:SCC:CQIReporting:STReam2?
```

```
// *****************************************************************************
// Return CQI bar graphs and median CQI traces for a MIMO configuration with
// carrier aggregation (PCC and SCC1).
// *****************************************************************************
FETCh:LTE:SIGN:EBLer:TRACe:CQIReporting:PCC:STReam1?
FETCh:LTE:SIGN:EBLer:TRACe:CQIReporting:PCC:STReam2?
FETCh:LTE:SIGN:EBLer:TRACe:THRoughput:PCC:MCQI:STReam1?
FETCh:LTE:SIGN:EBLer:TRACe:THRoughput:PCC:MCQI:STReam2?

FETCh:LTE:SIGN:EBLer:TRACe:CQIReporting:SCC:STReam1?
FETCh:LTE:SIGN:EBLer:TRACe:CQIReporting:SCC:STReam2?
FETCh:LTE:SIGN:EBLer:TRACe:THRoughput:SCC:MCQI:STReam1?
FETCh:LTE:SIGN:EBLer:TRACe:THRoughput:SCC:MCQI:STReam2?

// *****************************************************************************
// Return RI and PMI bar graphs for PCC and SCC1.
// *****************************************************************************
FETCh:LTE:SIGN:EBLer:PCC:RI?
FETCh:LTE:SIGN:EBLer:PCC:PMI:RI1?
FETCh:LTE:SIGN:EBLer:PCC:PMI:RI2?

FETCh:LTE:SIGN:EBLer:SCC:RI?
FETCh:LTE:SIGN:EBLer:SCC:PMI:RI1?
FETCh:LTE:SIGN:EBLer:SCC:PMI:RI2?

// *****************************************************************************
// Return uplink BLER results.
// *****************************************************************************
FETCh:LTE:SIGN:EBLer:UPLink?

// *****************************************************************************
// Return entire HARQ tables for a MIMO configuration with PCC and SCC1.
// *****************************************************************************
FETCh:LTE:SIGN:EBLer:PCC:HARQ:STReam1:TRANsmission:ABSolute?
FETCh:LTE:SIGN:EBLer:PCC:HARQ:STReam1:TRANsmission:RELative?
FETCh:LTE:SIGN:EBLer:PCC:HARQ:STReam2:TRANsmission:ABSolute?
FETCh:LTE:SIGN:EBLer:PCC:HARQ:STReam2:TRANsmission:RELative?
FETCh:LTE:SIGN:EBLer:PCC:HARQ:STReam1:SUBFrame:ABSolute?
FETCh:LTE:SIGN:EBLer:PCC:HARQ:STReam1:SUBFrame:RELative?
FETCh:LTE:SIGN:EBLer:PCC:HARQ:STReam2:SUBFrame:ABSolute?
FETCh:LTE:SIGN:EBLer:PCC:HARQ:STReam2:SUBFrame:RELative?

FETCh:LTE:SIGN:EBLer:SCC:HARQ:STReam1:TRANsmission:ABSolute?
FETCh:LTE:SIGN:EBLer:SCC:HARQ:STReam1:TRANsmission:RELative?
FETCh:LTE:SIGN:EBLer:SCC:HARQ:STReam2:TRANsmission:ABSolute?
FETCh:LTE:SIGN:EBLer:SCC:HARQ:STReam2:TRANsmission:RELative?
FETCh:LTE:SIGN:EBLer:SCC:HARQ:STReam1:SUBFrame:ABSolute?
FETCh:LTE:SIGN:EBLer:SCC:HARQ:STReam1:SUBFrame:RELative?
```

```
FETCh:LTE:SIGN:EBLer:SCC:HARQ:STReam2:SUBFrame:ABSolute?
FETCh:LTE:SIGN:EBLer:SCC:HARQ:STReam2:SUBFrame:RELative?
```

2.5.3 RLC Throughput Tests

The RLC throughput measurement provided by the LTE signaling application is programmed as follows:

- The application is controlled by SCPI commands with the following syntax: `...:LTE:SIGN:THRoughput:...`
- After a `*RST`, the measurement is switched off.
  You can start the measurement using `INIT:LTE:SIGN:THRoughput` and retrieve the results using `FETCh:LTE:SIGN:THRoughput:...?`.

The examples in this section focus on commands directly related to the RLC throughput measurement. For general configuration of the signaling application, refer to chapter 2.5.1, "General Configuration", on page 219.

2.5.3.1 Configuring an RLC Throughput Measurement

```
// *****************************************************************************
// System-Reset
// *****************************************************************************
*RST; *OPC?
*CLS; *OPC?

// *****************************************************************************
// Configure repetition mode, update interval and window size.
// *****************************************************************************
CONFigure:LTE:SIGN:THRoughput:REPetition SINGleshot
CONFigure:LTE:SIGN:THRoughput:UPDate 200
CONFigure:LTE:SIGN:THRoughput:WINDow 20000

// *****************************************************************************
// Select the data application mode
// *****************************************************************************
CONFigure:LTE:SIGN:CONNection:CTYPe DAPPlication
```

2.5.3.2 Setting up a Data Connection

Proceed as follows:

1. Configure the other settings of the signaling application compatible to your UE and configure the data application unit (see DAU documentation).
2. Switch on the cell signal and attach the UE.
3. Set up a data connection.

4. Generate IP traffic, for example using the IPerf measurement provided by the DAU.

2.5.3.3 Performing an RLC Throughput Measurement

```
// *****************************************************************************
// Start the measurement and return the contents of the result table.
// Query the measurement state (should be "RDY").
// *****************************************************************************
INIT:LTE:SIGN:THRoughput
FETCh:LTE:SIGN:THRoughput?
FETCh:LTE:SIGN:THRoughput:STATe?

// *****************************************************************************
// Query the result traces.
// *****************************************************************************
FETCh:LTE:SIGN:THRoughput:TRACe:DL:PDU:CURRent?
FETCh:LTE:SIGN:THRoughput:TRACe:DL:PDU:AVERage?
FETCh:LTE:SIGN:THRoughput:TRACe:UL:PDU:CURRent?
FETCh:LTE:SIGN:THRoughput:TRACe:UL:PDU:AVERage?
```

2.6 Command Reference

The following sections provide detailed reference information on the remote control commands of the LTE signaling application.

2.6.1 Conventions and General Information

The following sections describe the most important conventions and general information concerning the command reference.

2.6.1.1 SIGN<i>

`SIGN<i>` is used as abbreviation of `SIGNaling<instance>`. For better readability, only the abbreviated form (which is also accepted by the instrument) is given in the command reference.

The `<instance>` is relevant for instruments supporting several instances of the same firmware application. It can be omitted if the instrument supports only one instance, or to address the first instance.

See also: "Firmware Applications" in the R&S CMW user manual, chapter "Remote Control"

2.6.1.2 STReam<s> and DL<s>

Commands that contain a `STReam<s>` or a `DL<s>` mnemonic are related to a single downlink stream.

The suffix `<s>` selects the downlink stream and is only relevant for scenarios with MIMO. For SISO scenarios, you can omit the suffix.

2.6.1.3 PCC and SCC Commands

For carrier aggregation scenarios, many settings are configurable per carrier. The following command variants are relevant in this context:

- A `[:PCC]` command configures the PCC. The command may also be relevant for scenarios without carrier aggregation.
- An `:SCC<c>` command configures the SCC number <c>. For the SCC number 1, you can omit the suffix 1.
- An `:SCC` command configures the SCC number 1. Other SCCs can not be configured via such a command.

2.6.1.4 Values for Signal Path Selection

To select an RF path, you must specify an RF connector and a TX or RX module (converter). To select an I/Q path, you specify a DIG IQ connector.

Which connectors and modules can be specified in a command, depends on the installed hardware and the active sub-instrument or instance <i>.

This section lists all values available for path selection. Depending on your configuration, only a subset may be relevant for you. Virtual connector names are only relevant for setting commands. Queries return the physical connector names.

Additional information is available in the base software documentation. It describes typical instrument configurations with the resulting *RST values, allowed connector/module combinations and the mapping of virtual connector names to physical connectors.

See also: "Signal Path Settings" in the R&S CMW user manual, chapter "Remote Control"

RF path selection values:

- RX module:
  `RX1 | RX2 | RX3 | RX4`
- TX module:
  `TX1 | TX2 | TX3 | TX4`
- RX connector:
  `RF1C | RF2C | RF3C | RF4C | RFAC | RFBC`
  RF 1 COM to RF 4 COM plus virtual connector names
- TX connector:
  `RF1C | RF2C | RF3C | RF4C | RFAC | RFBC`
  `RF1O | RF3O | RFAO`
  RF 1 COM to RF 4 COM plus virtual connector names
  RF 1 OUT and RF 3 OUT plus virtual connector name

I/Q path selection values:

- I/Q output connector:
  `IQ2O | IQ4O | IQ6O | IQ8O`
  DIG IQ OUT 2 to 8

2.6.1.5 Keywords

Selected keywords used in the command description are described in the following.

- **Command usage**
  If the usage is not explicitly stated, the command allows you to set parameters and query parameters. Otherwise the command usage is stated as follows:
  – "Setting only": command can only be used to set parameters
  – "Query only": command can only be used to query parameters
  – "Event": command initiates an event
- **Parameter usage**
  The parameter usage is indicated by the keyword preceding the parameter(s):
  – "Parameters" are sent with a setting or query command and are returned as the result of a query
  – "Setting parameters" are only sent with a setting command
  – "Query parameters" are only sent with a query command (to refine the query)
  – "Return values" are only returned as the result of a query
- **Firmware/Software:**
  Indicates the lowest software version supporting the command. Command enhancements in later software versions are also indicated. Indications of enhancements before V3.0.10 have been purged to improve the readability.

2.6.1.6 Reliability Indicator

The first value in the output arrays of `FETCh...?`, `READ...?` and `CALCulate...?` queries indicates the most severe error that has occurred during the measurement.

Example for an output array: 0, 10.22, 10.15, 10.01, 10.29, 100 (reliability = 0, followed by 5 numeric measurement values).

The reliability indicator has one of the following values:

- **0 (OK)**:
  Measurement values available, no error detected.
- **1 (Measurement Timeout)**:
  The measurement has been stopped after the (configurable) measurement timeout. Measurement results may be available, however, at least a part of the measurement provides only INValid results or has not completed the full statistic count.
- **2 (Capture Buffer Overflow)**:
  The measurement configuration results in a capture length, exceeding the available memory.
- **3 (Overdriven) / 4 (Underdriven)**:
  The accuracy of measurement results may be impaired because the input signal level was too high / too low.
- **6 (Trigger Timeout)**:
  The measurement could not be started or continued because no trigger event was detected.
- **7 (Acquisition Error)**:
  The R&S CMW could not properly decode the RF input signal.
- **8 (Sync Error)**:
  The R&S CMW could not synchronize to the RF input signal.
- **9 (Uncal)**:
  Due to an inappropriate configuration of resolution bandwidth, video bandwidth or sweep time, the measurement results are not within the specified data sheet limits.
- **15 (Reference Frequency Error)**:
  The instrument has been configured to use an external reference signal but the reference oscillator could not be phase locked to the external signal (e.g. signal level too low, frequency out of range or reference signal not available at all).
- **16 (RF Not Available)**:
  The measurement could not be started because the configured RF input path was not active. This problem may occur e.g. when a measurement is started in combined signal path mode and the master application has not yet activated the input path. The LEDs above the RF connectors indicate whether the input and output paths are active.
- **17 (RF Level not Settled) / 18 (RF Frequency not Settled)**:
  The measurement could not be started because the R&S CMW was not yet ready to deliver stable results after a change of the input signal power / the input signal frequency.
- **19 (Call not Established)**:
  For measurements: The measurement could not be started because no signaling connection to the DUT was established.

For DAU IMS service: Establishing a voice over IMS call failed.

- **20 (Call Type not Usable)**:
  For measurements: The measurement could not be started because the established signaling connection had wrong properties.
  For DAU IMS service: The voice over IMS settings could not be applied.
- **21 (Call Lost)**:
  For measurements: The measurement was interrupted because the signaling connection to the DUT was lost.
  For DAU IMS service: The voice over IMS call was lost.
- **23 (Missing Option)**:
  The ARB file cannot be played by the GPRF generator due to a missing option.
- **26 (Resource Conflict)**:
  The application could not be started or has been stopped due to a conflicting hardware resource or software option that is allocated by another application.
  Stop the application that has allocated the conflicting resources and try again.
- **27 (No Sensor Connected)**:
  The GPRF External Power Sensor measurement could not be started due to missing power sensor.
- **30 (File not Found)**:
  The specified file could not be found.
- **40 (ARB File CRC Error)**:
  The ARB file CRC check failed. The ARB file is corrupt and not reliable.
- **42 (ARB Header Tag Invalid)**:
  The ARB file selected in the GPRF generator contains an invalid header tag.
- **43 (ARB Segment Overflow)**:
  The number of segments in the multi-segment ARB file is higher than the allowed maximum.
- **44 (ARB File not Found)**:
  The selected ARB file could not be found.
- **45 (ARB Memory Overflow)**:
  The ARB file length is greater than the available memory.
- **50 (Startup Error)**:
  The Data Application Unit (DAU), a DAU service or a DAU measurement could not be started. Please execute a DAU selftest.
- **51 (No Reply)**:
  The DAU has received no response, for example for a ping request.
- **52 (Connection Error)**:
  The DAU could not establish a connection to internal components. Please restart the instrument.
- **53 (Configuration Error)**:
  The current DAU configuration by the user is incomplete or wrong and could not be applied. Check especially the IP address configuration.
- **54 (Filesystem Error)**:
  The hard disk of the DAU is full or corrupt. Please execute a DAU selftest.
- **60 (Invalid RF-Connector Setting)**

The individual segments of a list mode measurement with R&S CMWS use different connector benches. This is not allowed. All segments must use the same bench.
Check the "Info" dialog for the relevant segment numbers.

- **101 (Firmware Error)**:
  Indicates a firmware or software error. If you encounter this error for the first time, restart the instrument.
  If the error occurs again, consider the following hints:
  - Firmware errors can often be repaired by restoring the factory default settings. To restore these settings, restart your instrument and press the "Factory Default" softkey during startup.
  - If a software package (update) has not been properly installed this is often indicated in the "Setup" dialog, section "SW/HW-Equipment > Installed Software".
  - A software update correcting the error may be available. Updates are e.g. provided in the "CMW Customer Web" on GLORIS (registration required): https://extranet.rohde-schwarz.com.

  If you get firmware errors even with the properly installed latest software version, please send a problem report including log files to Rohde & Schwarz.
- **102 (Unidentified Error)**:
  Indicates an error not covered by other reliability values. For troubleshooting please follow the steps described for "101 (Firmware Error)".
- **103 (Parameter Error)**:
  Indicates that the measurement could not be performed due to internal conflicting parameter settings.
  A good approach to localize the conflicting settings is to start with a reset or preset or even restore the factory default settings. Then reconfigure the measurement step by step and check when the error occurs for the first time.
  If you need assistance to localize the conflicting parameter settings, please contact Rohde & Schwarz (see http://www.service.rohde-schwarz.com).

2.6.2 General Settings

The following commands select the duplex mode and the SCC activation mode, trigger a swap of PCC and SCC settings and enable the speech codec.

CONFigure:LTE:SIGN<i>:DMODe <Mode>

Selects the duplex mode of the LTE signal: FDD or TDD.

Parameters:

<Mode>	FDD | TDD
Example:	See Specifying General Settings

Firmware/Software: V2.1.20

Options: R&S CMW-KS500/-KS550 for FDD/TDD

Manual operation: See "Duplex Mode" on page 121

CONFigure:LTE:SIGN<i>:SCC:AMODe <Mode>

Selects the SCC activation mode. For manual triggering of a state transition, see CALL:LTE:SIGN<i>:SCC<c>:ACTion.

Parameters:

<Mode> AUTO | MANual | SEMiauto

AUTO: All SCCs are activated automatically at UE attach, so that the state "MAC Activated" is reached.
MANual: Each state transition step must be initiated separately for each SCC. So several actions are required to reach the state "MAC Activated".
SEMiauto: The activation must be initiated manually for each SCC. As a result, all state transitions required to reach the state "MAC Activated" are performed.

*RST: AUTO

Example: See Specifying General Settings

Firmware/Software: V3.2.50

Options: R&S CMW-KS512 for MANual and SEMiauto

Manual operation: See "SCC Activation Mode" on page 124

CONFigure:LTE:SIGN<i>:CONNection:SCC<c>:SEXecute

Initiates a swap of settings between the PCC and the SCC number <c>.

Suffix:

<c> 1..2

Usage: Event

Firmware/Software: V3.2.60

Manual operation: See "Swap (Button)" on page 106

CONFigure:LTE:SIGN<i>:CONNection:SCC<c>:CEXecute

Copies PCC DL settings to the SCC number <c>.

Suffix:

<c> 1..2

Usage: Event

Firmware/Software: V3.2.82

Manual operation: See "Copy (Button)" on page 108

CONFigure:LTE:SIGN<i>:ESCode <Enable>

Enables a connection to the audio board. This setting can only be modified while the cell is off.

Parameters:

<Enable> OFF | ON

*RST: OFF

Example: See Specifying General Settings

Firmware/Software: V3.2.70

Options: R&S CMW-KS510, R&S CMW-B405A and R&S CMW-B400B

Manual operation: See "Enable Speech Codec" on page 125

2.6.3 Connection Control and States

The commands in the following sections control the connection to the UE and retrieve connection-related information.

2.6.3.1 General Commands

The following commands control the connection to the UE and retrieve connection-related information.

Preparation commands for `CALL:LTE:SIGN<i>:PSWitched:ACTion` are described in the subsequent sections.

SOURce:LTE:SIGN<i>:CELL:STATe <Control>

Turns the generator (the cell) on or off.

Setting parameters:

<Control> OFF | ON

Switch generator **ON** or **OFF**

*RST: OFF

Return values:

<GeneratorState> OFF | PENDing | ON

OFF: generator switched off
PEND: generator switched on but no signal available yet
ON: generator switched on, signal available

*RST: OFF

Example: See Attaching the UE and Activating SCCs

Firmware/Software: V1.0.15.20

Manual operation: See "Cell" on page 99

SOURce:LTE:SIGN<i>:CELL:STATe:ALL?

Returns detailed information about the "LTE Signaling" generator state.

Return values:

<MainState> OFF | ON | RFHandover

OFF: generator switched off
ON: generator switched on
RFHandover: ready to receive a handover from another signaling application

<SyncState> PENDing | ADJusted

PENDing: the generator has been turned on (off) but the signal is not yet (still) available
ADJusted: the physical output signal corresponds to the main generator state

Example: See Attaching the UE and Activating SCCs

Usage: Query only

Firmware/Software: V1.0.15.20
V3.0.10: RFHandover added

Manual operation: See "ON | OFF (key) / LTE Signaling (softkey)" on page 115

SENSe:LTE:SIGN<i>:RRCState?

Queries whether an RRC connection is established (connected) or not (idle).

Return values:

<State> IDLE | CONNected

Example: See Attaching the UE and Activating SCCs

Usage: Query only

Firmware/Software: V3.0.20

Manual operation: See "RRC State" on page 99

CALL:LTE:SIGN<i>:PSWitched:ACTion <PSAction>

Controls the PS connection state. As a prerequisite, the DL signal must be switched on, see `SOURce:LTE:SIGN<i>:CELL:STATe`.

Setting parameters:

<PSAction> CONNect | DISConnect | SMS | DETach | HANDover

CONNect: Initiate a mobile terminated connection setup
DISConnect: Release the connection
SMS: Send an SMS
DETach: Detach the UE
HANDover: Initiate a handover (within the LTE signaling application or to another signaling application)

Example: See Setting up a Test Mode Connection

Usage: Event

Firmware/Software: V2.1.20
V3.0.10: added DETach and HANDover

Manual operation: See "Connection control hotkeys" on page 116

CALL:LTE:SIGN<i>:SCC<c>:ACTion <SCCAction>

Controls the state of the Secondary Component Carrier (SCC) number <c>.

Suffix:

<c> 1..2

Setting parameters:

<SCCAction> **OFF:** Switch SCC off
ON: Switch SCC on
RRCadd: Add SCC RRC connection
MACactivate: Activate MAC for the SCC
MACDeactivat: Deactivate MAC for the SCC
RRCDelete: Delete SCC RRC connection

Usage: Event

Firmware/Software: V3.2.50

Manual operation: See "Connection control hotkeys" on page 116

FETCh:LTE:SIGN<i>:PSWitched:STATe?

Queries the PS connection state, see also chapter 2.2.8.1, "Packet-Switched States", on page 25.

Return values:

<PS State> OFF | ON | ATTached | CESTablished | DISConnect | CONNecting | SIGNaling | SMESsage | RMESsage | IHANdover | OHANdover

OFF: Signal Off
ON: Signal On
ATTached: UE attached
CESTablished: Connection Established
DISConnect: Disconnect in Progress
CONNecting: Connection Setup in Progress
SIGNaling: Signaling in Progress
SMESsage: Sending Message
RMESsage: Receiving Message
IHANdover: Incoming Handover in Progress
OHANdover: Outgoing Handover in Progress

*RST: OFF

Example: See Setting up a Test Mode Connection

Usage: Query only

Firmware/Software: V2.1.20
V3.0.10: added IHANdover, OHANdover

Manual operation: See "Packet Switched" on page 99

FETCh:LTE:SIGN<i>:SCC<c>:STATe?

Queries the state of the SCC number <c>, see also chapter 2.2.8.2, "SCC States", on page 27.

Suffix:

<c> 1..2

Return values:

<SCC State> OFF | ON | RRCadded | MACactivated

OFF: SCC Off
ON: SCC On
RRCadded: RRC Added
MACactivated: MAC Activated

Example: See Attaching the UE and Activating SCCs

Usage: Query only

Firmware/Software: V3.2.50

Manual operation: See "SCC<n> State" on page 99

2.6.3.2 Connect/Disconnect Preparation

The following commands configure the dedicated bearer settings as a preparation for a dedicated bearer connect or disconnect, initiated via `CALL:LTE:SIGN<i>:PSWitched:ACTion`.

The commands are only relevant for the connection type "Data Application". For the connection type "Testmode", no preparation is required.

CATalog:LTE:SIGN<i>:CONNection:DEFBearer?

Queries a list of all established default bearers.

Return values:

<ID> Comma-separated list of bearer IDs as strings
String example: "5 (cmw500.rohde-schwarz.com)"

Example: See Connecting/Releasing Dedicated Bearers

Usage: Query only

Firmware/Software: V3.2.80

Manual operation: See "Connect" on page 117

CATalog:LTE:SIGN<i>:CONNection:DEDBearer?

Queries a list of all established dedicated bearers.

Return values:

<ID> Comma-separated list of bearer IDs as strings
String example: "6 (->5, Voice)"

Example: See Connecting/Releasing Dedicated Bearers

Usage: Query only

Firmware/Software: V3.2.80

Manual operation: See "Disconnect" on page 118

PREPare:LTE:SIGN<i>:CONNection:DEDBearer <DefBearerID>, <Profile>, <TFTportLow>, <TFTportHigh>

Configures dedicated bearer settings as a preparation for a bearer setup via `CALL:LTE:SIGN:PSWitched:ACTion CONNect`.

Parameters:

<DefBearerID> Bearer ID string, selecting the default bearer, to which the dedicated bearer shall be mapped.
String example: "5 (cmw500.rohde-schwarz.com)"
To query a list of IDs for all established default bearers, see `CATalog:LTE:SIGN<i>:CONNection:DEFBearer?`.

<Profile> VOICe | VIDeo | DRAM | DRUM
Selects a dedicated bearer profile
VOICe: for voice connections
VIDeo: for video connections
DRAM: for data connections with RLC acknowledged mode
DRUM: for data connections with RLC unacknowledged mode
*RST: DRUM

<TFTportLow> Selects the lower end of the port range, for which traffic shall be routed to the dedicated bearer
Range: 1 to 65535
*RST: 1

<TFTportHigh> Selects the upper end of the port range
Range: 1 to 65535
*RST: 65535

Example: See Connecting/Releasing Dedicated Bearers

Firmware/Software: V3.2.80

Options: R&S CMW-KS510

Manual operation: See "Connect" on page 117

CONFigure:LTE:SIGN<i>:CONNection:DEDBearer <ID>

Selects a dedicated bearer as a preparation for a bearer release via `CALL:LTE:SIGN:PSWitched:ACTion DISConnect`.

Parameters:

<ID> Dedicated bearer ID as string
String example: "6 (->5, Voice)"
To query a list of IDs for all established dedicated bearers, see `CATalog:LTE:SIGN<i>:CONNection:DEDBearer?`.

Example: See Connecting/Releasing Dedicated Bearers

Firmware/Software: V3.2.80

Options: R&S CMW-KS510

Manual operation: See "Disconnect" on page 118

2.6.3.3 Handover Preparation

The following commands configure the handover settings as a preparation for a handover action, initiated via `CALL:LTE:SIGN<i>:PSWitched:ACTion`.

PREPare:LTE:SIGN<i>:HANDover <Band>, <DLChannel>, <DLBandwidth>, <AddSpecEmission>

Configures the destination parameters for an intra-RAT handover within the LTE signaling application.

Parameters:

<Band>
FDD: OB1 | ... | OB28 | OB30 | OB31 | UDEFined
TDD: OB33 | ... | OB44 | UDEFined
Operating band of the handover destination
*RST: OB1 for FDD, OB33 for TDD

<DLChannel>
DL channel number valid for the selected operating band. The related UL channel number is calculated and set automatically.
For channel numbers depending on operating bands, see chapter 2.2.16, "Operating Bands", on page 59.
Range: depends on operating band
*RST: 300

<DLBandwidth>
B014 | B030 | B050 | B100 | B150 | B200
DL cell/channel bandwidth (also used for UL)
1.4 MHz, 3 MHz, 5 MHz, 10 MHz, 15 MHz, 20 MHz
*RST: B100

<AddSpecEmission>
NS01 | ... | NS24
Value signaled to the UE as additional ACLR and spectrum emission requirement
*RST: NS01

Example: See Performing an Intra-RAT Handover

Firmware/Software:	V3.0.10 V3.0.30: OB27, OB28, OB44 V3.2.50: OB30, OB31 V3.2.70: NS16, NS17, NS18, NS20 V3.2.82: NS19, NS21, NS22, NS23, NS24
Options:	R&S CMW-KB036 for frequencies above 3.3 GHz R&S CMW-KS525 for UDEFined
Manual operation:	See "Inter/Intra-RAT (hotkey)" on page 118

PREPare:LTE:SIGN<i>:HANDover:DESTination <Destination>

Selects the handover destination. A complete list of all supported values can be displayed using `PREPare:LTE:SIGN<i>:HANDover:CATalog:DESTination?` on page 263.

Parameters:

<Destination>	Destination as string
Example:	See Performing an Inter-RAT Handover
Firmware/Software:	V3.0.10
Manual operation:	See "Inter/Intra-RAT (hotkey)" on page 118

PREPare:LTE:SIGN<i>:HANDover:CATalog:DESTination?

Lists all handover destinations that can be selected using `PREPare:LTE:SIGN<i>:HANDover:DESTination`.

Return values:

<Destination>	Comma-separated list of all supported destinations. Each destination is represented as a string. "No Connection" means handover to another instrument. The "...Sig..." strings refer to signaling applications at the same instrument.
Example:	See Performing an Inter-RAT Handover
Usage:	Query only
Firmware/Software:	V3.0.10
Manual operation:	See "Inter/Intra-RAT (hotkey)" on page 118

PREPare:LTE:SIGN<i>:HANDover:MMODe <Mode>

Selects the mechanism to be used for handover to another signaling application.

Parameters:

<Mode>	REDirection | MTCSfallback *RST: RED
Example:	See Performing an Inter-RAT Handover

Firmware/Software: V3.2.50

Options: R&S CMW-KS510 for MTCSfallback

Manual operation: See "Inter/Intra-RAT (hotkey)" on page 118

PREPare:LTE:SIGN<i>:HANDover:EXTernal:DESTination <Destination>

Selects the target radio access technology for handover to another instrument.

Parameters:

<Destination> LTE | EVDO | CDMA | GSM | WCDMa | TDSCdma

*RST: LTE

Example: See Performing a Handover to another Instrument

Firmware/Software: V3.0.20

Manual operation: See "Inter/Intra-RAT (hotkey)" on page 118

PREPare:LTE:SIGN<i>:HANDover:EXTernal:CDMA <BandClass>, <DLChannel>
PREPare:LTE:SIGN<i>:HANDover:EXTernal:EVDO <BandClass>, <DLChannel>

Configures the destination parameters for handover to a CDMA2000 or 1xEV-DO destination at another instrument.

Parameters:

<BandClass> USC | KCEL | NAPC | TACS | JTAC | KPCS | N45T | IM2K | NA7C | B18M | NA8S | PA4M | PA8M | IEXT | USPC | AWS | U25B | U25F | NA9C | PS7C | LO7C

USC: BC 0, US-Cellular
KCEL: BC 0, Korean Cellular
NAPC: BC 1, North American PCS
TACS: BC 2, TACS Band
JTAC: BC 3, JTACS Band
KPCS: BC 4, Korean PCS
N45T: BC 5, NMT-450
IM2K: BC 6, IMT-2000
NA7C: BC 7, Upper 700 MHz
B18M: BC 8, 1800 MHz Band
NA9C: BC 9, North American 900 MHz
NA8S: BC 10, Secondary 800 MHz
PA4M: BC 11, European 400 MHz PAMR
PA8M: BC 12, 800 MHz PAMR
IEXT: BC 13, IMT-2000 2.5 GHz Extension
USPC: BC 14, US PCS 1900 MHz
AWS: BC 15, AWS Band
U25B: BC 16, US 2.5 GHz Band
U25F: BC 17, US 2.5 GHz Forward
PS7C: BC 18, Public Safety Band 700 MHz
LO7C: BC 19, Lower 700 MHz

*RST: USC

<DLChannel> Channel number

Range: depends on the band class, see table below
*RST: 283

Example: See Performing a Handover to another Instrument

Firmware/Software: V3.0.20

Manual operation: See "Inter/Intra-RAT (hotkey)" on page 118

Table 2-22: Channel number range depending on band class

Band Class	Channel Number
USC, KCEL	1 to 799, 991 to 1323
NAPC, IM2K	0 to 1199
TACS	0 to 1000, 1329 to 2108
JTAC	1 to 799, 801 to 1039, 1041 to 1199, 1201 to 1600
KPCS	0 to 599
N45T	1 to 400, 472 to 871, 1039 to 1473, 1536 to 1715, 1792 to 2016
NA7C, PS7C	0 to 240
B18M	0 to 1499
NA9C	0 to 699
NA8S	0 to 919
PA4M	1 to 400, 472 to 871, 1536 to 1715
PA8M	0 to 239
IEXT	0 to 1399
USPC	0 to 1299
AWS	0 to 899
U25B, U25F	140 to 1459
LO7C	0 to 360

PREPare:LTE:SIGN<i>:HANDover:EXTernal:GSM <Band>, <DLChannel>, <BandIndicator>

Configures the destination parameters for handover to a GSM destination at another instrument.

Parameters:

<Band> G085 | G09 | G18 | G19

GSM 850, GSM 900, GSM 1800, GSM 1900

*RST: G09

<DLChannel> Channel number used for the BCCH

Range: depends on GSM band, see table below
*RST: 20

<BandIndicator> G18 | G19

Band Indicator for distinction of GSM 1800 and GSM 1900 bands. The two bands partially use the same channel numbers for different frequencies.

*RST: G18

Example: See Performing a Handover to another Instrument

Firmware/Software: V3.0.20

Manual operation: See "Inter/Intra-RAT (hotkey)" on page 118

Table 2-23: Channel number range depending on GSM band

Band	Channel Number
G085	128 to 251
G09	0 to 124, 955 to 1023
G18	512 to 885
G19	512 to 810

PREPare:LTE:SIGN<i>:HANDover:EXTernal:LTE <Band>, <DLChannel>

Configures the destination parameters for handover to an LTE destination at another instrument.

For channel number ranges depending on operating bands, see chapter 2.2.16, "Operating Bands", on page 59. For band 32, the range is 10562 to 10838.

Parameters:

<Band> OB1 | ... | OB44 | UDEFined

Operating band 1 to 44, UDEFined = user-defined band

*RST: OB1

<DLChannel> Downlink channel number

Range: depends on operating band
*RST: 300

Example: See Performing a Handover to another Instrument

Firmware/Software: V3.0.20
V3.0.30: added OB44

Manual operation: See "Inter/Intra-RAT (hotkey)" on page 118

PREPare:LTE:SIGN<i>:HANDover:EXTernal:TDSCdma <Band>, <DLChannel>

Configures the destination parameters for handover to a TD-SCDMA destination at another instrument.

Parameters:

<Band> OB1 | OB2 | OB3

OB1: Band 1 (F), 1880 MHz to 1920 MHz
OB2: Band 2 (A), 2010 MHz to 2025 MHz
OB3: Band 3 (E), 2300 MHz to 2400 MHz

*RST: OB1

<DLChannel> Downlink channel number
The allowed range depends on the frequency band:
OB1: 9400 to 9600
OB2: 10050 to 10125
OB3: 11500 to 12000

*RST: 10563

Example: See Performing a Handover to another Instrument

Firmware/Software: V3.0.50

Manual operation: See "Inter/Intra-RAT (hotkey)" on page 118

PREPare:LTE:SIGN<i>:HANDover:EXTernal:WCDMa <Band>, <DLChannel>

Configures the destination parameters for handover to a WCDMA destination at another instrument.

Parameters:

<Band> OB1 | OB2 | OB3 | OB4 | OB5 | OB6 | OB7 | OB8 | OB9 | OB10 | OB11 | OB12 | OB13 | OB14 | OB19 | OB20 | OB21 | OBS1 | OBS2 | OBS3 | OBL1

OB1, ..., OB14: Operating Band I to XIV
OB19, ..., OB21: Operating Band XIX to XXI
OBS1: Operating Band S
OBS2: Operating Band S 170 MHz
OBS3: Operating Band S 190 MHz
OBL1: Operating Band L

*RST: OB1

<DLChannel> Downlink channel number

Range: Depends on operating band, see table below
*RST: not documented

Example: See Performing a Handover to another Instrument

Firmware/Software: V3.0.20

Manual operation: See "Inter/Intra-RAT (hotkey)" on page 118

Table 2-24: Channel number range depending on operating band

Operating Band	Channel Number
OB1	10562 to 10838
OB2	412 to 687 (step 25), 9662 to 9938

Operating Band	Channel Number
OB3	1162 to 1513
OB4	1537 to 1738, 1887 to 2087 (step 25)
OB5	1007, 1012, 1032, 1037, 1062, 1087, 4357 to 4458
OB6	1037, 1062, 4387 to 4413
OB7	2237 to 2563, 2587 to 2912 (step 25)
OB8	2937 to 3088
OB9	9237 to 9387
OB10	3112 to 3388, 3412 to 3687 (step 25)
OB11	3712 to 3812
OB12	3837 to 3903, 3927, 3932, 3957, 3962, 3987, 3992
OB13	4017 to 4043, 4067, 4092
OB14	4117 to 4143, 4167, 4192
OB19	712 to 763, 787, 812, 837
OB20	4512 to 4638
OB21	862 to 912
OBS1	5912 to 5987 (step 25), 10912 to 10988
OBS2	10900 to 10950
OBS3	5962, 5987, 10950 to 11000
OBL1	7637 to 7783, 7788 to 7933

2.6.4 Event Log

The following commands retrieve event log entries.

SENSe:LTE:SIGN<i>:ELOG:LAST?

Queries the latest entry of the event log.

Return values:

<Timestamp> Timestamp of the entry as string in the format "hh:mm:ss"

<Category> INFO | WARNing | ERRor | CONTinue
Category of the entry, as indicated in the main view by an icon

<Event> Text string describing the event, e.g. "RRC Connection Established"

Usage: Query only

Firmware/Software: V2.1.30

Manual operation: See "Event log entries" on page 100

SENSe:LTE:SIGN<i>:ELOG:ALL?

Queries all entries of the event log.

For each entry, three parameters are returned, from oldest to latest entry: {<Timestamp>, <Category>, <Event>}$_{\text{entry 1}}$, {<Timestamp>, <Category>, <Event>}$_{\text{entry 2}}$, ...

Return values:

<Timestamp> Timestamp of the entry as string in the format "hh:mm:ss"

<Category> INFO | WARNing | ERRor | CONTinue
Category of the entry, as indicated in the main view by an icon

<Event> Text string describing the event, e.g. "RRC Connection Established"

Usage: Query only

Firmware/Software: V2.1.30

Manual operation: See "Event log entries" on page 100

2.6.5 UE Measurement Report Contents

The following commands retrieve UE measurement report contents for the serving cell and for measured neighbor cells.

SENSe:LTE:SIGN<i>:UEReport[:PCC]:RSRP?
SENSe:LTE:SIGN<i>:UEReport:SCC<c>:RSRP?

Returns the RSRP reported by the UE as dimensionless index.

Suffix:

<c>	1..2

Return values:

<RSRP>	Range: 0 to 97

Usage: Query only

Firmware/Software: V2.0.10, SCC command V3.2.70

Manual operation: See "LTE Serving Cell > RSRP" on page 101

SENSe:LTE:SIGN<i>:UEReport[:PCC]:RSRP:RANGe?
SENSe:LTE:SIGN<i>:UEReport:SCC<c>:RSRP:RANGe?

Returns the RSRP value range, corresponding to the RSRP index reported by the UE.

Suffix:

<c>	1..2

Return values:

<Lower>	Range: -140 dBm to -44 dBm Default unit: dBm
<Upper>	Range: -140 dBm to -44 dBm Default unit: dBm

Usage: Query only

Firmware/Software: V2.0.10, SCC command V3.2.70

Manual operation: See "LTE Serving Cell > RSRP" on page 101

SENSe:LTE:SIGN<i>:UEReport[:PCC]:RSRQ?
SENSe:LTE:SIGN<i>:UEReport:SCC<c>:RSRQ?

Returns the RSRQ reported by the UE as dimensionless index.

Suffix:

<c>	1..2

Return values:

<RSRQ>	Range: 0 to 34

Usage: Query only

Firmware/Software: V2.0.10, SCC command V3.2.70

Manual operation: See "LTE Serving Cell > RSRQ" on page 101

SENSe:LTE:SIGN<i>:UEReport[:PCC]:RSRQ:RANGe?
SENSe:LTE:SIGN<i>:UEReport:SCC<c>:RSRQ:RANGe?

Returns the RSRQ value range, corresponding to the RSRQ index reported by the UE.

Suffix:
<c> 1..2

Return values:
<Lower> Range: -19.5 dB to -3 dB
Default unit: dB

<Upper> Range: -19.5 dB to -3 dB
Default unit: dB

Usage: Query only

Firmware/Software: V2.0.10, SCC command V3.2.70

Manual operation: See "LTE Serving Cell > RSRQ" on page 101

SENSe:LTE:SIGN<i>:UEReport[:PCC]:SCELl?
SENSe:LTE:SIGN<i>:UEReport:SCC<c>:SCELl?

Returns measurement report values for the serving LTE cell.

Suffix:
<c> 1..2

Return values:
<RSRP> RSRP as dimensionless index
Range: 0 to 97

<RSRQ> RSRQ as dimensionless index
Range: 0 to 34

Example: See Querying UE Measurement Report Contents

Usage: Query only

Firmware/Software: V3.0.50, SCC command V3.2.70

Manual operation: See "LTE Serving Cell > RSRP" on page 101

SENSe:LTE:SIGN<i>:UEReport[:PCC]:SCELl:RANGe?
SENSe:LTE:SIGN<i>:UEReport:SCC<c>:SCELl:RANGe?

Returns the value ranges corresponding to the dimensionless index values reported for the serving LTE cell.

Suffix:
<c> 1..2

Return values:

<RSRPlower> RSRP minimum value

Range: -140 dBm to -44 dBm
Default unit: dBm

<RSRPupper> RSRP maximum value

Range: -140 dBm to -44 dBm
Default unit: dBm

<RSRQlower> RSRQ minimum value

Range: -19.5 dB to -3 dB
Default unit: dB

<RSRQupper> RSRQ maximum value

Range: -19.5 dB to -3 dB
Default unit: dB

Example: See Querying UE Measurement Report Contents

Usage: Query only

Firmware/Software: V3.0.50, SCC command V3.2.70

Manual operation: See "LTE Serving Cell > RSRP" on page 101

SENSe:LTE:SIGN<i>:UEReport:NCELl:LTE:CELL<no>?

Returns measurement report values for the LTE neighbor cell number <no>.

Suffix:

<no> 1..16

Return values:

<RSRP> RSRP as dimensionless index

Range: 0 to 97

<RSRQ> RSRQ as dimensionless index

Range: 0 to 34

Example: See Querying UE Measurement Report Contents

Usage: Query only

Firmware/Software: V3.0.50

Options: R&S CMW-KS510

Manual operation: See "LTE Neighbor Cells > RSRP, RSRQ" on page 102

SENSe:LTE:SIGN<i>:UEReport:NCELl:LTE:CELL<no>:RANGe?

Returns the value ranges corresponding to the dimensionless index values reported for the LTE neighbor cell number <no>.

Suffix:
<no> 1..16

Return values:

<RSRPlower> RSRP minimum value

Range: -140 dBm to -44 dBm
Default unit: dBm

<RSRPupper> RSRP maximum value

Range: -140 dBm to -44 dBm
Default unit: dBm

<RSRQlower> RSRQ minimum value

Range: -19.5 dB to -3 dB
Default unit: dB

<RSRQupper> RSRQ maximum value

Range: -19.5 dB to -3 dB
Default unit: dB

Example: See Querying UE Measurement Report Contents

Usage: Query only

Firmware/Software: V3.0.50

Options: R&S CMW-KS510

Manual operation: See "LTE Neighbor Cells > RSRP, RSRQ" on page 102

SENSe:LTE:SIGN<i>:UEReport:NCELl:GSM:CELL<no>?

Returns the RSSI value reported as dimensionless index for the GSM neighbor cell number <no>.

Suffix:
<no> 1..4

Return values:
<RSSI> Range: 0 to 63

Example: See Querying UE Measurement Report Contents

Usage: Query only

Firmware/Software: V3.0.50

Options: R&S CMW-KS510

Manual operation: See "GSM > RSSI" on page 102

SENSe:LTE:SIGN<i>:UEReport:NCELl:GSM:CELL<no>:RANGe?

Returns the value range corresponding to the dimensionless RSSI index value reported for the GSM neighbor cell number <no>.

Suffix:

<no>	1..4

Return values:

<RSSIlower>	RSSI minimum value Range: -110 dBm to -48 dBm Default unit: dBm
<RSSIupper>	RSSI maximum value Range: -110 dBm to -48 dBm Default unit: dBm

Example: See Querying UE Measurement Report Contents

Usage: Query only

Firmware/Software: V3.0.50

Options: R&S CMW-KS510

Manual operation: See "GSM > RSSI" on page 102

SENSe:LTE:SIGN<i>:UEReport:NCELl:WCDMa:CELL<no>?

Returns measurement report values for the WCDMA neighbor cell number <no>.

Suffix:

<no>	1..4

Return values:

<RSCP>	RSCP as dimensionless index Range: -5 to 91
<EcNO>	Ec/No as dimensionless index Range: 0 to 49

Example: See Querying UE Measurement Report Contents

Usage: Query only

Firmware/Software: V3.0.50

Options: R&S CMW-KS510

Manual operation: See "WCDMA > RSCP, EcNO" on page 102

SENSe:LTE:SIGN<i>:UEReport:NCELl:WCDMa:CELL<no>:RANGe?

Returns the value ranges corresponding to the dimensionless index values reported for the WCDMA neighbor cell number <no>.

Suffix:

<no>	1..4

Return values:

<RSCPlower> RSCP minimum value

Range: -120 dBm to -25 dBm
Default unit: dBm

<RSCPupper> RSCP maximum value

Range: -120 dBm to -25 dBm
Default unit: dBm

<EcNOlower> Ec/No minimum value

Range: -24 dB to 0 dB
Default unit: dB

<EcNOupper> Ec/No maximum value

Range: -24 dB to 0 dB
Default unit: dB

Example: See Querying UE Measurement Report Contents

Usage: Query only

Firmware/Software: V3.0.50

Options: R&S CMW-KS510

Manual operation: See "WCDMA > RSCP, EcNO" on page 102

SENSe:LTE:SIGN<i>:UEReport:NCELl:CDMA:CELL<no>?

Returns measurement report values for the CDMA2000 neighbor cell number <no>.

Suffix:

<no> 1..4

Return values:

<pilotPnPhase> Reported pilot PN phase value

Range: 0 PN Chips to 32767 PN Chips
Default unit: PN Chips

<pilotStrength> Reported pilot strength value

Range: 0 to 63

Example: See Querying UE Measurement Report Contents

Usage: Query only

Firmware/Software: V3.0.50

Options: R&S CMW-KS510

Manual operation: See "CDMA2000 / 1xEV-DO > pilot Pn Phase, pilot Strength" on page 102

SENSe:LTE:SIGN<i>:UEReport:NCELl:EVDO:CELL<no>?

Returns measurement report values for the 1xEV-DO neighbor cell number <no>.

Suffix:
<no> 1..4

Return values:
<pilotPnPhase> Reported pilot PN phase value

Range: 0 PN Chips to 32767 PN Chips
Default unit: PN Chips

<pilotStrength> Reported pilot strength value

Range: 0 to 63

Example: See Querying UE Measurement Report Contents

Usage: Query only

Firmware/Software: V3.0.50

Options: R&S CMW-KS510

Manual operation: See "CDMA2000 / 1xEV-DO > pilot Pn Phase, pilot Strength" on page 102

SENSe:LTE:SIGN<i>:UEReport:NCELl:TDSCdma:CELL<no>?

Returns measurement report values for the TD-SCDMA neighbor cell number <no>.

Suffix:
<no> 1..4

Return values:
<RSCP> RSCP as dimensionless index

Range: -5 to 91

Example: See Querying UE Measurement Report Contents

Usage: Query only

Firmware/Software: V3.2.20

Options: R&S CMW-KS510

Manual operation: See "TD-SCDMA > RSCP" on page 103

SENSe:LTE:SIGN<i>:UEReport:NCELl:TDSCdma:CELL<no>:RANGe?

Returns the value ranges corresponding to the dimensionless index values reported for the TD-SCDMA neighbor cell number <no>.

Suffix:
<no> 1..4

Return values:

<RSCPlower> RSCP minimum value

Range: -120 dBm to -25 dBm
Default unit: dBm

<RSCPupper> RSCP maximum value

Range: -120 dBm to -25 dBm
Default unit: dBm

Example: See Querying UE Measurement Report Contents

Usage: Query only

Firmware/Software: V3.2.20

Options: R&S CMW-KS510

Manual operation: See "TD-SCDMA > RSCP" on page 103

2.6.6 UE Capabilities

The commands in this section retrieve information about the connected mobile as shown in the "UE Capabilities" area of the main view.

For some parameters, three remote control commands are listed:

- First command:
  Queries the parameter in the upper part of the capability report. Features indicated as "supported" are supported for FDD and TDD.
- Command with additional `:FAUeeutra:` mnemonic:
  Queries the parameter in section "fdd Add UE-EUTRA Capabilities". Features indicated as "supported" are supported only for FDD, not for TDD.
- Command with additional `:TAUeeutra:` mnemonic:
  Queries the parameter in section "tdd Add UE-EUTRA Capabilities". Features indicated as "supported" are supported only for TDD, not for FDD.

2.6.6.1 General UE Capability Information

The following commands query the information at the highest level of the "UE Capabilities" section (or the highest level of the additional FDD section and additional TDD section).

SENSe:LTE:SIGN<i>:UECapability:ASRelease?

Returns the "Access Stratum Release" according to the UE capability information.

Return values:

<AccStratRelease>	REL8 | REL9 | REL10 | REL11 | REL12
Example:	See Querying UE Capability Report Contents
Usage:	Query only
Firmware/Software:	V3.2.10
Manual operation:	See "Access Stratum Release" on page 204

SENSe:LTE:SIGN<i>:UECapability:UECategory?

Returns the UE category according to the UE capability information.

Return values:

<UEcategory>	Range: 1 to 8
Example:	See Querying UE Capability Report Contents
Usage:	Query only
Firmware/Software:	V3.2.70
Manual operation:	See "UE Category" on page 204

SENSe:LTE:SIGN<i>:UECapability:FGINdicators?
SENSe:LTE:SIGN<i>:UECapability:FAUeeutra:FGINdicators?
SENSe:LTE:SIGN<i>:UECapability:TAUeeutra:FGINdicators?

Returns the "featureGroupIndicators" contained in the UE capability information.

The 32-bit value contains one bit per feature group (1 = supported, 0 = not supported).

Return values:

<FeatureGroupInd>	Range: #B0 to #B11111111111111111111111111111111
Example:	See Querying UE Capability Report Contents
Usage:	Query only
Firmware/Software:	V2.1.30, `FAUeeutra` / `TAUeeutra` V3.2.80
Manual operation:	See "Feature Group Indicators" on page 204

SENSe:LTE:SIGN<i>:UECapability:FGINdicators:RNADd?
SENSe:LTE:SIGN<i>:UECapability:FAUeeutra:FGINdicators:RNADd?
SENSe:LTE:SIGN<i>:UECapability:TAUeeutra:FGINdicators:RNADd?

Returns the "featureGroupIndRel9Add-r9" contained in the UE capability information.

The 32-bit value contains one bit per feature group (1 = supported, 0 = not supported).

Return values:
<FeatureGroupInd> Range: #B0 to #B11111111111111111111111111111111

Example: See Querying UE Capability Report Contents

Usage: Query only

Firmware/Software: V3.2.80

Manual operation: See "Feature Group Indicators Rel9 Add" on page 205

SENSe:LTE:SIGN<i>:UECapability:FGINdicators:RTEN?
SENSe:LTE:SIGN<i>:UECapability:FAUeeutra:FGINdicators:RTEN?
SENSe:LTE:SIGN<i>:UECapability:TAUeeutra:FGINdicators:RTEN?

Returns the "featureGroupIndRel10-r10" contained in the UE capability information.

The 32-bit value contains one bit per feature group (1 = supported, 0 = not supported).

Return values:
<FeatureGroupInd> Range: #B0 to #B11111111111111111111111111111111

Example: See Querying UE Capability Report Contents

Usage: Query only

Firmware/Software: V3.2.80

Manual operation: See "Feature Group Indicators Rel 10" on page 205

SENSe:LTE:SIGN<i>:UECapability:DTYPe?

Returns whether the UE benefits from NW-based battery consumption optimization or not.

Return values:
<DeviceType> NBFBcopt | NAV

NBFBcopt: UE does not benefit
NAV: UE does benefit

Example: See Querying UE Capability Report Contents

Usage: Query only

Firmware/Software: V3.2.80

Manual operation: See "Device Type" on page 205

SENSe:LTE:SIGN<i>:UECapability:RREPort?

Returns whether the UE supports the delivery of RACH reports or not.

Return values:

<Supported>	OFF | ON
Example:	See Querying UE Capability Report Contents
Usage:	Query only
Firmware/Software:	V3.2.80
Manual operation:	See "rach Report" on page 205

2.6.6.2 PDCP UE Capabilities

The following commands query in which way the UE supports the PDCP protocol.

SENSe:LTE:SIGN<i>:UECapability:PDCP:SRPRofiles?

Returns UE capability information indicating the support of the individual RObust Header Compression (ROHC) profiles.

Return values:

<ROHC_RTP>	OFF | ON Support of profile 0x0001, ROHC RTP
<ROHC_UDP>	OFF | ON Support of profile 0x0002, ROHC UDP
<ROHC_ESP>	OFF | ON Support of profile 0x0003, ROHC ESP
<ROHC_IP>	OFF | ON Support of profile 0x0004, ROHC IP
<ROHC_TCP>	OFF | ON Support of profile 0x0006, ROHC TCP
<ROHCv2_RTP>	OFF | ON Support of profile 0x0101, ROHCv2 RTP
<ROHCv2_UDP>	OFF | ON Support of profile 0x0102, ROHCv2 UDP
<ROHCv2_ESP>	OFF | ON Support of profile 0x0103, ROHCv2 ESP
<ROHCv2_IP>	OFF | ON Support of profile 0x0104, ROHCv2 IP

Example: See Querying UE Capability Report Contents

Usage: Query only

Firmware/Software: V2.1.30

Manual operation: See "ROHC RTP to ROHCv2 IP" on page 206

SENSe:LTE:SIGN<i>:UECapability:PDCP:MRCSessions?

Returns the maximum number of ROHC context sessions supported by the UE.

Return values:

<MaxSessions> CS2 | CS4 | CS8 | CS12 | CS16 | CS24 | CS32 | CS48 | CS64 | CS128 | CS256 | CS512 | CS1024 | CS16384

Example: See Querying UE Capability Report Contents

Usage: Query only

Firmware/Software: V2.1.30

Manual operation: See "Max Num ROHC Context Sessions" on page 206

2.6.6.3 Physical Layer UE Capabilities

The following commands query the physical layer capabilities of the UE.

SENSe:LTE:SIGN<i>:UECapability:PLAYer:UTASupported?
SENSe:LTE:SIGN<i>:UECapability:FAUeeutra:PLAYer:UTASupported?
SENSe:LTE:SIGN<i>:UECapability:TAUeeutra:PLAYer:UTASupported?

Returns whether the UE supports transmit antenna selection or not.

Return values:
<UE_TXantSelSupp> OFF | ON

Example: See Querying UE Capability Report Contents

Usage: Query only

Firmware/Software: V2.1.30, `FAUeeutra` / `TAUeeutra` V3.2.80

Manual operation: See "UE TX Antenna Selection Supported" on page 207

SENSe:LTE:SIGN<i>:UECapability:PLAYer:USRSsupport?
SENSe:LTE:SIGN<i>:UECapability:FAUeeutra:PLAYer:USRSsupport?
SENSe:LTE:SIGN<i>:UECapability:TAUeeutra:PLAYer:USRSsupport?

Returns whether the UE supports PDSCH transmission mode 7 for FDD or not.

Return values:
<UEspRefSigsSupp> OFF | ON

Example: See Querying UE Capability Report Contents

Usage: Query only

Firmware/Software: V2.1.30, `FAUeeutra` / `TAUeeutra` V3.2.80

Manual operation: See "UE-Specific Ref. Sigs. Supported" on page 207

SENSe:LTE:SIGN<i>:UECapability:PLAYer:EDLFsupport?

Returns whether the UE supports enhanced dual layer (PDSCH TM8) for FDD or not.

Return values:
<EnDualLayFDDsup> OFF | ON

Example: See Querying UE Capability Report Contents

Usage: Query only

Firmware/Software: V3.2.80

Manual operation: See "enhanced Dual layer FDD/TDD Supported" on page 207

SENSe:LTE:SIGN<i>:UECapability:PLAYer:EDLTsupport?

Returns whether the UE supports enhanced dual layer (PDSCH TM8) for TDD or not.

Return values:
<EnDualLayTDDsup> OFF | ON

Example: See Querying UE Capability Report Contents

Usage: Query only

Firmware/Software: V3.2.80

Manual operation: See "enhanced Dual layer FDD/TDD Supported" on page 207

SENSe:LTE:SIGN<i>:UECapability:PLAYer:TAPPsupport?
SENSe:LTE:SIGN<i>:UECapability:FAUeeutra:PLAYer:TAPPsupport?
SENSe:LTE:SIGN<i>:UECapability:TAUeeutra:PLAYer:TAPPsupport?

Returns whether the UE supports transmit diversity for specific PUCCH formats.

Return values:
<Supported> OFF | ON

Example: See Querying UE Capability Report Contents

Usage: Query only

Firmware/Software: V3.2.80

Manual operation: See "Two Antenna Ports for PUCCH Supported" on page 207

SENSe:LTE:SIGN<i>:UECapability:PLAYer:TWEFsupport?
SENSe:LTE:SIGN<i>:UECapability:FAUeeutra:PLAYer:TWEFsupport?
SENSe:LTE:SIGN<i>:UECapability:TAUeeutra:PLAYer:TWEFsupport?

Returns whether the UE supports PDSCH TM9 with 8 CSI reference signal ports for FDD.

Return values:
<Supported> OFF | ON

Example: See Querying UE Capability Report Contents

Usage: Query only

Firmware/Software: V3.2.80

Manual operation: See "tm9 with 8TX FDD Supported" on page 207

SENSe:LTE:SIGN<i>:UECapability:PLAYer:PDSupport?
SENSe:LTE:SIGN<i>:UECapability:FAUeeutra:PLAYer:PDSupport?
SENSe:LTE:SIGN<i>:UECapability:TAUeeutra:PLAYer:PDSupport?

Returns whether the UE supports PMI disabling.

Return values:
<Supported> OFF | ON

Example: See Querying UE Capability Report Contents

Usage: Query only

Firmware/Software: V3.2.80

Manual operation: See "pmi Disabling Supported" on page 207

SENSe:LTE:SIGN<i>:UECapability:PLAYer:CCSSupport?
SENSe:LTE:SIGN<i>:UECapability:FAUeeutra:PLAYer:CCSSupport?
SENSe:LTE:SIGN<i>:UECapability:TAUeeutra:PLAYer:CCSSupport?

Returns whether the UE supports cross-carrier scheduling for CA.

Return values:
<Supported> OFF | ON

Example: See Querying UE Capability Report Contents

Usage: Query only

Firmware/Software: V3.2.80

Manual operation: See "cross Carrier Scheduling Supported" on page 208

SENSe:LTE:SIGN<i>:UECapability:PLAYer:SPPSupport?
SENSe:LTE:SIGN<i>:UECapability:FAUeeutra:PLAYer:SPPSupport?
SENSe:LTE:SIGN<i>:UECapability:TAUeeutra:PLAYer:SPPSupport?

Returns whether the UE supports the simultaneous transmission of PUCCH and PUSCH.

Return values:
<Supported> OFF | ON

Example: See Querying UE Capability Report Contents

Usage: Query only

Firmware/Software: V3.2.80

Manual operation: See "simultaneous PUCCH PUSCH Supported" on page 208

SENSe:LTE:SIGN<i>:UECapability:PLAYer:MCPCsupport?
SENSe:LTE:SIGN<i>:UECapability:FAUeeutra:PLAYer:MCPCsupport?
SENSe:LTE:SIGN<i>:UECapability:TAUeeutra:PLAYer:MCPCsupport?

Returns whether the UE supports multi-cluster PUSCH transmission within a CC.

Return values:
<Supported> OFF | ON

Example: See Querying UE Capability Report Contents

Usage: Query only

Firmware/Software: V3.2.80

Manual operation: See "multi Cluster PUSCH within CC Supported" on page 208

SENSe:LTE:SIGN<i>:UECapability:PLAYer:NURClist?
SENSe:LTE:SIGN<i>:UECapability:FAUeeutra:PLAYer:NURClist?
SENSe:LTE:SIGN<i>:UECapability:TAUeeutra:PLAYer:NURClist?

Returns a list of values, indicating whether the UE supports non-contiguous UL resource allocations within a CC for the individual E-UTRA operating bands.

Return values:

<SupportedBand> OFF | ON
45 values: band 1 to band 44, user-defined band

Example: See Querying UE Capability Report Contents

Usage: Query only

Firmware/Software: V3.2.80

Manual operation: See "non Contiguous UL RA within CC List Supported" on page 208

2.6.6.4 RF UE Capabilities

The following commands query the supported E-UTRA operating bands and band combinations.

SENSe:LTE:SIGN<i>:UECapability:RF:SUPPorted?

Returns a list of values indicating the support of the individual E-UTRA operating bands by the UE.

Return values:

<SupportedBand> OFF | ON
45 values: band 1 to band 44, user-defined band

Example: See Querying UE Capability Report Contents

Usage: Query only

Firmware/Software: V3.0.30

Manual operation: See "Supported Bands" on page 209

SENSe:LTE:SIGN<i>:UECapability:RF:HDUPlex?

Returns a list of values indicating whether the UE supports only half duplex operation for the individual E-UTRA operating bands.

Return values:

<HalfDuplex> OFF | ON

45 values: band 1 to band 44, user-defined band

Example: See Querying UE Capability Report Contents

Usage: Query only

Firmware/Software: V3.0.30

Manual operation: See "Supported Bands" on page 209

SENSe:LTE:SIGN<i>:UECapability:RF:BCOMbination:V<Number>:BCSet?

Returns a list of binary numbers, indicating which bandwidth combination sets the UE supports for the individual carrier aggregation band combinations.

Suffix:

<Number> 1020

Return values:

<Band> Comma-separated list of binary numbers, one binary number per band combination (combination 0 to n)
Each binary number indicates which bandwidth combination sets are supported for the band combination. The leftmost bit corresponds to set 0, the next bit to set 1 and so on. "0" means not supported. "1" means supported.

Example: See Querying UE Capability Report Contents

Usage: Query only

Firmware/Software: V3.2.80

Manual operation: See "Supported Band Combination v1020" on page 209

SENSe:LTE:SIGN<i>:UECapability:RF:BCOMbination:V<Number>:EUTRa<BandNr>?

Returns the operating band combinations supported for carrier aggregation.

Suffix:

<Number> 1020,1090
Selects the UE capability report element to be evaluated:
`RF-Parameters-v1020` or `RF-Parameters-v1090`

<BandNr> 1..2
Selects which band of the band combinations shall be returned: first band or second band

Return values:

<Band> OB1 | OB2 | ... | OB44 | UDEFined
Comma-separated list of bands, one band per band combination (combination 0 to n)

Example: See Querying UE Capability Report Contents

Usage: Query only

Firmware/Software: V3.2.80

Manual operation: See "Supported Band Combination v1020" on page 209

SENSe:LTE:SIGN<i>:UECapability:RF:BCOMbination:V<Number>:EUTRa<BandNr>:BCLass:UL?
SENSe:LTE:SIGN<i>:UECapability:RF:BCOMbination:V<Number>:EUTRa<BandNr>:BCLass:DL?

Returns the bandwidth classes supported by the UE in the uplink or downlink. The information is returned for a selected band of all supported carrier aggregation band combinations.

Suffix:

<Number> 1020

<BandNr> 1..2
Selects for which band of the band combinations the information shall be returned: first band or second band

Return values:

<BandwidthClass> Comma-separated list of strings, one string per band combination (combination 0 to n)
Each string indicates the bandwidth classes supported for the selected band (<BandNr>) of the combination, for example "abc".

Example: See Querying UE Capability Report Contents

Usage: Query only

Firmware/Software: V3.2.80

Manual operation: See "Supported Band Combination v1020" on page 209

SENSe:LTE:SIGN<i>:UECapability:RF:BCOMbination:V<Number>:EUTRa<BandNr>:MCAPability:UL?
SENSe:LTE:SIGN<i>:UECapability:RF:BCOMbination:V<Number>:EUTRa<BandNr>:MCAPability:DL?

Returns the number of layers supported by the UE for spatial multiplexing in the uplink or downlink. The information is returned for a selected band of all supported carrier aggregation band combinations.

Suffix:

<Number> 1020

<BandNr> 1..2
Selects for which band of the band combinations the information shall be returned: first band or second band

Return values:

<MIMOcapability> Comma-separated list of numbers, 26 numbers per band combination (combination 0 to n)
The 26 numbers indicate the supported number of layers for bandwidth class "a" to "z".

Example: See Querying UE Capability Report Contents

Usage: Query only

Firmware/Software: V3.2.80

Manual operation: See "Supported Band Combination v1020" on page 209

2.6.6.5 Measurement UE Capabilities

The following commands query whether the UE needs measurement gaps.

SENSe:LTE:SIGN<i>:UECapability:MEAS:IFNGaps? [<Index>]

Returns a list of values indicating the need for downlink measurement gaps when operating on a specific E-UTRA band and measuring on (another) specific E-UTRA band.

The full list contains 45 times 45 values. The 45 values/repetitions correspond to band 1 to 44 plus user-defined band. The list is ordered as follows:

{measured band: 1, 2, ..., 44, user-defined}$_{\text{used band: 1}}$,

{measured band: 1, 2, ..., 44, user-defined}$_{\text{used band: 2}}$, ...,

{measured band: 1, 2, ..., 44, user-defined}$_{\text{used band: user-defined}}$

Via the optional parameter <Index>, you can alternatively query the list for one measured band:

{used band: 1, 2, ..., 44, user-defined}$_{\text{measured band <Index>}}$

Query parameters:

<Index> OB1 | OB2 | ... | OB44 | UDEFined

Selects the measured E-UTRA band, for which the list shall be returned.

Return values:

<Value> OFF | ON

Without <Index>: 45 x 45 = 2025 values
With <Index>: 45 values

Example: See Querying UE Capability Report Contents

Usage: Query only

Firmware/Software: V3.0.30
V3.2.80: added <Index>

Manual operation: See "Inter-Freq Need for Gaps" on page 211

SENSe:LTE:SIGN<i>:UECapability:MEAS:IRNGaps:UFDD? [<Index>]

Returns a list of values indicating the need for downlink measurement gaps when operating on a specific E-UTRA band and measuring on a specific UTRA FDD band.

The full list contains 32 times 45 values. Each block of 32 values corresponds to the UTRA FDD bands. The 45 repetitions correspond to the E-UTRA bands:

{measured band: 1, 2, ..., 32}$_{\text{used band: 1}}$,

{measured band: 1, 2, ..., 32}$_{\text{used band: 2}}$, ...,

{measured band: 1, 2, ..., 32}$_{\text{used band: user-defined}}$

Via the optional parameter <Index>, you can alternatively query the list for a single UTRA FDD band:

{used band: 1, 2, ..., 44, user-defined}$_{\text{measured band <Index>}}$

Query parameters:

<Index> OB1 | OB2 | ... | OB32

Selects the measured UTRA FDD band, for which the list shall be returned.

Return values:

<Value>	OFF | ON Without <Index>: 32 x 45 = 1440 values With <Index>: 45 values

Example: See Querying UE Capability Report Contents

Usage: Query only

Firmware/Software: V3.0.30
V3.2.80: added <Index>

Manual operation: See "Inter-RAT Need for Gaps" on page 211

SENSe:LTE:SIGN<i>:UECapability:MEAS:IRNGaps:UTDD<n>? [<Index>]

Returns a list of values indicating the need for downlink measurement gaps when operating on a specific E-UTRA band and measuring on a specific UTRA TDD band.

The full list contains 32 times 45 values. Each block of 32 values corresponds to the UTRA TDD bands. The 45 repetitions correspond to the E-UTRA bands:

{measured band: 1, 2, ..., 32}$_{\text{used band: 1}}$,

{measured band: 1, 2, ..., 32}$_{\text{used band: 2}}$, ...,

{measured band: 1, 2, ..., 32}$_{\text{used band: user-defined}}$

Via the optional parameter <Index>, you can alternatively query the list for a single UTRA TDD band:

{used band: 1, 2, ..., 44, user-defined}$_{\text{measured band <Index>}}$

Suffix:

<n>	128

Query parameters:

<Index>	OB1 | OB2 | ... | OB32 Selects the measured UTRA TDD band, for which the list shall be returned.

Return values:

<Value>	OFF | ON Without <Index>: 32 x 45 = 1440 values With <Index>: 45 values

Example: See Querying UE Capability Report Contents

Usage: Query only

Firmware/Software: V3.2.80

Manual operation: See "Inter-RAT Need for Gaps" on page 211

SENSe:LTE:SIGN<i>:UECapability:MEAS:IRNGaps:GERan? [<Index>]

Returns a list of values indicating the need for downlink measurement gaps when operating on a specific E-UTRA band and measuring on a specific GERAN band.

The full list contains 11 times 45 values. Each block of 11 values corresponds to the following GERAN bands: GSM 450, GSM 480, GSM 710, GSM 750, GSM 810, GSM 850, P-GSM 900, E-GSM 900, R-GSM 900, GSM 1800, GSM 1900. The 45 repetitions correspond to the E-UTRA bands:

{measured band: GSM 450, GSM 480, ..., GSM 1900}$_{\text{used band: 1}}$,

{measured band: GSM 450, GSM 480, ..., GSM 1900}$_{\text{used band: 2}}$, ...,

{measured band: GSM 450, GSM 480, ..., GSM 1900}$_{\text{used band: user-defined}}$

Via the optional parameter <Index>, you can alternatively query the list for a single GERAN band:

{used band: 1, 2, ..., 44, user-defined}$_{\text{measured band <Index>}}$

Query parameters:

<Index> G045 | G048 | G071 | G075 | G081 | G085 | G09P | G09E | G09R | G18 | G19

Selects the measured GERAN band, for which the list shall be returned.

Return values:

<Value> OFF | ON

Without <Index>: 11 x 45 = 495 values
With <Index>: 45 values

Example: See Querying UE Capability Report Contents

Usage: Query only

Firmware/Software: V3.0.30
V3.2.80: added <Index>

Manual operation: See "Inter-RAT Need for Gaps" on page 211

SENSe:LTE:SIGN<i>:UECapability:MEAS:IRNGaps:CHRPd? [<Index>]

Returns a list of values indicating the need for downlink measurement gaps when operating on a specific E-UTRA band and measuring on a specific CDMA2000 HRPD band.

The full list contains 18 times 45 values. Each block of 18 values corresponds to the CDMA2000 band classes. The 45 repetitions correspond to the E-UTRA bands:

{measured band: 0, 1, ..., 17}$_{\text{used band: 1}}$,

{measured band: 0, 1, ..., 17}$_{\text{used band: 2}}$, ...,

{measured band: 0, 1, ..., 17}$_{\text{used band: user-defined}}$

Via the optional parameter <Index>, you can alternatively query the list for a single CDMA2000 band class:

{used band: 1, 2, ..., 44, user-defined}$_{\text{measured band <Index>}}$

Query parameters:

<Index> BC0 | BC1 | ... | BC17

Selects the measured CDMA2000 band class, for which the list shall be returned.

Return values:

<Value> OFF | ON

Without <Index>: 18 x 45 = 810 values
With <Index>: 45 values

Example: See Querying UE Capability Report Contents

Usage: Query only

Firmware/Software: V3.0.30
V3.2.80: added <Index>

Manual operation: See "Inter-RAT Need for Gaps" on page 211

SENSe:LTE:SIGN<i>:UECapability:MEAS:IRNGaps:CXRTt? [<Index>]

Returns a list of values indicating the need for downlink measurement gaps when operating on a specific E-UTRA band and measuring on a specific CDMA2000 1xRTT band class.

The full list contains 18 times 45 values. Each block of 18 values corresponds to the CDMA2000 band classes. The 45 repetitions correspond to the E-UTRA bands:

{measured band: 0, 1, ..., 17}$_{\text{used band: 1}}$,

{measured band: 0, 1, ..., 17}$_{\text{used band: 2}}$, ...,

{measured band: 0, 1, ..., 17}$_{\text{used band: user-defined}}$

Via the optional parameter <Index>, you can alternatively query the list for a single CDMA2000 band class:

{used band: 1, 2, ..., 44, user-defined}$_{\text{measured band <Index>}}$

Query parameters:

<Index> BC0 | BC1 | ... | BC17

Selects the measured CDMA2000 band class, for which the list shall be returned.

Return values:

<Value> OFF | ON

Without <Index>: 18 x 45 = 810 values
With <Index>: 45 values

Example: See Querying UE Capability Report Contents

Usage: Query only

Firmware/Software: V3.0.30
V3.2.80: added <Index>

Manual operation: See "Inter-RAT Need for Gaps" on page 211

SENSe:LTE:SIGN<i>:UECapability:MEAS:IFNGaps:V<number>? [<Index>]

Returns a list of values indicating the need for downlink measurement gaps when operating on a specific E-UTRA band combination and measuring on a specific E-UTRA band.

The full list contains 45 times n+1 values. Each block of 45 values corresponds to the measured E-UTRA bands. Each repetition corresponds to a supported band combination.

The list is ordered as follows:

{measured band: 1, 2, ..., 44, user-defined}$_{\text{used band combination 0}}$,

{measured band: 1, 2, ..., 44, user-defined}$_{\text{used band combination 1}}$, ...,

{measured band: 1, 2, ..., 44, user-defined}$_{\text{used band combination n}}$

Via the optional parameter <Index>, you can alternatively query the list for a single measured E-UTRA band:

{used combination: 0, 1, ..., n}$_{\text{measured band <Index>}}$

Suffix:
<number> 1020

Query parameters:
<Index> OB1 | OB2 | ... | OB44 | UDEFined
Selects the measured E-UTRA band, for which the list shall be returned.

Return values:
<Value> OFF | ON
Without <Index>: 45 x (n+1) values
With <Index>: n+1 values

Example: See Querying UE Capability Report Contents

Usage: Query only

Firmware/Software: V3.2.80

Manual operation: See "Inter-Freq Need for Gaps v1020" on page 212

SENSe:LTE:SIGN<i>:UECapability:MEAS:IRNGaps:V<number>:UFDD? [<Index>]

Returns a list of values indicating the need for downlink measurement gaps when operating on a specific E-UTRA band combination and measuring on a specific UTRA FDD band.

The full list contains 32 times n+1 values. Each block of 32 values corresponds to the UTRA FDD bands. Each repetition corresponds to a supported band combination:

{measured band: 1, 2, ..., 32}$_{\text{used band combination 0}}$,

{measured band: 1, 2, ..., 32}$_{\text{used band combination 1}}$, ...,

{measured band: 1, 2, ..., 32}$_{\text{used band combination n}}$

Via the optional parameter <Index>, you can alternatively query the list for a single UTRA FDD band:

{used combination: 0, 1, ..., n}$_{\text{measured band <Index>}}$

Suffix:

<number> 1020

Query parameters:

<Index> OB1 | OB2 | ... | OB32

Selects the measured UTRA FDD band, for which the list shall be returned.

Return values:

<Value> OFF | ON

Without <Index>: 32 x (n+1) values
With <Index>: n+1 values

Example: See Querying UE Capability Report Contents

Usage: Query only

Firmware/Software: V3.2.80

Manual operation: See "Inter-RAT Need for Gaps v1020" on page 212

SENSe:LTE:SIGN<i>:UECapability:MEAS:IRNGaps:V<number>:UTDD<n>? [<Index>]

Returns a list of values indicating the need for downlink measurement gaps when operating on a specific E-UTRA band combination and measuring on a specific UTRA TDD band.

The full list contains 32 times n+1 values. Each block of 32 values corresponds to the UTRA TDD bands. Each repetition corresponds to a supported band combination:

{measured band: 1, 2, ..., 32}$_{\text{used band combination 0}}$,

{measured band: 1, 2, ..., 32}$_{\text{used band combination 1}}$, ...,

{measured band: 1, 2, ..., 32}$_{\text{used band combination n}}$

Via the optional parameter <Index>, you can alternatively query the list for a single UTRA TDD band:

{used combination: 0, 1, ..., n}$_{\text{measured band <Index>}}$

Suffix:

<n> 128

<number> 1020

Query parameters:

<Index> OB1 | OB2 | ... | OB32

Selects the measured UTRA TDD band, for which the list shall be returned.

Return values:

<Value> OFF | ON

Without <Index>: 32 x (n+1) values
With <Index>: n+1 values

Example: See Querying UE Capability Report Contents

Usage: Query only

Firmware/Software: V3.2.80

Manual operation: See "Inter-RAT Need for Gaps v1020" on page 212

SENSe:LTE:SIGN<i>:UECapability:MEAS:IRNGaps:V<number>:GERan? [<Index>]

Returns a list of values indicating the need for downlink measurement gaps when operating on a specific E-UTRA band combination and measuring on a specific GERAN band.

The full list contains 11 times n+1 values. Each block of 11 values corresponds to the following GERAN bands: GSM 450, GSM 480, GSM 710, GSM 750, GSM 810, GSM 850, P-GSM 900, E-GSM 900, R-GSM 900, GSM 1800, GSM 1900. Each repetition corresponds to a supported band combination:

{measured band: GSM 450, GSM 480, ..., GSM 1900}$_{\text{used band combination 0}}$,

{measured band: GSM 450, GSM 480, ..., GSM 1900}$_{\text{used band combination 1}}$, ...,

{measured band: GSM 450, GSM 480, ..., GSM 1900}$_{\text{used band combination n}}$

Via the optional parameter <Index>, you can alternatively query the list for a single GERAN band:

{used combination: 0, 1, ..., n}$_{\text{measured band <Index>}}$

Suffix:

<number> 1020

Query parameters:

<Index> G045 | G048 | G071 | G075 | G081 | G085 | G09P | G09E | G09R | G18 | G19

Selects the measured GERAN band, for which the list shall be returned.

Return values:

<Value> OFF | ON

Without <Index>: 11 x (n+1) values
With <Index>: n+1 values

Example: See Querying UE Capability Report Contents

Usage: Query only

Firmware/Software: V3.2.80

Manual operation: See "Inter-RAT Need for Gaps v1020" on page 212

SENSe:LTE:SIGN<i>:UECapability:MEAS:IRNGaps:V<number>:CHRPd? [<Index>]

Returns a list of values indicating the need for downlink measurement gaps when operating on a specific E-UTRA band combination and measuring on a specific CDMA2000 HRPD band class.

The full list contains 18 times n+1 values. Each block of 18 values corresponds to the CDMA2000 band classes. Each repetition corresponds to a supported band combination:

{measured band: 0, 1, ..., 17}$_{\text{used band combination 0}}$,

{measured band: 0, 1, ..., 17}$_{\text{used band combination 1}}$, ...,

{measured band: 0, 1, ..., 17}$_{\text{used band combination n}}$

Via the optional parameter <Index>, you can alternatively query the list for a single CDMA2000 band class:

{used combination: 0, 1, ..., n}$_{\text{measured band <Index>}}$

Suffix:

<number> 1020

Query parameters:

<Index> BC0 | BC1 | ... | BC17

Selects the measured CDMA2000 band class, for which the list shall be returned.

Return values:

<Value> OFF | ON

Without <Index>: 18 x (n+1) values
With <Index>: n+1 values

Example: See Querying UE Capability Report Contents

Usage: Query only

Firmware/Software: V3.2.80

Manual operation: See "Inter-RAT Need for Gaps v1020" on page 212

SENSe:LTE:SIGN<i>:UECapability:MEAS:IRNGaps:V<number>:CXRTt? [<Index>]

Returns a list of values indicating the need for downlink measurement gaps when operating on a specific E-UTRA band combination and measuring on a specific CDMA2000 1xRTT band class.

The full list contains 18 times n+1 values. Each block of 18 values corresponds to the CDMA2000 band classes. Each repetition corresponds to a supported band combination:

{measured band: 0, 1, ..., 17}$_{\text{used band combination 0}}$,

{measured band: 0, 1, ..., 17}$_{\text{used band combination 1}}$, ...,

{measured band: 0, 1, ..., 17}$_{\text{used band combination n}}$

Via the optional parameter <Index>, you can alternatively query the list for a single CDMA2000 band class:

{used combination: 0, 1, ..., n}$_{\text{measured band <Index>}}$

Suffix:
<number> 1020

Query parameters:
<Index> BC0 | BC1 | ... | BC17

Selects the measured CDMA2000 band class, for which the list shall be returned.

Return values:
<Value> OFF | ON

Without <Index>: 18 x (n+1) values
With <Index>: n+1 values

Example: See Querying UE Capability Report Contents

Usage: Query only

Firmware/Software: V3.2.80

Manual operation: See "Inter-RAT Need for Gaps v1020" on page 212

2.6.6.6 Inter-RAT UE Capabilities

The following commands query the inter-RAT handover capabilities of the UE.

SENSe:LTE:SIGN<i>:UECapability:IRAT:UFDD:SUPPorted?

Returns a list of values indicating the support of the individual UTRA FDD operating bands by the UE.

Return values:

<SupportedBand> OFF | ON

32 values: band 1, ..., band 32

Example: See Querying UE Capability Report Contents

Usage: Query only

Firmware/Software: V2.1.30

Manual operation: See "Supported Bands" on page 213

SENSe:LTE:SIGN<i>:UECapability:IRAT:UFDD:EREDirection:UTRA?
SENSe:LTE:SIGN<i>:UECapability:FAUeeutra:IRAT:EREDirection:UTRA?
SENSe:LTE:SIGN<i>:UECapability:TAUeeutra:IRAT:EREDirection:UTRA?

Returns whether the UE supports an enhanced redirection to UTRA FDD or not.

Return values:

<Supported> OFF | ON

Example: See Querying UE Capability Report Contents

Usage: Query only

Firmware/Software: V3.2.80

Manual operation: See "e Redirection UTRA" on page 213

SENSe:LTE:SIGN<i>:UECapability:IRAT:UTDD128:SUPPorted?

Returns a list of values indicating the support of the individual UTRA TDD operating bands by the UE, according to the UE capability information.

Return values:

<SupportedBand> OFF | ON

26 values: band a to band z

Example: See Querying UE Capability Report Contents

Usage: Query only

Firmware/Software: V3.2.80

Manual operation: See "Supported Bands" on page 213

SENSe:LTE:SIGN<i>:UECapability:IRAT:UTDD128:EREDirection:UTDD?
SENSe:LTE:SIGN<i>:UECapability:FAUeeutra:IRAT:EREDirection:UTDD?
SENSe:LTE:SIGN<i>:UECapability:TAUeeutra:IRAT:EREDirection:UTDD?

Returns whether the UE supports an enhanced redirection to UTRA TDD or not.

Return values:

<Supported> OFF | ON

Example: See Querying UE Capability Report Contents

Usage: Query only

Firmware/Software: V3.2.80

Manual operation: See "e Redirection UTRA TDD" on page 214

SENSe:LTE:SIGN<i>:UECapability:IRAT:GERan:SUPPorted?
SENSe:LTE:SIGN<i>:UECapability:FAUeeutra:IRAT:GERan:SUPPorted?
SENSe:LTE:SIGN<i>:UECapability:TAUeeutra:IRAT:GERan:SUPPorted?

Returns a list of values indicating the support of the individual GERAN operating bands by the UE.

Return values:

<SupportedBand> OFF | ON

11 values: GSM 450, GSM 480, GSM 710, GSM 750, GSM 810, GSM 850, P-GSM 900, E-GSM 900, R-GSM 900, GSM 1800, GSM 1900

Example: See Querying UE Capability Report Contents

Usage: Query only

Firmware/Software: V2.1.30, `FAUeeutra` / `TAUeeutra` V3.2.80

Manual operation: See "Supported Bands" on page 214

SENSe:LTE:SIGN<i>:UECapability:IRAT:GERan:PHGeran?
SENSe:LTE:SIGN<i>:UECapability:FAUeeutra:IRAT:GERan:PHGeran?
SENSe:LTE:SIGN<i>:UECapability:TAUeeutra:IRAT:GERan:PHGeran?

Returns whether the UE supports handover to GERAN or not.

Return values:

<PS_HO_GERAN> OFF | ON

Example: See Querying UE Capability Report Contents

Usage: Query only

Firmware/Software: V2.1.30, `FAUeeutra` / `TAUeeutra` V3.2.80

Manual operation: See "Inter-RAT PS HO to GERAN" on page 214

SENSe:LTE:SIGN<i>:UECapability:IRAT:GERan:DTM?

Returns whether the UE supports DTM in GERAN or not.

Return values:

<Supported> OFF | ON

Example: See Querying UE Capability Report Contents

Usage: Query only

Firmware/Software: V3.2.80

Manual operation: See "dtm" on page 214

SENSe:LTE:SIGN<i>:UECapability:IRAT:GERan:EREDirection?

Returns whether the UE supports an enhanced redirection to GERAN or not.

Return values:

<Supported> OFF | ON

Example: See Querying UE Capability Report Contents

Usage: Query only

Firmware/Software: V3.2.80

Manual operation: See "e Redirection GERAN" on page 214

SENSe:LTE:SIGN<i>:UECapability:IRAT:CHRPd:SUPPorted?

Returns a list of values indicating the support of the individual CDMA2000 HRPD band classes by the UE.

Return values:

<SupportedBand> OFF | ON

18 values: band class 0 to 17

Example: See Querying UE Capability Report Contents

Usage: Query only

Firmware/Software: V2.1.30

Manual operation: See "Supported Bands" on page 214

SENSe:LTE:SIGN<i>:UECapability:IRAT:CHRPd:TCONfig?

Returns whether the UE supports dual transmitter for HRPD/E-UTRAN or only single transmitter.

Return values:
<TXconfiguration> SINGle | DUAL

Example: See Querying UE Capability Report Contents

Usage: Query only

Firmware/Software: V2.1.30

Manual operation: See "TX Config" on page 215

SENSe:LTE:SIGN<i>:UECapability:IRAT:CHRPd:RCONfig?

Returns whether the UE supports dual receiver for HRPD/E-UTRAN or only single receiver.

Return values:
<RXconfiguration> SINGle | DUAL

Example: See Querying UE Capability Report Contents

Usage: Query only

Firmware/Software: V2.1.30

Manual operation: See "RX Config" on page 215

SENSe:LTE:SIGN<i>:UECapability:IRAT:CXRTt:SUPPorted?

Returns a list of values indicating the support of the individual CDMA2000 1xRTT band classes by the UE.

Return values:
<SupportedBand> OFF | ON
18 values: band class 0 to 17

Example: See Querying UE Capability Report Contents

Usage: Query only

Firmware/Software: V2.1.30

Manual operation: See "Supported Bands" on page 215

SENSe:LTE:SIGN<i>:UECapability:IRAT:CXRTt:TCONfig?

Returns whether the UE supports dual transmitter for 1xRTT/E-UTRAN or only single transmitter.

Return values:
<TXconfiguration> SINGle | DUAL

Example: See Querying UE Capability Report Contents

Usage: Query only

Firmware/Software: V2.1.30

Manual operation: See "TX Config" on page 215

SENSe:LTE:SIGN<i>:UECapability:IRAT:CXRTt:RCONfig?

Returns whether the UE supports dual receiver for 1xRTT/E-UTRAN or only single receiver.

Return values:
<RXconfiguration> SINGle | DUAL

Example: See Querying UE Capability Report Contents

Usage: Query only

Firmware/Software: V2.1.30

Manual operation: See "RX Config" on page 215

SENSe:LTE:SIGN<i>:UECapability:IRAT:CXRTt:ECSFb?
SENSe:LTE:SIGN<i>:UECapability:FAUeeutra:IRAT:CXRTt:ECSFb?
SENSe:LTE:SIGN<i>:UECapability:TAUeeutra:IRAT:CXRTt:ECSFb?

Returns whether the UE supports enhanced CS fallback to CDMA2000 1xRTT or not.

Return values:
<Supported> OFF | ON

Example: See Querying UE Capability Report Contents

Usage: Query only

Firmware/Software: V3.2.80

Manual operation: See "e CSFB" on page 215

SENSe:LTE:SIGN<i>:UECapability:IRAT:CXRTt:ECCMob?
SENSe:LTE:SIGN<i>:UECapability:FAUeeutra:IRAT:CXRTt:ECCMob?
SENSe:LTE:SIGN<i>:UECapability:TAUeeutra:IRAT:CXRTt:ECCMob?

Returns whether the UE supports concurrent enhanced CS fallback to CDMA2000 1xRTT and handover/redirection to CDMA2000 HRPD or not.

Return values:
<Supported> OFF | ON

Example: See Querying UE Capability Report Contents

Usage: Query only

Firmware/Software: V3.2.80

Manual operation: See "e CSFB ConcPS Mob" on page 215

SENSe:LTE:SIGN<i>:UECapability:IRAT:CXRTt:ECDual?
SENSe:LTE:SIGN<i>:UECapability:FAUeeutra:IRAT:CXRTt:ECDual?
SENSe:LTE:SIGN<i>:UECapability:TAUeeutra:IRAT:CXRTt:ECDual?

Returns whether the UE supports enhanced CS fallback to CDMA2000 1xRTT for dual Rx/Tx configuration or not.

Return values:
<Supported> OFF | ON

Example: See Querying UE Capability Report Contents

Usage: Query only

Firmware/Software: V3.2.80

Manual operation: See "e CSFB dual" on page 216

2.6.6.7 CSG Proximity Indication Capabilities

The following commands query whether the UE supports proximity indications or not.

SENSe:LTE:SIGN<i>:UECapability:CPINdication:FREQuency:INTRa?

Returns whether the UE supports proximity indications for intra-frequency E-UTRAN CSG member cells or not.

Return values:
<Supported> OFF | ON

Example: See Querying UE Capability Report Contents

Usage: Query only

Firmware/Software: V3.2.80

Manual operation: See "Intra Freq Proximity Indication" on page 216

SENSe:LTE:SIGN<i>:UECapability:CPINdication:FREQuency:INTer?

Returns whether the UE supports proximity indications for inter-frequency E-UTRAN CSG member cells or not.

Return values:
<Supported> OFF | ON

Example: See Querying UE Capability Report Contents

Usage: Query only

Firmware/Software: V3.2.80

Manual operation: See "Inter Freq Proximity Indication" on page 216

SENSe:LTE:SIGN<i>:UECapability:CPINdication:UTRan?

Returns whether the UE supports proximity indications for UTRAN CSG member cells or not.

Return values:
<Supported> OFF | ON

Example: See Querying UE Capability Report Contents

Usage: Query only

Firmware/Software: V3.2.80

Manual operation: See "utran Proximity Indication" on page 216

2.6.6.8 Neighbor Cell SI-Acquisition Capabilities

The following commands query whether the UE supports system information requests for handover or not.

SENSe:LTE:SIGN<i>:UECapability:NCSacq:FREQuency:INTRa?
SENSe:LTE:SIGN<i>:UECapability:FAUeeutra:NCSacq:FREQuency:INTRa?
SENSe:LTE:SIGN<i>:UECapability:TAUeeutra:NCSacq:FREQuency:INTRa?

Returns whether the UE supports system information acquisition for intra-frequency neighbor cells or not.

Return values:
<Supported> OFF | ON

Example: See Querying UE Capability Report Contents

Usage: Query only

Firmware/Software: V3.2.80

Manual operation: See "Intra Freq SI-Acquisition for HO" on page 217

SENSe:LTE:SIGN<i>:UECapability:NCSacq:FREQuency:INTer?
SENSe:LTE:SIGN<i>:UECapability:FAUeeutra:NCSacq:FREQuency:INTer?
SENSe:LTE:SIGN<i>:UECapability:TAUeeutra:NCSacq:FREQuency:INTer?

Returns whether the UE supports system information acquisition for inter-frequency neighbor cells or not.

Return values:
<Supported> OFF | ON

Example: See Querying UE Capability Report Contents

Usage: Query only

Firmware/Software: V3.2.80

Manual operation: See "Inter Freq SI-Acquisition for HO" on page 217

SENSe:LTE:SIGN<i>:UECapability:NCSacq:UTRan?
SENSe:LTE:SIGN<i>:UECapability:FAUeeutra:NCSacq:UTRan?
SENSe:LTE:SIGN<i>:UECapability:TAUeeutra:NCSacq:UTRan?

Returns whether the UE supports system information acquisition for UMTS neighbor cells or not.

Return values:
<Supported> OFF | ON

Example: See Querying UE Capability Report Contents

Usage: Query only

Firmware/Software: V3.2.80

Manual operation: See "utran SI-Acquisition for HO" on page 217

2.6.6.9 UE-Based Network Performance Measurement Capabilities

The following commands query the UE capabilities for UE-based network performance measurements.

SENSe:LTE:SIGN<i>:UECapability:UBNPmeas:LMIDle?

Returns whether the UE supports logged measurements in idle mode or not.

Return values:
<Supported> OFF | ON

Example: See Querying UE Capability Report Contents

Usage: Query only

Firmware/Software: V3.2.80

Manual operation: See "logged Measurements Idle" on page 217

SENSe:LTE:SIGN<i>:UECapability:UBNPmeas:SGLocation?

Returns whether the UE is equipped with a GNSS receiver or not.

Return values:
<Supported> OFF | ON

Example: See Querying UE Capability Report Contents

Usage: Query only

Firmware/Software: V3.2.80

Manual operation: See "Standalone GNSS Location" on page 217

2.6.7 UE Info

The following queries retrieve information about the connected mobile as shown in the "UE Info" area of the main view.

SENSe:LTE:SIGN<i>:UESinfo:IMEI?

Queries the IMEI of the UE.

Return values:
<IMEI> IMEI as string with up to 18 digits

Example: See Querying UE Information

Usage: Query only

Firmware/Software: V2.0.20

Manual operation: See "IMEI" on page 104

SENSe:LTE:SIGN<i>:UESinfo:IMSI?

Queries the IMSI of the UE.

Return values:
<IMSI> IMSI as string with up to 16 digits

Example: See Querying UE Information

Usage: Query only

Firmware/Software: V2.0.20

Manual operation: See "IMSI" on page 104

SENSe:LTE:SIGN<i>:UESinfo:VDPReference?

Queries the voice domain preference of the UE.

Return values:
<Value> CVONly | IPVonly | CVPRefered | IPVPrefered

CVONly: CS voice only
IPVonly: IMS PS voice only
CVPRefered: CS voice preferred, IMS PS voice as secondary
IPVPrefered: IMS PS voice preferred, CS voice as secondary

Example: See Querying UE Information

Usage: Query only

Firmware/Software: V3.2.80

Manual operation: See "Voice Domain Preference" on page 104

SENSe:LTE:SIGN<i>:UESinfo:UEUSage?

Queries the usage setting of the UE.

Return values:
<Usage> VCENtric | DCENtric

VCENtric: Voice centric
DCENtric: Data centric

Example: See Querying UE Information

Usage: Query only

Firmware/Software: V3.2.80

Manual operation: See "UE's Usage Setting" on page 104

SENSe:LTE:SIGN<i>:UESinfo:UEADdress:IPV<n>?

Returns the IPv4 addresses (<n> = 4) or the IPv6 prefixes (<n> = 6) assigned to the UE by the R&S CMW.

Suffix:
<n> 4,6

Return values:
<IPAddresses> Comma-separated list of IP address/prefix strings

Example: See Setting up a Test Mode Connection

Usage: Query only

Firmware/Software: V3.0.20

Manual operation: See "Default Bearer" on page 105

SENSe:LTE:SIGN<i>:UESinfo:UEADdress:DEDBearer?

Returns information about all established dedicated bearers. Three values are returned per bearer:

{<ID>, <TFTPortLow>, <TFTPortHigh>}$_{\text{Bearer 1}}$, ..., {...}$_{\text{Bearer n}}$

Return values:

<ID> Dedicated bearer ID as string
Example: "6 (->5, Voice)" means dedicated bearer 6, mapped to default bearer 5, using dedicated bearer profile "Voice"

<TFTPortLow> Lower end of TFT port range assigned to the dedicated bearer
Range: 1 to 65535

<TFTPortHigh> Upper end of TFT port range assigned to the dedicated bearer
Range: 1 to 65535

Example: See Querying UE Information

Usage: Query only

Firmware/Software: V3.2.80

Manual operation: See "Dedicated Bearer" on page 105

2.6.8 Routing Settings

The following commands configure the signal input and output paths.

2.6.8.1 Signal Routing

The following commands configure the scenario, select the paths for the generated downlink signal (output) and the analyzed signal (input) and define external attenuation values.

ROUTe:LTE:SIGN<i>:SCENario:SCELl <RXConnector>, <RXConverter>, <TXConnector>, <TXConverter>

Activates the scenario "1 Cell - 1 RF Out" and selects the signal paths.

For possible connector and converter values, see chapter 2.6.1.4, "Values for Signal Path Selection", on page 250.

Parameters:

<RXConnector> RF connector for the input path

<RXConverter> RX module for the input path

<TXConnector> RF connector for the output path

<TXConverter> TX module for the output path

Example: See Selecting a Scenario

Firmware/Software: V1.0.15.20

Manual operation: See "Scenario, Fading" on page 122

ROUTe:LTE:SIGN<i>:SCENario:TRO <RXConnector>, <RXConverter>, <TXConnector>, <TXConverter>, <TX2Connector>, <TX2Converter>

Activates the scenario "1 Cell - 2 RF Out" and selects the signal paths.

For possible connector and converter values, see chapter 2.6.1.4, "Values for Signal Path Selection", on page 250.

Parameters:

<RXConnector>	RF connector for the input path
<RXConverter>	RX module for the input path
<TXConnector>	RF connector for the first output path
<TXConverter>	TX module for the first output path
<TX2Connector>	RF connector for the second output path Select different connectors for the two paths.
<TX2Converter>	TX module for the second output path Select different modules for the two paths.
Firmware/Software:	V2.0.20
Options:	R&S CMW-KS520
Manual operation:	See "Scenario, Fading" on page 122

ROUTe:LTE:SIGN<i>:SCENario:FRO <RXConnector>, <RXConverter>, <TX1Connector>, <TX1Converter>, <TX2Connector>, <TX2Converter>, <TX3Connector>, <TX3Converter>, <TX4Connector>, <TX4Converter>

Activates the scenario "1 Cell - 4 RF Out" and selects the signal paths.

For possible connector and converter values, see chapter 2.6.1.4, "Values for Signal Path Selection", on page 250.

Parameters:

<RXConnector>	RF connector for the input path
<RXConverter>	RX module for the input path
<TX1Connector>	RF connector for the first output path Select different connectors for all output paths.
<TX1Converter>	TX module for the first output path Select different modules for all output paths.
<TX2Connector>	RF connector for the second output path
<TX2Converter>	TX module for the second output path
<TX3Connector>	RF connector for the third output path
<TX3Converter>	TX module for the third output path
<TX4Connector>	RF connector for the fourth output path
<TX4Converter>	TX module for the fourth output path

Firmware/Software: V3.2.70

Options: R&S CMW-KS520 and R&S CMW-KS521

Manual operation: See "Scenario, Fading" on page 122

ROUTe:LTE:SIGN<i>:SCENario:CATRfout <RXConnector>, <RXConverter>, <PCCTXConnector>, <PCCTXConverter>, <SCCTXConnector>, <SCCTXConverter>

Activates the scenario "2CC CA - 2 RF Out" and selects the signal paths.

For possible connector and converter values, see chapter 2.6.1.4, "Values for Signal Path Selection", on page 250.

Parameters:

<RXConnector> RF connector for the input path

<RXConverter> RX module for the input path

<PCCTXConnector> RF connector for the PCC output path

<PCCTXConverter> TX module for the PCC output path
Select different modules for the two output paths.

<SCCTXConnector> RF connector for the SCC output path

<SCCTXConverter> TX module for the SCC output path

Firmware/Software: V3.2.50

Options: R&S CMW-KS502 for FDD / R&S CMW-KS552 for TDD

Manual operation: See "Scenario, Fading" on page 122

ROUTe:LTE:SIGN<i>:SCENario:CAFRfout <RXConnector>, <RXConverter>, <PCCTX1Connect>, <PCCTX1Convert>, <PCCTX2Connect>, <PCCTX2Convert>, <SCCTX1Connect>, <SCCTX1Convert>, <SCCTX2Connect>, <SCCTX2Convert>

Activates the scenario "2CC CA - 4 RF Out" and selects the signal paths.

For possible connector and converter values, see chapter 2.6.1.4, "Values for Signal Path Selection", on page 250.

Parameters:

<RXConnector> RF connector for the input path

<RXConverter> RX module for the input path

<PCCTX1Connect> RF connector for the first PCC output path
Select different connectors for the two PCC paths.

<PCCTX1Convert> TX module for the first PCC output path
Select different modules for all PCC and SCC output paths.

<PCCTX2Connect> RF connector for the second PCC output path

<PCCTX2Convert>	TX module for the second PCC output path
<SCCTX1Connect>	RF connector for the first SCC output path Select different connectors for the two SCC paths.
<SCCTX1Convert>	TX module for the first SCC output path
<SCCTX2Connect>	RF connector for the second SCC output path
<SCCTX2Convert>	TX module for the second SCC output path

Firmware/Software: V3.2.50

Options: R&S CMW-KS520
R&S CMW-KS502 for FDD / R&S CMW-KS552 for TDD

Manual operation: See "Scenario, Fading" on page 122

ROUTe:LTE:SIGN<i>:SCENario:CCTHree:RFTHree <RXConnector>, <RXConverter>, <PCCTXConnector>, <PCCTXConverter>, <SCC1TXConnect>, <SCC1TXConvert>, <SCC2TXConnect>, <SCC2TXConvert>

Activates the scenario "3CC CA - 3 RF Out" and selects the signal paths.

For possible connector and converter values, see chapter 2.6.1.4, "Values for Signal Path Selection", on page 250.

Parameters:

<RXConnector>	RF connector for the input path
<RXConverter>	RX module for the input path
<PCCTXConnector>	RF connector for the PCC output path
<PCCTXConverter>	TX module for the PCC output path Select a different module for each output path.
<SCC1TXConnect>	RF connector for the SCC1 output path
<SCC1TXConvert>	TX module for the SCC1 output path
<SCC2TXConnect>	RF connector for the SCC2 output path
<SCC2TXConvert>	TX module for the SCC2 output path

Firmware/Software: V3.5.10

Options: R&S CMW-KS502 for FDD / R&S CMW-KS552 for TDD
R&S CMW-KS512

Manual operation: See "Scenario, Fading" on page 122

ROUTe:LTE:SIGN<i>:SCENario:CCTHree:PMIMo:RFFour <RXConnector>, <RXConverter>, <PCCTX1Connect>, <PCCTX1Convert>, <PCCTX2Connect>, <PCCTX2Convert>, <SCC1TXConnect>, <SCC1TXConvert>, <SCC2TXConnect>, <SCC2TXConvert>

Activates the scenario "3CC CA - PCC MIMO - 4 RF Out" and selects the signal paths.

For possible connector and converter values, see chapter 2.6.1.4, "Values for Signal Path Selection", on page 250.

Parameters:

<RXConnector>	RF connector for the input path
<RXConverter>	RX module for the input path
<PCCTX1Connect>	RF connector for the first PCC output path Select different connectors for the two PCC paths.
<PCCTX1Convert>	TX module for the first PCC output path Select different modules for all output paths.
<PCCTX2Connect>	RF connector for the second PCC output path
<PCCTX2Convert>	TX module for the second PCC output path
<SCC1TXConnect>	RF connector for the SCC1 output path
<SCC1TXConvert>	TX module for the SCC1 output path
<SCC2TXConnect>	RF connector for the SCC2 output path
<SCC2TXConvert>	TX module for the SCC2 output path

Firmware/Software: V3.5.10

Options: R&S CMW-KS502 for FDD / R&S CMW-KS552 for TDD
R&S CMW-KS512, R&S CMW-KS520

Manual operation: See "Scenario, Fading" on page 122

ROUTe:LTE:SIGN<i>:SCENario:CCTHree:SMIMo:RFFour <RXConnector>, <RXConverter>, <PCCTX1Connect>, <PCCTX1Convert>, <SCC1TX1Connect>, <SCC1TX1Convert>, <SCC1TX2Connect>, <SCC1TX2Convert>, <SCC2TXConnect>, <SCC2TXConvert>

Activates the scenario "3CC CA - SCC1 MIMO - 4 RF Out" and selects the signal paths.

For possible connector and converter values, see chapter 2.6.1.4, "Values for Signal Path Selection", on page 250.

Parameters:

<RXConnector>	RF connector for the input path
<RXConverter>	RX module for the input path
<PCCTX1Connect>	RF connector for the PCC output path

<PCCTX1Convert>	TX module for the PCC output path Select different modules for all output paths.
<SCC1TX1Connect>	RF connector for the first SCC1 output path Select different connectors for the two SCC1 paths.
<SCC1TX1Convert>	TX module for the first SCC1 output path
<SCC1TX2Connect>	RF connector for the second SCC1 output path
<SCC1TX2Convert>	TX module for the second SCC1 output path
<SCC2TXConnect>	RF connector for the SCC2 output path
<SCC2TXConvert>	TX module for the SCC2 output path

Example: See Selecting a Scenario

Firmware/Software: V3.5.10

Options: R&S CMW-KS502 for FDD / R&S CMW-KS552 for TDD
R&S CMW-KS512, R&S CMW-KS520

Manual operation: See "Scenario, Fading" on page 122

ROUTe:LTE:SIGN<i>:SCENario:SCFading[:EXTernal] <RXConnector>, <RXConverter>, <TXConnector>, <TXConverter>, <IQConnector>

Activates the scenario "1 Cell - Fading - 1 RF Out" with external fading and selects the signal paths.

For possible connector and converter values, see chapter 2.6.1.4, "Values for Signal Path Selection", on page 250.

Parameters:

<RXConnector>	RF connector for the input path
<RXConverter>	RX module for the input path
<TXConnector>	RF connector for the output path
<TXConverter>	TX module for the output path
<IQConnector>	DIG IQ OUT connector for external fading of the output path

Firmware/Software: V3.0.10

Options: R&S CMW-KS510

Manual operation: See "Scenario, Fading" on page 122

ROUTe:LTE:SIGN<i>:SCENario:SCFading:INTernal <RXConnector>, <RXConverter>, <TXConnector>, <TXConverter>, <Fader>

Activates the scenario "1 Cell - Fading - 1 RF Out" with internal fading and selects the signal paths. The fading I/Q board is selectable.

For possible connector and converter values, see chapter 2.6.1.4, "Values for Signal Path Selection", on page 250.

Parameters:

<RXConnector>	RF connector for the input path
<RXConverter>	RX module for the input path
<TXConnector>	RF connector for the output path
<TXConverter>	TX module for the output path
<Fader>	FAD1 | FAD2 I/Q board used for fading **FAD1**: first I/Q board (board with I/Q connectors 1 to 4) **FAD2**: second I/Q board (board with I/Q connectors 5 to 8) *RST: FAD1

Firmware/Software: V3.2.10

Options: R&S CMW-KS510, R&S CMW-KE100 and R&S CMW-KE500

Manual operation: See "Scenario, Fading" on page 122

ROUTe:LTE:SIGN<i>:SCENario:SCFading:INTernal:FFADer <RXConnector>, <RXConverter>, <TXConnector>, <TXConverter>

Activates the scenario "1 Cell - Fading - 1 RF Out" with internal fading and selects the signal paths.

I/Q board 1 is used for fading. If you want to use I/Q board 2, see `ROUTe:LTE:SIGN<i>:SCENario:SCFading:INTernal`.

For possible connector and converter values, see chapter 2.6.1.4, "Values for Signal Path Selection", on page 250.

Parameters:

<RXConnector>	RF connector for the input path
<RXConverter>	RX module for the input path
<TXConnector>	RF connector for the output path
<TXConverter>	TX module for the output path

Firmware/Software: V3.0.20

Options: R&S CMW-KS510, R&S CMW-KE100 and R&S CMW-KE500

Manual operation: See "Scenario, Fading" on page 122

ROUTe:LTE:SIGN<i>:SCENario:TROFading[:EXTernal] <RXConnector>, <RXConverter>, <TX1Connector>, <TX1Converter>, <IQ1Connector>, <TX2Connector>, <TX2Converter>, <IQ2Connector>

Activates the scenario "1 Cell - Fading - 2 RF Out" with external fading and selects the signal paths.

For possible connector and converter values, see chapter 2.6.1.4, "Values for Signal Path Selection", on page 250.

Parameters:

<RXConnector>	RF connector for the input path
<RXConverter>	RX module for the input path
<TX1Connector>	RF connector for the first output path
<TX1Converter>	TX module for the first output path
<IQ1Connector>	DIG IQ OUT connector for external fading of the first output path
<TX2Connector>	RF connector for the second output path Select different connectors for the two paths.
<TX2Converter>	TX module for the second output path Select different modules for the two paths.
<IQ2Connector>	DIG IQ OUT connector for external fading of the second output path. Select different connectors for the two paths.

Firmware/Software: V3.0.10

Options: R&S CMW-KS510 and R&S CMW-KS520

Manual operation: See "Scenario, Fading" on page 122

ROUTe:LTE:SIGN<i>:SCENario:TROFading:INTernal <RXConnector>, <RXConverter>, <TX1Connector>, <TX1Converter>, <TX2Connector>, <TX2Converter>, <Fader>

Activates the scenario "1 Cell - Fading - 2 RF Out" with internal fading and selects the signal paths. The fading I/Q board is selectable.

For possible connector and converter values, see chapter 2.6.1.4, "Values for Signal Path Selection", on page 250.

Parameters:

<RXConnector>	RF connector for the input path
<RXConverter>	RX module for the input path
<TX1Connector>	RF connector for the first output path
<TX1Converter>	TX module for the first output path
<TX2Connector>	RF connector for the second output path Select different connectors for the two paths.
<TX2Converter>	TX module for the second output path Select different modules for the two paths.
<Fader>	FAD1 | FAD2 I/Q board used for fading **FAD1**: first I/Q board (board with I/Q connectors 1 to 4) **FAD2**: second I/Q board (board with I/Q connectors 5 to 8) *RST: FAD1

Firmware/Software: V3.2.10

Options: R&S CMW-KS510, R&S CMW-KS520, R&S CMW-KE100 and R&S CMW-KE500

Manual operation: See "Scenario, Fading" on page 122

ROUTe:LTE:SIGN<i>:SCENario:TROFading:INTernal:FFADer <RXConnector>, <RXConverter>, <TX1Connector>, <TX1Converter>, <TX2Connector>, <TX2Converter>

Activates the scenario "1 Cell - Fading - 2 RF Out" with internal fading and selects the signal paths.

I/Q board 1 is used for fading. If you want to use I/Q board 2, see `ROUTe:LTE:SIGN<i>:SCENario:TROFading:INTernal`.

For possible connector and converter values, see chapter 2.6.1.4, "Values for Signal Path Selection", on page 250.

Parameters:

<RXConnector> RF connector for the input path

<RXConverter> RX module for the input path

<TXConnector> RF connector for the first output path

<TXConverter> TX module for the first output path

<TX2Connector> RF connector for the second output path
Select different connectors for the two paths.

<TX2Converter> TX module for the second output path
Select different modules for the two paths.

Firmware/Software: V3.0.20

Options: R&S CMW-KS510, R&S CMW-KS520, R&S CMW-KE100 and R&S CMW-KE500

Manual operation: See "Scenario, Fading" on page 122

ROUTe:LTE:SIGN<i>:SCENario:MTFading[:EXTernal] <RXConnector>, <RXConverter>, <TX1Connector>, <TX1Converter>, <IQ1Connector>, <IQ2Connector>, <TX2Connector>, <TX2Converter>, <IQ3Connector>, <IQ4Connector>

Activates the scenario "1 Cell - Fading - MIMO4x2 - 2 RF Out" with external fading and selects the signal paths.

For possible connector and converter values, see chapter 2.6.1.4, "Values for Signal Path Selection", on page 250.

Parameters:

<RXConnector> RF connector for the input path

<RXConverter> RX module for the input path

<TX1Connector> RF connector for the first output path

<TX1Converter>	TX module for the first output path
<IQ1Connector>	DIG IQ OUT connector for external fading of the first output path
<IQ2Connector>	DIG IQ OUT connector for external fading of the second output path. Select different connectors for the paths.
<TX2Connector>	RF connector for the second output path Select different connectors for the two paths.
<TX2Converter>	TX module for the second output path Select different modules for the two paths.
<IQ3Connector>	DIG IQ OUT connector for external fading of the third output path. Select different connectors for the paths.
<IQ4Connector>	DIG IQ OUT connector for external fading of the fourth output path. Select different connectors for the paths.

Firmware/Software: V3.2.80

Options: R&S CMW-KS510, R&S CMW-KS520 and R&S CMW-KS521

Manual operation: See "Scenario, Fading" on page 122

ROUTe:LTE:SIGN<i>:SCENario:MTFading:INTernal <RXConnector>, <RXConverter>, <TX1Connector>, <TX1Converter>, <TX2Connector>, <TX2Converter>

Activates the scenario "1 Cell - Fading - MIMO4x2 - 2 RF Out" with internal fading and selects the signal paths.

For possible connector and converter values, see chapter 2.6.1.4, "Values for Signal Path Selection", on page 250.

Parameters:

<RXConnector>	RF connector for the input path
<RXConverter>	RX module for the input path
<TX1Connector>	RF connector for the first output path
<TX1Converter>	TX module for the first output path
<TX2Connector>	RF connector for the second output path Select different connectors for the two paths.
<TX2Converter>	TX module for the second output path Select different modules for the two paths.

Example: See Selecting a Scenario

Firmware/Software: V3.2.80

Options: R&S CMW-KS510, R&S CMW-KS520, R&S CMW-KS521
R&S CMW-KE100, R&S CMW-KE500 and R&S CMW-KE501

Manual operation: See "Scenario, Fading" on page 122

ROUTe:LTE:SIGN<i>:SCENario:CATF[:EXTernal] <RXConnector>, <RXConverter>, <PCCTXConnector>, <PCCTXConverter>, <PCCIQConnector>, <SCCTXConnector>, <SCCTXConverter>, <SCCIQConnector>

Activates the scenario "2CC CA - Fading - 2 RF Out" with external fading and selects the signal paths.

For possible connector and converter values, see chapter 2.6.1.4, "Values for Signal Path Selection", on page 250.

Parameters:

<RXConnector>	RF connector for the input path
<RXConverter>	RX module for the input path
<PCCTXConnector>	RF connector for the PCC output path
<PCCTXConverter>	TX module for the PCC output path Select different modules for the two output paths.
<PCCIQConnector>	DIG IQ OUT connector for external fading of the PCC output path
<SCCTXConnector>	RF connector for the SCC output path
<SCCTXConverter>	TX module for the SCC output path
<SCCIQConnector>	DIG IQ OUT connector for external fading of the SCC output path. Select different connectors for the PCC and the SCC.

Example: See Selecting a Scenario

Firmware/Software: V3.2.70

Options: R&S CMW-KS512
R&S CMW-KS502 for FDD / R&S CMW-KS552 for TDD

Manual operation: See "Scenario, Fading" on page 122

ROUTe:LTE:SIGN<i>:SCENario:CATF:INTernal <RXConnector>, <RXConverter>, <PCCTXConnector>, <PCCTXConverter>, <SCCTXConnector>, <SCCTXConverter>

Activates the scenario "2CC CA - Fading - 2 RF Out" with internal fading and selects the signal paths.

For possible connector and converter values, see chapter 2.6.1.4, "Values for Signal Path Selection", on page 250.

Parameters:

<RXConnector>	RF connector for the input path
<RXConverter>	RX module for the input path
<PCCTXConnector>	RF connector for the PCC output path
<PCCTXConverter>	TX module for the PCC output path Select different modules for the two output paths.

<SCCTXConnector>	RF connector for the SCC output path
<SCCTXConverter>	TX module for the SCC output path

Firmware/Software: V3.2.70

Options: R&S CMW-KS512, R&S CMW-KE100 and R&S CMW-KE500
R&S CMW-KS502 for FDD / R&S CMW-KS552 for TDD

Manual operation: See "Scenario, Fading" on page 122

ROUTe:LTE:SIGN<i>:SCENario:CAFF[:EXTernal] <RXConnector>, <RXConverter>, <PCCTX1Connect>, <PCCTX1Convert>, <PCCIQ1Connect>, <PCCTX2Connect>, <PCCTX2Convert>, <PCCIQ2Connect>, <SCCTX1Connect>, <SCCTX1Convert>, <SCCIQ1Connect>, <SCCTX2Connect>, <SCCTX2Convert>, <SCCIQ2Connect>

Activates the scenario "2CC CA - Fading - 4 RF Out" with external fading and selects the signal paths.

For possible connector and converter values, see chapter 2.6.1.4, "Values for Signal Path Selection", on page 250.

Parameters:

<RXConnector>	RF connector for the input path
<RXConverter>	RX module for the input path
<PCCTX1Connect>	RF connector for the first PCC output path Select different RF connectors for the two PCC paths.
<PCCTX1Convert>	TX module for the first PCC output path Select different modules for all output paths.
<PCCIQ1Connect>	DIG IQ OUT connector for external fading of the first PCC output path. Select different I/Q connectors for all output paths.
<PCCTX2Connect>	RF connector for the second PCC output path
<PCCTX2Convert>	TX module for the second PCC output path
<PCCIQ2Connect>	DIG IQ OUT connector for external fading of the second PCC output path
<SCCTX1Connect>	RF connector for the first SCC output path Select different RF connectors for the two SCC paths.
<SCCTX1Convert>	TX module for the first SCC output path Select different modules for all output paths.
<SCCIQ1Connect>	DIG IQ OUT connector for external fading of the first SCC output path.
<SCCTX2Connect>	RF connector for the second SCC output path
<SCCTX2Convert>	TX module for the second SCC output path
<SCCIQ2Connect>	DIG IQ OUT connector for external fading of the second SCC output path.

Firmware/Software: V3.2.70

Options: R&S CMW-KS512, R&S CMW-KS520
R&S CMW-KS502 for FDD / R&S CMW-KS552 for TDD

Manual operation: See "Scenario, Fading" on page 122

ROUTe:LTE:SIGN<i>:SCENario:CAFF:INTernal <RXConnector>, <RXConverter>, <PCCTX1Connect>, <PCCTX1Convert>, <PCCTX2Connect>, <PCCTX2Convert>, <SCCTX1Connect>, <SCCTX1Convert>, <SCCTX2Connect>, <SCCTX2Convert>

Activates the scenario "2CC CA - Fading - 4 RF Out" with internal fading and selects the signal paths.

For possible connector and converter values, see chapter 2.6.1.4, "Values for Signal Path Selection", on page 250.

Parameters:

<RXConnector> RF connector for the input path

<RXConvert> RX module for the input path

<PCCTX1Connect> RF connector for the first PCC output path
Select different RF connectors for the two PCC paths.

<PCCTX1Convert> TX module for the first PCC output path
Select different modules for all PCC and SCC output paths.

<PCCTX2Connect> RF connector for the second PCC output path

<PCCTX2Convert> TX module for the second PCC output path

<SCCTX1Connect> RF connector for the first SCC output path
Select different RF connectors for the two SCC paths.

<SCCTX1Convert> TX module for the first SCC output path

<SCCTX2Connect> RF connector for the second SCC output path

<SCCTX2Convert> TX module for the second SCC output path

Example: See Selecting a Scenario

Firmware/Software: V3.2.70

Options: R&S CMW-KS512, R&S CMW-KE100 and R&S CMW-KE500
R&S CMW-KS520
R&S CMW-KS502 for FDD / R&S CMW-KS552 for TDD

Manual operation: See "Scenario, Fading" on page 122

ROUTe:LTE:SIGN<i>:SCENario:IORI <RXConnector>, <RXConverter>, <TXConnector>, <TXConverter>

Activates the scenario "1 Cell - IQ Out, RF In" and selects the signal paths.

For possible connector and converter values, see chapter 2.6.1.4, "Values for Signal Path Selection", on page 250.

Parameters:

<RXConnector>	RF connector for the input path
<RXConverter>	RX module for the input path
<TXConnector>	DIG IQ OUT rear panel connector for the output path
<TXConverter>	For future use. In this software version, it is recommended to always send KEEP to ensure compatible settings.

Firmware/Software: V3.0.10

Manual operation: See "Scenario, Fading" on page 122

ROUTe:LTE:SIGN<i>:SCENario?

Returns the active scenario.

Return values:

<Scenario>

SCEL | TRO | FRO | CATR | CAFR | CC | CCMP | CCMS1 | SCF | TROF | MTF | CATF | CAFF | IORI

SCEL: 1 Cell - 1 RF Out
TRO: 1 Cell - 2 RF Out
FRO: 1 Cell - 4 RF Out
CATR: 2CC CA - 2 RF Out
CAFR: 2CC CA - 4 RF Out
CC: 3CC CA - 3 RF Out
CCMP: 3CC CA - PCC MIMO - 4 RF Out
CCMS1: 3CC CA - SCC1 MIMO - 4 RF Out
SCF: 1 Cell - Fading - 1 RF Out
TROF: 1 Cell - Fading - 2 RF Out
MTF: 1 Cell - Fading - MIMO4x2 - 2 RF Out
CATF: 2CC CA - Fading - 2 RF Out
CAFF:2CC CA - Fading - 4 RF Out
IORI: 1 Cell - IQ Out, RF In

<Fader>

EXTernal | INTernal

Only returned for fading scenarios, e.g. SCF, TROF
Indicates whether internal or external fading is active.

Usage: Query only

Firmware/Software: V2.0.10, some return values added in later versions
V3.0.20: added <Fader>

Manual operation: See "Scenario, Fading" on page 122

ROUTe:LTE:SIGN<i>?

Returns the configured routing settings. The number of returned values depends on the active scenario (6 to 10 values).

For possible connector and converter values, see chapter 2.6.1.4, "Values for Signal Path Selection", on page 250.

Return values:

<Scenario>	SCEL | TRO | FRO | CATR | CAFR | CC | CCMP | CCMS1 | SCF | TROF | MTF | CATF | CAFF | IORI **SCEL**: 1 Cell - 1 RF Out **TRO**: 1 Cell - 2 RF Out **FRO**: 1 Cell - 4 RF Out **CATR**: 2CC CA - 2 RF Out **CAFR**: 2CC CA - 4 RF Out **CC**: 3CC CA - 3 RF Out **CCMP**: 3CC CA - PCC MIMO - 4 RF Out **CCMS1**: 3CC CA - SCC1 MIMO - 4 RF Out **SCF**: 1 Cell - Fading - 1 RF Out **TROF**: 1 Cell - Fading - 2 RF Out **MTF**: 1 Cell - Fading - MIMO4x2 - 2 RF Out **CATF**: 2CC CA - Fading - 2 RF Out **CAFF**:2CC CA - Fading - 4 RF Out **IORI**: 1 Cell - IQ Out, RF In
<Controller>	For future use - returned value not relevant
<RXConnector>	RF connector for the input path
<RXConverter>	RX module for the input path
<TXConnector1>	RF or DIG IQ OUT connector for output path 1
<TXConverter1>	TX or I/Q module for output path 1
<TXConnector2>	RF connector for output path 2, only returned for scenarios with two RF output paths
<TXConverter2>	TX module for output path 2, only returned for scenarios with two RF output paths
<IQConnector>	DIG IQ OUT connector for the first output path, only returned for scenarios with external fading
<IQ2Connector>	DIG IQ OUT connector for the second output path, only returned for scenarios with two RF output paths plus external fading
Usage:	Query only
Firmware/Software:	V2.0.10, some return values added in later versions
Manual operation:	See "Scenario, Fading" on page 122

CONFiGure:LTE:SIGN<i>:RFSettings[:PCC]:EATTenuation:OUTPut<n> <ExtRFOutAtt>
CONFiGure:LTE:SIGN<i>:RFSettings:SCC<c>:EATTenuation:OUTPut<n> <ExtRFOutAtt>

Defines an external attenuation (or gain, if the value is negative), to be applied to the RF output path number <n>. Depending on the transmission scheme, several output paths are used for each carrier and the attenuation can be configured per output path.

Suffix:

<n> 1..4 for PCC, 1..2 for SCC

<c> 1..2

Parameters:

<ExtRFOutAtt> Range: -50 dB to 90 dB
*RST: 0 dB
Default unit: dB

Example: See Selecting a Scenario

Firmware/Software: V1.0.15.20, SCC command V3.2.50

Manual operation: See "External Attenuation" on page 128

CONFiGure:LTE:SIGN<i>:RFSettings[:PCC]:EATTenuation:INPut <ExtRFInAtt>

Defines an external attenuation (or gain, if the value is negative), to be applied to the RF input connector.

Parameters:

<ExtRFInAtt> Range: -50 dB to 90 dB
*RST: 0 dB
Default unit: dB

Example: See Selecting a Scenario

Firmware/Software: V1.0.15.20

Manual operation: See "External Attenuation" on page 129

CONFigure:LTE:SIGN<i>:RFSettings:EDC:OUTPut <Time>
CONFigure:LTE:SIGN<i>:RFSettings:EDC:INPut <Time>

Defines the value of an external time delay in the output path and in the input path, so that it can be compensated.

Parameters:

<Time> Range: 0 s to 20E-6 s
*RST: 0 s
Default unit: s

Example: See Specifying General Settings

Firmware/Software: V3.2.50

Manual operation: See "External Delay Compensation" on page 129

2.6.8.2 Signal Settings

The following commands provide settings for the downlink and uplink signals.

SENSe:LTE:SIGN<i>:IQOut[:PCC]:PATH<n>?
SENSe:LTE:SIGN<i>:IQOut:SCC:PATH<n>?

Queries properties of the baseband signal at the I/Q output for DL path number <n>.

Suffix:

<n> 1..2

Return values:

<SampleRate> M100

Fixed value, indicating a sample rate of 100 Msps (100 MHz)

<PEP> Peak envelope power of the baseband signal

Range: -60 dBFS to 0 dBFS
Default unit: dBFS

<CrestFactor> Crest factor of the baseband signal

Range: 0 dB to 60 dB
Default unit: dB

Example: See Configuring the I/Q Settings

Usage: Query only

Firmware/Software: V3.0.10, SCC command V3.2.70

Manual operation: See "Sample Rate (Out / In)" on page 126

CONFigure:LTE:SIGN<i>:IQIN[:PCC]:PATH<n> <PEP>, <Level>
CONFigure:LTE:SIGN<i>:IQIN:SCC:PATH<n> <PEP>, <Level>

Specifies properties of the baseband signal at the I/Q input for DL path number <n>.

Suffix:

<n> 1..2

Parameters:

<PEP> Peak envelope power of the incoming baseband signal

Range: -60 dBFS to 0 dBFS
*RST: 0 dBFS
Default unit: dBFS

<Level> Average level of the incoming baseband signal (without noise)

Range: depends on crest factor and level of outgoing baseband signal
Default unit: dBFS

Example: See Configuring the I/Q Settings

Firmware/Software: V3.0.10, SCC command V3.2.70

Manual operation: See "Baseband PEP (Out / In)" on page 126

CONFigure:LTE:SIGN<i>:RFSettings:ALL:BWCHannel <BandPCC>, <DLChannelPCC>, <BandwidthPCC>[, <BandSCC1>, <DLChannelSCC1>, <BandwidthSCC1>]

Selects the operating band, the channel number and the cell bandwidth for the PCC and optionally for the SCC1.

Parameters:

<BandPCC> FDD: OB1 | ... | OB28 | OB30 | OB31 | UDEFined

TDD: OB33 | ... | OB44 | UDEFined
Selects the PCC operating band
UDEFined = user-defined band

*RST: OB1 (OB33 for TDD)

<DLChannelPCC> PCC DL channel number

Range: depends on operating band
*RST: 300

<BandwidthPCC> B014 | B030 | B050 | B100 | B150 | B200

PCC cell bandwidth
B014: 1.4 MHz
B030: 3 MHz
B050: 5 MHz
B100: 10 MHz
B150: 15 MHz
B200: 20 MHz

*RST: B100

<BandSCC1>	FDD: OB1 | ... | OB31 | UDEFined TDD: OB33 | ... | OB44 | UDEFined SCC1 operating band *RST: OB1 (OB33 for TDD)
<DLChannelSCC1>	SCC1 DL channel number Range: depends on operating band *RST: 302
<BandwidthSCC1>	B014 | B030 | B050 | B100 | B150 | B200 SCC1 cell bandwidth *RST: B100
Firmware/Software:	V3.2.80
Options:	R&S CMW-KB036 for frequencies above 3.3 GHz R&S CMW-KS525 for UDEFined
Manual operation:	See "Operating Band, Channel, Frequency" on page 130

CONFigure:LTE:SIGN<i>[:PCC]:BAND <Band>
CONFigure:LTE:SIGN<i>:SCC<c>:BAND <Band>

Selects the Operating Band (OB). The allowed input range depends on the duplex mode (FDD or TDD).

Suffix:

<c>	1..2

Parameters:

<Band>	FDD: OB1 | ... | OB31 | UDEFined TDD: OB33 | ... | OB44 | UDEFined UDEFined = user-defined band OB29 only for SCC, not for PCC
Example:	See Specifying General Settings
Firmware/Software:	V3.0.10 V3.0.30: OB27, OB28, OB44 V3.2.50: SCC command, OB29 to OB31
Options:	R&S CMW-KB036 for frequencies above 3.3 GHz R&S CMW-KS525 for UDEFined
Manual operation:	See "Operating Band, Channel, Frequency" on page 130

CONFigure:LTE:SIGN<i>:RFSettings[:PCC]:CHANnel:DL <Channel>
CONFigure:LTE:SIGN<i>:RFSettings:SCC:CHANnel:DL <Channel>
CONFigure:LTE:SIGN<i>:RFSettings:SCC:CHANnel:DL:SCC2 <Channel>

Selects the DL channel number for the PCC or SCC1 or SCC2. The channel number must be valid for the current operating band. If you set the PCC DL channel number, the related PCC UL channel number is calculated and set automatically.

By appending a Hz unit (e.g. Hz, kHz, MHz) to a setting command, you can set the channel via its center frequency (only integer numbers accepted). By appending a Hz unit to a query command, you can query the center frequency instead of the channel number.

For channel numbers and frequencies depending on operating bands see chapter 2.2.16, "Operating Bands", on page 59.

Parameters:

<Channel>	Range:	depends on operating band

Example: See Specifying General Settings

Firmware/Software: V1.0.15.20, SCC command V3.2.50, SCC2 command V3.5.10

Manual operation: See "Operating Band, Channel, Frequency" on page 130

CONFigure:LTE:SIGN<i>:RFSettings[:PCC]:CHANnel:UL <Channel>

Selects the UL channel number. The channel number must be valid for the current operating band. The related DL channel number is calculated and set automatically.

By appending a Hz unit (e.g. Hz, kHz, MHz) to a setting command, you can set the channel via its center frequency (only integer numbers accepted). By appending a Hz unit to a query command, you can query the center frequency instead of the channel number.

For channel numbers and frequencies depending on operating bands see chapter 2.2.16, "Operating Bands", on page 59.

Parameters:

<Channel>	Range:	depends on operating band
	*RST:	18300

Example: See Specifying General Settings

Firmware/Software: V1.0.15.20

Manual operation: See "Operating Band, Channel, Frequency" on page 130

CONFigure:LTE:SIGN<i>:RFSettings[:PCC]:FOFFset:DL <Offset>
CONFigure:LTE:SIGN<i>:RFSettings:SCC<c>:FOFFset:DL <Offset>

Specifies a positive or negative frequency offset to be added to the center frequency of the configured downlink channel.

You can use the PCC command to configure the same offset for the PCC and all SCCs. Or you can use the PCC and SCC command to configure different values. See also `CONFigure:LTE:SIGN<i>:RFSettings[:PCC]:FOFFset:DL:UCSPecific` on page 329.

Suffix:

<c>	1..2

Parameters:

<Offset> Range: -100E+3 Hz to 100E+3 Hz
*RST: 0 Hz
Default unit: Hz

Example: See Specifying General Settings

Firmware/Software: V3.2.10, SCC command V3.2.81

Manual operation: See "Frequency Offset" on page 131

CONFigure:LTE:SIGN<i>:RFSettings[:PCC]:FOFFset:DL:UCSPecific <Enable>

Enables or disables the usage of different frequency offset values for the individual component carriers.

Parameters:

<Enable> OFF | ON

OFF: The configured PCC offset is also used for all SCCs. The configured SCC offsets have no effect.
ON: You can configure the frequency offset per carrier.

*RST: OFF

Example: See Specifying General Settings

Firmware/Software: V3.2.80

Manual operation: See "Frequency Offset" on page 131

CONFigure:LTE:SIGN<i>:RFSettings[:PCC]:FOFFset:UL <Offset>

Specifies a positive or negative frequency offset to be added to the center frequency of the configured uplink channel (`CONFigure:LTE:SIGN<i>:RFSettings[:PCC]:CHANnel:UL`).

Parameters:

<Offset> Range: -100E+3 Hz to 100E+3 Hz
*RST: 0 Hz
Default unit: Hz

Example: See Specifying General Settings

Firmware/Software: V3.2.10

Manual operation: See "Frequency Offset" on page 131

CONFigure:LTE:SIGN<i>:RFSettings:ENPMode <Mode>

Selects the expected nominal power mode. The expected nominal power of the UL signal can be defined manually or calculated automatically, according to the UL power control settings.

For manual configuration see:

- `CONFigure:LTE:SIGN<i>:RFSettings:ENPower` on page 330

- CONFigure:LTE:SIGN<i>:RFSettings:UMARgin on page 330

For UL power control settings see chapter 2.6.11, "Uplink Power Control", on page 350.

Parameters:

<Mode> MANual | ULPC

MANual: The expected nominal power and margin are specified manually.
ULPC: The expected nominal power is calculated according to the UL power control settings. For the margin 12 dB are applied.

*RST: ULPC

Example: See Specifying General Settings

Firmware/Software: V1.0.15.21

Manual operation: See "Exp. Nominal Power..., Margin" on page 133

CONFigure:LTE:SIGN<i>:RFSettings:ENPower <ExpectedPower>

Sets the expected nominal power of the UL signal in manual mode or queries the result if the expected nominal power is calculated automatically according to the UL power control settings.

To configure the expected nominal power mode see CONFigure:LTE:SIGN<i>:RFSettings:ENPMode on page 329.

Parameters:

<ExpectedPower> In manual mode the range of the expected nominal power can be calculated as follows:
Range (Expected Nominal Power) = Range (Input Power) + External Attenuation - Margin

Range: -47 dBm to 42 dBm for the input power at the RF COM connectors (please notice also the ranges quoted in the data sheet)
*RST: -20 dBm
Default unit: dBm

Example: See Specifying General Settings

Firmware/Software: V1.0.15.21

Manual operation: See "Exp. Nominal Power..., Margin" on page 133

CONFigure:LTE:SIGN<i>:RFSettings:UMARgin <UserMargin>

Sets the margin that the R&S CMW adds to the expected nominal power in order to determine the reference level in manual mode. If the expected nominal power is calculated automatically according to the UL power control settings, a fix margin of 12 dB is used instead.

The reference level minus the external input attenuation must be within the power range of the selected input connector; refer to the data sheet.

Refer also to the following commands:

- `CONFigure:LTE:SIGN<i>:RFSettings:ENPMode` on page 329
- `CONFigure:LTE:SIGN<i>:RFSettings:ENPower` on page 330
- `CONFigure:LTE:SIGN<i>:RFSettings[:PCC]:EATTenuation:INPut` on page 324

Parameters:

<UserMargin> Range: 0 dB to (42 dB + External Attenuation - Expected Nominal Power)
*RST: 12 dB
Default unit: dB

Example: See Specifying General Settings

Firmware/Software: V1.0.15.21

Manual operation: See "Exp. Nominal Power..., Margin" on page 133

CONFigure:LTE:SIGN<i>:RFSettings:MLOFfset <MixLevOffset>

Varies the input level of the mixer in the analyzer path.

Parameters:

<MixLevOffset> Range: -10 dB to 10 dB
*RST: 0 dB
Default unit: dB

Example: See Specifying General Settings

Firmware/Software: V3.2.10

Manual operation: See "Mixer Level Offset" on page 134

2.6.8.3 User-Defined Band

The following commands configure a user-defined band.

CONFigure:LTE:SIGN<i>:RFSettings[:PCC]:UDEFined:UDSeparation <Frequency>

Configures the PCC UL/DL separation F_{DL} - F_{UL} for the user-defined band.

The allowed range depends on the remaining user-defined band settings: The resulting uplink carrier center frequencies must be within the allowed frequency range. For calculations see `CONFigure:LTE:SIGN<i>:RFSettings[:PCC]:UDEFined:FREQuency:DL:MINimum`.

Parameters:

<Frequency> Depending on the other settings, only a part of the following range is allowed.

Range: -5930E+6 Hz to 5930E+6 Hz
*RST: 190E+6 Hz
Default unit: Hz

Example: See Specifying General Settings

Firmware/Software: V2.1.30

Options: R&S CMW-KS525

Manual operation: See "UL/DL Separation" on page 131

CONFigure:LTE:SIGN<i>:RFSettings[:PCC]:UDEFined:BINDicator <BandIndicator>
CONFigure:LTE:SIGN<i>:RFSettings:SCC<c>:UDEFined:BINDicator <BandIndicator>

Configures the frequency band indicator, identifying the user-defined band in signaling messages.

Suffix:

<c> 1..2

Parameters:

<BandIndicator> Range: 1 to 64
*RST: 1

Example: See Specifying General Settings

Firmware/Software: V2.1.30, SCC command V3.2.50

Options: R&S CMW-KS525

Manual operation: See "Band Indicator" on page 132

CONFigure:LTE:SIGN<i>:RFSettings[:PCC]:UDEFined:CHANnel:DL:MINimum <Channel>
CONFigure:LTE:SIGN<i>:RFSettings[:PCC]:UDEFined:CHANnel:DL:MAXimum <Channel>
CONFigure:LTE:SIGN<i>:RFSettings[:PCC]:UDEFined:CHANnel:UL:MINimum <Channel>

Configures channel numbers for the PCC user-defined band: the minimum downlink channel number, the maximum downlink channel number and the minimum uplink channel number.

Combinations that result in frequencies outside of the allowed range are corrected automatically.

Parameters:

<Channel> Range: 0 to 65535
*RST: DL:MIN = 0, DL:MAX = 599, UL:MIN = 18000

Example: See Specifying General Settings

Firmware/Software: V2.1.30

Options: R&S CMW-KS525

Manual operation: See "UL Channel, Frequency" on page 132

CONFigure:LTE:SIGN<i>:RFSettings[:PCC]:UDEFined:CHANnel:UL:MAXimum?

Queries the maximum PCC uplink channel number for the user-defined band, resulting from the other PCC channel number settings:

CHAN:UL:MAX = CHAN:UL:MIN + CHAN:DL:MAX - CHAN:DL:MIN

Return values:

<Channel> Range: 0 to 124835

Example: See Specifying General Settings

Usage: Query only

Firmware/Software: V2.1.30

Options: R&S CMW-KS525

Manual operation: See "UL Channel, Frequency" on page 132

CONFigure:LTE:SIGN<i>:RFSettings[:PCC]:UDEFined:FREQuency:DL:MINimum <Frequency>

Configures the PCC carrier center frequency corresponding to the minimum downlink channel number for the user-defined band.

The other frequencies are calculated from the settings as follows:

*FREQ:DL:MAX = FREQ:DL:MIN + (CHAN:DL:MAX - CHAN:DL:MIN) * 100 kHz*

FREQ:UL:MIN = FREQ:DL:MIN - UDSeparation

*FREQ:UL:MAX = FREQ:DL:MIN - UDSeparation + (CHAN:DL:MAX - CHAN:DL:MIN) * 100 kHz*

Parameters:

<Frequency> The allowed range depends on the remaining user-defined band settings. All frequencies resulting from the calculations stated above must be located within the following frequency range.

Range: 70E+6 Hz to 6E+9 Hz
*RST: 2110E+6 Hz
Default unit: Hz

Example: See Specifying General Settings

Firmware/Software: V2.1.30

Options: R&S CMW-KS525
R&S CMW-KB036 required for frequencies above 3.3 GHz

Manual operation: See "DL Channel, Frequency" on page 132

CONFigure:LTE:SIGN<i>:RFSettings[:PCC]:UDEFined:FREQuency:DL:MAXimum?
CONFigure:LTE:SIGN<i>:RFSettings[:PCC]:UDEFined:FREQuency:UL:MINimum?
CONFigure:LTE:SIGN<i>:RFSettings[:PCC]:UDEFined:FREQuency:UL:MAXimum?

Queries PCC carrier center frequencies resulting from the user-defined band settings: maximum downlink frequency, minimum and maximum uplink frequencies. For calculations see `CONFigure:LTE:SIGN<i>:RFSettings[:PCC]:UDEFined:FREQuency:DL:MINimum`.

Return values:

<Frequency> Range: 70E+6 Hz to 6E+9 Hz
Default unit: Hz

Example: See Specifying General Settings

Usage: Query only

Firmware/Software: V2.1.30

Options: R&S CMW-KS525
R&S CMW-KB036 required for frequencies above 3.3 GHz

Manual operation: See "UL Channel, Frequency" on page 132

CONFigure:LTE:SIGN<i>:RFSettings:SCC:UDEFined:CHANnel:DL:MINimum <Channel>
CONFigure:LTE:SIGN<i>:RFSettings:SCC:UDEFined:CHANnel:DL:MAXimum <Channel>

Configures channel numbers for the SCC1 user-defined band: the minimum downlink channel number and the maximum downlink channel number.

Combinations that result in frequencies outside of the allowed range are corrected automatically.

Parameters:

<Channel> Range: 0 to 65535
*RST:

Example: See Specifying General Settings

Firmware/Software: V3.2.50

Options: R&S CMW-KS525

Manual operation: See "DL Channel, Frequency" on page 132

CONFigure:LTE:SIGN<i>:RFSettings:SCC:UDEFined:FREQuency:DL:MINimum <Frequency>

Configures the SCC1 carrier center frequency corresponding to the minimum downlink channel number for the user-defined band.

The frequency corresponding to the maximum downlink channel number is calculated from the settings as follows:

*FREQ:DL:MAX = FREQ:DL:MIN + (CHAN:DL:MAX - CHAN:DL:MIN) * 100 kHz*

Parameters:

<Frequency> The allowed range depends on the remaining user-defined band settings. Both the minimum frequency and the maximum frequency resulting from the calculation stated above must be located within the following frequency range.

Range: 70E+6 Hz to 6E+9 Hz
*RST: 2110E+6 Hz
Default unit: Hz

Example: See Specifying General Settings

Firmware/Software: V3.2.50

Options: R&S CMW-KS525
R&S CMW-KB036 for frequencies above 3.3 GHz

Manual operation: See "DL Channel, Frequency" on page 132

CONFigure:LTE:SIGN<i>:RFSettings:SCC:UDEFined:FREQuency:DL:MAXimum?

Queries the maximum SCC1 carrier center frequency resulting from the user-defined band settings. For calculation, see `CONFigure:LTE:SIGN<i>:RFSettings:SCC:UDEFined:FREQuency:DL:MINimum`.

Return values:

<Frequency> Range: 70E+6 Hz to 6E+9 Hz
Default unit: Hz

Example: See Specifying General Settings

Usage: Query only

Firmware/Software: V3.2.50

Options: R&S CMW-KS525
R&S CMW-KB036 for frequencies above 3.3 GHz

Manual operation: See "DL Channel, Frequency" on page 132

CONFigure:LTE:SIGN<i>:RFSettings:SCC:UDEFined:CHANnel:DL:MINimum:SCC<c> <Channel>
CONFigure:LTE:SIGN<i>:RFSettings:SCC:UDEFined:CHANnel:DL:MAXimum:SCC<c> <Channel>

Configures channel numbers for the SCC<c> user-defined band: the minimum downlink channel number and the maximum downlink channel number.

Combinations that result in frequencies outside of the allowed range are corrected automatically.

Suffix:
<c> 2

Parameters:
<Channel> Range: 0 to 65535
*RST:

Firmware/Software: V3.5.10

Options: R&S CMW-KS525

Manual operation: See "DL Channel, Frequency" on page 132

CONFigure:LTE:SIGN<i>:RFSettings:SCC:UDEFined:FREQuency:DL:MINimum:SCC<c> <Frequency>

Configures the SCC<c> carrier center frequency corresponding to the minimum downlink channel number for the user-defined band.

The frequency corresponding to the maximum downlink channel number is calculated from the settings as follows:

*FREQ:DL:MAX = FREQ:DL:MIN + (CHAN:DL:MAX - CHAN:DL:MIN) * 100 kHz*

Suffix:
<c> 2

Parameters:
<Frequency> The allowed range depends on the remaining user-defined band settings. Both the minimum frequency and the maximum frequency resulting from the calculation stated above must be located within the following frequency range.
Range: 70E+6 Hz to 6E+9 Hz
*RST: 2110E+6 Hz
Default unit: Hz

Firmware/Software: V3.5.10

Options: R&S CMW-KS525
R&S CMW-KB036 for frequencies above 3.3 GHz

Manual operation: See "DL Channel, Frequency" on page 132

CONFigure:LTE:SIGN<i>:RFSettings:SCC:UDEFined:FREQuency:DL:MAXimum: SCC<c>?

Queries the maximum SCC<c> carrier center frequency resulting from the user-defined band settings. For calculation, see `CONFigure:LTE:SIGN<i>:RFSettings:SCC:UDEFined:FREQuency:DL:MINimum:SCC<c>`.

Suffix:

<c> 2

Return values:

<Frequency> Range: 70E+6 Hz to 6E+9 Hz
Default unit: Hz

Usage: Query only

Firmware/Software: V3.5.10

Options: R&S CMW-KS525
R&S CMW-KB036 for frequencies above 3.3 GHz

Manual operation: See "DL Channel, Frequency" on page 132

2.6.9 Internal Fading

The following commands configure the internal fader of the R&S CMW.

2.6.9.1 Fading Simulator

The following commands configure the fading simulator of the internal fader for fading of the PCC and SCC downlink.

CONFigure:LTE:SIGN<i>:FADing[:PCC]:FSIMulator:ENABle <Enable>
CONFigure:LTE:SIGN<i>:FADing:SCC:FSIMulator:ENABle <Enable>

Enables/disables the fading simulator.

Parameters:

<Enable>	OFF | ON *RST: OFF
Example:	See Configuring Internal Fading
Firmware/Software:	V3.0.20, SCC command V3.2.70
Options:	See relevant fading scenario
Manual operation:	See "Enable" on page 135

CONFigure:LTE:SIGN<i>:FADing[:PCC]:FSIMulator:STANdard <Standard>
CONFigure:LTE:SIGN<i>:FADing:SCC:FSIMulator:STANdard <Standard>

Selects a propagation condition profile.

Parameters:

<Standard> EP5Low | EP5Medium | EP5High | EV5Low | EV5Medium | EV5High | EV7Low | EV7Medium | EV7High | ET7Low | ET7Medium | ET7High | ET3Low | ET3Medium | ET3High | HSTRain | HST | CTESt | ETL30 | ETM30 | ETH30

EP5Low | EP5Medium | EP5High
EPA, 5 Hz Doppler, low/medium/high correlation

EV5Low | EV5Medium | EV5High
EVA, 5 Hz Doppler, low/medium/high correlation

EV7Low | EV7Medium | EV7High
EVA, 70 Hz Doppler, low/medium/high correlation

ETL30 | ETM30 | ETH30
ETU, 30 Hz Doppler, low/medium/high correlation

ET7Low | ET7Medium | ET7High
ETU, 70 Hz Doppler, low/medium/high correlation

ET3Low | ET3Medium | ET3High
ETU, 300 Hz Doppler, low/medium/high correlation

HSTRain | HST
high speed train scenario (both values have the same effect)

CTESt
multi-path profile for CQI tests

*RST: EP5Low

Example: See Configuring Internal Fading

Firmware/Software: V3.0.20
V3.2.10: HSTRain
V3.2.20: ETL30, ETM30, ETH30
V3.2.70: SCC command
V3.2.82: HST

Options: See relevant fading scenario

Manual operation: See "Profile" on page 135

CONFigure:LTE:SIGN<i>:FADing[:PCC]:FSIMulator:RESTart:MODE <RestartMode>
CONFigure:LTE:SIGN<i>:FADing:SCC:FSIMulator:RESTart:MODE <RestartMode>

Sets the restart mode of the fading simulator.

The scenario "1 Cell - Fading - MIMO4x2 - 2 RF Out" supports only the mode `TRIGger`. The other scenarios support only the modes `AUTO` and `MANual`.

Parameters:

<RestartMode> AUTO | MANual | TRIGger

AUTO: fading automatically starts with the DL signal
MANual: fading is started and restarted manually (see `CONFigure:...:FSIMulator:RESTart`)
TRIGger: fading starts automatically and synchronously on both I/Q boards

*RST: AUTO

Example: See Configuring Internal Fading

Firmware/Software: V3.0.20
V3.2.70: SCC command
V3.2.80: TRIGger

Options: See relevant fading scenario

Manual operation: See "Restart Event" on page 135

CONFigure:LTE:SIGN<i>:FADing[:PCC]:FSIMulator:RESTart
CONFigure:LTE:SIGN<i>:FADing:SCC:FSIMulator:RESTart

Restarts the fading process in `MANual` mode (see also `CONFigure:...:FSIMulator:RESTart:MODE`).

Usage: Event

Firmware/Software: V3.0.20, SCC command V3.2.70

Options: See relevant fading scenario

Manual operation: See "Restart Event" on page 135

CONFigure:LTE:SIGN<i>:FADing[:PCC]:FSIMulator:GLOBal:SEED <Seed>
CONFigure:LTE:SIGN<i>:FADing:SCC:FSIMulator:GLOBal:SEED <Seed>

Sets the start seed for the pseudo-random fading algorithm.

Parameters:

<Seed> Range: 0 to 9
*RST: 0

Example: See Configuring Internal Fading

Firmware/Software: V3.0.20, SCC command V3.2.70

Options: See relevant fading scenario

Manual operation: See "Start Seed" on page 136

CONFigure:LTE:SIGN<i>:FADing[:PCC]:FSIMulator:ILOSs:MODE <InsertLossMode>
CONFigure:LTE:SIGN<i>:FADing:SCC:FSIMulator:ILOSs:MODE <InsertLossMode>

Sets the insertion loss mode.

Parameters:

<InsertLossMode> NORMal | USER

NORMal: the insertion loss is determined by the fading profile
USER: the insertion loss can be adjusted by the user

*RST: NORM

Example: See Configuring Internal Fading

Firmware/Software: V3.0.20, SCC command V3.2.70

Options: See relevant fading scenario

Manual operation: See "Insertion Loss" on page 136

CONFigure:LTE:SIGN<i>:FADing[:PCC]:FSIMulator:ILOSs:LOSS <InsertionLoss>
CONFigure:LTE:SIGN<i>:FADing:SCC:FSIMulator:ILOSs:LOSS <InsertionLoss>

Sets the insertion loss for the fading simulator.

A setting is only allowed in `USER` mode (see `CONFigure:...:FSIMulator:ILOSs:MODE`).

Parameters:

<InsertionLoss> Range: 0 dB to 18 dB
*RST: 0 dB
Default unit: dB

Firmware/Software: V3.0.20, SCC command V3.2.70

Options: See relevant fading scenario

Manual operation: See "Insertion Loss" on page 136

SENSe:LTE:SIGN<i>:FADing[:PCC]:FSIMulator:ILOSs:CSAMples<path>?
SENSe:LTE:SIGN<i>:FADing:SCC:FSIMulator:ILOSs:CSAMples<n>?

Returns the percentage of clipped samples for the output path number <n>.

Suffix:

<n> 1..2

Return values:

<ClippedSamples> Range: 0 % to 100 %
Default unit: %

Usage: Query only

Firmware/Software: V3.2.10, SCC command V3.2.70

Options: See relevant fading scenario

Manual operation: See "Insertion Loss" on page 136

CONFigure:LTE:SIGN<i>:FADing[:PCC]:FSIMulator:DSHift:MODE <Mode>
CONFigure:LTE:SIGN<i>:FADing:SCC:FSIMulator:DSHift:MODE <Mode>

Sets the Doppler shift mode.

Parameters:

<Mode> NORMal | USER

NORMal: The maximum Doppler frequency is determined by the fading profile.
USER: The maximum Doppler frequency can be adjusted by the user.

*RST: NORM

Example: See Configuring Internal Fading

Firmware/Software: V3.2.20, SCC command V3.2.70

Options: See relevant fading scenario

Manual operation: See "Doppler Frequency Mode, Doppler Frequency" on page 136

CONFigure:LTE:SIGN<i>:FADing[:PCC]:FSIMulator:DSHift <Frequency>
CONFigure:LTE:SIGN<i>:FADing:SCC:FSIMulator:DSHift <Frequency>

Sets the maximum Doppler frequency for the fading simulator.

A setting is only allowed in `USER` mode (see `CONFigure:LTE:SIGN<i>:FADing[:PCC]:FSIMulator:DSHift:MODE`).

Parameters:

<Frequency> Range: 1 Hz to 2000 Hz
*RST: 5 Hz
Default unit: Hz

Example: See Configuring Internal Fading

Firmware/Software: V3.2.20, SCC command V3.2.70

Options: See relevant fading scenario

Manual operation: See "Doppler Frequency Mode, Doppler Frequency" on page 136

2.6.9.2 DL Settings

The following commands query noise power information for the PCC and SCC downlink.

CONFigure:LTE:SIGN<i>:FADing[:PCC]:POWer:NOISe?
CONFigure:LTE:SIGN<i>:FADing:SCC:POWer:NOISe?

Queries the calculated noise power on the DL channel, i.e. within the cell bandwidth.

Return values:

<NoisePower> Default unit: dBm

Example: See Configuring Internal Fading

Usage: Query only

Firmware/Software: V3.0.20, SCC command V3.2.70

Options: See relevant fading scenario

Manual operation: See "Noise (System BW) Power" on page 137

CONFigure:LTE:SIGN<i>:FADing[:PCC]:POWer:NOISe:TOTal?
CONFigure:LTE:SIGN<i>:FADing:SCC:POWer:NOISe:TOTal?

Queries the total noise power for one carrier.

Return values:

<NoisePower> Default unit: dBm

Usage: Query only

Firmware/Software: V3.0.20, SCC command V3.2.70

Options: See relevant fading scenario

Manual operation: See "Noise (Total BW) Power" on page 137

CONFigure:LTE:SIGN<i>:FADing[:PCC]:POWer:SUM?
CONFigure:LTE:SIGN<i>:FADing:SCC:POWer:SUM?

Queries the calculated total power (signal + noise) on the DL channel, i.e. within the cell bandwidth.

Return values:

<Power> Default unit: dBm

Usage: Query only

Firmware/Software: V3.0.20, SCC command V3.2.70

Options: See relevant fading scenario

Manual operation: See "Signal + Noise (System BW) Power" on page 137

2.6.9.3 Fading Module AWGN

The following commands configure the AWGN generator of the internal fader for the PCC and SCC downlink.

CONFigure:LTE:SIGN<i>:FADing[:PCC]:AWGN:ENABle <Enable>
CONFigure:LTE:SIGN<i>:FADing:SCC:AWGN:ENABle <Enable>

Enables or disables AWGN insertion via the fading module.

Parameters:

<Enable> OFF | ON
*RST: OFF

Example: See Configuring Internal Fading

Firmware/Software: V3.0.20, SCC command V3.2.70

Options: See relevant fading scenario

Manual operation: See "Enable" on page 138

CONFigure:LTE:SIGN<i>:FADing[:PCC]:AWGN:BWIDth:RATio <Ratio>
CONFigure:LTE:SIGN<i>:FADing:SCC:AWGN:BWIDth:RATio <Ratio>

Specifies the minimum ratio between the noise bandwidth and the cell bandwidth.

Parameters:

<Ratio> Range: 1 to 57.1
*RST: 1

Example: See Configuring Internal Fading

Firmware/Software: V3.0.20, SCC command V3.2.70

Options: See relevant fading scenario

Manual operation: See "Min. Noise/System BW Ratio" on page 138

CONFigure:LTE:SIGN<i>:FADing[:PCC]:AWGN:BWIDth:NOISe?
CONFigure:LTE:SIGN<i>:FADing:SCC:AWGN:BWIDth:NOISe?

Queries the noise bandwidth.

Return values:

<NoiseBandwidth> Range: 0 Hz to 80E+6 Hz
Default unit: Hz

Usage: Query only

Firmware/Software: V3.0.20, SCC command V3.2.70

Options: See relevant fading scenario

Manual operation: See "Noise Bandwidth" on page 138

CONFigure:LTE:SIGN<i>:FADing[:PCC]:AWGN:SNRatio <Ratio>
CONFigure:LTE:SIGN<i>:FADing:SCC:AWGN:SNRatio <Ratio>

Specifies the signal to noise ratio for the AWGN inserted on the internal fading module.

Parameters:

<Ratio> Range: -50 dB to 40 dB
*RST: 0 dB
Default unit: dB

Example: See Configuring Internal Fading

Firmware/Software: V3.0.20, SCC command V3.2.70

Options: See relevant fading scenario

Manual operation: See "Signal/Noise Ratio" on page 138

2.6.10 Downlink Power Levels

The following commands define power levels of physical downlink channels and signals.

CONFigure:LTE:SIGN<i>:DL[:PCC]:RSEPre:LEVel <Level>
CONFigure:LTE:SIGN<i>:DL:SCC<c>:RSEPre:LEVel <Level>

Defines the Energy Per Resource Element (EPRE) of the Reference Signal (RS). The power levels of resource elements used for other channels/signals are defined relative to this power level.

The allowed value range depends basically on the used connector, the number of allocated resource blocks (specified via the cell bandwidth) and the external attenuation in the output path.

$Level_{RS\ EPRE,\ min} = Level_{Connector,\ min} - 10*log_{10}(12*N_{RB}) - ExtAtt_{out}$

$Level_{RS\ EPRE,\ max} = Level_{Connector,\ max} - 10*log_{10}(12*N_{RB}) - ExtAtt_{out} - 15\ dB$

With $\text{Level}_{\text{Connector, min}}$ = -130 dBm (-120 dBm), $\text{Level}_{\text{Connector, max}}$ = -5 dBm (8 dBm) for RFx Com (RFx Out); please also notice the ranges quoted in the data sheet.

The range is additionally affected by active AWGN ("Downlink Power Levels" parameter), internal fading (insertion loss value) and external fading (baseband level).

MIMO 4x2 decreases the maximum value by 3 dB.

Suffix:
<c> 1..2

Parameters:
<Level> Range: see above
*RST: -85 dBm/15kHz
Default unit: dBm/15kHz

Example: See Configuring DL Power Levels

Firmware/Software: V1.0.15.20, SCC command V3.2.50

Manual operation: See "RS EPRE" on page 139

SENSe:LTE:SIGN<i>:DL[:PCC]:FCPower?
SENSe:LTE:SIGN<i>:DL:SCC<c>:FCPower?

Queries the "Full Cell BW Power". The power results from the configured RS EPRE and the cell bandwidth.

Suffix:
<c> 1..2

Return values:
<Level> Range: -220 dBm to 48 dBm
Default unit: dBm

Example: See Configuring DL Power Levels

Usage: Query only

Firmware/Software: V3.0.10, SCC command V3.2.50

Manual operation: See "RS EPRE" on page 139

CONFigure:LTE:SIGN<i>:DL[:PCC]:PSS:POFFset <Offset>
CONFigure:LTE:SIGN<i>:DL:SCC<c>:PSS:POFFset <Offset>

Defines the power level of a Primary Synchronization Signal (PSS) resource element.

Suffix:
<c> 1..2

Parameters:
<Offset> PSS power relative to RS EPRE

Range: -30 dB to 0 dB
*RST: 0 dB
Default unit: dB

Example: See Configuring DL Power Levels

Firmware/Software: V1.0.15.20, SCC command V3.2.50

Manual operation: See "PSS Power Offset" on page 140

CONFigure:LTE:SIGN<i>:DL[:PCC]:SSS:POFFset <Offset>
CONFigure:LTE:SIGN<i>:DL:SCC<c>:SSS:POFFset <Offset>

Defines the power level of a Secondary Synchronization Signal (SSS) resource element.

Suffix:
<c> 1..2

Parameters:
<Offset> SSS power relative to RS EPRE

Range: -30 dB to 0 dB
*RST: 0 dB
Default unit: dB

Example: See Configuring DL Power Levels

Firmware/Software: V1.0.15.20, SCC command V3.2.50

Manual operation: See "SSS Power Offset" on page 140

CONFigure:LTE:SIGN<i>:DL[:PCC]:PBCH:POFFset <Offset>
CONFigure:LTE:SIGN<i>:DL:SCC<c>:PBCH:POFFset <Offset>

Defines the power level of a Physical Broadcast Channel (PBCH) resource element.

Suffix:
<c> 1..2

Parameters:

<Offset> PBCH power relative to RS EPRE

Range: -30 dB to 0 dB
*RST: 0 dB
Default unit: dB

Example: See Configuring DL Power Levels

Firmware/Software: V1.0.15.20, SCC command V3.2.50

Manual operation: See "PBCH Power Offset" on page 140

CONFigure:LTE:SIGN<i>:DL[:PCC]:PCFich:POFFset <Offset>
CONFigure:LTE:SIGN<i>:DL:SCC<c>:PCFich:POFFset <Offset>

Defines the power level of a Physical Control Format Indicator Channel (PCFICH) resource element.

Suffix:

<c> 1..2

Parameters:

<Offset> PCFICH power relative to RS EPRE

Range: -30 dB to 0 dB
*RST: 0 dB
Default unit: dB

Example: See Configuring DL Power Levels

Firmware/Software: V1.0.15.20, SCC command V3.2.50

Manual operation: See "PCFICH Power Offset" on page 140

CONFigure:LTE:SIGN<i>:DL[:PCC]:PHICh:POFFset <Offset>
CONFigure:LTE:SIGN<i>:DL:SCC<c>:PHICh:POFFset <Offset>

Defines the power level of a Physical Hybrid ARQ Indicator Channel (PHICH) resource element.

Suffix:

<c> 1..2

Parameters:

<Offset> PHICH power relative to RS EPRE

Range: -30 dB to 0 dB
*RST: 0 dB
Default unit: dB

Example: See Configuring DL Power Levels

Firmware/Software: V3.2.10, SCC command V3.2.50

Manual operation: See "PHICH Power Offset" on page 140

CONFigure:LTE:SIGN<i>:DL[:PCC]:PDCCh:POFFset <Offset>
CONFigure:LTE:SIGN<i>:DL:SCC<c>:PDCCh:POFFset <Offset>

Defines the power level of a Physical Downlink Control Channel (PDCCH) resource element.

Suffix:

<c> 1..2

Parameters:

<Offset> PDCCH power relative to RS EPRE

Range: -30 dB to 0 dB
*RST: 0 dB
Default unit: dB

Example: See Configuring DL Power Levels

Firmware/Software: V1.0.15.20, SCC command V3.2.50

Manual operation: See "PDCCH Power Offset" on page 141

CONFigure:LTE:SIGN<i>:DL[:PCC]:OCNG <Enable>
CONFigure:LTE:SIGN<i>:DL:SCC<c>:OCNG <Enable>

Enables or disables the OFDMA Channel Noise Generator (OCNG).

Suffix:

<c> 1..2

Parameters:

<Enable> OFF | ON

*RST: OFF

Example: See Configuring DL Power Levels

Firmware/Software: V1.0.15.20, SCC command V3.2.50

Manual operation: See "OCNG" on page 141

CONFigure:LTE:SIGN<i>:DL[:PCC]:PDSCh:PA <PA>
CONFigure:LTE:SIGN<i>:DL:SCC<c>:PDSCh:PA <PA>

Defines the power offset P_A. The offset is required for calculation of the power level of a Physical Downlink Shared Channel (PDSCH) resource element.

Suffix:

<c> 1..2

Parameters:

<PA> ZERO | N3DB | N6DB

Power offset of 0 dB | -3 dB | -6 dB

*RST: ZERO

Example: See Configuring DL Power Levels

Firmware/Software: V1.0.15.21, SCC command V3.2.50

Manual operation: See "PDSCH" on page 141

CONFigure:LTE:SIGN<i>:DL[:PCC]:PDSCh:RINDex <RatioIndex>
CONFigure:LTE:SIGN<i>:DL:SCC<c>:PDSCh:RINDex <RatioIndex>

Defines the power ratio index P_B. The index is required for calculation of the power level of a Physical Downlink Shared Channel (PDSCH) resource element.

Suffix:
<c> 1..2

Parameters:
<RatioIndex> Range: 0 to 3
*RST: 0

Example: See Configuring DL Power Levels

Firmware/Software: V1.0.15.20, SCC command V3.2.50

Manual operation: See "PDSCH" on page 141

CONFigure:LTE:SIGN<i>:DL[:PCC]:AWGN <AWGN>
CONFigure:LTE:SIGN<i>:DL:SCC<c>:AWGN <AWGN>

Specifies the total level of the Additional White Gaussian Noise (AWGN) interferer. The unit dBm/15 kHz indicates the spectral density integrated across one subcarrier.

The range depends on a number of parameters. It either equals the range of the RS EPRE or is a part of this range.

Suffix:
<c> 1..2

Parameters:
<AWGN> Range: depends on many parameters
*RST: -98 dBm/15kHz, OFF
Default unit: dBm/15kHz
Additional parameters: OFF | ON (disables | enables the AWGN interferer)

Example: See Configuring DL Power Levels

Firmware/Software: V1.0.15.21, SCC command V3.2.50

Options: R&S CMW-KS510

Manual operation: See "AWGN" on page 141

2.6.11 Uplink Power Control

The following commands define parameters related to UE uplink power control by the instrument.

2.6.11.1 PRACH and Initial PUSCH Power

The following commands define parameters related to PRACH and initial PUSCH power configuration and specify the cell-specific maximum allowed power.

CONFigure:LTE:SIGN<i>:UL:APPower:EASettings <Enable>

Enables or disables advanced configuration of the PRACH and open loop power settings via the other `CONFigure:LTE:SIGN:UL:APPower:...` commands.

Parameters:

<Enable> OFF | ON
*RST: OFF

Example: See Configuring UL Power Control for Call Setup

Firmware/Software: V3.0.50

Manual operation: See "Enable Advanced Settings" on page 143

CONFigure:LTE:SIGN<i>:UL:OLNPower <Power>

Defines a cell-specific nominal power value for full resource block allocation in the UL (entire channel bandwidth used). From this value the cell-specific nominal power value $P_{O\_NOMINAL\_PUSCH}$ related to one resource block is determined and sent to all UEs via broadcast.

This command is only relevant for basic configuration and rejected if advanced configuration is active, see `CONFigure:LTE:SIGN<i>:UL:APPower:EASettings` on page 351.

Parameters:

<Power> Range: -50 dBm to 23 dBm
*RST: -20 dBm
Default unit: dBm

Example: See Configuring UL Power Control for Call Setup

Firmware/Software: V3.0.50

Manual operation: See "Open Loop Nominal Power" on page 143

SENSe:LTE:SIGN<i>:UL:APPower:RSPower:BASic?

Queries the "referenceSignalPower" value, signaled to the UE if basic UL power configuration applies.

Return values:

<RefSignalPower> Range: -60 dBm to 50 dBm
Default unit: dBm

Example: See Configuring UL Power Control for Call Setup

Usage: Query only

Firmware/Software: V3.0.50

Manual operation: See "Reference Signal Power" on page 143

SENSe:LTE:SIGN<i>:UL:APPower:PIRPower:BASic?

Queries the "preambleInitialReceivedTargetPower" value, signaled to the UE if basic UL power configuration applies.

Return values:

<TargetPower> Range: -120 dBm to -90 dBm
Default unit: dBm

Example: See Configuring UL Power Control for Call Setup

Usage: Query only

Firmware/Software: V3.0.50

Manual operation: See "Preamble Initial Received Target Power" on page 143

SENSe:LTE:SIGN<i>:UL:APPower:PNPusch:BASic?

Queries the "p0-NominalPUSCH" value, signaled to the UE if basic UL power configuration applies.

Return values:

<P0NominalPUSCH> Range: -126 dBm to 24 dBm
Default unit: dBm

Example: See Configuring UL Power Control for Call Setup

Usage: Query only

Firmware/Software: V3.0.50

Manual operation: See "P0 Nominal PUSCH" on page 144

SENSe:LTE:SIGN<i>:UL:APPower:PCALpha:BASic?

Queries the value of parameter "alpha", signaled to the UE if basic UL power configuration applies.

Return values:

<PathCompAlpha> ZERO | DOT4 | DOT5 | DOT6 | DOT7 | DOT8 | DOT9 | ONE

ZERO: 0
DOT4 ... DOT9: 0.4 ... 0.9
ONE: 1.0

Example: See Configuring UL Power Control for Call Setup

Usage: Query only

Firmware/Software: V3.0.50

Manual operation: See "Pathloss Compensation Alpha" on page 144

SENSe:LTE:SIGN<i>:UL:APPower:TPRRcsetup:BASic?

Queries the state of P0-UE-PUSCH toggling, determining the P0-UE-PUSCH values signaled to the UE during RRC connection setup if basic UL power configuration applies.

Return values:

<Enable> OFF | ON

*RST: OFF

Example: See Configuring UL Power Control for Call Setup

Usage: Query only

Firmware/Software: V3.2.20

Manual operation: See "Toggle P0-UE-PUSCH at RRC Setup" on page 144

CONFigure:LTE:SIGN<i>:UL:APPower:RSPower:ADVanced <RefSignalPower>

Specifies the "referenceSignalPower" value, signaled to the UE if advanced UL power configuration applies.

Parameters:

<RefSignalPower> Range: -60 dBm to 50 dBm
*RST: 18 dBm
Default unit: dBm

Example: See Configuring UL Power Control for Call Setup

Firmware/Software: V3.0.50

Manual operation: See "Reference Signal Power" on page 143

CONFigure:LTE:SIGN<i>:UL:APPower:PIRPower:ADVanced <TargetPower>

Specifies the "preambleInitialReceivedTargetPower" value, signaled to the UE if advanced UL power configuration applies.

Parameters:

<TargetPower> Range: -120 dBm to -90 dBm
Increment: 2 dB
*RST: -104 dBm
Default unit: dBm

Example: See Configuring UL Power Control for Call Setup

Firmware/Software: V3.0.50

Manual operation: See "Preamble Initial Received Target Power" on page 143

CONFigure:LTE:SIGN<i>:UL:APPower:PNPusch:ADVanced <P0NominalPUSCH>

Specifies the "p0-NominalPUSCH" value, signaled to the UE if advanced UL power configuration applies.

Parameters:

<P0NominalPUSCH> Range: -126 dBm to 24 dBm
*RST: -85 dBm
Default unit: dBm

Example: See Configuring UL Power Control for Call Setup

Firmware/Software: V3.0.50

Manual operation: See "P0 Nominal PUSCH" on page 144

CONFigure:LTE:SIGN<i>:UL:APPower:PCALpha:ADVanced <PathCompAlpha>

Specifies the value of parameter "alpha", signaled to the UE if advanced UL power configuration applies.

Parameters:

<PathCompAlpha> ZERO | DOT4 | DOT5 | DOT6 | DOT7 | DOT8 | DOT9 | ONE

ZERO: 0
DOT4 ... DOT9: 0.4 ... 0.9
ONE: 1.0

*RST: DOT8

Example: See Configuring UL Power Control for Call Setup

Firmware/Software: V3.0.50

Manual operation: See "Pathloss Compensation Alpha" on page 144

CONFigure:LTE:SIGN<i>:UL:APPower:TPRRcsetup:ADVanced <Enable>

Enables or disables P0-UE-PUSCH toggling and thus determines the P0-UE-PUSCH values signaled to the UE during RRC connection setup if advanced UL power configuration applies.

Parameters:

<Enable> OFF | ON

*RST: OFF

Example: See Configuring UL Power Control for Call Setup

Firmware/Software: V3.2.20

Manual operation: See "Toggle P0-UE-PUSCH at RRC Setup" on page 144

SENSe:LTE:SIGN<i>:UL:APPower:PATHloss?

Queries the pathloss resulting from the advanced UL power settings.

Return values:

<Pathloss> Default unit: dB

Example: See Configuring UL Power Control for Call Setup

Usage: Query only

Firmware/Software: V3.0.50

Manual operation: See "Pathloss" on page 144

SENSe:LTE:SIGN<i>:UL:APPower:EPPPower?

Queries the expected power of the first preamble, resulting from the advanced UL power settings.

Return values:

<Power> Default unit: dBm

Example: See Configuring UL Power Control for Call Setup

Usage: Query only

Firmware/Software: V3.0.50

Manual operation: See "Expected PRACH Preamble Power" on page 144

SENSe:LTE:SIGN<i>:UL:APPower:EOPower?

Queries the expected initial PUSCH power, resulting from the advanced UL power settings.

Return values:

<ExpectedOLpower> Default unit: dBm

Example: See Configuring UL Power Control for Call Setup

Usage: Query only

Firmware/Software: V3.0.50

Manual operation: See "Expected OL Power" on page 145

CONFigure:LTE:SIGN<i>:UL:PMAX <Power>

Specifies the maximum allowed UE power.

Parameters:

<Power> Range: -30 dBm to 33 dBm
*RST: 24 dBm
Default unit: dBm
Additional parameters: OFF | ON (disables | enables signaling of the value to the UE)

Example: See Configuring UL Power Control for Call Setup

Firmware/Software: V3.0.10
V3.2.60: range enhanced

Manual operation: See "Max. allowed Power P-Max" on page 147

2.6.11.2 TX Power Control (TPC)

The following commands define parameters related to UE uplink power control via TPC commands.

CONFigure:LTE:SIGN<i>:UL:PUSCh:TPC:SET <SetType>

Selects the active TPC setup to be executed for power control of the PUSCH.

For some setups, additional commands are available for configuration or to trigger the execution:

- `CONFigure:LTE:SIGN<i>:UL:PUSCh:TPC:PEXecute` for `SINGle`, `UDSingle`, `RPControl`
- `CONFigure:LTE:SIGN<i>:UL:PUSCh:TPC:SINGle` for `SINGle`
- `CONFigure:LTE:SIGN<i>:UL:PUSCh:TPC:UDPattern` for `UDSingle`, `UDContinuous`
- `CONFigure:LTE:SIGN<i>:UL:PUSCh:TPC:CLTPower` for `CLOop`
- `CONFigure:LTE:SIGN<i>:UL:PUSCh:TPC:RPControl` for `RPControl`

Parameters:

<SetType> MINPower | MAXPower | CONStant | SINGle | UDSingle | UDContinuous | ALT0 | CLOop | RPControl

MINPower: command the UE to minimum power
MAXPower: command the UE to maximum power
CONStant: command the UE to keep the power constant
SINGle: send a pattern once (pattern contains only one type of TPC command)
UDSingle: send a pattern once (mix of different TPC commands possible)
UDContinuous: send a pattern over and over again
ALT0: send an alternating pattern continuously
CLOop: command the UE to a configurable target power
RPControl: patterns for 3GPP relative power control test

*RST: CLO

Example: See Modifying Parameters for an Established Connection

Firmware/Software: V3.2.50

Manual operation: See "Active TPC Setup" on page 145

CONFigure:LTE:SIGN<i>:UL:PUSCh:TPC:PEXecute

Execute the active TPC setup for power control of the PUSCH. This is only relevant for setups which are not executed automatically (`SINGle`, `UDSingle`, `RPControl`).

For selection of the active TPC setup see `CONFigure:LTE:SIGN<i>:UL:PUSCh:TPC:SET` on page 356.

Example: See Modifying Parameters for an Established Connection

Usage: Event

Firmware/Software: V2.0.20

Manual operation: See "Active TPC Setup" on page 145

CONFigure:LTE:SIGN<i>:UL:PUSCh:TPC:RPControl <Pattern>

Selects a TPC pattern for 3GPP relative power control tests with the TPC setup `RPControl`.

For selection of the active TPC setup see `CONFigure:LTE:SIGN<i>:UL:PUSCh:TPC:SET` on page 356.

Parameters:

<Pattern> RUA | RDA | RUB | RDB | RUC | RDC

RUA | RUB | RUC: ramping up A | B | C
RDA | RDB | RDC: ramping down A | B | C

*RST: RUA

Example: See Modifying Parameters for an Established Connection

Firmware/Software: V3.2.50

Manual operation: See "3GPP Rel. Pow. Ctrl. Pattern" on page 146

CONFigure:LTE:SIGN<i>:UL:PUSCh:TPC:CLTPower <Power>

Defines the target power for power control with the TPC setup `CLOop`.

For selection of the active TPC setup see `CONFigure:LTE:SIGN<i>:UL:PUSCh:TPC:SET` on page 356.

Parameters:

<Power>	Range:	-50 dBm to 33 dBm
	*RST:	-20 dBm
	Default unit:	dBm

Example: See Modifying Parameters for an Established Connection

Firmware/Software: V3.2.60

Manual operation: See "Closed Loop Target Power" on page 147

CONFigure:LTE:SIGN<i>:UL:PUSCh:TPC:SINGle <NoOfSteps>, <StepDirection>

Defines a pattern for power control of the PUSCH with the TPC setup `SINGle`. The pattern consists of 1 to 35 up (+1 dB) or down (-1 dB) commands, followed by "constant power" commands (0 dB).

For selection of the active TPC setup see `CONFigure:LTE:SIGN<i>:UL:PUSCh:TPC:SET` on page 356.

Parameters:

<NoOfSteps>	Range:	1 to 35
	*RST:	1
<StepDirection>	UP | DOWN	
	*RST:	UP

Example: See Modifying Parameters for an Established Connection

Firmware/Software: V3.0.10

Manual operation: See "Single Pattern" on page 147

CONFigure:LTE:SIGN<i>:UL:PUSCh:TPC:UDPattern <PatternLength>, <Value1>[, <Value2>, ..., <Value20>]

Defines a pattern for power control of the PUSCH with the TPC setup `UDSingle` or `UDContinuous`.

The pattern consists of 1 to 20 TPC commands. To configure the pattern, specify the pattern length and a corresponding number of TPC commands.

If you specify less TPC commands than required according to the pattern length, the previously defined values are used for the remaining commands. If you specify more TPC commands than required according to the pattern length, all values are set, but only the values corresponding to the pattern length are used.

For selection of the active TPC setup see `CONFigure:LTE:SIGN<i>:UL:PUSCh:TPC:SET` on page 356.

Parameters:

<PatternLength> Number of values to be considered for the pattern

Range: 1 to 20
*RST: 10

<Value1>, ..., <Value20> -1 | 0 | 1 | 3

Pattern values (-1 dB, 0 dB, +1 dB, +3 dB)

*RST: 1,1,1,1,1,-1,-1,-1,-1,-1,1,1,1,1,1,-1,-1,-1,-1,-1

Example: See Modifying Parameters for an Established Connection

Firmware/Software: V2.0.20

Manual operation: See "User-Defined Pattern" on page 147

2.6.12 Physical Cell Setup

The following commands configure physical layer attributes of the simulated cell.

CONFigure:LTE:SIGN<i>:CELL:BANDwidth[:PCC]:DL <Bandwidth>
CONFigure:LTE:SIGN<i>:CELL:BANDwidth:SCC<c>:DL <Bandwidth>

Defines the DL cell/channel bandwidth. The PCC DL bandwidth is also used for the UL.

Suffix:

<c> 1..2

Parameters:

<Bandwidth> B014 | B030 | B050 | B100 | B150 | B200

B014: 1.4 MHz
B030: 3 MHz
B050: 5 MHz
B100: 10 MHz
B150: 15 MHz
B200: 20 MHz

*RST: B100

Example: See Configuring Physical Cell Setup

Firmware/Software: V1.0.15.20, SCC command V3.2.50

Manual operation: See "DL / UL Cell Bandwidth" on page 148

CONFigure:LTE:SIGN<i>:CELL[:PCC]:PCID <ID>
CONFigure:LTE:SIGN<i>:CELL:SCC<c>:PCID <ID>

Defines the physical cell ID used for generation of the DL physical synchronization signals. If you use carrier aggregation, configure different values for the component carriers.

Suffix:

<c> 1..2

Parameters:

<ID> Range: 0 to 503
*RST: 0 for PCC / 1 for SCC1 / 2 for SCC2

Example: See Configuring Physical Cell Setup

Firmware/Software: V1.0.15.20, SCC command V3.2.50

Manual operation: See "Physical Cell ID" on page 149

CONFigure:LTE:SIGN<i>:CELL:CPRefix <CyclicPrefix>

Defines whether a normal or extended Cyclic Prefix (CP) is used.

Parameters:

<CyclicPrefix> NORMal | EXTended

*RST: NORM

Example: See Configuring Physical Cell Setup

Firmware/Software: V3.0.50

Options: R&S CMW-KS510 for EXTended

Manual operation: See "Cyclic Prefix" on page 149

CONFigure:LTE:SIGN<i>:CELL:SRS:ENABle <Enable>

Enables support of SRS.

Parameters:

<Enable> OFF | ON

*RST: OFF

Example: See Configuring Physical Cell Setup

Firmware/Software: V2.0.20

Manual operation: See "Sounding RS (SRS)" on page 149

CONFigure:LTE:SIGN<i>:CELL:SRS:MCENable <Enable>

Enables or disables the manual configuration of the "srs-SubframeConfig" and "srs-ConfigIndex" values.

Parameters:

<Enable> OFF | ON

*RST: OFF

Example: See Configuring Physical Cell Setup

Firmware/Software: V3.2.60

Options: R&S CMW-KS510

Manual operation: See "Manual Configuration" on page 150

CONFigure:LTE:SIGN<i>:CELL:SRS:SFConfig <Subframe>

Specifies the "srs-SubframeConfig" value.

The setting is only used if manual configuration is enabled, see `CONFigure:LTE:SIGN<i>:CELL:SRS:MCENable`.

Parameters:

<Subframe> Range: 0 to 15

*RST: 3

Example: See Configuring Physical Cell Setup

Firmware/Software: V3.2.60

Options: R&S CMW-KS510

Manual operation: See "Subframe Configuration" on page 150

CONFigure:LTE:SIGN<i>:CELL:SRS:SCINdex:FDD <Index>

Specifies the "srs-ConfigIndex" value for FDD.

The setting is only used if manual configuration is enabled, see `CONFigure:LTE:SIGN<i>:CELL:SRS:MCENable`.

Parameters:

<Index>	Range:	0 to 636
	*RST:	7

Example: See Configuring Physical Cell Setup

Firmware/Software: V3.2.70

Options: R&S CMW-KS510

Manual operation: See "Configuration Index" on page 150

CONFigure:LTE:SIGN<i>:CELL:SRS:SCINdex:TDD <Index>

Specifies the "srs-ConfigIndex" value for TDD.

The setting is only used if manual configuration is enabled, see `CONFigure:LTE:SIGN<i>:CELL:SRS:MCENable`.

Parameters:

<Index>	Range:	0 to 644
	*RST:	0

Example: See Configuring Physical Cell Setup

Firmware/Software: V3.2.70

Options: R&S CMW-KS510

Manual operation: See "Configuration Index" on page 150

CONFigure:LTE:SIGN<i>:CELL:ULDL <UplinkDownlink>

Selects an uplink-downlink configuration, defining the combination of uplink, downlink and special subframes within a radio frame. This command is only relevant for duplex mode TDD.

Parameters:

<UplinkDownlink>	Range:	0 to 6
	*RST:	1

Example: See Configuring Physical Cell Setup

Firmware/Software: V3.0.10
V3.0.50: added value 0, 2, 3, 4, 6

Options: R&S CMW-KS550 and R&S CMW-KS510

Manual operation: See "Uplink Downlink Configuration" on page 150

CONFigure:LTE:SIGN<i>:CELL:SSUBframe <SpecialSubframe>

Selects a special subframe configuration, defining the inner structure of special sub-frames. This parameter is only relevant for TDD signals.

The special subframe configurations are defined in 3GPP TS 36.211, chapter 4, "Frame Structure".

Parameters:

<SpecialSubframe> Value 7 and 8 cannot be used with extended cyclic prefix.

Range: 0 to 8
*RST: 7

Example: See Configuring Physical Cell Setup

Firmware/Software: V2.1.20

Options: R&S CMW-KS550

Manual operation: See "Special Subframe" on page 151

CONFigure:LTE:SIGN<i>:CELL:PRACh:NRPReambles <Enable>

Selects whether the application shall ignore received preambles or not.

Parameters:

<Enable> OFF | ON | NIPReambles

OFF: respond to received preambles
ON: ignore received preambles
NIPReambles: ignore a configured number of preambles, then respond to subsequent preambles - for configuration see `CONFigure:LTE:SIGN<i>:CELL:PRACh:NIPRach`, only allowed for power ramping step size 0 dB

*RST: OFF

Example: See Configuring Physical Cell Setup

Firmware/Software: V3.2.20

Manual operation: See "No Response to Preambles, # Ignored Preambles" on page 151

CONFigure:LTE:SIGN<i>:CELL:PRACh:NIPRach <Count>

Configures the number of preambles to be ignored if the mode NIPReambles is active, see `CONFigure:LTE:SIGN<i>:CELL:PRACh:NRPReambles`.

Parameters:

<Count> Range: 1 to 250
*RST: 1

Firmware/Software: V3.2.20

Manual operation: See "No Response to Preambles, # Ignored Preambles" on page 151

CONFigure:LTE:SIGN<i>:CELL:PRACh:PRSTep <Step>

Specifies the transmit power difference between two consecutive preambles.

Parameters:

<Step> ZERO | P2DB | P4DB | P6DB

0 dB, 2 dB, 4 dB, 6 dB

*RST: P2DB

Example: See Configuring Physical Cell Setup

Firmware/Software: V2.0.20

Manual operation: See "Power Ramping Step" on page 151

CONFigure:LTE:SIGN<i>:CELL:PRACh:PCINdex:FDD <PRACHconfIndex>

Selects the PRACH configuration index for FDD.

Parameters:

<PRACHconfIndex> Range: 0 to 63

*RST: 12

Example: See Configuring Physical Cell Setup

Firmware/Software: V2.1.20

Options: R&S CMW-KS500

Manual operation: See "Configuration Index" on page 152

CONFigure:LTE:SIGN<i>:CELL:PRACh:PCINdex:TDD <PRACHconfIndex>

Selects the PRACH configuration index for TDD.

Parameters:

<PRACHconfIndex> Range: depends on UL-DL configuration, see table below

*RST: 12

Example: See Configuring Physical Cell Setup

Firmware/Software: V2.1.20

Options: R&S CMW-KS550

Manual operation: See "Configuration Index" on page 152

The general range for the TDD PRACH configuration index equals 0 to 57. Within this range 3GPP defines forbidden values depending on the UL-DL configuration, see 3GPP TS 36.211, table 5.7.1-4. The following table lists the allowed values.

UL-DL configuration	Allowed PRACH configuration indices
0	0-10, 12-18, 20-57
1	0-7, 9-12, 15-39, 48-57

UL-DL configuration	Allowed PRACH configuration indices
2	0-4, 6, 9, 10, 12, 15, 16, 18, 48-57
3	0-9, 12-18, 20, 21, 23, 25-29, 30, 31, 33, 35-39, 40, 41, 43, 45-49, 51, 53-57
4	0-4, 6, 9, 10, 12, 15, 16, 18, 20, 21, 23, 25-29, 30, 31, 33, 35-39, 48, 49, 51, 53-57
5	0, 1, 3, 6, 9, 12, 15, 18, 48, 49, 51, 53-57
6	0-15, 18-41, 43, 45-57

CONFigure:LTE:SIGN<i>:CELL:PRACh:PFOFfset <PRACHfreqOffset>

Specifies the PRACH frequency offset.

Parameters:

<PRACHfreqOffset> Range: 0 to <total RB - 6> depending on channel bandwidth, see table below
*RST: 0

Example: See Configuring Physical Cell Setup

Firmware/Software: V2.0.10

Manual operation: See "Frequency Offset" on page 152

Table 2-25: Maximum input value depending on channel bandwidth

Channel Bandwidth [MHz]	1.4	3	5	10	15	20
<total RB - 6>	0	9	19	44	69	94

CONFigure:LTE:SIGN<i>:CELL:PRACh:LRSindex <LogRootSeqIndex>

Specifies the logical root sequence index to be used by the UE for generation of the preamble sequence.

Parameters:

<LogRootSeqIndex> Range: 0 to 837
*RST: 123

Example: See Configuring Physical Cell Setup

Firmware/Software: V2.0.10

Manual operation: See "Logical Root Sequ.Idx" on page 152

CONFigure:LTE:SIGN<i>:CELL:PRACh:ZCZConfig <ZeroCorrZoneCon>

Specifies the zero correlation zone config.

Parameters:

<ZeroCorrZoneCon> Range: 0 to 15
*RST: 9

Example: See Configuring Physical Cell Setup

Firmware/Software: V2.0.10

Manual operation: See "Zero Corr. Zone Conf." on page 152

2.6.13 Network Settings

The commands in this section configure parameters of the simulated radio network.

2.6.13.1 Neighbor Cell Settings

The following commands define neighbor cell information to be broadcasted to the UE.

CONFigure:LTE:SIGN<i>:NCELl:LTE:THResholds:LOW <Low>

Configures the reselection threshold value "threshX-Low" for LTE neighbor cells.

Parameters:

<Low> Range: 0 to 31
*RST: 5

Example: See Configuring Network Settings

Firmware/Software: V2.1.30

Manual operation: See "Threshold" on page 154

CONFigure:LTE:SIGN<i>:NCELl:GSM:THResholds:LOW <Low>

Configures the reselection threshold value "threshX-Low" for GSM neighbor cells.

Parameters:

<Low>	Range:	0 to 31
	*RST:	0

Example: See Configuring Network Settings

Firmware/Software: V2.1.30

Manual operation: See "Threshold" on page 154

CONFigure:LTE:SIGN<i>:NCELl:WCDMa:THResholds:LOW <Low>

Configures the reselection threshold value "threshX-Low" for WCDMA neighbor cells.

Parameters:

<Low>	Range:	0 to 31
	*RST:	5

Example: See Configuring Network Settings

Firmware/Software: V2.1.30

Manual operation: See "Threshold" on page 154

CONFigure:LTE:SIGN<i>:NCELl:CDMA:THResholds:LOW <Low>

Configures the reselection threshold value "threshX-Low" for CDMA2000 neighbor cells.

Parameters:

<Low>	Range:	0 to 63
	*RST:	0

Example: See Configuring Network Settings

Firmware/Software: V2.1.30

Manual operation: See "Threshold" on page 154

CONFigure:LTE:SIGN<i>:NCELl:EVDO:THResholds:LOW <Low>

Configures the reselection threshold value "threshX-Low" for 1xEV-DO neighbor cells.

Parameters:

<Low>	Range:	0 to 63
	*RST:	0

Example: See Configuring Network Settings

Firmware/Software: V2.1.30

Manual operation: See "Threshold" on page 154

CONFigure:LTE:SIGN<i>:NCELl:TDSCdma:THResholds:LOW <Low>

Configures the reselection threshold value "threshX-Low" for TD-SCDMA neighbor cells.

Parameters:

<Low> Range: 0 to 31
*RST: 5

Example: See Configuring Network Settings

Firmware/Software: V3.2.20

Manual operation: See "Threshold" on page 154

CONFigure:LTE:SIGN<i>:NCELl:ALL:THResholds:LOW <Valid>, <Low>

Configures a common reselection threshold value "threshX-Low" applicable to all technologies.

Alternatively to a common threshold you can also use individual thresholds. They are defined per technology via the commands `CONFigure:LTE:SIGN<i>:NCELl:<Technology>:THResholds:LOW`. The parameter `<Valid>` selects whether common or individual thresholds are used.

Parameters:

<Valid> OFF | ON
OFF: use individual thresholds defined by separate commands
ON: use common threshold defined by this command
*RST: OFF

<Low> Range: 0 to 31
*RST: 5

Firmware/Software: V2.1.30

Manual operation: See "Threshold" on page 154

CONFigure:LTE:SIGN<i>:NCELl:LTE:CELL<n> <Enable>, <Band>, <Channel>, <CellID>, <QOffset>[, <Measurement>]

Configures the entry number <n> of the neighbor cell list for LTE.

For channel number ranges depending on operating bands see chapter 2.2.16, "Operating Bands", on page 59.

Note that only 5 entries with different channel numbers can be active at a time. Entries with the same channel number must have different cell IDs.

Suffix:

<n> 1..16

Parameters:

<Enable> OFF | ON

Enables or disables the entry

*RST: OFF

<Band> FDD: OB1 | ... | OB31 | UDEFined

TDD: OB33 | ... | OB44 | UDEFined
UDEFined = user-defined band

*RST: OB1

<Channel> Downlink channel number

Range: depends on operating band
*RST: 300

<CellID> Physical layer cell ID

Range: 0 to 503
*RST: 0

<QOffset> N24 | N22 | N20 | N18 | N16 | N14 | N12 | N10 | N8 | N6 | N5 | N4 | N3 | N2 | N1 | ZERO | P1 | P2 | P3 | P4 | P5 | P6 | P8 | P10 | P12 | P14 | P16 | P18 | P20 | P22 | P24

Corresponds to value "q-OffsetCell" in 3GPP TS 36.331
N24 to N1: -24 dB to -1 dB
ZERO: 0 dB
P1 to P24: 1 dB to 24 dB

*RST: ZERO

<Measurement> OFF | ON

Disables / enables neighbor cell measurements for the entry
ON is only allowed if also <Enable> = ON

*RST: OFF

Example: See Configuring Network Settings

Firmware/Software: V3.0.10
V3.0.30: added OB27, OB28, OB44
V3.0.50: added <Measurement>
V3.2.50: added OB30, OB31
V3.2.82: added OB29

Options: R&S CMW-KS510 for neighbor cell measurements

Manual operation: See "LTE" on page 155

CONFigure:LTE:SIGN<i>:NCELl:GSM:CELL<n> <Enable>, <Band>, <Channel>[, <Measurement>]

Configures the entry number <n> of the neighbor cell list for GSM.

Suffix:

<n> 1..4

Parameters:

<Enable> OFF | ON

Enables or disables the entry

*RST: OFF

<Band> G085 | G09 | G18 | G19

GSM 850, GSM 900, GSM 1800, GSM 1900

*RST: G09

<Channel> Channel number used for the Broadcast Control Channel (BCCH)

Range: 0 to 1023, depending on GSM band, see table below

*RST: 20

<Measurement> OFF | ON

Disables / enables neighbor cell measurements for the entry
ON is only allowed if also <Enable> = ON

*RST: OFF

Example: See Configuring Network Settings

Firmware/Software: V3.0.50

Options: R&S CMW-KS510 for neighbor cell measurements

Manual operation: See "GSM" on page 155

Table 2-26: Channel number range depending on GSM band

Band	Channel Number
G085	128 to 251
G09	0 to 124, 955 to 1023
G18	512 to 885
G19	512 to 810

CONFigure:LTE:SIGN<i>:NCELl:WCDMa:CELL<n> <Enable>, <Band>, <Channel>, <ScramblingCode>[, <Measurement>]

Configures the entry number <n> of the neighbor cell list for WCDMA.

Suffix:

<n> 1..4

Parameters:

<Enable> OFF | ON

Enables or disables the entry

*RST: OFF

<Band> OB1 | OB2 | OB3 | OB4 | OB5 | OB6 | OB7 | OB8 | OB9 | OB10 | OB11 | OB12 | OB13 | OB14 | OB19 | OB20 | OB21 | OBS1 | OBS2 | OBS3 | OBL1

OB1, ..., OB14: Operating Band I to XIV
OB19, ..., OB21: Operating Band XIX to XXI
OBS1: Operating Band S
OBS2: Operating Band S 170 MHz
OBS3: Operating Band S 190 MHz
OBL1: Operating Band L

*RST: OB1

<Channel> Downlink channel number

Range: 412 to 11000, depending on operating band, see table below
*RST: 10563

<ScramblingCode> Primary scrambling code

Range: #H0 to #H1FF
*RST: #H0

<Measurement> OFF | ON

Disables / enables neighbor cell measurements for the entry
ON is only allowed if also <Enable> = ON

*RST: OFF

Example: See Configuring Network Settings

Firmware/Software: V3.0.50

Options: R&S CMW-KS510 for neighbor cell measurements

Manual operation: See "WCDMA FDD" on page 155

Table 2-27: Channel number range depending on operating band

Operating Band	Channel Number
OB1	10562 to 10838
OB2	412 to 687 (step 25), 9662 to 9938
OB3	1162 to 1513
OB4	1537 to 1738, 1887 to 2087 (step 25)
OB5	1007, 1012, 1032, 1037, 1062, 1087, 4357 to 4458
OB6	1037, 1062, 4387 to 4413
OB7	2237 to 2563, 2587 to 2912 (step 25)
OB8	2937 to 3088
OB9	9237 to 9387
OB10	3112 to 3388, 3412 to 3687 (step 25)
OB11	3712 to 3812
OB12	3837 to 3903, 3927, 3932, 3957, 3962, 3987, 3992

Operating Band	Channel Number
OB13	4017 to 4043, 4067, 4092
OB14	4117 to 4143, 4167, 4192
OB19	712 to 763, 787, 812, 837
OB20	4512 to 4638
OB21	862 to 912
OBS1	5912 to 5987 (step 25), 10912 to 10988
OBS2	10900 to 10950
OBS3	5962, 5987, 10950 to 11000
OBL1	7637 to 7783, 7788 to 7933

CONFigure:LTE:SIGN<i>:NCELl:CDMA:CELL<n> <Enable>, <BandClass>, <Channel>, <CellID>[, <Measurement>]
CONFigure:LTE:SIGN<i>:NCELl:EVDO:CELL<n> <Enable>, <BandClass>, <Channel>, <CellID>[, <Measurement>]

Configures the entry number <n> of the neighbor cell list for CDMA2000 (1xRTT) or 1xEV-DO (HRPD).

Suffix:

<n> 1..4

Parameters:

<Enable> OFF | ON

Enables or disables the entry

*RST: OFF

<BandClass>	USC | KCEL | NAPC | TACS | JTAC | KPCS | N45T | IM2K | NA7C | B18M | NA8S | PA4M | PA8M | IEXT | USPC | AWS | U25B | U25F | NA9C | PS7C | LO7C **USC:** BC 0, US-Cellular **KCEL:** BC 0, Korean Cellular **NAPC:** BC 1, North American PCS **TACS:** BC 2, TACS Band **JTAC:** BC 3, JTACS Band **KPCS:** BC 4, Korean PCS **N45T:** BC 5, NMT-450 **IM2K:** BC 6, IMT-2000 **NA7C:** BC 7, Upper 700 MHz **B18M:** BC 8, 1800 MHz Band **NA9C:** BC 9, North American 900 MHz **NA8S:** BC 10, Secondary 800 MHz **PA4M:** BC 11, European 400 MHz PAMR **PA8M:** BC 12, 800 MHz PAMR **IEXT:** BC 13, IMT-2000 2.5 GHz Extension **USPC:** BC 14, US PCS 1900 MHz **AWS:** BC 15, AWS Band **U25B:** BC 16, US 2.5 GHz Band **U25F:** BC 17, US 2.5 GHz Forward **PS7C:** BC 18, Public Safety Band 700 MHz **LO7C:** BC 19, Lower 700 MHz *RST: USC
<Channel>	Channel number Range: 0 to 2108, depending on band class, see table below *RST: 283
<CellID>	Physical cell ID Range: 0 to 511 *RST: 0
<Measurement>	OFF | ON Disables / enables neighbor cell measurements for the entry ON is only allowed if also <Enable> = ON *RST: OFF
Example:	See Configuring Network Settings
Firmware/Software:	V3.0.50
Options:	R&S CMW-KS510 for neighbor cell measurements
Manual operation:	See "CDMA2000, 1xEV-DO" on page 155

Table 2-28: Channel number range depending on band class

Band Class	Channel Number
USC, KCEL	1 to 799, 991 to 1323
NAPC, IM2K	0 to 1199
TACS	0 to 1000, 1329 to 2108
JTAC	1 to 799, 801 to 1039, 1041 to 1199, 1201 to 1600
KPCS	0 to 599
N45T	1 to 400, 472 to 871, 1039 to 1473, 1536 to 1715, 1792 to 2016
NA7C, PS7C	0 to 240
B18M	0 to 1499
NA9C	0 to 699
NA8S	0 to 919
PA4M	1 to 400, 472 to 871, 1536 to 1715
PA8M	0 to 239
IEXT	0 to 1399
USPC	0 to 1299
AWS	0 to 899
U25B, U25F	140 to 1459
LO7C	0 to 360

CONFigure:LTE:SIGN<i>:NCELl:TDSCdma:CELL<n> <Enable>, <Band>, <Channel>, <ScramblingCode>[, <Measurement>]

Configures the entry number <n> of the neighbor cell list for TD-SCDMA.

Suffix:

<n> 1..4

Parameters:

<Enable> OFF | ON

Enables or disables the entry

*RST: OFF

<Band> OB1 | OB2 | OB3

OB1: Band 1 (F), channel 9400 to 9600
OB2: Band 2 (A), channel 10050 to 10125
OB3: Band 3 (E), channel 11500 to 12000

*RST: OB1

<Channel> Channel number

Range: 9400 to 12000, depending on operating band
*RST: 9600

<ScramblingCode> Cell parameter ID

Range: #H0 to #H7F
*RST: #H0

<Measurement> OFF | ON

Disables / enables neighbor cell measurements for the entry
ON is only allowed if also <Enable> = ON

*RST: OFF

Example: See Configuring Network Settings

Firmware/Software: V3.2.20

Options: R&S CMW-KS510 for neighbor cell measurements

Manual operation: See "TD-SCDMA" on page 156

2.6.13.2 Cell Reselection Settings

The following commands define cell reselection information to be broadcasted to the UE.

CONFigure:LTE:SIGN<i>:CELL:RESelection:SEARch:INTRasearch <Sintrasearch>

Defines the threshold $S_{IntraSearch}$. The value divided by 2 is broadcasted to the UE in SIB3.

Parameters:

<Sintrasearch> Range: 0 dB to 62 dB
Increment: 2 dB
*RST: 32 dB
Default unit: dB
Additional parameters: OFF | ON (disables | enables transmission of the information element)

Example: See Configuring Network Settings

Firmware/Software: V3.2.70

Options: R&S CMW-KS510

Manual operation: See "S IntraSearch" on page 156

CONFigure:LTE:SIGN<i>:CELL:RESelection:SEARch:NINTrasearch <Snonintrasearch>

Defines the threshold $S_{nonIntraSearch}$. The value divided by 2 is broadcasted to the UE in SIB3.

Parameters:

<Snonintrasearch>
Range: 0 dB to 62 dB
Increment: 2 dB
*RST: 32 dB
Default unit: dB
Additional parameters: OFF | ON (disables | enables transmission of the information element)

Example: See Configuring Network Settings

Firmware/Software: V3.2.70

Options: R&S CMW-KS510

Manual operation: See "S NonIntraSearch" on page 156

CONFigure:LTE:SIGN<i>:CELL:RESelection:TSLow <Value>

Defines $Thresh_{Serving,Low}$. The value divided by 2 is broadcasted to the UE in SIB3.

Parameters:

<Value>
Range: 0 dB to 62 dB
Increment: 2 dB
*RST: 16 dB
Default unit: dB

Example: See Configuring Network Settings

Firmware/Software: V3.2.70

Options: R&S CMW-KS510

Manual operation: See "ThreshServingLow" on page 156

CONFigure:LTE:SIGN<i>:CELL:RESelection:QUALity:RXLevmin <Qrxlevmin>

Defines the level $Q_{rxlevmin}$. The value divided by 2 is broadcasted to the UE in SIB1.

Parameters:

<Qrxlevmin>
Range: -140 dBm to -44 dBm
Increment: 2 dB
*RST: -132 dBm
Default unit: dBm

Example: See Configuring Network Settings

Firmware/Software: V3.0.10

Options: R&S CMW-KS510

Manual operation: See "Q rxlevmin" on page 157

2.6.13.3 Identity Settings

The following commands configure identities of the simulated radio network.

CONFigure:LTE:SIGN<i>:CELL:MCC <MCC>

Specifies the 3-digit Mobile Country Code (MCC). Leading zeros may be omitted.

Parameters:

<MCC> Range: 0 to 999
*RST: 1

Example: See Configuring Network Settings

Firmware/Software: V1.0.15.20

Manual operation: See "MCC" on page 157

CONFigure:LTE:SIGN<i>:CELL:MNC <MNC>

Specifies the Mobile Network Code (MNC). Leading zeros may be omitted.

A two or three-digit MNC can be set, see `CONFigure:LTE:SIGN<i>:CELL:MNC:DIGits`.

Parameters:

<MNC> Range: 0 to 99 or 999
*RST: 1

Example: See Configuring Network Settings

Firmware/Software: V1.0.15.20

Manual operation: See "MNC" on page 157

CONFigure:LTE:SIGN<i>:CELL:MNC:DIGits <NoDigits>

Specifies the number of digits of the Mobile Network Code (MNC).

For setting the MNC, see `CONFigure:LTE:SIGN<i>:CELL:MNC`.

Parameters:

<NoDigits> TWO | THRee
*RST: TWO

Example: See Configuring Network Settings

Firmware/Software: V1.0.15.20

Manual operation: See "MNC" on page 157

CONFigure:LTE:SIGN<i>:CELL:TAC <TAC>

Specifies the tracking area code.

Parameters:

<TAC>	Range:	0 to 65535
	*RST:	1

Example: See Configuring Network Settings

Firmware/Software: V1.0.15.20

Manual operation: See "TAC" on page 157

CONFigure:LTE:SIGN<i>:CELL[:PCC]:CID:EUTRan <CID>
CONFigure:LTE:SIGN<i>:CELL:SCC<c>:CID:EUTRan <CID>

Specifies the E-UTRAN cell identifier (28-digit binary number). If you use carrier aggregation, configure different values for the component carriers.

Suffix:

<c> 1..2

Parameters:

<CID>	Range:	#B0 to #B1111111111111111111111111111
	*RST:	#B100000000 for PCC, #B100000001 for SCC1, #B100000010 for SCC2

Example: See Configuring Network Settings

Firmware/Software: V1.0.15.20, SCC command V3.2.50

Manual operation: See "E-UTRAN Cell Identifier" on page 157

2.6.13.4 Security Settings

The following commands configure parameters related to the authentication procedure and other security procedures.

CONFigure:LTE:SIGN<i>:CELL:SECurity:AUTHenticat <Enable>

Enables or disables authentication, to be performed during the attach procedure.

Parameters:

<Enable> OFF | ON

*RST: ON

Example: See Configuring Network Settings

Firmware/Software: V1.0.15.20

Manual operation: See "Authentication" on page 158

CONFigure:LTE:SIGN<i>:CELL:SECurity:NAS <Enable>

Enables or disables the NAS security mode.

Parameters:

<Enable> OFF | ON

*RST: ON

Example: See Configuring Network Settings

Firmware/Software: V1.0.15.20

Manual operation: See "NAS Security" on page 158

CONFigure:LTE:SIGN<i>:CELL:SECurity:AS <Enable>

Enables or disables the AS security mode.

Parameters:

<Enable> OFF | ON

*RST: ON

Example: See Configuring Network Settings

Firmware/Software: V1.0.15.20

Manual operation: See "AS Security" on page 159

CONFigure:LTE:SIGN<i>:CELL:SECurity:IALGorithm <Algorithm>

Selects an algorithm for integrity protection.

Parameters:

<Algorithm> NULL | S3G

NULL: no integrity protection
S3G: SNOW3G (EIA1) algorithm

*RST: S3G

Example: See Configuring Network Settings

Firmware/Software: V3.2.50

Manual operation: See "Integrity Algorithm" on page 159

CONFigure:LTE:SIGN<i>:CELL:SECurity:MILenage <Enable>

Enables or disables using the MILENAGE algorithm set instead of the standard algorithms.

Parameters:

<Enable> OFF | ON

*RST: OFF

Example: See Configuring Network Settings

Firmware/Software: V1.0.15.20

Manual operation: See "Milenage" on page 159

CONFigure:LTE:SIGN<i>:CELL:SECurity:OPC <OPC>

Specifies the key OP_c as 32-digit hexadecimal number.

Parameters:

<OPC> Range: #H00000000000000000000000000000000 to #HFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF

*RST: #H00000000000000000000000000000000

Example: See Configuring Network Settings

Firmware/Software: V1.0.15.20

Manual operation: See "OPc" on page 159

CONFigure:LTE:SIGN<i>:CELL:SECurity:SKEY <SecretKey>

Defines the secret key K as 32-digit hexadecimal number. Leading zeros may be omitted.

K is used for the authentication procedure including a possible integrity check.

Parameters:

<SecretKey> Range: #H0 to #HFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF

*RST: #H000102030405060708090A0B0C0D0E0F

Example: See Configuring Network Settings

Firmware/Software: V1.0.15.20

Manual operation: See "Secret Key" on page 159

CONFigure:LTE:SIGN<i>:CELL:SECurity:RVALue <Mode>

Selects whether an even or odd RAND value shall be used.

Parameters:
<Mode> EVEN | ODD

Example: See Configuring Network Settings

Firmware/Software: V2.1.20

Manual operation: See "RAND Value" on page 159

2.6.13.5 UE Identity

The following command configures the default IMSI.

CONFigure:LTE:SIGN<i>:CELL:UEIDentity:IMSI <Value>

Specifies the default IMSI.

Parameters:
<Value> String value, containing 14 to 16 digits.
*RST: '001010123456063'

Firmware/Software: V1.0.15.20

Manual operation: See "Default IMSI" on page 160

2.6.13.6 Timer and Constants

The commands in this section configure timer.

CONFigure:LTE:SIGN<i>:CELL:TOUT:OSYNch <Value>

Specifies the time after which the instrument, having waited for a signal from the connected UE, releases the connection.

Parameters:
<Value> Range: 1 s to 50 s
*RST: 5 s
Default unit: s

Example: See Configuring Network Settings

Firmware/Software: V2.1.30

Manual operation: See "Out of Sync" on page 160

CONFigure:LTE:SIGN<i>:CELL:TOUT:T<no> <Value>

Configures the periodic tracking area update timer T3412.

The type of the related information element is "GPRS Timer". The element supports the values 1 to 31 combined with the units 2 seconds, 1 minute and 6 minutes.

This command configures the timer value in seconds. So there are three sub-ranges with different increments.

Suffix:
<no> 3412

Parameters:
<Value>
Range: 2 s to 11160 s
Increment: 2 s (2 s to 62 s), 60 s (120 s to 1860 s), 360 s (2160 s to 11160 s)
*RST: 2 s
Additional parameters: OFF | ON (disables | enables the timer)

Example: See Configuring Network Settings

Firmware/Software: V3.0.10

Manual operation: See "T3412" on page 160

2.6.13.7 Time

The commands in this section configure and send date and time information to the UE.

CONFigure:LTE:SIGN<i>:CELL:TIME:TSOurce <SourceTime>

Selects the date and time source.

The time source DATE is configured via the following commands:

- `CONFigure:LTE:SIGN<i>:CELL:TIME:DATE`
- `CONFigure:LTE:SIGN<i>:CELL:TIME:TIME`
- `CONFigure:LTE:SIGN<i>:CELL:TIME:DSTime`

Parameters:
<SourceTime> CMWTime | DATE

CMWTime: Windows date and time
DATE: Date and time specified via remote commands

*RST: CMWT

Example: See Sending Date and Time Information to the UE

Firmware/Software: V3.0.30

Options: R&S CMW-KS510

Manual operation: See "Time Source" on page 161

CONFigure:LTE:SIGN<i>:CELL:TIME:DATE <Day>, <Month>, <Year>

Specifies the UTC date for the time source `DATE` (see `CONFigure:LTE:SIGN<i>:CELL:TIME:TSOurce` on page 382).

Parameters:

<Day>	Range:	1 to 31
	*RST:	11
<Month>	Range:	1 to 12
	*RST:	11
<Year>	Range:	2011 to 9999
	*RST:	2011

Example: See Sending Date and Time Information to the UE

Firmware/Software: V3.0.30

Options: R&S CMW-KS510

Manual operation: See "Date / Time (UTC)" on page 161

CONFigure:LTE:SIGN<i>:CELL:TIME:TIME <Hour>, <Minute>, <Second>

Specifies the UTC time for the time source `DATE` (see `CONFigure:LTE:SIGN<i>:CELL:TIME:TSOurce` on page 382).

Parameters:

<Hour>	Range:	0 to 23
	*RST:	11
<Minute>	Range:	0 to 59
	*RST:	11
<Second>	Range:	0 to 59
	*RST:	0

Example: See Sending Date and Time Information to the UE

Firmware/Software: V3.0.30

Options: R&S CMW-KS510

Manual operation: See "Date / Time (UTC)" on page 161

CONFigure:LTE:SIGN<i>:CELL:TIME:DSTime <Enable>

Specifies a Daylight Saving Time (DST) offset for the time source `DATE` (see `CONFigure:LTE:SIGN<i>:CELL:TIME:TSOurce` on page 382).

Parameters:

<Enable> P1H | P2H

P1H: +1h offset if DST is ON
P2H: +2h offset if DST is ON

*RST: OFF (P1H)
Additional parameters: OFF | ON (disables | enables DST)

Example: See Sending Date and Time Information to the UE

Firmware/Software: V3.0.30

Options: R&S CMW-KS510

Manual operation: See "Daylight Saving Time" on page 161

CONFigure:LTE:SIGN<i>:CELL:TIME:SNOW

Triggers the transfer of the date and time information to the UE.

Example: See Sending Date and Time Information to the UE

Usage: Event

Firmware/Software: V3.0.30

Options: R&S CMW-KS510

Manual operation: See "Send Time" on page 161

CONFigure:LTE:SIGN<i>:CELL:TIME:SATTach <Enable>

Specifies whether the date and time information is sent to the UE during the attach procedure or not.

Parameters:

<Enable> OFF | ON

ON: send date and time at attach
OFF: do not send date and time at attach

*RST: OFF

Example: See Sending Date and Time Information to the UE

Firmware/Software: V3.0.30

Options: R&S CMW-KS510

Manual operation: See "Send Time" on page 161

2.6.13.8 NAS Signaling Settings

The commands in this section configure settings related to NAS signaling messages to be sent to the UE.

CONFigure:LTE:SIGN<i>:CONNection:SDNSpco <Enable>

Enables or disables sending of a DNS IP address to the UE.

Parameters:

<Enable> OFF | ON

*RST: ON

Example: See Configuring Network Settings

Firmware/Software: V3.0.10

Manual operation: See "Send DNS PCO" on page 162

CONFigure:LTE:SIGN<i>:CELL:RCAuse:ATTach <Cause>
CONFigure:LTE:SIGN<i>:CELL:RCAuse:TAU <Cause>

Enables or disables the rejection of attach requests and tracking area update requests and selects the rejection cause to be transmitted.

Parameters:

<Cause> IUE3 | EPS7 | PLMN11 | TANA12 | C13 | CONG22

IUE3: value 3 (Illegal UE)
EPS7: value 7 (EPS services not allowed)
PLMN11: value 11 (PLMN not allowed)
TANA12: value 12 (Tracking Area not allowed)
C13: value 13 (Roaming not allowed in this tracking area)
CONG22: value 22 (Congestion)

*RST: PLMN11, OFF
Additional parameters: OFF | ON (disables | enables the rejection of requests)

Example: See Configuring Network Settings

Firmware/Software: V3.0.20
V3.2.70: added C13

Manual operation: See "Attach Reject Cause, TAU Reject Cause" on page 162

CONFigure:LTE:SIGN<i>:CELL:NAS:EPSNetwork <Enable>

Enables or disables sending of the information element "EPS Network Feature Support" to the UE in the attach accept message.

For configuration of the information element contents, see other `CONFigure:LTE:SIGN<i>:CELL:NAS:...` commands.

Parameters:

<Enable> OFF | ON

*RST: OFF

Example: See Configuring Network Settings

Firmware/Software: V3.2.20

Options: R&S CMW-KS510

Manual operation: See "EPS Network Feature Support" on page 162

CONFigure:LTE:SIGN<i>:CELL:NAS:IMSVops <Support>

Configures the field "IMS voice over PS session indicator" of the information element "EPS Network Feature Support".

Parameters:

<Support> NSUPported | SUPPorted

NSUPported: not supported
SUPPorted: supported

*RST: NSUP

Example: See Configuring Network Settings

Firmware/Software: V3.2.20

Options: R&S CMW-KS510

Manual operation: See "IMS Voice Over PS Session Indicator" on page 163

CONFigure:LTE:SIGN<i>:CELL:NAS:EMCBs <Support>

Configures the field "Emergency bearer services indicator" of the information element "EPS Network Feature Support".

Parameters:

<Support> NSUPported | SUPPorted

NSUPported: not supported
SUPPorted: supported

*RST: NSUP

Example: See Configuring Network Settings

Firmware/Software: V3.2.20

Options: R&S CMW-KS510

Manual operation: See "Emergency Bearer Services Indicator" on page 163

CONFigure:LTE:SIGN<i>:CELL:NAS:EPCLcs <Support>

Configures the field "Location services indicator in EPC" of the information element "EPS Network Feature Support".

Parameters:

<Support> NSUPported | SUPPorted

NSUPported: not supported
SUPPorted: supported

*RST: NSUP

Example: See Configuring Network Settings

Firmware/Software: V3.2.20

Options: R&S CMW-KS510

Manual operation: See "Location Service Indicator in EPC" on page 163

CONFigure:LTE:SIGN<i>:CELL:NAS:CSLCs <Support>

Configures the field "Location services indicator in CS" of the information element "EPS Network Feature Support".

Parameters:

<Support> NSUPported | SUPPorted | NINFormation

NSUPported: not supported
SUPPorted: supported
NINFormation: no information

*RST: NSUP

Example: See Configuring Network Settings

Firmware/Software: V3.2.20

Options: R&S CMW-KS510

Manual operation: See "Location Service Indicator in CS" on page 163

2.6.13.9 Synchronization Settings

The commands in this section configure the synchronization to other signaling applications and the synchronization between the component carriers.

CONFigure:LTE:SIGN<i>:CELL[:PCC]:SYNC:ZONE <Zone>

Selects the synchronization zone for the signaling application.

Parameters:

<Zone> NONE | Z1

NONE: no synchronization
Z1: synchronization to zone 1

*RST: NONE

Example: See Configuring Network Settings

Firmware/Software: V3.2.50

Manual operation: See "Synchronization Zone" on page 164

CONFigure:LTE:SIGN<i>:CELL[:PCC]:SYNC:OFFSet <Offset>
CONFigure:LTE:SIGN<i>:CELL:SCC<c>:SYNC:OFFSet <Offset>

Configures the timing offset relative to the time zone.

Suffix:

<c> 1..2

Parameters:

<Offset> Range: 0 s to 1E-3 s
*RST: 0 s
Default unit: s

Example: See Configuring Network Settings

Firmware/Software: V3.2.50

Options: R&S CMW-KS510 for PCC, R&S CMW-KS512 for SCC

Manual operation: See "Synchronization Offset" on page 164

2.6.14 Connection Configuration

The commands in this section define parameters for the supported scheduling types.

2.6.14.1 General Connection Settings

The following commands define general connection parameters.

CONFigure:LTE:SIGN<i>:CONNection:GHOPping <Enable>

Enables or disables group hopping.

Parameters:

<Enable> OFF | ON

*RST: OFF

Example: See Configuring General Connection Settings

Firmware/Software: V3.0.30

Options: R&S CMW-KS510

Manual operation: See "Group Hopping" on page 165

CONFigure:LTE:SIGN<i>:CONNection:UECategory:MANual <UECatManual>

Configures the UE category to be used by the R&S CMW if no reported value is available or usage of the reported value is disabled, see `CONFigure:LTE:SIGN<i>:CONNection:UECategory:REPorted`.

Parameters:

<UECatManual> Range: 1 to 7
*RST: 5

Example: See Configuring General Connection Settings

Firmware/Software: V3.0.10
V3.2.70: range enhanced to 7

Manual operation: See "UE Category" on page 166

CONFigure:LTE:SIGN<i>:CONNection:UECategory:REPorted <UseReported>

Enables or disables the usage of the UE category value reported by the UE.

When disabled, the UE category must be set manually, see `CONFigure:LTE:SIGN<i>:CONNection:UECategory:MANual`. The manually set value is also used if no reported value is available.

Parameters:

<UseReported> OFF | ON

*RST: ON

Return values:

<UECatReported> UE category reported by the UE (NAV indicates that none has been reported)

Range: 1 to 5

Example: See Configuring General Connection Settings

Firmware/Software: V3.0.10

Manual operation: See "UE Category" on page 166

CONFigure:LTE:SIGN<i>:CONNection:DPCYcle <Cycle>

Selects the cell-specific default paging cycle.

Parameters:

<Cycle> P032 | P064 | P128 | P256

32, 64, 128 or 256 radio frames

*RST: P064

Example: See Configuring General Connection Settings

Firmware/Software: V2.1.30

Manual operation: See "Default Paging Cycle" on page 166

CONFigure:LTE:SIGN<i>:CONNection:ASEMission <Value>

Selects a value signaled to the UE as additional ACLR and spectrum emission requirement.

Parameters:

<Value> NS01 | NS02 | NS03 | NS04 | NS05 | NS06 | NS07 | NS08 | NS09 | NS10 | NS11 | NS12 | NS13 | NS14 | NS15 | NS16 | NS17 | NS18 | NS19 | NS20 | NS21 | NS22 | NS23 | NS24

*RST: NS01

Example: See Configuring General Connection Settings

Firmware/Software: V3.0.10
V3.2.70: added NS16, NS17, NS18, NS20
V3.2.82: added NS19, NS21, NS22, NS23, NS24

Manual operation: See "Additional Spectrum Emission" on page 166

CONFigure:LTE:SIGN<i>:CONNection:FCOefficient <Filter>

Selects the value to be sent to the UE as "filterCoefficient" in RRC messages containing this information element.

Parameters:

<Filter> FC4 | FC8

*RST: FC4

Example: See Configuring General Connection Settings

Firmware/Software: V1.0.15.21

Manual operation: See "UE Meas. Filter Coefficient" on page 166

CONFigure:LTE:SIGN<i>:CONNection:CTYPe <Type>

Selects the connection type to be applied.

Parameters:

<Type> TESTmode | DAPPlication

TESTmode: for signaling tests not involving the DAU
DAPPlication: for data application measurements using the DAU

*RST: TEST

Example: See Configuring General Connection Settings

Firmware/Software: V2.0.20

Options: For DAPPlication: installed DAU with R&S CMW-KM050 or external DAU

Manual operation: See "Connection Type" on page 167

CONFigure:LTE:SIGN<i>:CONNection:EDAU:ENABle <Enable>

Enables usage of an external DAU.

Parameters:

<Enable> OFF | ON

*RST: OFF

Example: See Configuring General Connection Settings

Firmware/Software: V3.2.80

Options: R&S CMW-KA120

Manual operation: See "Use external DAU" on page 167

CONFigure:LTE:SIGN<i>:CONNection:EDAU:NSEGment <NetworkSegment>

Specifies the network segment of the instrument where the external DAU is installed.

Parameters:

<NetworkSegment> A | B | C

*RST: A

Example: See Configuring General Connection Settings

Firmware/Software: V3.2.80

Options: R&S CMW-KA120

Manual operation: See "Network Segment, Subnet Node ID" on page 167

CONFigure:LTE:SIGN<i>:CONNection:EDAU:NID <ID>

Specifies the subnet node ID of the instrument where the external DAU is installed.

Parameters:

<ID> Range: 1 to 254
*RST: 1

Example: See Configuring General Connection Settings

Firmware/Software: V3.2.80

Options: R&S CMW-KA120

Manual operation: See "Network Segment, Subnet Node ID" on page 167

CONFigure:LTE:SIGN<i>:CONNection:TMODe <Enable>

Specifies whether the UE is forced into a test mode. If enabled, the message "ACTIVATE TEST MODE" is sent to the UE.

Parameters:

<Enable> OFF | ON

*RST: ON

Example: See Configuring General Connection Settings

Firmware/Software: V2.1.20

Manual operation: See "Testmode > Use "Activate Testmode" Message" on page 168

CONFigure:LTE:SIGN<i>:CONNection:RLCMode <Mode>

Selects the RLC mode for downlink transmissions.

The acknowledged mode is only allowed for data application tests, see `CONFigure:LTE:SIGN<i>:CONNection:CTYPe` on page 391.

Parameters:

<Mode> UM | AM

UM: unacknowledged mode
AM: acknowledged mode

*RST: UM

Example: See Configuring General Connection Settings

Firmware/Software: V2.1.20

Options: R&S CMW-KS510

Manual operation: See "RLC Mode" on page 168

CONFigure:LTE:SIGN<i>:CONNection:IPVersion <IPversion>

Configures the allowed IP versions for default bearers and data application tests. In test mode, the setting is fixed and can only be queried.

Parameters:

<IPversion> IPV4 | IPV6 | IPV46

IPV4: IPV4 only
IPV6: IPV6 only
IPV46: IPv4 and IPv6

*RST: IPV46

Example: See Configuring General Connection Settings

Firmware/Software: V3.2.80

Options: R&S CMW-KS510

Manual operation: See "IP Version" on page 168

CONFigure:LTE:SIGN<i>:CONNection:APN <APN>

Configures the default APN for default bearers and data application tests. In test mode, the setting is fixed and can only be queried.

Parameters:

<APN> APN default value as string

*RST: "cmw500.rohde-schwarz.com"

Example: See Configuring General Connection Settings

Firmware/Software: V3.2.80

Options: R&S CMW-KS510

Manual operation: See "APN" on page 168

CONFigure:LTE:SIGN<i>:CONNection:QCI <QCI>

Configures the QCI value for default bearers and data application tests. In test mode, the setting is fixed and can only be queried.

Parameters:

<QCI> Quality of service class identifier

Range: 5 to 9
*RST: 7

Example: See Configuring General Connection Settings

Firmware/Software: V3.2.80

Options: R&S CMW-KS510

Manual operation: See "QCI" on page 168

CONFigure:LTE:SIGN<i>:CONNection:SIBReconfig <Type>

Selects a method for information of the UE about changes in the system information, resulting from modified parameters: SIB paging or RRC reconfiguration.

Parameters:

<Type> SIBPaging | RRCReconfig

*RST: SIBP

Example: See Configuring General Connection Settings

Firmware/Software: V3.0.20

Manual operation: See "SIB Reconfiguration" on page 168

CONFigure:LTE:SIGN<i>:CONNection:KRRC <Enable>

Selects whether the RRC connection shall be kept or released after attach.

Parameters:

<Enable> OFF | ON

OFF: the RRC connection is released after the inactivity timer has expired
ON: the RRC connection is kept

*RST: ON

Example: See Configuring General Connection Settings

Firmware/Software: V2.1.20

Manual operation: See "Keep RRC Connection" on page 169

CONFigure:LTE:SIGN<i>:CONNection:RITimer <Time>

Configures the inactivity timeout for disabled "Keep RRC Connection" (`CONFigure:LTE:SIGN:CONNection:KRRC OFF`).

Parameters:

<Time> Range: 1 s to 255 s
*RST: 5 s
Default unit: s

Example: See Configuring General Connection Settings

Firmware/Software: V3.2.50

Options: R&S CMW-KS510

Manual operation: See "Keep RRC Connection" on page 169

CONFigure:LTE:SIGN<i>:CONNection:DLPadding <Value>

Activates or deactivates downlink padding at the MAC layer (filling an allocated RMC with padding bits when no data is available from higher layers).

Parameters:

<Value> OFF | ON

*RST: ON

Example: See Configuring General Connection Settings

Firmware/Software: V1.0.15.20

Manual operation: See "Downlink MAC Padding" on page 169

CONFigure:LTE:SIGN<i>:CONNection:DLEinsertion <Value>

Configures the rate of transport block errors to be inserted into the downlink data.

Parameters:

<Value>
Range: 0 % to 100 %
Increment: 10 %
*RST: 0 %
Default unit: %

Example: See Configuring General Connection Settings

Firmware/Software: V1.0.15.20

Manual operation: See "Downlink MAC Error Insertion" on page 170

CONFigure:LTE:SIGN<i>:CONNection[:PCC]:STYPe <Type>[, <CQIMode>]
CONFigure:LTE:SIGN<i>:CONNection:SCC<c>:STYPe <Type>[, <CQIMode>]

Selects the scheduling type.

Suffix:

<c> 1..2

Parameters:

<Type> RMC | UDCHannels | UDTTibased | CQI | SPS

RMC: 3GPP compliant reference measurement channel
UDCHannels: user-defined channel
UDTTibased: user-defined channel configurable per TTI
CQI: CQI channel, as specified by next parameter
SPS: semi-persistent scheduling (only PCC, not SCC)

*RST: RMC

<CQIMode> TTIBased | FWB | FPMI | FCPRi | FCRI

Only relevant for <Type> = CQI
TTIBased: fixed CQI
FWB: follow wideband CQI
FPMI: follow wideband PMI
FCPRi: follow wideband CQI-PMI-RI
FCRI: follow wideband CQI-RI

*RST: TTIB

Example: See Configuring General Connection Settings

Firmware/Software: V3.0.10
V3.0.50: added <CQIMode>
V3.2.50: added SCC command
V3.2.80: added SPS, FPMI, FCPRi and FCRI

Options: R&S CMW-KS510 for UDCH, UDTT, SPS, CQI-TTIB
R&S CMW-KS510/-KS512 (without CA/with CA) for CQI-FWB, CQI-FPMI, CQI-FCPR

Manual operation: See "Scheduling Type" on page 174

CONFigure:LTE:SIGN<i>:CONNection:TTIBundling <Enable>

Enables or disables TTI bundling for the uplink.

Parameters:

<Enable> OFF | ON
*RST: OFF

Example: See Configuring General Connection Settings

Firmware/Software: V3.2.80

Options: R&S CMW-KS510

Manual operation: See "TTI Bundling" on page 176

CONFigure:LTE:SIGN<i>:CONNection:ROHC:ENABle <Enable>

Enables or disables robust header compression.

Parameters:

<Enable> OFF | ON
*RST: OFF

Example: See Configuring General Connection Settings

Firmware/Software: V3.2.80

Options: R&S CMW-KS510

Manual operation: See "Enable Header Compression" on page 177

CONFigure:LTE:SIGN<i>:CONNection:ROHC:PROFiles <Profile0x0001>, <Profile0x0002>, <Profile0x0004>

Enables header compression profiles. You can enable one or two profiles, but not all three profiles in parallel.

Parameters:

<Profile0x0001> OFF | ON
Profile 1, for IP/UDP/RTP
*RST: OFF

<Profile0x0002> OFF | ON
Profile 2, for IP/UDP/...
*RST: OFF

<Profile0x0004> OFF | ON
Profile 4, for IP/...
*RST: OFF

Example: See Configuring General Connection Settings

Firmware/Software: V3.2.80

Options: R&S CMW-KS510

Manual operation: See "Profile ..." on page 177

CONFigure:LTE:SIGN<i>:CONNection[:PCC]:PDCCh:SYMBol <PDCCH>
CONFigure:LTE:SIGN<i>:CONNection:SCC<c>:PDCCh:SYMBol <PDCCH>

Configures the number of PDCCH symbols per normal subframe.

Suffix:
<c> 1..2

Parameters:
<PDCCH> AUTO | P1 | P2 | P3 | P4
AUTO: automatic configuration depending on scheduling type
P1 to **P4**: 1, 2, 3, 4 symbols
*RST: AUTO

Example: See Configuring General Connection Settings

Firmware/Software: V3.2.82

Manual operation: See "PDCCH Symbol Config, #PDCCH Symbols" on page 177

Table 2-29: Allowed values, depending on cell bandwidth

	1.4 MHz	3 MHz	5 MHz	10 MHz	15 MHz	20 MHz
AUTO				X	X	X
P1				X	X	X
P2		X	X	X	X	X
P3		X	X	X	X	X
P4	X					

SENSe:LTE:SIGN<i>:CONNection[:PCC]:PDCCh:PSYMbols?
SENSe:LTE:SIGN<i>:CONNection:SCC<c>:PDCCh:PSYMbols?

Queries the number of PDCCH symbols per normal subframe.

Suffix:
<c> 1..2

Return values:
<PDCCHsymbols> Range: 1 to 4

Example: See Configuring General Connection Settings

Usage: Query only

Firmware/Software: V3.0.50, SCC command V3.2.50

Manual operation: See "PDCCH Symbol Config, #PDCCH Symbols" on page 177

CONFigure:LTE:SIGN<i>:CONNection[:PCC]:PDCCh:ALEVel <Aggregationlevel>
CONFigure:LTE:SIGN<i>:CONNection:SCC<c>:PDCCh:ALEVel <Aggregationlevel>

Configures the aggregation levels for DCI messages with C-RNTI.

Suffix:
<c> 1..2

Parameters:
<Aggregationlevel> AUTO | D8U4 | D4U4 | D4U2 | D1U1

AUTO: automatic configuration
D<a>U<b>: <a> CCE for DCI messages for the DL, <b> CCE for messages for the UL

*RST: AUTO

Example: See Configuring General Connection Settings

Firmware/Software: V3.2.82

Manual operation: See "Aggr. Level DL/UL Config, Aggreg. Level ..." on page 178

Table 2-30: Allowed values, depending on cell bandwidth

	1.4 MHz	3 MHz	5 MHz	10 MHz	15 MHz	20 MHz
AUTO	X	X	X	X	X	X
D8U4			X			
D4U4		X	X			
D4U2	X	X				
D1U1	X					

SENSe:LTE:SIGN<i>:CONNection[:PCC]:PDCCh:ALEVel?
SENSe:LTE:SIGN<i>:CONNection:SCC<c>:PDCCh:ALEVel?

Queries the used PDCCH aggregation levels.

Suffix:
<c> 1..2

Return values:
<DLDCI_CRNTI> DCI for DL with C-RNTI

Range: 1 to 8

<ULDCI_CRNTI> DCI for UL with C-RNTI

Range: 1 to 8

<DLDCI_SIRNTI> DCI for DL with SI-RNTI
Range: 1 to 8

Example: See Configuring General Connection Settings

Usage: Query only

Firmware/Software: V3.0.50, SCC command V3.2.50

Manual operation: See "Aggr. Level DL/UL Config, Aggreg. Level ..." on page 178

CONFigure:LTE:SIGN<i>:CONNection[:PCC]:PDCCh:RPDCch <ReducedPDCCH>
CONFigure:LTE:SIGN<i>:CONNection:SCC<c>:PDCCh:RPDCch <ReducedPDCCH>

Enables / disables the reduction of PDCCH resources.

Suffix:
<c> 1..2

Parameters:
<ReducedPDCCH> OFF | ON
*RST: OFF

Firmware/Software: V3.0.50, SCC command V3.2.50

Manual operation: See "Reduced PDCCH" on page 178

CONFigure:LTE:SIGN<i>:CONNection:OBCHange <Mode>

Selects the mechanism to be used for inter-band handover.

Parameters:
<Mode> BHANdover | REDirection
Blind handover or redirection
*RST: RED

Example: See Configuring General Connection Settings

Firmware/Software: V2.1.30

Manual operation: See "Operating Band Change, Frequency Change" on page 178

CONFigure:LTE:SIGN<i>:CONNection:FCHange <Mode>

Selects the mechanism to be used for inter-frequency handover (operating band not changed).

Parameters:
<Mode> BHANdover | REDirection
Blind handover or redirection
*RST: BHAN

Example: See Configuring General Connection Settings

Firmware/Software: V2.1.20

Manual operation: See "Operating Band Change, Frequency Change" on page 178

CONFigure:LTE:SIGN<i>:CONNection:CSFB:DESTination <Destination>

Selects the target radio access technology for MO CSFB.

Parameters:

<Destination> GSM | WCDMa
*RST: GSM

Example: See Configuring General Connection Settings

Firmware/Software: V3.2.20

Options: R&S CMW-KS510

Manual operation: See "CS Fallback (MO)" on page 179

CONFigure:LTE:SIGN<i>:CONNection:CSFB:GSM <Band>, <DLChannel>, <BandIndicator>

Configures the GSM target for MO CSFB.

Parameters:

<Band> G085 | G09 | G18 | G19
GSM 850, GSM 900, GSM 1800, GSM 1900
*RST: G09

<DLChannel> Channel number used for the Broadcast Control Channel (BCCH)
Range: 0 to 1023, depending on GSM band, see table below
*RST: 20

<BandIndicator> G18 | G19
Band Indicator for distinction of GSM 1800 and GSM 1900 bands. The two bands partially use the same channel numbers for different frequencies.
*RST: G18

Example: See Configuring General Connection Settings

Firmware/Software: V3.2.20

Options: R&S CMW-KS510

Manual operation: See "CS Fallback (MO)" on page 179

Table 2-31: Channel number range depending on GSM band

Band	Channel Number
G085	128 to 251
G09	0 to 124, 955 to 1023
G18	512 to 885
G19	512 to 810

CONFigure:LTE:SIGN<i>:CONNection:CSFB:WCDMa <Band>, <DLChannel>

Configures the WCDMA target for MO CSFB.

Parameters:

<Band> OB1 | OB2 | OB3 | OB4 | OB5 | OB6 | OB7 | OB8 | OB9 | OB10 | OB11 | OB12 | OB13 | OB14 | OB19 | OB20 | OB21 | OBS1 | OBS2 | OBS3 | OBL1

OB1, ..., OB14: Operating Band I to XIV
OB19, ..., OB21: Operating Band XIX to XXI
OBS1: Operating Band S
OBS2: Operating Band S 170 MHz
OBS3: Operating Band S 190 MHz
OBL1: Operating Band L

*RST: OB1

<DLChannel> Downlink channel number

Range: 412 to 11000, depending on operating band, see table below
*RST: 10563

Example: See Configuring General Connection Settings

Firmware/Software: V3.2.20

Options: R&S CMW-KS510

Manual operation: See "CS Fallback (MO)" on page 179

Table 2-32: Channel number range depending on operating band

Operating Band	Channel Number
OB1	10562 to 10838
OB2	412 to 687 (step 25), 9662 to 9938
OB3	1162 to 1513
OB4	1537 to 1738, 1887 to 2087 (step 25)
OB5	1007, 1012, 1032, 1037, 1062, 1087, 4357 to 4458
OB6	1037, 1062, 4387 to 4413
OB7	2237 to 2563, 2587 to 2912 (step 25)
OB8	2937 to 3088

Operating Band	Channel Number
OB9	9237 to 9387
OB10	3112 to 3388, 3412 to 3687 (step 25)
OB11	3712 to 3812
OB12	3837 to 3903, 3927, 3932, 3957, 3962, 3987, 3992
OB13	4017 to 4043, 4067, 4092
OB14	4117 to 4143, 4167, 4192
OB19	712 to 763, 787, 812, 837
OB20	4512 to 4638
OB21	862 to 912
OBS1	5912 to 5987 (step 25), 10912 to 10988
OBS2	10900 to 10950
OBS3	5962, 5987, 10950 to 11000
OBL1	7637 to 7783, 7788 to 7933

CONFigure:LTE:SIGN<i>:CONNection:AMDBearer <Enable>

Enables/disables accepting multiple default bearer requests.

Parameters:

<Enable> OFF | ON

*RST: ON

Example: See Configuring General Connection Settings

Firmware/Software: V3.2.50

Manual operation: See "Accept Multiple Default Bearer" on page 179

2.6.14.2 MIMO Connection Settings

The following commands configure MIMO connection settings.

CONFigure:LTE:SIGN<i>:CONNection[:PCC]:TRANsmission <Mode>
CONFigure:LTE:SIGN<i>:CONNection:SCC<c>:TRANsmission <Mode>

Selects the LTE transmission mode. The value must be compatible to the active scenario, see table 2-2.

Suffix:
<c> 1..2

Parameters:
<Mode> TM1 | TM2 | TM3 | TM4 | TM6 | TM7 | TM8
Transmission mode 1, 2, 3, 4, 6, 7, 8
*RST: TM1

Example: See Configuring General Connection Settings

Firmware/Software: V3.2.70

Options: R&S CMW-KS520 for all values except TM1

Manual operation: See "Transmission Mode" on page 171

CONFigure:LTE:SIGN<i>:CONNection[:PCC]:DCIFormat <DCI>
CONFigure:LTE:SIGN<i>:CONNection:SCC<c>:DCIFormat <DCI>

Selects the DCI format. The value must be compatible to the transmission mode, see table 2-2.

Suffix:
<c> 1..2

Parameters:
<DCI> D1 | D1A | D1B | D2 | D2A | D2B
Format 1, 1A, 1B, 2, 2A, 2B
*RST: D1A

Example: See Configuring General Connection Settings

Firmware/Software: V3.2.70

Manual operation: See "DCI Format" on page 171

CONFigure:LTE:SIGN<i>:CONNection[:PCC]:NENBantennas <Antennas>
CONFigure:LTE:SIGN<i>:CONNection:SCC<c>:NENBantennas <Antennas>

Selects the number of downlink Tx antennas. The value must be compatible to the active scenario and transmission mode, see table 2-2.

Suffix:

<c> 1..2

Parameters:

<Antennas> ONE | TWO | FOUR

*RST: ONE

Example: See Configuring General Connection Settings

Firmware/Software: V3.0.50, SCC command V3.2.50

Options: R&S CMW-KS520 for TWO
R&S CMW-KS520 and R&S CMW-KS521 for FOUR

Manual operation: See "Antenna Configuration" on page 171

SENSe:LTE:SIGN<i>:CONNection[:PCC]:TSCHeme?
SENSe:LTE:SIGN<i>:CONNection:SCC<c>:TSCHeme?

Queries the transmission scheme.

Suffix:

<c> 1..2

Return values:

<Scheme> SISO | SIMO | TXDiversity | OLSMultiplex | CLSMultiplex | CLSingle | SBF5 | SBF8 | DBF78

SISO: single input single output
SIMO: single input multiple output (receive diversity)
TXDiversity: transmit diversity
OLSMultiplex: open loop spatial multiplexing
CLSMultiplex: closed loop spatial multiplexing
CLSingle: closed loop spatial multiplexing, single layer
SBF5: single-layer beamforming (port 5)
SBF8: single-layer beamforming (port 8)
DBF78: dual-layer beamforming (port 7,8)

Example: See Configuring General Connection Settings

Usage: Query only

Firmware/Software: V3.2.70

Manual operation: See "Transmission Scheme" on page 171

CONFigure:LTE:SIGN<i>:CONNection[:PCC]:PMATrix <Mode>
CONFigure:LTE:SIGN<i>:CONNection:SCC<c>:PMATrix <Mode>

Selects the precoding matrix for closed loop spatial multiplexing. The value must be compatible to the active scenario and transmission mode, see table 2-2.

Suffix:
<c> 1..2

Parameters:
<Mode> PMI0 | PMI1 | PMI2 | PMI3 | PMI4 | PMI5 | PMI6 | PMI7 | PMI8 | PMI9 | PMI10 | PMI11 | PMI12 | PMI13 | PMI14 | PMI15

Matrix according to PMI 0, PMI 1, ... PMI15.

*RST: PMI0

Example: See Configuring General Connection Settings

Firmware/Software: V3.0.10
V3.0.50: PMI2 to PMI15
V3.2.50: SCC command

Options: R&S CMW-KS510, R&S CMW-KS520

Manual operation: See "Precoding Matrix" on page 172

CONFigure:LTE:SIGN<i>:CONNection[:PCC]:SCHModel:ENABle <Enable>
CONFigure:LTE:SIGN<i>:CONNection:SCC<c>:SCHModel:ENABle <Enable>

Enables or disables the MIMO 2x2 static channel model. Disabling the static channel model results in an ideal radio channel without any coupling between the downlink signals.

Suffix:
<c> 1..2

Parameters:
<Enable> OFF | ON

*RST: OFF

Example: See Configuring General Connection Settings

Firmware/Software: V2.0.10, SCC command V3.2.50

Options: R&S CMW-KS520

Manual operation: See "Static Channel Model" on page 172

CONFigure:LTE:SIGN<i>:CONNection[:PCC]:SCHModel <h11abs>, <h11phi>, <h12phi>, <h21abs>, <h21phi>, <h22phi>
CONFigure:LTE:SIGN<i>:CONNection:SCC<c>:SCHModel <h11abs>, <h11phi>, <h12phi>, <h21abs>, <h21phi>, <h22phi>

Configures the channel coefficients, characterizing the radio channel for MIMO 2x2.

Suffix:

<c> 1..2

Parameters:

<h11abs> Square of magnitude of h_{11}

Range: 0 to 1
*RST: 1

<h11phi> Phase of h_{11}

Range: 0 deg to 345 deg
*RST: 0 deg
Default unit: deg

<h12phi> Phase of h_{12}

Range: 0 deg to 345 deg
*RST: 0 deg
Default unit: deg

<h21abs> Square of magnitude of h_{21}

Range: 0 to 1
*RST: 0

<h21phi> Phase of h_{21}

Range: 0 deg to 345 deg
*RST: 0 deg
Default unit: deg

<h22phi> Phase of h_{22}

Range: 0 deg to 345 deg
*RST: 0 deg
Default unit: deg

Example: See Configuring General Connection Settings

Firmware/Software: V2.0.10, SCC command V3.2.50

Options: R&S CMW-KS520

Manual operation: See "Static Channel Model" on page 172

CONFigure:LTE:SIGN<i>:CONNection[:PCC]:SCHModel:MIMO<Mimo> <h11abs>, <h11phi>, <h12abs>, <h12phi>, <h13abs>, <h13phi>, <h14abs>, <h14phi>, <h21abs>, <h21phi>, <h22abs>, <h22phi>, <h23abs>, <h23phi>, <h24abs>, <h24phi>

CONFigure:LTE:SIGN<i>:CONNection:SCC<c>:SCHModel:MIMO<Mimo> <h11abs>, <h11phi>, <h12abs>, <h12phi>, <h13abs>, <h13phi>, <h14abs>, <h14phi>, <h21abs>, <h21phi>, <h22abs>, <h22phi>, <h23abs>, <h23phi>, <h24abs>, <h24phi>

Configures the channel coefficients, characterizing the radio channel for MIMO 4x2.

There are two types of parameters:

- <hnmabs> defines the square of the magnitude of the channel coefficient nm:

<hnmabs> = $(h_{nm})^2$
The sum of all <h1mabs> and of all <h2mabs> must equal 1:
<h11abs> + <h12abs> + <h13abs> + <h14abs> = 1
<h21abs> + <h22abs> + <h23abs> + <h24abs> = 1

- <hnmphi> defines the phase of the channel coefficient nm:
  <hnmphi> = $\varphi(h_{nm})$

Suffix:

<Mimo>	42
<c>	1..2

Parameters:

<h11abs>	Range: 0 to 1 *RST: 0.25
<h11phi>	Range: 0 deg to 345 deg *RST: 0 deg Default unit: deg
<h12abs>	Range: 0 to 1 *RST: 0.25
<h12phi>	Range: 0 deg to 345 deg *RST: 0 deg Default unit: deg
<h13abs>	Range: 0 to 1 *RST: 0.25
<h13phi>	Range: 0 deg to 345 deg *RST: 0 deg Default unit: deg
<h14abs>	Range: 0 to 1 *RST: 0.25
<h14phi>	Range: 0 deg to 345 deg *RST: 270 deg Default unit: deg
<h21abs>	Range: 0 to 1 *RST: 0.25
<h21phi>	Range: 0 deg to 345 deg *RST: 270 deg Default unit: deg
<h22abs>	Range: 0 to 1 *RST: 0.25
<h22phi>	Range: 0 deg to 345 deg *RST: 90 deg Default unit: deg
<h23abs>	Range: 0 to 1 *RST: 0.25

<h23phi>	Range: 0 deg to 345 deg *RST: 90 deg Default unit: deg
<h24abs>	Range: 0 to 1 *RST: 0.25
<h24phi>	Range: 0 deg to 345 deg *RST: 180 deg Default unit: deg

Example: See Configuring General Connection Settings

Firmware/Software: V3.0.50, SCC command V3.2.50

Options: R&S CMW-KS520 and R&S CMW-KS521

Manual operation: See "Static Channel Model" on page 172

CONFigure:LTE:SIGN<i>:CONNection[:PCC]:BEAMforming:MODE <Mode>
CONFigure:LTE:SIGN<i>:CONNection:SCC<c>:BEAMforming:MODE <Mode>

Enables or disables beamforming.

Suffix:
<c> 1..2

Parameters:
<Mode> OFF | ON | TSBF

OFF: Beamforming is disabled
ON: Beamforming is enabled. The configured beamforming matrix is used.
TSBF: Beamforming is enabled. The beamforming matrix is selected randomly as defined in 3GPP TS 36.521, Annex B.4.1 and B.4.2.

*RST: OFF

Example: See Configuring General Connection Settings

Firmware/Software: V3.2.70

Options: R&S CMW-KS520

Manual operation: See "Beamforming Mode" on page 173

CONFigure:LTE:SIGN<i>:CONNection[:PCC]:BEAMforming:NOLayers <Number>
CONFigure:LTE:SIGN<i>:CONNection:SCC<c>:BEAMforming:NOLayers <Number>

Selects the number of layers for transmission mode 8.

Suffix:
<c> 1..2

Parameters:

<Number> L1 | L2

L1: single-layer beamforming
L2: dual-layer beamforming

*RST: L2

Example: See Configuring General Connection Settings

Firmware/Software: V3.2.70

Options: R&S CMW-KS520

Manual operation: See "Number of Layers" on page 173

CONFigure:LTE:SIGN<i>:CONNection[:PCC]:BEAMforming:MATRix <h11phi>[, <h12phi>[, <h11abs>, <h12abs>, <h21phi>, <h22phi>[, <h13phi>, <h14phi>[, <h13abs>, <h14abs>, <h23phi>, <h24phi>]]]]
CONFigure:LTE:SIGN<i>:CONNection:SCC<c>:BEAMforming:MATRix <h11phi>[, <h12phi>[, <h11abs>, <h12abs>, <h21phi>, <h22phi>[, <h13phi>, <h14phi>[, <h13abs>, <h14abs>, <h23phi>, <h24phi>]]]]

Configures the beamforming matrix coefficients.

There are two types of parameters:

- <hnmabs> defines the square of the magnitude of the coefficient nm:
  <hnmabs> = $(h_{nm})^2$
- <hnmphi> defines the phase of the coefficient nm:
  <hnmphi> = $\varphi(h_{nm})$
  The phase can be entered in steps of 15 degrees. The setting is rounded, if required.

Depending on the size of your matrix, use the following parameters:

- 1x1: <h11phi>
- 1x2: <h11phi>, <h12phi>
- 2x2: <h11phi>, <h12phi>, <h11abs>, <h12abs>, <h21phi>, <h22phi>

The last six parameters are for future use and can always be omitted.

Suffix:

<c> 1..2

Parameters:

<h11phi> Range: 0 deg to 345 deg
*RST: 0 deg
Default unit: deg

<h12phi> Range: 0 deg to 345 deg
Default unit: deg

<h11abs> Range: 0 to 1

<h12abs> Range: 0 to 1

<h21phi>	Range: 0 deg to 345 deg Default unit: deg	
<h22phi>	Range: 0 deg to 345 deg Default unit: deg	
<h13phi>	Range: 0 deg to 345 deg Default unit: deg	
<h14phi>	Range: 0 deg to 345 deg Default unit: deg	
<h13abs>	Range: 0 to 1	
<h14abs>	Range: 0 to 1	
<h23phi>	Range: 0 deg to 345 deg Default unit: deg	
<h24phi>	Range: 0 deg to 345 deg Default unit: deg	

Example: See Configuring General Connection Settings

Firmware/Software: V3.2.70

Options: R&S CMW-KS520

Manual operation: See "Beamforming Matrix" on page 173

2.6.14.3 HARQ Connection Settings

The following commands configure HARQ connection settings.

CONFigure:LTE:SIGN<i>:CONNection:HARQ:DL:ENABle <Enable>

Enables or disables HARQ for downlink transmissions.

Parameters:

<Enable> OFF | ON
*RST: OFF

Example: See Configuring General Connection Settings

Firmware/Software: V3.0.50

Options: R&S CMW-KS510 for scenarios without carrier aggregation
R&S CMW-KS512 for scenarios with carrier aggregation

Manual operation: See "DL HARQ" on page 180

CONFigure:LTE:SIGN<i>:CONNection:HARQ:DL:NHT <Number>

Specifies the maximum number of downlink transmissions, including initial transmissions and retransmissions.

Parameters:

<Number> Range: 2 to 4
*RST: 2

Example: See Configuring General Connection Settings

Firmware/Software: V3.0.50

Manual operation: See "Number of HARQ Transmissions" on page 180

CONFigure:LTE:SIGN<i>:CONNection:HARQ:DL:RVCSequence <Sequence>

Selects the redundancy version sequence for DL HARQ.

Parameters:

<Sequence> TS1 | TS4 | UDEFined

TS1: according to 3GPP TS 36.101
TS4: according to 3GPP TS 36.104
UDEFined: user-defined sequence, see `CONFigure:LTE:SIGN<i>:CONNection:HARQ:DL:UDSequence`

*RST: TS1

Example: See Configuring General Connection Settings

Firmware/Software: V3.0.50

Manual operation: See "Redundancy Version Coding Sequence, User-Defined Sequence" on page 180

CONFigure:LTE:SIGN<i>:CONNection:HARQ:DL:UDSequence:LENGth <Length>

Specifies the length of the user-defined redundancy version sequence.

Parameters:

<Length> Range: 1 to 4
*RST: 4

Example: See Configuring General Connection Settings

Firmware/Software: V3.0.50

Manual operation: See "Redundancy Version Coding Sequence, User-Defined Sequence" on page 180

CONFigure:LTE:SIGN<i>:CONNection:HARQ:DL:UDSequence <Value1>[, <Value2>, <Value3>, <Value4>]

Specifies the user-defined redundancy version sequence. Only the first n values are used, according to the specified length, see `CONFigure:LTE:SIGN<i>:CONNection:HARQ:DL:UDSequence:LENGth`.

You can either set the first value only (relevant for initial transmissions) or all four values.

Parameters:

<Value1> The first value is currently fixed set to 0.
Range: 0
*RST: 0

<Value2> Range: 0 to 3
*RST: 0

<Value3> Range: 0 to 3
*RST: 0

<Value4> Range: 0 to 3
*RST: 0

Example: See Configuring General Connection Settings

Firmware/Software: V3.0.50

Manual operation: See "Redundancy Version Coding Sequence, User-Defined Sequence" on page 180

2.6.14.4 Connected DRX Settings

The following commands configure Discontinuous Reception (DRX) of the UE during an established connection.

CONFigure:LTE:SIGN<i>:CONNection:CDRX:ENABle <Enable>

Enables or disables DRX and selects a set of DRX settings.

Parameters:

<Enable> DRXS | DRXL | UDEFined

DRXS: DRX_S, 3GPP TS 36.521-3, table H.3.6-1
DRXL: DRX_L, 3GPP TS 36.521-3, table H.3.6-2
UDEFined: user-defined DRX settings

*RST: DRXS

Example: See Configuring Connected DRX

Firmware/Software: V3.2.20

Options: R&S CMW-KS510

Manual operation: See "Connected DRX" on page 182

CONFigure:LTE:SIGN<i>:CONNection:CDRX:ODTimer <Timer>

Configures the onDurationTimer. The value must be smaller than or equal to the long DRX cycle duration.

Parameters:

<Timer> PSF1 | PSF2 | PSF3 | PSF4 | PSF5 | PSF6 | PSF8 | PSF10 | PSF20 | PSF30 | PSF40 | PSF50 | PSF60 | PSF80 | PSF100 | PSF200

PSFn means n PDCCH subframes

*RST: PSF2

Example: See Configuring Connected DRX

Firmware/Software: V3.2.20

Options: R&S CMW-KS510

Manual operation: See "On Duration Timer" on page 182

CONFigure:LTE:SIGN<i>:CONNection:CDRX:ITIMer <Timer>

Configures the drx-InactivityTimer.

Parameters:

<Timer> PSF1 | PSF2 | PSF3 | PSF4 | PSF5 | PSF6 | PSF8 | PSF10 | PSF20 | PSF30 | PSF40 | PSF50 | PSF60 | PSF80 | PSF100 | PSF200 | PSF300 | PSF500 | PSF750 | PSF1280 | PSF1920 | PSF2560

PSFn means n PDCCH subframes

*RST: PSF100

Example: See Configuring Connected DRX

Firmware/Software: V3.2.20

Options: R&S CMW-KS510

Manual operation: See "Inactivity Timer" on page 182

CONFigure:LTE:SIGN<i>:CONNection:CDRX:RTIMer <Timer>

Configures the drx-RetransmissionTimer.

Parameters:

<Timer>	PSF1 | PSF2 | PSF4 | PSF6 | PSF8 | PSF16 | PSF24 | PSF33 PSFn means n PDCCH subframes *RST: PSF16
Example:	See Configuring Connected DRX
Firmware/Software:	V3.2.20
Options:	R&S CMW-KS510
Manual operation:	See "Retransmission Timer" on page 182

CONFigure:LTE:SIGN<i>:CONNection:CDRX:LDCYcle <Cycle>

Configures the duration of one long DRX cycle. If short DRX cycles are enabled, the long DRX cycle duration must be a multiple of the short DRX cycle duration.

Parameters:

<Cycle>	SF10 | SF20 | SF32 | SF40 | SF64 | SF80 | SF128 | SF160 | SF256 | SF320 | SF512 | SF640 | SF1024 | SF1280 | SF2048 | SF2560 SFn means n subframes *RST: SF40
Example:	See Configuring Connected DRX
Firmware/Software:	V3.2.20
Options:	R&S CMW-KS510
Manual operation:	See "Long DRX Cycle" on page 182

CONFigure:LTE:SIGN<i>:CONNection:CDRX:SOFFset <Offset>

Configures the drxStartOffset, shifting all DRX cycles.

Parameters:

<Offset>	Range: 0 to length of long DRX cycle - 1 *RST: 0
Example:	See Configuring Connected DRX
Firmware/Software:	V3.2.20
Options:	R&S CMW-KS510
Manual operation:	See "Start Offset" on page 182

CONFigure:LTE:SIGN<i>:CONNection:CDRX:SCENable <Enable>

Enables or disables short DRX cycles.

Parameters:

<Enable> OFF | ON

*RST: OFF

Example: See Configuring Connected DRX

Firmware/Software: V3.2.20

Options: R&S CMW-KS510

Manual operation: See "Enable" on page 183

CONFigure:LTE:SIGN<i>:CONNection:CDRX:SDCYcle <Cycle>

Configures the duration of one short DRX cycle. The long DRX cycle duration must be a multiple of the short DRX cycle duration.

Parameters:

<Cycle> SF2 | SF5 | SF8 | SF10 | SF16 | SF20 | SF32 | SF40 | SF64 | SF80 | SF128 | SF160 | SF256 | SF320 | SF512 | SF640

SFn means n subframes
If a query returns NAV, short cycles are disabled.

*RST: SF2

Example: See Configuring Connected DRX

Firmware/Software: V3.2.20

Options: R&S CMW-KS510

Manual operation: See "Short DRX Cycle" on page 183

CONFigure:LTE:SIGN<i>:CONNection:CDRX:SCTimer <Timer>

Configures the short cycle timer.

Parameters:

<Timer> Number of short DRX cycles

Range: 1 to 16
*RST: 1

Example: See Configuring Connected DRX

Firmware/Software: V3.2.20

Options: R&S CMW-KS510

Manual operation: See "Short Cycle Timer" on page 183

CONFigure:LTE:SIGN<i>:CONNection:CDRX:UDSCheduling <Enable>

Enables or disables uplink dynamic scheduling.

Parameters:

<Enable> OFF | ON

*RST: OFF

Example: See Configuring Connected DRX

Firmware/Software: V3.2.70

Options: R&S CMW-KS510

Manual operation: See "UL Dynamic Scheduling" on page 183

2.6.14.5 Global UL/DL Commands

The following commands are related to UL/DL settings and are independent of the scheduling type.

Scheduling-type specific commands are described in the subsequent sections.

CONFigure:LTE:SIGN<i>:CONNection[:PCC]:DLEQual <Enable>
CONFigure:LTE:SIGN<i>:CONNection:SCC<c>:DLEQual <Enable>

Enables or disables the coupling of all MIMO downlink streams.

When you switch the coupling on, the settings for DL stream 1 are applied to all DL streams.

With enabled coupling, commands of the format `CONFigure:...:DL<s>...` configure all DL streams at once, independent of the specified `<s>`.

With disabled coupling, such commands configure a single selected DL stream `<s>`. However, some settings are never configurable per stream and are always coupled.

Suffix:

<c> 1..2

Parameters:

<Enable> OFF | ON

*RST: ON

Example: See Configuring RMCs

Firmware/Software: V3.2.60

Manual operation: See "Use Stream 1 Settings" on page 184

SENSe:LTE:SIGN<i>:CONNection:ETHRoughput:DL[:PCC]:STReam<s>?
SENSe:LTE:SIGN<i>:CONNection:ETHRoughput:DL:SCC<c>:STReam<s>?

Returns the expected maximum throughput (averaged over one frame) for one DL stream of one component carrier. The throughput is calculated for the currently selected scheduling type.

Suffix:

<s> 1..2

<c> 1..2

Return values:

<Throughput> Range: 0 Mbit/s to 99 Mbit/s
Default unit: Mbit/s

Example: See Configuring User-Defined Channels

Usage: Query only

Firmware/Software: V3.0.20, SCC command V3.2.50

Manual operation: See "Throughput" on page 111

SENSe:LTE:SIGN<i>:CONNection:ETHRoughput:DL[:PCC]?
SENSe:LTE:SIGN<i>:CONNection:ETHRoughput:DL:SCC<c>?

Returns the expected maximum throughput (averaged over one frame) for the sum of all DL streams of one component carrier. The throughput is calculated for the currently selected scheduling type.

Suffix:

<c> 1..2

Return values:

<Throughput> Range: 0 Mbit/s to 200 Mbit/s
Default unit: Mbit/s

Example: See Configuring User-Defined Channels

Usage: Query only

Firmware/Software: V3.2.50

Manual operation: See "Max Throughput" on page 176

SENSe:LTE:SIGN<i>:CONNection:ETHRoughput:DL:ALL?

Returns the expected maximum throughput (averaged over one frame) for the sum of all DL streams of all component carriers. The throughput is calculated for the currently selected scheduling type.

Return values:

<Throughput>	Range: 0 Mbit/s to 400 Mbit/s Default unit: Mbit/s

Example: See Configuring User-Defined Channels

Usage: Query only

Firmware/Software: V3.0.20

SENSe:LTE:SIGN<i>:CONNection:ETHRoughput:UL?

Returns the expected maximum throughput (averaged over one frame) for uplink. The throughput is calculated for the currently selected scheduling type.

Return values:

<Throughput>	Range: 0 Mbit/s to 99 Mbit/s Default unit: Mbit/s

Example: See Configuring User-Defined Channels

Usage: Query only

Firmware/Software: V3.0.20

Manual operation: See "Throughput" on page 111

2.6.14.6 RMC Settings

The following commands define parameters for the scheduling type "RMC".

CONFigure:LTE:SIGN<i>:CONNection[:PCC]:RMC:DL<s> <NumberRB>, <Modulation>, <TransBlockSizeIdx>
CONFigure:LTE:SIGN<i>:CONNection:SCC<c>:RMC:DL<s> <NumberRB>, <Modulation>, <TransBlockSizeIdx>

Configures a downlink reference measurement channel (RMC). Only certain value combinations are accepted, see chapter 2.2.12, "Scheduling Type RMC", on page 39.

Suffix:

<s>	1..2
<c>	1..2

Parameters:

<NumberRB> ZERO | N1 | N2 | N3 | N4 | N5 | N6 | N8 | N9 | N10 | N12 | N15 | N16 | N17 | N18 | N20 | N24 | N25 | N27 | N30 | N32 | N36 | N40 | N45 | N48 | N50 | N54 | N60 | N75 | N80 | N83 | N100

Number of allocated resource blocks. The same value must be configured for all streams of the carrier.

*RST: N50

<Modulation> QPSK | Q16 | Q64

Modulation type QPSK | 16-QAM | 64-QAM

*RST: QPSK

<TransBlockSizeIdx> ZERO | T1 | T2 | T3 | T4 | T5 | T6 | T11 | T12 | T13 | T14 | T17 | T18 | T19 | T21 | T22 | T23 | T24 | T25

Transport block size index. Use KEEP to automatically select a compatible value.

*RST: T5

Example: See Configuring RMCs

Firmware/Software: V3.0.20
V3.2.50: added SCC command
V3.2.70: added N32, N45, N60
V3.2.82: added T17, T22

Manual operation: See "# Resource Blocks" on page 185

CONFigure:LTE:SIGN<i>:CONNection[:PCC]:RMC:UL <NumberRB>, <Modulation>, <TransBlockSizeIdx>

Configures an uplink reference measurement channel (RMC). Only certain value combinations are accepted, see chapter 2.2.12, "Scheduling Type RMC", on page 39.

Parameters:

<NumberRB> ZERO | N1 | N2 | N3 | N4 | N5 | N6 | N8 | N9 | N10 | N12 | N15 | N16 | N17 | N18 | N20 | N24 | N25 | N27 | N30 | N32 | N36 | N40 | N45 | N48 | N50 | N54 | N60 | N75 | N80 | N83 | N100

Number of allocated resource blocks

*RST: N50

<Modulation> QPSK | Q16 | Q64

Modulation type QPSK | 16-QAM | 64-QAM

*RST: QPSK

<TransBlockSizeIdx> ZERO | T1 | T2 | T3 | T4 | T5 | T6 | T11 | T12 | T13 | T14 | T17 | T18 | T19 | T21 | T22 | T23 | T24 | T25

Transport block size index. Use KEEP to automatically select a compatible value.

*RST: T6

Example: See Configuring RMCs

Firmware/Software: V3.0.20
V3.2.70: added N32, N45, N60
V3.2.82: added T17, T22

Manual operation: See "# Resource Blocks" on page 185

CONFigure:LTE:SIGN<i>:CONNection[:PCC]:RMC:RBPosition:DL<s> <Position>
CONFigure:LTE:SIGN<i>:CONNection:SCC<c>:RMC:RBPosition:DL<s> <Position>

Selects the position of the allocated downlink resource blocks within the channel bandwidth. Set the same value for both streams of a carrier.

The RBs can always be located at the lower end, starting with RB number 0, or at the upper end of the channel. The other values are only allowed for certain one TX antenna configurations, see chapter 2.2.12.2, "DL RMCs, One TX Antenna (TM 1)", on page 48.

Suffix:

<s>	1..2
<c>	1..2

Parameters:

<Position> LOW | HIGH | P5 | P10 | P23 | P35 | P48
*RST: LOW

Example: See Configuring RMCs

Firmware/Software: V3.2.50

Manual operation: See "RB Position/Start RB" on page 185

CONFigure:LTE:SIGN<i>:CONNection[:PCC]:RMC:RBPosition:UL <Position>

Selects the position of the allocated uplink resource blocks within the channel bandwidth.

The RBs can always be located at the lower end, starting with RB number 0, or at the upper end of the channel. The other values are only allowed for certain RMC configurations, see chapter 2.2.12.1, "UL RMCs", on page 40.

Parameters:

<Position> LOW | HIGH | MID | P1 | P2 | P3 | P4 | P7 | P9 | P10 | P11 | P13 | P14 | P15 | P16 | P19 | P25 | P36 | P37 | P39 | P43 | P44 | P48 | P49 | P56 | P74 | P75 | P99
*RST: LOW

Example: See Configuring RMCs

Firmware/Software: V3.0.20
V3.2.70: values P1 - P4, P7, P9, P10, P14, P15, P36, P39, P44, P49, P74, P75, P99

Manual operation: See "RB Position/Start RB" on page 185

CONFigure:LTE:SIGN<i>:CONNection[:PCC]:RMC:VERSion:DL<s> <Version>
CONFigure:LTE:SIGN<i>:CONNection:SCC<c>:RMC:VERSion:DL<s> <Version>

Selects the version to distinguish ambiguous RMCs. This is only relevant for certain downlink RMCs for TDD multiple antenna configurations, see chapter 2.2.12.3, "DL RMCs, Multiple TX Antennas (TM 2 to 6)", on page 50.

Suffix:

<s> 1..2

<c> 1..2

Parameters:

<Version> Range: 0 to 1
*RST: 0

Example: See Configuring RMCs

Firmware/Software: V3.2.70

Manual operation: See "Version" on page 185

2.6.14.7 User-Defined Channel Settings

The following commands define parameters for the scheduling type "User-Defined Channels".

CONFigure:LTE:SIGN<i>:CONNection[:PCC]:UDCHannels:DL<s> <NumberRB>, <StartRB>, <Modulation>, <TransBlockSizeIdx>
CONFigure:LTE:SIGN<i>:CONNection:SCC<c>:UDCHannels:DL<s> <NumberRB>, <StartRB>, <Modulation>, <TransBlockSizeIdx>

Configures a user-defined downlink channel. The allowed input ranges have dependencies and are described in the background information, see chapter 2.2.13, "User-Defined Channels", on page 54.

Suffix:

<s> 1..2

<c> 1..2

Parameters:

<NumberRB> Number of allocated resource blocks. Configure the same value for all streams of a carrier.
*RST: 50

<StartRB> Position of first resource block. Configure the same value for all streams of a carrier.
*RST: 0

<Modulation> QPSK | Q16 | Q64
Modulation type QPSK | 16-QAM | 64-QAM
*RST: QPSK

<TransBlockSizeIdx> Transport block size index
*RST: 5

Example: See Configuring User-Defined Channels

Firmware/Software: V2.0.10, SCC command V3.2.50

Options: R&S CMW-KS510

Manual operation: See "# Resource Blocks ... Transport Block Size" on page 187

CONFigure:LTE:SIGN<i>:CONNection[:PCC]:UDCHannels:UL <NumberRB>, <StartRB>, <Modulation>, <TransBlockSizeIdx>

Configures a user-defined uplink channel. The allowed input ranges have dependencies and are described in the background information, see chapter 2.2.13, "User-Defined Channels", on page 54.

Parameters:

<NumberRB> Number of allocated resource blocks
*RST: 50

<StartRB> Position of first resource block
*RST: 0

<Modulation> QPSK | Q16
Modulation type QPSK | 16-QAM
*RST: QPSK

<TransBlockSizeIdx> Transport block size index
*RST: 6

Example: See Configuring User-Defined Channels

Firmware/Software: V2.0.20

Options: R&S CMW-KS510

Manual operation: See "# Resource Blocks ... Transport Block Size" on page 187

SENSe:LTE:SIGN<i>:CONNection[:PCC]:UDCHannels:DL<s>:CRATe:ALL?
SENSe:LTE:SIGN<i>:CONNection:SCC<c>:UDCHannels:DL<s>:CRATe:ALL?

Queries the code rate for all downlink subframes for the scheduling type "User-defined Channels".

Suffix:

<s>	1..2
<c>	1..2

Return values:

<CodeRate>	Comma-separated list of 10 values (subframe 0 to subframe 9) Range: 0 to 50

Example: See Configuring User-Defined Channels

Usage: Query only

Firmware/Software: V3.0.20, SCC command V3.2.50

Options: R&S CMW-KS510

Manual operation: See "Code Rate" on page 188

SENSe:LTE:SIGN<i>:CONNection[:PCC]:UDCHannels:UL:CRATe:ALL?

Queries the code rate for all uplink subframes for the scheduling type "User-defined Channels".

Return values:

<CodeRate>	Comma-separated list of 10 values (subframe 0 to subframe 9) Range: 0 to 10

Example: See Configuring User-Defined Channels

Usage: Query only

Firmware/Software: V3.0.20

Options: R&S CMW-KS510

Manual operation: See "Code Rate" on page 188

2.6.14.8 User-Defined TTI-Based Channel Settings

The following commands define parameters for the scheduling type "User-Defined TTI-Based Channels".

CONFigure:LTE:SIGN<i>:CONNection[:PCC]:UDTTibased:DL<s>:ALL
<NumberRB>(10), <StartRB>(10), <Modulation>(10), <TransBlockSizeIdx>(10)
CONFigure:LTE:SIGN<i>:CONNection:SCC<c>:UDTTibased:DL<s>:ALL
<NumberRB>(10), <StartRB>(10), <Modulation>(10), <TransBlockSizeIdx>(10)

Configures all downlink subframes for the scheduling type "User-defined TTI-Based".

The parameters are entered 10 times, so that all subframes are configured by a single command (index = subframe number 0 to 9):

<NumberRB>$_0$, ..., <NumberRB>$_9$, <StartRB>$_0$, ..., <StartRB>$_9$, <Modulation>$_0$, ..., <Modulation>$_9$, <TransBlockSizeIdx>$_0$, ..., <TransBlockSizeIdx>$_9$

The allowed input ranges have dependencies and are described in the background information, see chapter 2.2.13, "User-Defined Channels", on page 54.

Suffix:

<s>	1..2
<c>	1..2

Parameters:

<NumberRB>	Number of allocated resource blocks. The same value must be configured for all streams of the carrier. *RST: 50
<StartRB>	Position of first resource block. The same value must be configured for all streams of the carrier. *RST: 0
<Modulation>	QPSK | Q16 | Q64 Modulation type QPSK | 16-QAM | 64-QAM *RST: QPSK
<TransBlockSizeIdx>	Transport block size index *RST: 5

Example: See Configuring TTI-Based User-Defined Channels

Firmware/Software: V2.1.30, SCC command V3.2.50

Options: R&S CMW-KS510

Manual operation: See "User-Defined TTI-Based" on page 111

CONFigure:LTE:SIGN<i>:CONNection[:PCC]:UDTTibased:UL <TTI>, <NumberRB>, <StartRB>, <Modulation>, <TransBlockSizeIdx>
CONFigure:LTE:SIGN<i>:CONNection[:PCC]:UDTTibased:UL? <TTI>

Configures a selected uplink subframe for all scheduling types with a TTI-based UL definition.

The allowed input ranges have dependencies and are described in the background information, see chapter 2.2.13, "User-Defined Channels", on page 54.

Parameters:

<NumberRB> Number of allocated resource blocks

*RST: 50

<StartRB> Position of first resource block

*RST: 0

<Modulation> QPSK | Q16

Modulation type QPSK | 16-QAM

*RST: QPSK

<TransBlockSizeIdx> Transport block size index

*RST: 6

Parameters for setting and query:

<TTI> Number of the subframe to be configured/queried.

Range: 0 to 9
*RST: 0

Example: See Configuring TTI-Based User-Defined Channels

Firmware/Software: V2.0.20

Options: R&S CMW-KS510

Manual operation: See "UL Configuration Commands" on page 110

CONFigure:LTE:SIGN<i>:CONNection[:PCC]:UDTTibased:UL:ALL <NumberRB>(10), <StartRB>(10), <Modulation>(10), <TransBlockSizeIdx>(10)

Configures the uplink channel for all scheduling types with a TTI-based UL definition.

The parameters are entered 10 times, so that all subframes are configured by a single command (index = subframe number 0 to 9):

<NumberRB>$_0$, ..., <NumberRB>$_9$, <StartRB>$_0$, ..., <StartRB>$_9$, <Modulation>$_0$, ..., <Modulation>$_9$, <TransBlockSizeIdx>$_0$, ..., <TransBlockSizeIdx>$_9$

The allowed input ranges have dependencies and are described in the background information, see chapter 2.2.13, "User-Defined Channels", on page 54.

Parameters:

<NumberRB> Number of allocated resource blocks

*RST: 50

<StartRB> Position of first resource block

*RST: 0

<Modulation> QPSK | Q16

Modulation type QPSK | 16-QAM

*RST: QPSK

<TransBlockSizeIdx> Transport block size index

*RST: 6

Example: See Configuring TTI-Based User-Defined Channels

Firmware/Software: V2.1.30

Options: R&S CMW-KS510

Manual operation: See "UL Configuration Commands" on page 110

SENSe:LTE:SIGN<i>:CONNection[:PCC]:UDTTibased:DL<s>:CRATe:ALL?
SENSe:LTE:SIGN<i>:CONNection:SCC<c>:UDTTibased:DL<s>:CRATe:ALL?

Queries the code rate for all downlink subframes for the scheduling type "User-defined TTI-Based".

Suffix:

<s> 1..2

<c> 1..2

Return values:

<CodeRate> Comma-separated list of 10 values (subframe 0 to subframe 9)
Range: 0 to 50

Example: See Configuring TTI-Based User-Defined Channels

Usage: Query only

Firmware/Software: V3.0.20, SCC command V3.2.50

Options: R&S CMW-KS510

Manual operation: See "Code Rate" on page 111

SENSe:LTE:SIGN<i>:CONNection[:PCC]:UDTTibased:UL:CRATe:ALL?

Queries the code rate for all uplink subframes, applicable to all scheduling types with a TTI-based UL definition.

Return values:

<CodeRate> Comma-separated list of 10 values (subframe 0 to subframe 9)
Range: 0 to 10

Example: See Configuring TTI-Based User-Defined Channels

Usage: Query only

Firmware/Software: V3.0.20

Options: R&S CMW-KS510

Manual operation: See "Code Rate" on page 111

CONFigure:LTE:SIGN<i>:CONNection[:PCC]:UDTTibased:DL<s> <TTI>, <NumberRB>, <StartRB>, <Modulation>, <TransBlockSizeIdx>
CONFigure:LTE:SIGN<i>:CONNection[:PCC]:UDTTibased:DL<s>? <TTI>
CONFigure:LTE:SIGN<i>:CONNection:SCC<c>:UDTTibased:DL<s> <TTI>, <NumberRB>, <StartRB>, <Modulation>, <TransBlockSizeIdx>
CONFigure:LTE:SIGN<i>:CONNection:SCC<c>:UDTTibased:DL<s>? <TTI>

Configures a selected downlink subframe for the scheduling type "User-defined TTI-Based".

The allowed input ranges have dependencies and are described in the background information, see chapter 2.2.13, "User-Defined Channels", on page 54.

Suffix:

<s> 1..2

<c> 1..2

Parameters:

<NumberRB> Number of allocated resource blocks. The same value must be configured for all streams.

*RST: 50

<StartRB> Position of first resource block. The same value must be configured for all streams of the carrier.

*RST: 0

<Modulation> QPSK | Q16 | Q64

Modulation type QPSK | 16-QAM | 64-QAM

*RST: QPSK

<TransBlockSizeIdx> Transport block size index

*RST: 5

Parameters for setting and query:

<TTI> Number of the subframe to be configured/queried.

Range: 0 to 9
*RST: 0

Example: See Configuring TTI-Based User-Defined Channels

Firmware/Software: V3.2.50

Options: R&S CMW-KS510

Manual operation: See "User-Defined TTI-Based" on page 111

2.6.14.9 Fixed CQI Settings

The following commands define DL settings for the scheduling type "Fixed CQI".

For the query of code rates and all UL settings, use the "User-Defined TTI-Based" commands, see chapter 2.6.14.8, "User-Defined TTI-Based Channel Settings", on page 424.

CONFigure:LTE:SIGN<i>:CONNection[:PCC]:FCTTibased:DL<s> <TTI>, <NumberRB>, <StartRB>, <CQIIdx>
CONFigure:LTE:SIGN<i>:CONNection[:PCC]:FCTTibased:DL<s>? <TTI>
CONFigure:LTE:SIGN<i>:CONNection:SCC<c>:FCTTibased:DL<s> <TTI>, <NumberRB>, <StartRB>, <CQIIdx>
CONFigure:LTE:SIGN<i>:CONNection:SCC<c>:FCTTibased:DL<s>? <TTI>

Configures a selected downlink subframe for the scheduling type "Fixed CQI".

The allowed input ranges have dependencies and are described in the background information, see chapter 2.2.14, "CQI Channels", on page 56.

Suffix:

<s> 1..2

<c> 1..2

Parameters:

<NumberRB> Number of allocated resource blocks. The same value must be configured for all streams of the carrier.

*RST: 50

<StartRB> Position of first resource block. The same value must be configured for all streams of the carrier.

*RST: 0

<CQIIdx> CQI index

Range: 1 to 15
*RST: 1

Parameters for setting and query:

<TTI> Number of the subframe to be configured/queried

Range: 0 to 9
*RST: 0

Example: See Configuring CQI DL Channels

Firmware/Software: V3.0.10, SCC command V3.2.50

Options: R&S CMW-KS510

Manual operation: See "Fixed CQI" on page 111

CONFigure:LTE:SIGN<i>:CONNection[:PCC]:FCTTibased:DL<s>:ALL <NumberRB>(10), <StartRB>(10), <CQIIdx>(10)
CONFigure:LTE:SIGN<i>:CONNection:SCC<c>:FCTTibased:DL<s>:ALL <NumberRB>(10), <StartRB>(10), <CQIIdx>(10)

Configures the downlink channel for the scheduling type "Fixed CQI".

The parameters are entered 10 times, so that all subframes are configured by a single command (index = subframe number 0 to 9):

<NumberRB>$_0$, ..., <NumberRB>$_9$, <StartRB>$_0$, ..., <StartRB>$_9$, <CQIIdx>$_0$, ..., <CQIIdx>$_9$

The allowed input ranges have dependencies and are described in the background information, see chapter 2.2.14, "CQI Channels", on page 56.

Suffix:

<s> 1..2

<c> 1..2

Parameters:

<NumberRB> Number of allocated resource blocks. The same value must be configured for all streams of the carrier.

*RST: 50

<StartRB> Position of first resource block. The same value must be configured for all streams of the carrier.

*RST: 0

<CQIIdx> CQI index

Range: 1 to 15
*RST: 1

Example: See Configuring CQI DL Channels

Firmware/Software: V3.0.10, SCC command V3.2.50

Options: R&S CMW-KS510

Manual operation: See "Fixed CQI" on page 111

2.6.14.10 Follow WB CQI Settings

The following commands define DL settings for the scheduling type "Follow WB CQI".

For the UL settings, use the "User-Defined TTI-Based" commands, see chapter 2.6.14.8, "User-Defined TTI-Based Channel Settings", on page 424.

CONFigure:LTE:SIGN<i>:CONNection[:PCC]:FWBCqi:DL <NumberRB>, <StartRB>, <Table>
CONFigure:LTE:SIGN<i>:CONNection:SCC<c>:FWBCqi:DL <NumberRB>, <StartRB>, <Table>

Configures the downlink for the scheduling type "Follow WB CQI".

The allowed input ranges have dependencies and are described in the background information, see chapter 2.2.14, "CQI Channels", on page 56.

Suffix:

<c> 1..2

Parameters:

<NumberRB> Number of allocated resource blocks

*RST: 50

<StartRB> Position of first resource block

*RST: 0

<Table> DETermined | UDEFined

DETermined: Automatic CQI to MCS mapping table
UDEFined: User-defined mapping table

*RST: DET

Example: See Configuring CQI DL Channels

Firmware/Software: V3.0.50, SCC command V3.2.70

Options: R&S CMW-KS510/-KS512 (without CA/with CA)

Manual operation: See "Follow WB CQI" on page 113

CONFigure:LTE:SIGN<i>:CONNection[:PCC]:FWBCqi:DL:MCSTable:UDEFined <MCS>(15)
CONFigure:LTE:SIGN<i>:CONNection:SCC<c>:FWBCqi:DL:MCSTable:UDEFined <MCS>(15)

Configures a user-defined mapping table that assigns an MCS index value to each possible reported wideband CQI index value.

The table is used for the scheduling type "Follow WB CQI" if the table mode is set to `UDEFined`.

Suffix:

<c> 1..2

Parameters:

<MCS> Comma-separated list of 15 MCS values, for reported CQI index value 1 to 15

Range: 0 to 28
*RST: 0,1,2,3,5,7,9,12,14,16,19,22,24,27,28

Example: See Configuring CQI DL Channels

Firmware/Software: V3.0.50, SCC command V3.2.70

Options: R&S CMW-KS510/-KS512 (without CA/with CA)

Manual operation: See "Follow WB CQI" on page 113

SENSe:LTE:SIGN<i>:CONNection[:PCC]:FWBCqi:DL:MCSTable:DETermined?
SENSe:LTE:SIGN<i>:CONNection:SCC<c>:FWBCqi:DL:MCSTable:DETermined?

Queries the automatically determined mapping table. The table is used for the scheduling type "Follow WB CQI" if the table mode is set to `DETermined`.

Suffix:

<c> 1..2

Return values:

<MCS> Comma-separated list of 15 MCS values, for reported CQI index value 1 to 15

Range: 0 to 31

Usage: Query only

Firmware/Software: V3.0.50, SCC command V3.2.70

Options: R&S CMW-KS510/-KS512 (without CA/with CA)

Manual operation: See "Follow WB CQI" on page 113

2.6.14.11 Follow WB PMI Settings

The following commands define DL settings for the scheduling type "Follow WB PMI".

For the UL settings, use the "User-Defined TTI-Based" commands, see chapter 2.6.14.8, "User-Defined TTI-Based Channel Settings", on page 424.

CONFigure:LTE:SIGN<i>:CONNection[:PCC]:FPMI:DL <NumberRB>, <StartRB>, <Modulation>, <TransBlockSizeIdx>
CONFigure:LTE:SIGN<i>:CONNection:SCC:FPMI:DL <NumberRB>, <StartRB>, <Modulation>, <TransBlockSizeIdx>

Configures the downlink for the scheduling type "Follow WB PMI".

The allowed input ranges have dependencies and are described in the background information, see chapter 2.2.14, "CQI Channels", on page 56.

Parameters:

<NumberRB> Number of allocated resource blocks

*RST: 50

<StartRB> Position of first resource block

*RST: 0

<Modulation> QPSK | Q16 | Q64

Modulation type QPSK | 16-QAM | 64-QAM

*RST: QPSK

<TransBlockSizeIdx> Transport block size index

*RST: 5

Example: See Configuring CQI DL Channels

Firmware/Software: V3.2.80

Options: R&S CMW-KS510/-KS512 (without CA/with CA)

Manual operation: See "Follow WB PMI" on page 111

2.6.14.12 Follow WB CQI-RI Settings

The following commands define DL settings for the scheduling type "Follow WB CQI-RI".

For the UL settings, use the "User-Defined TTI-Based" commands, see chapter 2.6.14.8, "User-Defined TTI-Based Channel Settings", on page 424.

CONFigure:LTE:SIGN<i>:CONNection[:PCC]:FCRI:DL <NumberRB>, <StartRB>, <Table>
CONFigure:LTE:SIGN<i>:CONNection:SCC:FCRI:DL <NumberRB>, <StartRB>, <Table>

Configures the downlink for the scheduling type "Follow WB CQI-RI".

The allowed input ranges have dependencies and are described in the background information, see chapter 2.2.14, "CQI Channels", on page 56.

Parameters:

<NumberRB> Number of allocated resource blocks
*RST: 50

<StartRB> Position of first resource block
*RST: 0

<Table> DETermined | UDEFined
DETermined: Automatic CQI to MCS mapping table
UDEFined: User-defined mapping table
*RST: DET

Example: See Configuring CQI DL Channels

Firmware/Software: V3.2.80

Options: R&S CMW-KS510/-KS512 (without CA/with CA)

Manual operation: See "Follow WB CQI-RI" on page 113

CONFigure:LTE:SIGN<i>:CONNection[:PCC]:FCRI:DL:MCSTable:UDEFined <MCS>(15)
CONFigure:LTE:SIGN<i>:CONNection:SCC:FCRI:DL:MCSTable:UDEFined <MCS>(15)

Configures a user-defined mapping table that assigns an MCS index value to each possible reported wideband CQI index value.

The table is used for the scheduling type "Follow WB CQI-RI" if the table mode is set to `UDEFined`.

Parameters:

<MCS> Comma-separated list of 15 MCS values, for reported CQI index value 1 to 15

Range: 0 to 28
*RST: 0,1,2,3,5,7,9,12,14,16,19,22,24,27,28

Example: See Configuring CQI DL Channels

Firmware/Software: V3.2.80

Options: R&S CMW-KS510/-KS512 (without CA/with CA)

Manual operation: See "Follow WB CQI-RI" on page 113

SENSe:LTE:SIGN<i>:CONNection[:PCC]:FCRI:DL:MCSTable:DETermined?
SENSe:LTE:SIGN<i>:CONNection:SCC:FCRI:DL:MCSTable:DETermined?

Queries the automatically determined mapping table. The table is used for the scheduling type "Follow WB CQI-RI" if the table mode is set to `DETermined`.

Return values:

<MCS> Comma-separated list of 15 MCS values, for reported CQI index value 1 to 15

Range: 0 to 31

Usage: Query only

Firmware/Software: V3.2.80

Options: R&S CMW-KS510/-KS512 (without CA/with CA)

Manual operation: See "Follow WB CQI-RI" on page 113

2.6.14.13 Follow WB CQI-PMI-RI Settings

The following commands define DL settings for the scheduling type "Follow WB CQI-PMI-RI".

For the UL settings, use the "User-Defined TTI-Based" commands, see chapter 2.6.14.8, "User-Defined TTI-Based Channel Settings", on page 424.

CONFigure:LTE:SIGN<i>:CONNection[:PCC]:FCPRi:DL <NumberRB>, <StartRB>, <Table>
CONFigure:LTE:SIGN<i>:CONNection:SCC<c>:FCPRi:DL <NumberRB>, <StartRB>, <Table>

Configures the downlink for the scheduling type "Follow WB CQI-PMI-RI".

The allowed input ranges have dependencies and are described in the background information, see chapter 2.2.14, "CQI Channels", on page 56.

Suffix:
<c> 1..2

Parameters:
<NumberRB> Number of allocated resource blocks
*RST: 50

<StartRB> Position of first resource block
*RST: 0

<Table> DETermined | UDEFined
DETermined: Automatic CQI to MCS mapping table
UDEFined: User-defined mapping table
*RST: DET

Example: See Configuring CQI DL Channels

Firmware/Software: V3.2.80

Options: R&S CMW-KS510/-KS512 (without CA/with CA)

Manual operation: See "Follow WB CQI-PMI-RI" on page 113

CONFigure:LTE:SIGN<i>:CONNection[:PCC]:FCPRi:DL:MCSTable:UDEFined <MCS>(15)
CONFigure:LTE:SIGN<i>:CONNection:SCC<c>:FCPRi:DL:MCSTable:UDEFined <MCS>(15)

Configures a user-defined mapping table that assigns an MCS index value to each possible reported wideband CQI index value.

The table is used for the scheduling type "Follow WB CQI-PMI-RI" if the table mode is set to `UDEFined`.

Suffix:
<c> 1..2

Parameters:

<MCS> Comma-separated list of 15 MCS values, for reported CQI index value 1 to 15

Range: 0 to 28
*RST: 0,1,2,3,5,7,9,12,14,16,19,22,24,27,28

Example: See Configuring CQI DL Channels

Firmware/Software: V3.2.80

Options: R&S CMW-KS510/-KS512 (without CA/with CA)

Manual operation: See "Follow WB CQI-PMI-RI" on page 113

SENSe:LTE:SIGN<i>:CONNection[:PCC]:FCPRi:DL:MCSTable:DETermined?
SENSe:LTE:SIGN<i>:CONNection:SCC<c>:FCPRi:DL:MCSTable:DETermined?

Queries the automatically determined mapping table. The table is used for the scheduling type "Follow WB CQI-PMI-RI" if the table mode is set to `DETermined`.

Suffix:

<c> 1..2

Return values:

<MCS> Comma-separated list of 15 MCS values, for reported CQI index value 1 to 15

Range: 0 to 31

Usage: Query only

Firmware/Software: V3.2.80

Options: R&S CMW-KS510/-KS512 (without CA/with CA)

Manual operation: See "Follow WB CQI-PMI-RI" on page 113

2.6.14.14 SPS Settings

The following commands define parameters for the scheduling type "SPS".

CONFigure:LTE:SIGN<i>:CONNection[:PCC]:SPS:TIConfig <Enable>

Configures the parameter "twoIntervalsConfig", signaled to the UE for the scheduling type SPS in TDD mode.

Parameters:

<Enable> OFF | ON

*RST: OFF

Example: See Configuring SPS

Firmware/Software: V3.2.80

Options: R&S CMW-KS510

Manual operation: See "SPS TwoIntervalsConfig TDD" on page 176

CONFigure:LTE:SIGN<i>:CONNection[:PCC]:SPS:SINTerval <Interval>

Configures the subframe periodicity n for the scheduling type SPS. The UE is granted the configured RB allocation in every n^{th} subframe.

For TDD, the selected value is internally rounded down to a multiple of 10. Example: S128 means every 120^{th} subframe.

Parameters:

<Interval> S10 | S20 | S32 | S40 | S64 | S80 | S128 | S160 | S320 | S640

Every 10^{th} subframe to every 640^{th} subframe

*RST: S20

Example: See Configuring SPS

Firmware/Software: V3.2.80
V3.2.82: changed *RST value

Options: R&S CMW-KS510

Manual operation: See "Interval" on page 114

CONFigure:LTE:SIGN<i>:CONNection[:PCC]:SPS:DL <NumberRB>, <StartRB>, <Modulation>, <TransBlockSizeIdx>

Configures the downlink RB allocation for the scheduling type SPS.

The allowed input ranges have dependencies and are described in the background information, see chapter 2.2.15, "Semi-Persistent Scheduling (SPS)", on page 58.

Parameters:

<NumberRB> Number of allocated resource blocks

*RST: 50

<StartRB> Position of first resource block

*RST: 0

<Modulation> QPSK | Q16

Modulation type QPSK | 16-QAM

*RST: QPSK

<TransBlockSizeIdx> Transport block size index

*RST: 5

Example: See Configuring SPS

Firmware/Software: V3.2.80

Options: R&S CMW-KS510

Manual operation: See "# RB ... TBSI /TBS" on page 115

CONFigure:LTE:SIGN<i>:CONNection[:PCC]:SPS:UL <NumberRB>, <StartRB>, <Modulation>, <TransBlockSizeIdx>

Configures the uplink RB allocation for the scheduling type SPS.

The allowed input ranges have dependencies and are described in the background information, see chapter 2.2.15, "Semi-Persistent Scheduling (SPS)", on page 58.

Parameters:

<NumberRB> Number of allocated resource blocks

*RST: 50

<StartRB> Position of first resource block

*RST: 0

<Modulation> QPSK | Q16

Modulation type QPSK | 16-QAM

*RST: QPSK

<TransBlockSizeIdx> Transport block size index

*RST: 6

Example: See Configuring SPS

Firmware/Software: V3.2.80

Options: R&S CMW-KS510

Manual operation: See "# RB ... TBSI /TBS" on page 115

SENSe:LTE:SIGN<i>:CONNection[:PCC]:SPS:DL<s>:CRATe:ALL?

Queries the code rate for all downlink subframes for the scheduling type SPS.

Suffix:

<s> 1..2

Selects the downlink stream

Return values:

<CodeRate> Comma-separated list of 10 values (subframe 0 to subframe 9)

Range: 0 to 50

Example: See Configuring SPS

Usage: Query only

Firmware/Software: V3.2.80

Options: R&S CMW-KS510

Manual operation: See "Code Rate" on page 115

SENSe:LTE:SIGN<i>:CONNection[:PCC]:SPS:UL:CRATe:ALL?

Queries the code rate for all uplink subframes for the scheduling type SPS.

Return values:

<CodeRate> Comma-separated list of 10 values (subframe 0 to subframe 9)

Range: 0 to 10

Example: See Configuring SPS

Usage: Query only

Firmware/Software: V3.2.80

Options: R&S CMW-KS510

Manual operation: See "Code Rate" on page 115

2.6.15 CQI Reporting Settings

The following commands configure CQI reporting.

CONFigure:LTE:SIGN<i>:CQIReporting:ENABle <Enable>

Enables/disables periodic CQI reporting.

Parameters:

<Enable> OFF | PERiodic

OFF: no CQI reporting
PERiodic: periodic CQI reporting

*RST: OFF

Example: See Configuring CQI Reporting

Firmware/Software: V3.0.10

Options: R&S CMW-KS510 for scenarios without carrier aggregation

R&S CMW-KS512 for scenarios with carrier aggregation

Manual operation: See "Enable CQI Reporting" on page 189

CONFigure:LTE:SIGN<i>:CQIReporting:PRIReporting:ENABle <Enable>

Enables/disables PMI/RI reporting for transmission mode 8. As a prerequisite for PMI and RI reporting, CQI reporting must also be enabled.

Parameters:

<Enable> OFF | ON

OFF: only CQI reporting
ON: CQI, PMI and RI reporting

*RST: OFF

Example: See Configuring CQI Reporting

Firmware/Software: V3.2.80

Options: R&S CMW-KS510 for scenarios without carrier aggregation
R&S CMW-KS512 for scenarios with carrier aggregation

Manual operation: See "Enable PMI/RI Reporting (TM8)" on page 189

CONFigure:LTE:SIGN<i>:CQIReporting[:PCC]:CINDex[:FDD] <Index>
CONFigure:LTE:SIGN<i>:CQIReporting:SCC<c>:CINDex[:FDD] <Index>

Specifies the FDD cqi-pmi-ConfigIndex ($I_{CQI/PMI}$).

Suffix:

<c> 1..2

Parameters:

<Index> Range: 0 to 316, 318 to 541
*RST: PCC: 0, SCC: 8

Example: See Configuring CQI Reporting

Firmware/Software: V3.0.10, SCC command V3.2.70

Options: R&S CMW-KS500

Manual operation: See "CQI/PMI Config Index" on page 189

CONFigure:LTE:SIGN<i>:CQIReporting[:PCC]:CINDex:TDD <Index>
CONFigure:LTE:SIGN<i>:CQIReporting:SCC<c>:CINDex:TDD <Index>

Specifies the TDD cqi-pmi-ConfigIndex ($I_{CQI/PMI}$).

Suffix:

<c> 1..2

Parameters:

<Index> Range: 1 to 315
*RST: PCC: 3, SCC: 11

Example: See Configuring CQI Reporting

Firmware/Software: V3.0.50, SCC command V3.2.70

Options: R&S CMW-KS550

Manual operation: See "CQI/PMI Config Index" on page 189

SENSe:LTE:SIGN<i>:CQIReporting[:PCC]:RPERiod?
SENSe:LTE:SIGN<i>:CQIReporting:SCC<c>:RPERiod?

Queries the reporting period N_p in subframes, resulting from the configured cqi-pmi-ConfigIndex.

Suffix:
<c> 1..2

Return values:
<Period> Range: 1 to 160

Example: See Configuring CQI Reporting

Usage: Query only

Firmware/Software: V3.0.10, SCC command V3.2.70

Options: R&S CMW-KS510

Manual operation: See "CQI/PMI Reporting Period / Offset" on page 190

SENSe:LTE:SIGN<i>:CQIReporting[:PCC]:ROFFset?
SENSe:LTE:SIGN<i>:CQIReporting:SCC<c>:ROFFset?

Queries the reporting offset $N_{OFFSET,CQI}$ in subframes, resulting from the configured cqi-pmi-ConfigIndex.

Suffix:
<c> 1..2

Return values:
<Offset> Range: 0 to 159

Example: See Configuring CQI Reporting

Usage: Query only

Firmware/Software: V3.0.10, SCC command V3.2.70

Options: R&S CMW-KS510

Manual operation: See "CQI/PMI Reporting Period / Offset" on page 190

2.6.16 UE Measurement Report Settings

The following commands configure UE measurement reports.

CONFigure:LTE:SIGN<i>:UEReport:ENABle <Enable>

Enables or disables UE measurement reports.

Parameters:

<Enable> OFF | ON

*RST: OFF

Example: See Configuring Measurement Reports

Firmware/Software: V2.0.10

Manual operation: See "Report" on page 191

CONFigure:LTE:SIGN<i>:UEReport:RINTerval <Interval>

Sets the interval between two consecutive measurement reports.

Parameters:

<Interval> I120 | I240 | I480 | I640 | I1024 | I2048 | I5120 | I10240

Interval in ms, e.g. I240 = 240 ms

*RST: I1024

Example: See Configuring Measurement Reports

Firmware/Software: V2.1.20

Manual operation: See "Reporting Interval" on page 191

CONFigure:LTE:SIGN<i>:UEReport:MGPeriod <Gap>

Specifies the periodicity of transmission gaps for neighbor cell measurements.

Parameters:

<Gap> G040 | G080

G040: one gap per 40 ms
G080: one gap per 80 ms

*RST: G040

Example: See Configuring Measurement Reports

Firmware/Software: V3.0.50

Options: R&S CMW-KS510

Manual operation: See "Measurement Gap Period" on page 192

CONFigure:LTE:SIGN<i>:UEReport:FCOefficient:RSRP <Filter>

Selects the value to be sent to the UE as "filterCoefficientRSRP". It is used by the UE to measure the Reference Signal Received Power (RSRP).

Parameters:

<Filter>	FC0 | FC4	
	*RST:	FC4

Example: See Configuring Measurement Reports

Firmware/Software: V3.2.81

Manual operation: See "Filter Coefficient RSRP/RSRQ" on page 192

CONFigure:LTE:SIGN<i>:UEReport:FCOefficient:RSRQ <Filter>

Selects the value to be sent to the UE as "filterCoefficientRSRQ". It is used by the UE to measure the Reference Signal Received Quality (RSRQ).

Parameters:

<Filter>	FC0 | FC4	
	*RST:	FC4

Example: See Configuring Measurement Reports

Firmware/Software: V3.2.81

Manual operation: See "Filter Coefficient RSRP/RSRQ" on page 192

CONFigure:LTE:SIGN<i>:UEReport:WMQuantity <Quantity>

Selects whether the UE shall determine the RSCP or the Ec/No during WCDMA neighbor cell measurements.

Parameters:

<Quantity>	RSCP | ECNO	
	*RST:	RSCP

Example: See Configuring Measurement Reports

Firmware/Software: V3.0.50

Options: R&S CMW-KS510

Manual operation: See "WCDMA Measurement Quantity" on page 192

CONFigure:LTE:SIGN<i>:UEReport:MCSCell <Cycle>

Specifies the signaling parameter "measCycleSCell".

Parameters:

<Cycle> OFF | SF160 | SF256 | SF320 | SF512 | SF640 | SF1024 | SF1280

OFF: Do not signal "measCycleSCell"
SFn: n subframes

*RST: OFF

Example: See Configuring Measurement Reports

Firmware/Software: V3.2.70

Manual operation: See "Measurement Cycle SCell" on page 192

2.6.17 Messaging (SMS)

The following commands configure parameters of the Short Message Service (SMS) and return information about received short messages.

CONFigure:LTE:SIGN<i>:SMS:OUTGoing:INTernal <SMSInternal>

Defines the message text for outgoing 7-bit ASCII messages.

Parameters:

<SMSInternal> Message contents as string with up to 160 characters

RST: "R&S Short Message Service Text.The quick brown fox jumps over the lazy dog.THE QUICK BROWN FOX JUMPS OVER THE LAZY DOG. 0123456789 !"#%+-/()<>?=;@$,"

Example: See Sending / Receiving a Short Message

Firmware/Software: V2.1.20

Manual operation: See "Outgoing SMS" on page 193

CONFigure:LTE:SIGN<i>:SMS:OUTGoing:BINary <SMSbinary>

Defines the message contents for outgoing 8-bit binary messages.

Parameters:

<SMSbinary> Message contents as hexadecimal number with up to 280 digits

Example: See Sending / Receiving a Short Message

Firmware/Software: V3.2.70

Manual operation: See "Outgoing SMS binary" on page 194

CONFigure:LTE:SIGN<i>:SMS:OUTGoing:DCODing <DataCoding>

Selects the data coding for outgoing messages.

Parameters:

<DataCoding> BIT7 | BIT8

BIT7: 7-bit encoded ASCII message
BIT8: 8-bit encoded binary message

*RST: BIT7

Example: See Sending / Receiving a Short Message

Firmware/Software: V3.2.70

Manual operation: See "Data Coding / Character Set" on page 194

CONFigure:LTE:SIGN<i>:SMS:OUTGoing:CGRoup <CodingGroup>

Selects the coding group to be indicated to the message recipient in the TP-Data-Coding-Scheme field.

Parameters:

<CodingGroup> GDCoding | DCMClass

GDCoding: general data coding
DCMClass: data coding / message class

*RST: GDC

Example: See Sending / Receiving a Short Message

Firmware/Software: V3.2.70

Manual operation: See "Coding Group" on page 194

CONFigure:LTE:SIGN<i>:SMS:OUTGoing:MCLass <MessageClass>

Selects the message class to be indicated to the message recipient in the TP-Data-Coding-Scheme field.

Parameters:

<MessageClass> CL0 | CL1 | CL2 | CL3 | NONE

CL0, CL1, CL2, CL3: Class 0 to 3
NONE: Do not send message class

*RST: NONE

Example: See Sending / Receiving a Short Message

Firmware/Software: V3.2.70

Manual operation: See "Message Class" on page 194

CONFigure:LTE:SIGN<i>:SMS:OUTGoing:OSADdress <OrigSMSCAddress>

Specifies the originator short message service center address to be sent to the recipient.

Parameters:

<OrigSMSCAddress> Address as string

*RST: '764332637249279'

Example: See Sending / Receiving a Short Message

Firmware/Software: V3.2.70

Manual operation: See "Originator SMSC Address" on page 194

CONFigure:LTE:SIGN<i>:SMS:OUTGoing:OADDress <OrigAddress>

Specifies the originating address to be sent to the message recipient.

Parameters:

<OrigAddress> Address as string

*RST: '764332637249279'

Example: See Sending / Receiving a Short Message

Firmware/Software: V3.2.70

Manual operation: See "Originating Address" on page 194

CONFigure:LTE:SIGN<i>:SMS:OUTGoing:SCTStamp:TSOurce <SourceTime>

Selects the source for the service center time stamp.

The date and time for the source DATE is configured via the following commands:

- `CONFigure:LTE:SIGN<i>:SMS:OUTGoing:SCTStamp:DATE`
- `CONFigure:LTE:SIGN<i>:SMS:OUTGoing:SCTStamp:TIME`

Parameters:

<SourceTime> CMWTime | DATE

CMWTime: Current date and time of the operation system
DATE: Date and time specified via remote commands

*RST: CMWT

Example: See Sending / Receiving a Short Message

Firmware/Software: V3.2.80

Options: R&S CMW-KS510

Manual operation: See "Service Center Time Stamp" on page 194

CONFigure:LTE:SIGN<i>:SMS:OUTGoing:SCTStamp:DATE <Day>, <Month>, <Year>

Specifies the date of the service center time stamp for the time source `DATE` (see `CONFigure:LTE:SIGN<i>:SMS:OUTGoing:SCTStamp:TSOurce`).

Parameters:

<Day> Range: 1 to 31
*RST: 11

<Month> Range: 1 to 12
*RST: 11

<Year> Range: 2011 to 9999
*RST: 2011

Example: See Sending / Receiving a Short Message

Firmware/Software: V3.2.80

Options: R&S CMW-KS510

Manual operation: See "Service Center Time Stamp" on page 194

CONFigure:LTE:SIGN<i>:SMS:OUTGoing:SCTStamp:TIME <Hour>, <Minute>, <Second>

Specifies the time of the service center time stamp for the time source `DATE` (see `CONFigure:LTE:SIGN<i>:SMS:OUTGoing:SCTStamp:TSOurce`).

Parameters:

<Hour> Range: 0 to 23
*RST: 11

<Minute> Range: 0 to 59
*RST: 11

<Second> Range: 0 to 59
*RST: 0

Example: See Sending / Receiving a Short Message

Firmware/Software: V3.2.80

Options: R&S CMW-KS510

Manual operation: See "Service Center Time Stamp" on page 194

SENSe:LTE:SIGN<i>:SMS:INComing:INFO:DCODing?

Returns the data coding of the last message received from the UE.

Return values:
<MessageEncoding> Encoding as string, 7-bit ASCII message or 8-bit binary message

Example: See Sending / Receiving a Short Message

Usage: Query only

Firmware/Software: V3.2.70

Manual operation: See "Data Coding / Character Set" on page 195

SENSe:LTE:SIGN<i>:SMS:INComing:INFO:MTEXt?

Returns the text of the last SMS message received from the UE.

Return values:
<MessageText> Message text as string

Example: See Sending / Receiving a Short Message

Usage: Query only

Firmware/Software: V2.1.20

Manual operation: See "Message Text / Message Length" on page 195

SENSe:LTE:SIGN<i>:SMS:INComing:INFO:MLENgth?

Returns the length of the last SMS message received from the UE.

Return values:
<MessageLength> Number of characters of the message

Example: See Sending / Receiving a Short Message

Usage: Query only

Firmware/Software: V2.1.20

Manual operation: See "Message Text / Message Length" on page 195

CLEan:LTE:SIGN<i>:SMS:INComing:INFO:MTEXt

Resets all parameters related to a received SMS message. The "message read" flag is set to true.

Example: See Sending / Receiving a Short Message

Usage: Event

Firmware/Software: V2.1.20

Manual operation: See "Clear Message Text" on page 195

SENSe:LTE:SIGN<i>:SMS:INFO:LRMessage:RFLag?

Queries the "message read" flag for the last received message.

The flag is true (ON) in the following cases:

- No SMS message has been received.
- The last received SMS message has been read, see `SENSe:LTE:SIGN<i>:SMS:INComing:INFO:MTEXt?` on page 448.
- The last received SMS message has been deleted, see `CLEan:LTE:SIGN<i>:SMS:INComing:INFO:MTEXt` on page 448.

Return values:

<LastRecMessRead> OFF | ON

OFF: unread message available
ON: no unread message available

*RST: ON

Example: See Sending / Receiving a Short Message

Usage: Query only

Firmware/Software: V2.1.20

Manual operation: See "Clear Message Text" on page 195

2.6.18 Message Monitoring Settings

The following commands configure message monitoring for LTE.

CONFigure:LTE:SIGN<i>:MMONitor:ENABle <Enable>

Enables or disables message monitoring for the LTE signaling application.

Parameters:

<Enable> OFF | ON

*RST: OFF

Example: See Configuring Message Monitoring

Firmware/Software: V2.1.30

Manual operation: See "Add LTE Signaling to logging" on page 196

CONFigure:LTE:SIGN<i>:MMONitor:IPADdress <Index>

Selects the IP address to which signaling messages shall be sent for message monitoring. The address pool is configured globally via `CONFigure:BASE:MMONitor:IPADdress<n>`.

A query returns both the current index and the resulting IP address.

Parameters:

<Index> IP1 | IP2 | IP3

Address pool index

Return values:

<IPAddress> Used IP address as string

Example: See Configuring Message Monitoring

Firmware/Software: V3.0.10

Manual operation: See "Logging PC IPv4 Address" on page 196

2.6.19 BLER Measurement

The following sections describe the commands related to the "Extended BLER" measurement.

2.6.19.1 Measurement Control and States

The following commands control the measurement and return the current measurement state.

INITiate:LTE:SIGN<i>:EBLer
STOP:LTE:SIGN<i>:EBLer
ABORt:LTE:SIGN<i>:EBLer

Starts, stops, or aborts the measurement:

- `INITiate...` starts or restarts the measurement; the R&S CMW enters the "RUN" state.
- `STOP...` causes a running measurement to stop after the current evaluation period is terminated and valid results are available; the R&S CMW enters the "RDY" state.

- ABORt... causes a running measurement to stop immediately; the R&S CMW enters the "OFF" state.

Use FETCh...STATe? to query the current measurement state.

See also: "Measurement Control" in the R&S CMW user manual, chapter "Remote Control"

Example: See Performing a Single-Shot BLER Measurement

Usage: Event

Firmware/Software: V1.0.15.20

Manual operation: See "Extended BLER (Softkey)" on page 197

FETCh:LTE:SIGN<i>:EBLer:STATe?

Queries the main measurement state. Use FETCh:...:STATe:ALL? to query the measurement state including the substates. Use INITiate..., STOP..., ABORt... to change the measurement state.

See also: "Measurement Control" in the R&S CMW user manual, chapter "Remote Control"

Return values:

<State> OFF | RDY | RUN

OFF: measurement switched off, no resources allocated, no results available (when entered after ABORt...)
RDY: measurement has been terminated, valid results may be available
RUN: measurement running (after INITiate..., READ...), synchronization pending or adjusted, resources active or queued

*RST: OFF

Usage: Query only

Firmware/Software: V1.0.15.20

Manual operation: See "Extended BLER (Softkey)" on page 197

FETCh:LTE:SIGN<i>:EBLer:STATe:ALL?

Queries the main measurement state and the measurement substates. Both measurement substates are relevant for running measurements only. Use FETCh:...:STATe? to query the main measurement state only. Use INITiate..., STOP..., ABORt... to change the measurement state.

See also: "Measurement Control" in the R&S CMW user manual, chapter "Remote Control"

Return values:

<MainState> OFF | RDY | RUN

OFF: measurement switched off, no resources allocated, no results available (when entered after `STOP...`)
RDY: measurement has been terminated, valid results may be available
RUN: measurement running (after `INITiate...`, `READ...`), synchronization pending or adjusted, resources active or queued

*RST: OFF

<SyncState> PEND | ADJ | INV

PEND: waiting for resource allocation, adjustment, hardware switching ("pending")
ADJ: all necessary adjustments finished, measurement running ("adjusted")
INV: not applicable because <main_state>: OFF or RDY ("invalid")

<RessourceState> QUE | ACT | INV

QUE: measurement without resources, no results available ("queued")
ACT: resources allocated, acquisition of results in progress but not complete ("active")
INV: not applicable because <main_state>: OFF or RDY ("invalid")

Example: See Performing a Continuous BLER Measurement

Usage: Query only

Firmware/Software: V1.0.15.20

Manual operation: See "Extended BLER (Softkey)" on page 197

2.6.19.2 Measurement Settings

The following commands configure the BLER measurement.

CONFigure:LTE:SIGN<i>:EBLer:TOUT <Timeout>

Defines a timeout for the measurement. The timer is started when the measurement is initiated via a `READ` or `INIT` command. It is not started if the measurement is initiated manually (ON/OFF key or RESTART/STOP key).

When the measurement has completed the first measurement cycle (first single shot), the statistical depth is reached and the timer is reset.

If the first measurement cycle has not been completed when the timer expires, the measurement is stopped. The measurement state changes to `RDY` and the reliability indicator is set to 1, indicating that a measurement timeout occurred. Still running `READ`, `FETCh` or `CALCulate` commands are completed, returning the available results. At least for some results there are no values at all or the statistical depth has not been reached.

A timeout of 0 s corresponds to an infinite measurement timeout.

Parameters:
<Timeout> Default unit: s

Firmware/Software: V2.0.10

CONFigure:LTE:SIGN<i>:EBLer:REPetition <Repetition>

Specifies whether the measurement is stopped after a single shot or repeated continuously.

Parameters:
<Repetition> SINGleshot | CONTinuous

SINGleshot: Single-shot measurement
CONTinuous: Continuous measurement

*RST: SING

Example: See Configuring a BLER Measurement

Firmware/Software: V3.0.30

Manual operation: See "Repetition" on page 199

CONFigure:LTE:SIGN<i>:EBLer:SCONdition <StopCondition>

Selects whether a BLER measurement without stop condition or a confidence BLER measurement with early decision concept is performed.

Parameters:
<StopCondition> NONE | CLEVel

NONE: no stop condition, no early termination of measurement
CLEVel: confidence BLER measurement

*RST: NONE

Example: See Configuring a BLER Measurement

Firmware/Software: V3.0.30

Options: R&S CMW-KS510/-KS512 for CLEVel (without CA/with CA)

Manual operation: See "Stop Condition" on page 199

CONFigure:LTE:SIGN<i>:EBLer:SFRames <Subframes>

Defines the number of subframes (= number of transport blocks) to be processed per measurement cycle.

For confidence BLER measurements this parameter specifies only the length of the throughput result trace but does not influence the duration of the measurement.

Parameters:

<Subframes> Range: 100 to 400E+3
*RST: 10E+3

Example: See Configuring a BLER Measurement

Firmware/Software: V3.0.30

Manual operation: See "No. of Subframes" on page 199

CONFigure:LTE:SIGN<i>:EBLer:ERCalc <Algorithm>

Selects the formula to be used for calculation of the BLER from the number of ACK, NACK and DTX.

Parameters:

<Algorithm> ERC1 | ERC2 | ERC3 | ERC4

ERC1: *BLER = (NACK + DTX) / (ACK + NACK + DTX)*
ERC2: *BLER = DTX / (ACK + NACK + DTX)*
ERC3: *BLER = NACK / (ACK + NACK + DTX)*
ERC4: *BLER = NACK / (ACK + NACK)*

*RST: ERC1

Example: See Configuring a BLER Measurement

Firmware/Software: V3.0.30

Manual operation: See "Error Ratio Calculation" on page 200

CONFigure:LTE:SIGN<i>:EBLer:CONFidence:OASCondition <Condition>

Configures the stop decision and the overall result calculation for confidence BLER measurements with carrier aggregation.

Parameters:

<Condition> PCC | SCC1 | SCC2 | AC1St | ACWait

PCC: PCC only
SCC1: SCC1 only
SCC2: SCC2 only
AC1St: All Carrier, stop on 1st fail
ACWait: All Carrier, wait for all CCs

*RST: AC1S

Example: See Configuring a BLER Measurement

Firmware/Software: V3.2.80
V3.5.10: added SCC2

Options: R&S CMW-KS510/-KS512 (without CA/with CA)

Manual operation: See "Over All Stop Decision" on page 200

CONFigure:LTE:SIGN<i>:EBLer:CONFidence:MTTime <Time>

Specifies a minimum test time for confidence BLER measurements.

Parameters:

<Time> Minimum number of processed subframes

Range: 0 to 500E+3
Increment: 200
*RST: 0

Example: See Configuring a BLER Measurement

Firmware/Software: V3.0.30

Options: R&S CMW-KS510/-KS512 (without CA/with CA)

Manual operation: See "Minimum Test Time" on page 200

CONFigure:LTE:SIGN<i>:EBLer:CONFidence:LERate <Rate>

Selects the limit error ratio for a confidence BLER measurement.

Parameters:

<Rate> P001 | P010 | P050

P001: 0.1 %, 3GPP TS 36.521 Annex G.4
P010: 1 %, 3GPP TS 36.521 Annex G.4
P050: 5 %, 3GPP TS 36.521 Annex G.2

*RST: P050

Example: See Configuring a BLER Measurement

Firmware/Software: V3.0.30

Options: R&S CMW-KS510/-KS512 (without CA/with CA)

Manual operation: See "Limit Error Rate" on page 201

2.6.19.3 Measurement Results

All results of the BLER measurement are retrieved via `FETCh` commands.

There are two types of `FETCh` commands:

- `FETCh:LTE:...` waits until the current measurement cycle is complete and returns the final results of the measurement cycle.
  This type of command is available for all results.

- FETCh:INTermediate:LTE:... returns the already available measurement results immediately, even if the first measurement cycle is not yet complete. This type of command is only available for selected results.

The following commands retrieve the results of the BLER measurement.

FETCh:LTE:SIGN<i>:EBLer[:PCC]:CONFidence?
FETCh:LTE:SIGN<i>:EBLer:SCC<c>:CONFidence?

Returns the pass/fail result of a confidence BLER measurement, for one carrier.

Suffix:

<c> 1..2

Return values:

<Reliability> see Reliability Indicator

<Confidence> EPASs | EFAil | PASS | FAIL | UNDecided

EPASs, EFAil: Early Pass, Early Fail
PASS, FAIL: Pass, Fail
UNDecided: Undecided

Example: See Performing a Confidence BLER Measurement

Usage: Query only

Firmware/Software: V3.0.30
V3.2.80: added value UNDecided and SCC command

FETCh:LTE:SIGN<i>:EBLer:ALL:CONFidence?

Returns the overall pass/fail result of a confidence BLER measurement.

Return values:

<Reliability> see Reliability Indicator

<Confidence> EPASs | EFAil | PASS | FAIL | UNDecided

EPASs, EFAil: Early Pass, Early Fail
PASS, FAIL: Pass, Fail
UNDecided: Undecided

Example: See Performing a Confidence BLER Measurement

Usage: Query only

Firmware/Software: V3.2.80

FETCh:INTermediate:LTE:SIGN<i>:EBLer[:PCC]:ABSolute?
FETCh:INTermediate:LTE:SIGN<i>:EBLer:SCC<c>:ABSolute?
FETCh:LTE:SIGN<i>:EBLer[:PCC]:ABSolute?
FETCh:LTE:SIGN<i>:EBLer:SCC<c>:ABSolute?

Returns the absolute overall results of the BLER measurement for the sum of all DL streams of one carrier.

The number to the left of each result parameter is provided for easy identification of the parameter position within the result array.

Suffix:

<c>	1..2

Return values:

<1_Reliability>	see Reliability Indicator
<2_ACK>	Number of received acknowledgments (sum of all downlink streams) Range: 0 to 4E+9
<3_NACK>	Number of received negative acknowledgments (sum of all downlink streams) Range: 0 to 4E+9
<4_Subframes>	Number of already processed subframes (per downlink stream) Range: 0 to 2E+9
<5_ThroughputAver> <6_ThroughputMin> <7_ThroughputMax>	Average, minimum and maximum throughput (sum of all downlink streams) Range: 0 kbit/s to 200E+3 kbit/s Default unit: kbit/s
<8_DTX>	Number of sent scheduled subframes for which neither ACK nor NACK has been received (sum of all downlink streams) Range: 0 to 4E+9
<9_Scheduled>	Number of already sent scheduled subframes (per downlink stream) Range: 0 to 2E+9
<10_MedianCQI>	Median value of received CQI indices Range: 0 to 15

Example: See Performing a Continuous BLER Measurement

Usage: Query only

Firmware/Software: V3.0.10
V3.0.30: INTermediate command, max number of subframes enhanced for continuous measurements
V3.2.50: SCC command

FETCh:INTermediate:LTE:SIGN<i>:EBLer:ALL:ABSolute?
FETCh:LTE:SIGN<i>:EBLer:ALL:ABSolute?

Returns the absolute overall results of the BLER measurement for the sum of all downlink streams of all carriers.

The number to the left of each result parameter is provided for easy identification of the parameter position within the result array.

Return values:

<1_Reliability>	see Reliability Indicator

<2_ACK>	Number of received acknowledgments (sum of all downlink streams) Range: 0 to 4E+9
<3_NACK>	Number of received negative acknowledgments (sum of all downlink streams) Range: 0 to 4E+9
<4_Subframes>	Number of already processed subframes (per downlink stream) Range: 0 to 2E+9
<5_ThroughputAver> <6_ThroughputMin> <7_ThroughputMax>	Average, minimum and maximum throughput (sum of all downlink streams) Range: 0 kbit/s to 400E+3 kbit/s Default unit: kbit/s
<8_DTX>	Number of sent scheduled subframes for which neither ACK nor NACK has been received (sum of all downlink streams) Range: 0 to 4E+9
<9_Scheduled>	Number of already sent scheduled subframes (per downlink stream) Range: 0 to 2E+9
<10_MedianCQI>	Median value of received CQI indices Range: 0 to 15

Example: See Performing a Continuous BLER Measurement

Usage: Query only

Firmware/Software: V3.2.50

FETCh:INTermediate:LTE:SIGN<i>:EBLer[:PCC]:RELative?
FETCh:INTermediate:LTE:SIGN<i>:EBLer:SCC<c>:RELative?
FETCh:LTE:SIGN<i>:EBLer[:PCC]:RELative?
FETCh:LTE:SIGN<i>:EBLer:SCC<c>:RELative?

Returns the relative overall results of the BLER measurement for the sum of all DL streams of one carrier.

The number to the left of each result parameter is provided for easy identification of the parameter position within the result array.

Suffix:

<c>	1..2

Return values:

<1_Reliability>	see Reliability Indicator
<2_ACK>	Received acknowledgments (percentage of sent scheduled subframes) Range: 0 % to 100 % Default unit: %

<3_NACK>	Received negative acknowledgments (percentage of sent scheduled subframes) Range: 0 % to 100 % Default unit: %
<4_BLER>	Block error ratio (percentage of sent scheduled subframes for which no ACK has been received) Range: 0 % to 100 % Default unit: %
<5_ThroughputAver>	Average DL throughput (as percentage of maximum reachable throughput) Range: 0 % to 100 % Default unit: %
<6_DTX>	Percentage of sent scheduled subframes for which neither ACK nor NACK has been received Range: 0 % to 100 % Default unit: %
Example:	See Performing a Continuous BLER Measurement
Usage:	Query only
Firmware/Software:	V3.0.30, SCC command V3.2.50

FETCh:INTermediate:LTE:SIGN<i>:EBLer:ALL:RELative?
FETCh:LTE:SIGN<i>:EBLer:ALL:RELative?

Returns the relative overall results of the BLER measurement for the sum of all downlink streams of all carriers.

The number to the left of each result parameter is provided for easy identification of the parameter position within the result array.

Return values:

<1_Reliability>	see Reliability Indicator
<2_ACK>	Received acknowledgments (percentage of sent scheduled subframes) Range: 0 % to 100 % Default unit: %
<3_NACK>	Received negative acknowledgments (percentage of sent scheduled subframes) Range: 0 % to 100 % Default unit: %
<4_BLER>	Block error ratio (percentage of sent scheduled subframes for which no ACK has been received) Range: 0 % to 100 % Default unit: %

<5_ThroughputAver>	Average DL throughput (as percentage of maximum reachable throughput) Range: 0 % to 100 % Default unit: %
<6_DTX>	Percentage of sent scheduled subframes for which neither ACK nor NACK has been received Range: 0 % to 100 % Default unit: %

Example: See Performing a Continuous BLER Measurement

Usage: Query only

Firmware/Software: V3.2.50

FETCh:INTermediate:LTE:SIGN<i>:EBLer[:PCC]:STReam<s>:ABSolute?
FETCh:INTermediate:LTE:SIGN<i>:EBLer:SCC<c>:STReam<s>:ABSolute?
FETCh:LTE:SIGN<i>:EBLer[:PCC]:STReam<s>:ABSolute?
FETCh:LTE:SIGN<i>:EBLer:SCC<c>:STReam<s>:ABSolute?

Returns the absolute results of the BLER measurement for one downlink stream of one carrier.

The number to the left of each result parameter is provided for easy identification of the parameter position within the result array.

Suffix:

<s>	1..2
<c>	1..2

Return values:

<1_Reliability>	see Reliability Indicator
<2_ACK>	Number of received acknowledgments Range: 0 to 2E+9
<3_NACK>	Number of received negative acknowledgments Range: 0 to 2E+9
<4_Subframes>	Number of already processed subframes Range: 0 to 2E+9
<5_Throughput>	Average DL throughput Range: 0 kbit/s to 100E+3 kbit/s Default unit: kbit/s
<6_DTX>	Number of sent scheduled subframes for which neither ACK nor NACK has been received Range: 0 to 2E+9
<7_Scheduled>	Number of already sent scheduled subframes Range: 0 to 2E+9

<8_MedianCQI> Median value of received CQI indices

Range: 0 to 15

Example: See Performing a Continuous BLER Measurement

Usage: Query only

Firmware/Software: V3.0.10
V3.0.30: INTermediate command, max number of subframes enhanced for continuous measurements
V3.2.50: SCC command

Options: R&S CMW-KS520

FETCh:INTermediate:LTE:SIGN<i>:EBLer[:PCC]:STReam<s>:RELative?
FETCh:INTermediate:LTE:SIGN<i>:EBLer:SCC<c>:STReam<s>:RELative?
FETCh:LTE:SIGN<i>:EBLer[:PCC]:STReam<s>:RELative?
FETCh:LTE:SIGN<i>:EBLer:SCC<c>:STReam<s>:RELative?

Returns the relative results of the BLER measurement for one downlink stream of one carrier.

Suffix:

<s> 1..2

<c> 1..2

Return values:

<Reliability> see Reliability Indicator

<ACK> Received acknowledgments (percentage of sent scheduled subframes)

Range: 0 % to 100 %
Default unit: %

<NACK> Received negative acknowledgments (percentage of sent scheduled subframes)

Range: 0 % to 100 %
Default unit: %

<BLER> Block error ratio (percentage of sent scheduled subframes for which no ACK has been received)

Range: 0 % to 100 %
Default unit: %

<Throughput> Average DL throughput (percentage of maximum reachable throughput)

Range: 0 % to 100 %
Default unit: %

<DTX> Percentage of sent scheduled subframes for which neither ACK nor NACK has been received

Range: 0 % to 100 %
Default unit: %

Example: See Performing a Continuous BLER Measurement

Usage: Query only

Firmware/Software: V3.0.30, SCC command V3.2.50

Options: R&S CMW-KS520

FETCh:LTE:SIGN<i>:EBLer[:PCC]:CQIReporting:STReam<s>?
FETCh:LTE:SIGN<i>:EBLer:SCC<c>:CQIReporting:STReam<s>?

Returns the single results of the CQI reporting view for one downlink stream of one carrier.

Suffix:

<s> 1..2

<c> 1..2

Return values:

<Reliability> see Reliability Indicator

<CQImedian> Median reported CQI value
Range: 0 to 15

<RangeAbsolute> Number of reports received for the range from median CQI - 1 to median CQI + 1
Range: 0 to 2E+9

<RangeRelative> <RangeAbsolute> as percentage of total number of received reports
Range: 0 % to 100 %
Default unit: %

<BLER> Block error ratio (percentage of sent scheduled subframes for which no ACK has been received)
Range: 0 % to 100 %
Default unit: %

<TotalNumber> Total number of received CQI reports
Range: 0 to 2E+9

<ExpiredSubframes> Number of already sent scheduled subframes
Range: 0 to 2E+9

Example: See Performing a Single-Shot BLER Measurement

Usage: Query only

Firmware/Software: V3.0.30, SCC command V3.2.70

FETCh:LTE:SIGN<i>:EBLer:TRACe:THRoughput[:PCC]:STReam<s>?
FETCh:LTE:SIGN<i>:EBLer:TRACe:THRoughput:SCC<c>:STReam<s>?

Returns the throughput trace for one downlink stream of one carrier.

Each value is returned as a pair of X-value and Y-value. The number of result pairs n equals the number of subframes to be processed per measurement cycle, divided by 200.

Returned results: <Reliability>, <XValue>$_1$, <YValue>$_1$, ..., <XValue>$_n$, <YValue>$_n$

Suffix:

<s> 1..2

<c> 1..2

Return values:

<Reliability> see Reliability Indicator

<XValue> Subframe label, 0 = last processed subframe, -1 = previously processed subframe and so on

Range: -199800 to 0

<YValue> Throughput value calculated from the BLER result of 200 processed subframes (the labeled subframe and the previous 199 subframes)

Range: 0 kbit/s to 100E+3 kbit/s
Default unit: kbit/s

Example: See Performing a Single-Shot BLER Measurement

Usage: Query only

Firmware/Software: V2.0.10, SCC command V3.2.50

Options: R&S CMW-KS520

FETCh:LTE:SIGN<i>:EBLer:TRACe:THRoughput[:PCC]?
FETCh:LTE:SIGN<i>:EBLer:TRACe:THRoughput:SCC<c>?

Returns the throughput trace for the sum of all DL streams of one carrier.

Each value is returned as a pair of X-value and Y-value. The number of result pairs n equals the number of subframes to be processed per measurement cycle, divided by 200.

Returned results: <Reliability>, <XValue>$_1$, <YValue>$_1$, ..., <XValue>$_n$, <YValue>$_n$

Suffix:

<c> 1..2

Return values:

<Reliability> see Reliability Indicator

<XValue> Subframe label, 0 = last processed subframe, -1 = previously processed subframe and so on

Range: -199800 to 0

<YValue> Throughput value calculated from the BLER result of 200 processed subframes (the labeled subframe and the previous 199 subframes)

Range: 0 kbit/s to 200E+3 kbit/s
Default unit: kbit/s

Example: See Performing a Single-Shot BLER Measurement

Usage: Query only

Firmware/Software: V2.0.10. SCC command V3.2.50

FETCh:LTE:SIGN<i>:EBLer:TRACe:THRoughput:ALL?

Returns the throughput trace for the sum of all downlink streams of all carriers.

Each value is returned as a pair of X-value and Y-value. The number of result pairs n equals the number of subframes to be processed per measurement cycle, divided by 200.

Returned results: <Reliability>, <XValue>$_1$, <YValue>$_1$, ..., <XValue>$_n$, <YValue>$_n$

Return values:

<Reliability> see Reliability Indicator

<XValue> Subframe label, 0 = last processed subframe, -1 = previously processed subframe and so on

Range: -199800 to 0

<YValue> Throughput value calculated from the BLER result of 200 processed subframes (the labeled subframe and the previous 199 subframes)

Range: 0 kbit/s to 400E+3 kbit/s
Default unit: kbit/s

Example: See Performing a Single-Shot BLER Measurement

Usage: Query only

Firmware/Software: V3.2.50

FETCh:LTE:SIGN<i>:EBLer:TRACe:THRoughput[:PCC]:MCQI:STReam<s>?
FETCh:LTE:SIGN<i>:EBLer:TRACe:THRoughput:SCC<c>:MCQI:STReam<s>?

Returns the median CQI trace for one downlink stream.

Each value is returned as a pair of X-value and Y-value. The number of result pairs n equals the number of subframes to be processed per measurement cycle, divided by 200.

Returned results: <Reliability>, <XValue>$_1$, <YValue>$_1$, ..., <XValue>$_n$, <YValue>$_n$

Suffix:

<s> 1..2

<c> 1..2

Return values:

<Reliability> see Reliability Indicator

<XValue> Subframe label, 0 = last processed subframe, -1 = previously processed subframe and so on

Range: -199800 to 0

<YValue> Median CQI value calculated from the CQI indices reported within 200 processed subframes (the labeled subframe and the previous 199 subframes)

Range: 0 to 15

Example: See Performing a Single-Shot BLER Measurement

Usage: Query only

Firmware/Software: V3.0.10, SCC command V3.2.70

FETCh:LTE:SIGN<i>:EBLer:TRACe:CQIReporting[:PCC]:STReam<s>?
FETCh:LTE:SIGN<i>:EBLer:TRACe:CQIReporting:SCC<c>:STReam<s>?

Returns the Y-values of the CQI index bar graph for one downlink stream.

Suffix:

<s> 1..2

<c> 1..2

Return values:

<Reliability> see Reliability Indicator

<YValue> Comma-separated list of 16 Y-values, for CQI index 0 to 15

Range: 0 to 2E+9

Example: See Performing a Single-Shot BLER Measurement

Usage: Query only

Firmware/Software: V3.0.10, SCC command V3.2.70

FETCh:LTE:SIGN<i>:EBLer[:PCC]:RI?
FETCh:LTE:SIGN<i>:EBLer:SCC<c>:RI?

Returns the Rank Indicator (RI) results.

Suffix:

<c> 1..2

Return values:

<Reliability> see Reliability Indicator

<RI> Number of received rank indicators with value = 1

Range: 0 to 2E+9

Example: See Performing a Single-Shot BLER Measurement

Usage: Query only

Firmware/Software: V3.2.20, SCC command V3.2.70

FETCh:LTE:SIGN<i>:EBLer[:PCC]:PMI:RI<no>?
FETCh:LTE:SIGN<i>:EBLer:SCC<c>:PMI:RI<no>?

Returns the PMI results for the RI value <no>.

Suffix:

<no> 1..2

<c> 1..2

Return values:

<Reliability> see Reliability Indicator

<PMI> Comma-separated list of values, indicating number of received PMI values
The number of results depends on the number of transmit antennas and the selected RI:
2 antennas, RI = 1: 4 values for PMI = 0, 1, 2, 3
2 antennas, RI = 2: 2 values for PMI = 0, 1
4 antennas: 16 values for PMI = 0, 1, ..., 15
Range: 0 to 2E+9

Example: See Performing a Single-Shot BLER Measurement

Usage: Query only

Firmware/Software: V3.2.20, SCC command V3.2.70

FETCh:LTE:SIGN<i>:EBLer[:PCC]:HARQ:STReam<s>:TRANsmission:ABSolute?
FETCh:LTE:SIGN<i>:EBLer:SCC<c>:HARQ:STReam<s>:TRANsmission:ABSolute?

Returns absolute HARQ results for one downlink stream. All columns of the "HARQ per Transmissions" result table are returned:

<Reliability>, $\{$<Sent>, <ACK>, <NACK>, <DTX>$\}_{\text{column 1}}$, $\{...\}_{\text{col. 2}}$, $\{...\}_{\text{col. 3}}$, $\{...\}_{\text{col. 4}}$

Suffix:

<s> 1..2

<c> 1..2

Return values:

<Reliability> see Reliability Indicator

<Sent> Number of sent subframes
Range: 0 to 2E+9

<ACK> Number of received acknowledgments
Range: 0 to 2E+9

<NACK> Number of received negative acknowledgments
Range: 0 to 2E+9

<DTX> Number of sent subframes for which neither ACK nor NACK has been received

Range: 0 to 2E+9

Example: See Performing a Single-Shot BLER Measurement

Usage: Query only

Firmware/Software: V3.2.10, SCC command V3.2.70

FETCh:LTE:SIGN<i>:EBLer[:PCC]:HARQ:STReam<s>:TRANsmission:RELative?
FETCh:LTE:SIGN<i>:EBLer:SCC<c>:HARQ:STReam<s>:TRANsmission:RELative?

Returns relative HARQ results for one downlink stream. All columns of the "HARQ per Transmissions" result table are returned:

<Reliability>, {<Sent>, <ACK>, <NACK>, <DTX>}$_{\text{column 1}}$, {...}$_{\text{col. 2}}$, {...}$_{\text{col. 3}}$, {...}$_{\text{col. 4}}$

Suffix:

<s> 1..2

<c> 1..2

Return values:

<Reliability> see Reliability Indicator

<Sent> Sent subframes (percentage of sum of sent subframes over all transmissions)

Range: 0 % to 100 %
Default unit: %

<ACK> Received acknowledgments (percentage of ACK+NACK+DTX in the column)

Range: 0 % to 100 %
Default unit: %

<NACK> Received negative acknowledgments (percentage of ACK +NACK+DTX in the column)

Range: 0 % to 100 %
Default unit: %

<DTX> Sent subframes for which neither ACK nor NACK has been received (percentage of ACK+NACK+DTX in the column)

Range: 0 % to 100 %
Default unit: %

Example: See Performing a Single-Shot BLER Measurement

Usage: Query only

Firmware/Software: V3.2.10, SCC command V3.2.70

FETCh:LTE:SIGN<i>:EBLer[:PCC]:HARQ:STReam<s>:SUBFrame:ABSolute?
FETCh:LTE:SIGN<i>:EBLer:SCC<c>:HARQ:STReam<s>:SUBFrame:ABSolute?

Returns absolute HARQ results for one downlink stream. All columns of the "HARQ per Subframe" result table are returned:

<Reliability>, {<Sent>, <ACK>, <NACK>, <DTX>}$_{\text{column 0}}$, {...}$_{\text{column 1}}$, ..., {...}$_{\text{column 9}}$

Suffix:

<s> 1..2

<c> 1..2

Return values:

<Reliability> see Reliability Indicator

<Sent> NAV returned, for future use

<ACK> Number of received acknowledgments
Range: 0 to 2E+9

<NACK> Number of received negative acknowledgments
Range: 0 to 2E+9

<DTX> Number of sent subframes for which neither ACK nor NACK has been received
Range: 0 to 2E+9

Example: See Performing a Single-Shot BLER Measurement

Usage: Query only

Firmware/Software: V3.2.10, SCC command V3.2.70

FETCh:LTE:SIGN<i>:EBLer[:PCC]:HARQ:STReam<s>:SUBFrame:RELative?
FETCh:LTE:SIGN<i>:EBLer:SCC<c>:HARQ:STReam<s>:SUBFrame:RELative?

Returns relative HARQ results for one downlink stream. All columns of the "HARQ per Subframe" result table are returned:

<Reliability>, {<Sent>, <ACK>, <NACK>, <DTX>}$_{\text{column 0}}$, {...}$_{\text{column 1}}$, ..., {...}$_{\text{column 9}}$

Suffix:

<s> 1..2

<c> 1..2

Return values:

<Reliability> see Reliability Indicator

<Sent> NAV returned, for future use

<ACK> Received acknowledgments (percentage of ACK+NACK+DTX in the column)
Range: 0 % to 100 %
Default unit: %

<NACK> Received negative acknowledgments (percentage of ACK +NACK+DTX in the column)

Range: 0 % to 100 %
Default unit: %

<DTX> Sent subframes for which neither ACK nor NACK has been received (percentage of ACK+NACK+DTX in the column)

Range: 0 % to 100 %
Default unit: %

Example: See Performing a Single-Shot BLER Measurement

Usage: Query only

Firmware/Software: V3.2.10, SCC command V3.2.70

FETCh:LTE:SIGN<i>:EBLer:UPLink?

Returns the uplink results of the BLER measurement.

Return values:

<Reliability> see Reliability Indicator

<BLER> Block error ratio (percentage of received uplink subframes with failed CRC check)

Range: 0 % to 100 %
Default unit: %

<Throughput> Average uplink throughput

Range: 0 bit/s to 99E+6 bit/s
Default unit: bit/s

<CRCPass> Number of received subframes with passed CRC check

Range: 0 to 2E+9

<CRCFail> Number of received subframes with failed CRC check

Range: 0 to 2E+9

Example: See Performing a Single-Shot BLER Measurement

Usage: Query only

Firmware/Software: V3.0.50

Options: R&S CMW-KS510

2.6.20 RLC Throughput Measurement

The following sections describe the commands related to the "RLC Throughput" measurement.

2.6.20.1 Measurement Control and States

The following commands control the measurement and return the current measurement state.

INITiate:LTE:SIGN<i>:THRoughput
STOP:LTE:SIGN<i>:THRoughput
ABORt:LTE:SIGN<i>:THRoughput

Starts, stops, or aborts the measurement:

- `INITiate...` starts or restarts the measurement; the R&S CMW enters the "RUN" state.
- `STOP...` causes a running measurement to stop after the current evaluation period is terminated and valid results are available; the R&S CMW enters the "RDY" state.
- `ABORt...` causes a running measurement to stop immediately; the R&S CMW enters the "OFF" state.

Use `FETCh...STATe?` to query the current measurement state.

See also: "Measurement Control" in the R&S CMW user manual, chapter "Remote Control"

Example: See Performing an RLC Throughput Measurement

Usage: Event

Firmware/Software: V3.2.80

Manual operation: See "RLC Throughput (Softkey)" on page 201

FETCh:LTE:SIGN<i>:THRoughput:STATe?

Queries the main measurement state. Use `FETCh:...:STATe:ALL?` to query the measurement state including the substates. Use `INITiate...`, `STOP...`, `ABORt...` to change the measurement state.

See also: "Measurement Control" in the R&S CMW user manual, chapter "Remote Control"

Return values:

<State> OFF | RDY | RUN

OFF: measurement switched off, no resources allocated, no results available (when entered after `ABORt...`)
RDY: measurement has been terminated, valid results may be available
RUN: measurement running (after `INITiate..., READ...`), synchronization pending or adjusted, resources active or queued

*RST: OFF

Example: See Performing an RLC Throughput Measurement

Usage: Query only

Firmware/Software: V3.2.80

Manual operation: See "RLC Throughput (Softkey)" on page 201

FETCh:LTE:SIGN<i>:THRoughput:STATe:ALL?

Queries the main measurement state and the measurement substates. Both measurement substates are relevant for running measurements only. Use `FETCh:...:STATe?` to query the main measurement state only. Use `INITiate...`, `STOP...`, `ABORt...` to change the measurement state.

See also: "Measurement Control" in the R&S CMW user manual, chapter "Remote Control"

Return values:

<MainState> OFF | RDY | RUN

OFF: measurement switched off, no resources allocated, no results available (when entered after `STOP...`)
RDY: measurement has been terminated, valid results may be available
RUN: measurement running (after `INITiate..., READ...`), synchronization pending or adjusted, resources active or queued

*RST: OFF

<SyncState> PEND | ADJ | INV

PEND: waiting for resource allocation, adjustment, hardware switching ("pending")
ADJ: all necessary adjustments finished, measurement running ("adjusted")
INV: not applicable because <main_state>: OFF or RDY ("invalid")

<RessourceState> QUE | ACT | INV

QUE: measurement without resources, no results available ("queued")
ACT: resources allocated, acquisition of results in progress but not complete ("active")
INV: not applicable because <main_state>: OFF or RDY ("invalid")

Usage: Query only

Firmware/Software: V3.2.80

Manual operation: See "RLC Throughput (Softkey)" on page 201

2.6.20.2 Measurement Settings

The following commands configure the "RLC Throughput" measurement.

CONFigure:LTE:SIGN<i>:THRoughput:TOUT <Timeout>

Defines a timeout for the measurement. The timer is started when the measurement is initiated via a `READ` or `INIT` command. It is not started if the measurement is initiated manually (ON/OFF key or RESTART/STOP key).

When the measurement has completed the first measurement cycle (first single shot), the statistical depth is reached and the timer is reset.

If the first measurement cycle has not been completed when the timer expires, the measurement is stopped. The measurement state changes to `RDY` and the reliability indicator is set to 1, indicating that a measurement timeout occurred. Still running `READ`, `FETCh` or `CALCulate` commands are completed, returning the available results. At least for some results there are no values at all or the statistical depth has not been reached.

A timeout of 0 s corresponds to an infinite measurement timeout.

Parameters:
<Timeout> Default unit: s

Firmware/Software: V3.2.80

CONFigure:LTE:SIGN<i>:THRoughput:REPetition <Repetition>

Specifies whether the measurement is stopped after a single shot (window size) or repeated continuously.

Parameters:

<Repetition> SINGleshot | CONTinuous

SINGleshot: Single-shot measurement
CONTinuous: Continuous measurement

*RST: SING

Example: See Configuring an RLC Throughput Measurement

Firmware/Software: V3.2.80

Manual operation: See "Repetition" on page 203

CONFigure:LTE:SIGN<i>:THRoughput:UPDate <Interval>

Configures the number of subframes used to derive a single throughput result.

Parameters:

<Interval> Range: 200 to 10000
Increment: 100
*RST: 500

Example: See Configuring an RLC Throughput Measurement

Firmware/Software: V3.2.80

Manual operation: See "Update Interval" on page 203

CONFigure:LTE:SIGN<i>:THRoughput:WINDow <Size>

Configures the number of subframes on the X-axis of the throughput diagram (duration of a single-shot measurement).

The size cannot be smaller than the update interval.

Parameters:

<Size> Range: 200 to 120000
*RST: 60000

Example: See Configuring an RLC Throughput Measurement

Firmware/Software: V3.2.80

Manual operation: See "Window Size" on page 203

2.6.20.3 Measurement Results

The following commands retrieve the results of the "RLC Throughput" measurement.

FETCh:LTE:SIGN<i>:THRoughput?
READ:LTE:SIGN<i>:THRoughput?

Returns the contents of the RLC throughput result table.

Return values:

<Reliability>	see Reliability Indicator
<CurrDlPDU>	Current downlink throughput Default unit: bit/s
<AvgDlPDU>	Average downlink throughput Default unit: bit/s
<MaxDlPDU>	Maximum downlink throughput Default unit: bit/s
<MinDlPDU>	Minimum downlink throughput Default unit: bit/s
<BytesDlPDU>	Number of bytes transmitted in the downlink
<CurrUlPDU>	Current uplink throughput Default unit: bit/s
<AvgUlPDU>	Average uplink throughput Default unit: bit/s
<MaxUlPDU>	Maximum uplink throughput Default unit: bit/s
<MinUlPDU>	Minimum uplink throughput Default unit: bit/s
<BytesUlPDU>	Number of bytes received in the uplink
Example:	See Performing an RLC Throughput Measurement
Usage:	Query only
Firmware/Software:	V3.2.80

FETCh:LTE:SIGN<i>:THRoughput:TRACe:UL:PDU:CURRent?
FETCh:LTE:SIGN<i>:THRoughput:TRACe:UL:PDU:AVERage?
READ:LTE:SIGN<i>:THRoughput:TRACe:UL:PDU:CURRent?
READ:LTE:SIGN<i>:THRoughput:TRACe:UL:PDU:AVERage?

Returns the values of the uplink throughput traces. The results of the current and average traces can be retrieved.

The number of trace values n depends on the configured update interval and window size: *n = integer (<window size> / <update interval>) + 1*

Return values:

<Reliability> see Reliability Indicator

<UplinkPDU> Comma-separated list of n throughput values
Default unit: bit/s

Example: See Performing an RLC Throughput Measurement

Usage: Query only

Firmware/Software: V3.2.80

FETCh:LTE:SIGN<i>:THRoughput:TRACe:DL:PDU:CURRent?
FETCh:LTE:SIGN<i>:THRoughput:TRACe:DL:PDU:AVERage?
READ:LTE:SIGN<i>:THRoughput:TRACe:DL:PDU:CURRent?
READ:LTE:SIGN<i>:THRoughput:TRACe:DL:PDU:AVERage?

Returns the values of the downlink throughput traces. The results of the current and average traces can be retrieved.

The number of trace values n depends on the configured update interval and window size: *n = integer (<window size> / <update interval>) + 1*

Return values:

<Reliability> see Reliability Indicator

<DownlinkPDU> Comma-separated list of n throughput values
Default unit: bit/s

Example: See Performing an RLC Throughput Measurement

Usage: Query only

Firmware/Software: V3.2.80

2.7 List of Commands

3 LTE Multi Evaluation Measurement

The "LTE Multi Evaluation" measurement provides quick and flexible TX tests on LTE FDD and TDD uplink signals and an RX test (Block Error Ratio test). The TX tests cover the following UE transmitter properties:

- UE output power for each resource block (Inband Emissions)
- UE output power per subframe (Power Monitor)
- PUCCH/PUSCH OFF power, PUCCH/PUSCH ON power, SRS OFF power, SRS ON power (Power Dynamics)
- UE power variation across the allocated subcarrier range (Equalizer Spectrum Flatness)
- Modulation accuracy for each SC-FDMA symbol (EVM, Magnitude Error, Phase Error)
- Modulation accuracy for each subcarrier (EVM vs. Subcarrier)
- I/Q Constellation diagram
- Overview of allocated resource blocks (RB Allocation table)
- Out-of-band emissions (Spectrum Emission Mask and ACLR)

Many of the tests and conformance requirements are specified in 3GPP TS 36.101 or 3GPP TS 36.521.

The multi evaluation measurement requires option R&S CMW-KM500 for FDD signals and R&S CMW-KM550 for TDD signals.

3.1 What's New in this Revision

This revision describes version 3.2.82 and later of the "LTE Multi Evaluation Measurement" firmware application. Compared to version 3.2.80, it provides the following new features:

- Additional spectrum emission: new values NS_19, NS_21 to NS_24, see Network Signaled Value
- Additional spectrum emission mask limits set 1 applies also to NS_20 and NS_21, see Spectrum Emission Mask
- Shortcut softkey to the GPRF generator, see Shortcut Configuration

Software Version

To check your R&S CMW software version, open the "Setup" dialog and click "HW/SW Equipment". The initial software version for each remote control command is quoted in the reference description.

3.2 General Description

The LTE "Multi Evaluation" measurement captures an uplink (UL) LTE signal and provides the TX measurement results for a configurable UL subframe / range of subframes.

Both FDD signals (option R&S CMW-KM500) and TDD signals (option R&S CMW-KM550) can be measured. For signals with uplink carrier aggregation, an additional option is required (R&S CMW-KM502 for FDD, R&S CMW-KM552 for TDD).

With an additional ARB generator, it is also possible to perform Block Error Ratio (BLER) measurements (RX tests).

The following sections describe how to perform and configure the measurement.

3.2.1 LTE TX Tests

TX tests have many characteristics in common. The following sections describe these characteristics and show how to perform TX tests.

3.2.1.1 Test Setup

The external RF signal source (mobile station, signal generator etc.) is connected to one of the RF input connectors (RF COM) at the front panel of the R&S CMW. No additional cabling and no external trigger is needed.

The input level ranges of all RF COM connectors are identical.

See also: "RF Connectors" in the R&S CMW user manual, chapter "Getting Started"

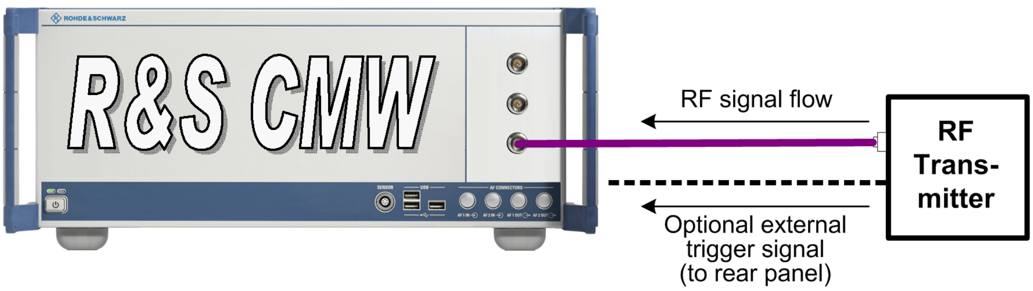


Fig. 3-1: Connecting an RF transmitter to the instrument

3.2.1.2 How to Measure an Uplink LTE Signal

After connecting your LTE UE to the R&S CMW, you have to adjust at least the following analyzer settings to the properties of the analyzed UL LTE signal:

- "Duplex Mode"
- Analyzer "Frequency"
- "Expected Nominal Power", "External Attenuation (Input)" and "User Margin"
  Recommended values: "Expected Nominal Power" = peak power of the UE signal during the measurement; "User Margin" = 0 dB. The smallest possible value of the "Expected Nominal Power" plus the "User Margin" ensures maximum dynamic range.

For synchronization to the received signal and proper decoding, a number of settings must be in accordance with the measured signal. In particular, ensure that the following parameters match up:

- For TDD signals: "Uplink Downlink", "Special Subframe" and "Measure Subframe"
  Ensure that you select an UL subframe as "Measure Subframe". When a frame trigger signal is used, subframe 0 selected by default is a DL subframe.
- Length of the "Cyclic Prefix"
- "Channel Bandwidth"
- For signals with PUCCH: "PUCCH Format"
- "Physical Cell ID" and "Delta Seq. Shift PUSCH"
- "Group Hopping"

The R&S CMW can auto-detect the "Modulation Scheme" of the received signal.

With matching "Measurement Control" settings, the R&S CMW is able to decode the signal and determine its frame timing. No additional measurement trigger is required (see chapter 3.2.1.6, "Trigger Modes", on page 495).

Non-matching "Measurement Control" settings generally result in large EVM results.

3.2.1.3 Defining the Scope of the Measurement

The LTE "Multi Evaluation" measurement can capture up to 320 consecutive subframes, starting at a configurable offset from the trigger event.

The results "Power Monitor" and "RB allocation table" are available for the entire range of captured subframes. All other TX measurement results are derived from a selected subframe within the range of captured subframes.

For TDD signals, you must ensure that the selected subframe (measure subframe) is an uplink subframe. Which subframe is labeled 0, depends on the type of trigger signal and the subframe offset. For subframe offset 0, the subframe labeled 0 is an uplink subframe for power trigger signals (first detected uplink subframe) and a downlink subframe for frame trigger signals (first subframe of frame).

For signals with carrier aggregation, some results are available for PCC and SCC. Other results are measured either on the PCC or on the SCC, depending on the selected "Measurement Carrier". For details, see chapter 3.2.1.4, "Carrier Aggregation", on page 493.

Depending on the measurement, the statistic count is defined in subframes or in slots.

Example:

Assume the following settings (see chapter 3.3.5, "Measurement Control Settings", on page 544):

- subframe offset = 3
- number of subframes = 10
- measure subframe = 4
- all statistic counts = 5

Resulting measurement scope:

- "Power Monitor" and "RB allocation table" show 10 subframes, labeled 0 to 9. The subframe labeled 0 is the fourth subframe (first + offset 3) captured after the trigger event.
  For the "Power Monitor", the 10 subframes are captured 5 times (statistic count) to complete one statistics cycle.
- For the "Power Dynamics" measurement, the subframe labeled 4 (measure subframe) is captured 5 times (statistic count) to complete one statistics cycle.
- For all other results, 5 slots (statistic count) have to be measured per statistics cycle and only slots within the subframe labeled 4 (measure subframe) contribute to the results.
  Each subframe contains 2 slots. To measure 5 slots, the entire subframe range has to be captured 3 times. The first and second time, both slots of subframe 4 are measured. The third time, only the first slot of subframe 4 is measured. Now the statistics cycle is complete and a single-shot measurement stops.

3.2.1.4 Carrier Aggregation

To measure signals with UL carrier aggregation, you must enhance the basic measurement functionality with option R&S CMW-KM502 for FDD or option R&S CMW-KM552 for TDD.

With these options, you can measure the Primary Component Carrier (PCC) and the Secondary Component Carrier (SCC) of an LTE UL signal with intra-band contiguous Carrier Aggregation (CA). The carriers can have different channel bandwidths and different RB allocations.

The following results are measured for one carrier at a time. For synchronization, this carrier must contain allocated RBs. You can either measure the PCC or the SCC.

- EVM, magnitude error, phase error
- I/Q diagram
- Modulation result tables
- Equalizer spectrum flatness
- Power dynamics

The spectrum results are measured for the combination of PCC and SCC, the aggregated bandwidth.

- Spectrum ACLR

- Spectrum emission mask

The following results are measured for both carriers in parallel. There are separate PCC and SCC results.

- Inband emission diagram
- Power monitor
- RB allocation table

How to measure an uplink LTE signal with CA

The basic measurement procedure is the same as for signals without carrier aggregation. Even the test setup is the same.

In addition, consider the following points:

- In the current software version, carrier aggregation measurements are only possible with the standalone scenario, not with the combined signal path scenario. List mode measurements are not supported.
- Enable carrier aggregation by selecting the "Carrier Aggregation Mode"
- Select a "Measurement Carrier". This carrier is used for synchronization, so it must have allocated RBs. The selected carrier is evaluated by single-carrier measurements, for example for measurement of modulation or power dynamics results.
- Configure the PCC and the SCC center frequency according to the 3GPP rules for intra-band contiguous CA.
  An automatism facilitates the configuration. You only need to configure the bandwidths and the PCC frequency. Then you specify whether the SCC frequency shall be above or below the PCC frequency and adjust the SCC frequency via a button.

See also chapter 3.3.4, "Carrier Aggregation Settings", on page 541

3.2.1.5 Parallel Signaling and Measurement

The multi evaluation measurement can be used in parallel to the LTE signaling application (option R&S CMW-KS500/-KS550), i.e. a connection to the UE can be set up by the signaling application and the resulting uplink signal can be measured using the multi evaluation measurement.

To use both applications in parallel, the combined signal path scenario must be activated (see "Scenario = Combined Signal Path" on page 538). Most signal routing and analyzer settings and some measurement control settings are then configured by the signaling application. The multi evaluation measurement displays the corresponding signaling settings instead of its own settings. These signaling settings can be configured both in the measurement GUI and in the GUI of the signaling application.

To configure these settings via remote commands, the commands of the signaling application must be used. For a command mapping table, see chapter 3.5.4, "Combined Signal Path Commands", on page 726.

The most important signaling parameters not relevant for standalone measurements can nevertheless be configured both in the measurement GUI and in the GUI of the signaling application. In the measurement GUI they can be accessed via hotkeys.

Whenever the combined signal path scenario is activated or the controlling application is changed, the frame trigger signal provided by the controlling signaling application is selected automatically as trigger source.

3.2.1.6 Trigger Modes

The LTE "Multi Evaluation" measurement can be performed in the following trigger modes:

- Free Run (Fast Sync): The measurement starts immediately after it is initiated. The R&S CMW decodes the signal to derive its slot and frame timing so that the "Measurement Length" can start at a slot or subframe boundary of the UL LTE signal.
  This trigger mode should only be used for uplink signals using all subframes for transmission.
- Free Run (No Sync): The measurement starts immediately after it is initiated, without any synchronization.
  This trigger mode is faster than the "Free Run (Fast Sync)" mode. It can be used for power monitor, ACLR and emission mask measurements, provided that the resource block allocation and uplink power are continuous. All other results must be ignored (e.g. modulation results, RB allocation and power dynamics).
- IF Power: With an internal IF power trigger, the measurement is triggered by the power ramp of the received bursts.
- External Trigger A/B: External trigger signal fed in via TRIG A or TRIG B on the rear panel of the instrument.
- Additional trigger modes: Other firmware applications, e.g. the LTE signaling application (option R&S CMW-KS500/-KS550) or the GPRF generator may provide additional trigger modes. Refer to the documentation of the corresponding firmware application for a description of these trigger modes.

For configuration see chapter 3.3.6, "Trigger Settings", on page 558

3.2.1.7 Calculation of Modulation Results

Modulation results are based on a comparison between the measured signal, corrected by the average frequency and timing offset for each measured subframe, and an ideal reference waveform.

See also: "Modulation Accuracy" in the R&S CMW user manual, chapter "System Overview"

3GPP TS 36.101, Annex F, specifies the following additional conditions:

- The I/Q origin offset shall be removed from the evaluated signal before calculating the EVM and the inband emissions.
- The EVM calculation shall be based on two different FFT processing windows in time domain, separated by the "EVM window length" W. The minimum test requirement applies to the larger of the two obtained EVM values.

The definition of the EVM window and the two FFT processing windows is shown below.

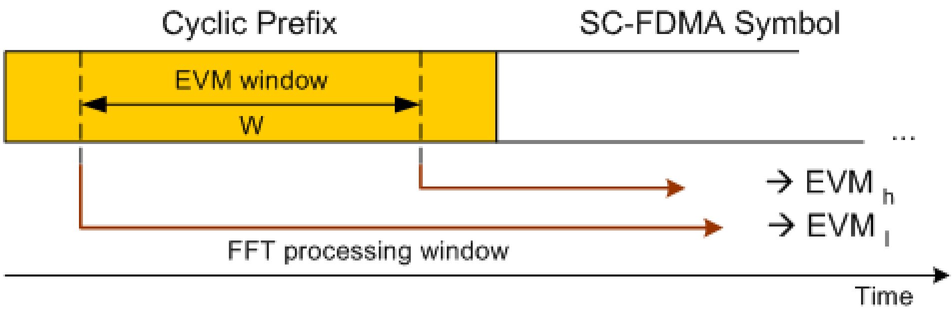


Fig. 3-2: EVM window definition

The EVM window is centered on the cyclic prefix (CP) at the beginning of the SC-FDMA symbol. Its length is specified in the standard, depending on the channel bandwidth and the cyclic prefix type (see 3GPP TS 36.101, tables F.5.3-1 and F.5.4-1).

The CP is a cyclic extension of the SC-FDMA symbol. As a consequence the EVM for a signal with good modulation accuracy is expected to be largely independent of the EVM window size. Differences between EVM_h and EVM_l arise e.g. due to the effects of time domain windowing of FIR pulse shaping.

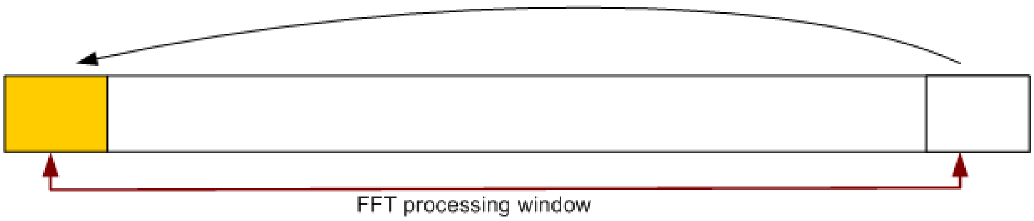


Fig. 3-3: Cyclic prefix

EVM window length settings

Use the settings in the "Config... > Measurement Control > Modulation > EVM Window Length" section to adjust the length of the EVM window (see "EVM Window Length" on page 554). The minimum value of 1 FFT symbol actually corresponds to a window of zero length so that EVM_h = EVM_l.

3.2.2 LTE RX Tests

RX tests can be carried out in parallel to the TX tests. The following sections describe how to perform LTE BLER tests in non-signaling mode, using the LTE "Multi Evaluation" measurement. In signaling mode (combined signal path) use the BLER measurement provided by the LTE signaling application.

3.2.2.1 Test Setup

The downlink RF generator signal of the R&S CMW is fed to the input of the DUT. The R&S CMW measures the uplink signal. Most conveniently, a bi-directional connection with a single coax cable is used. The DUT is connected to one of the RF input connectors (RF COM) at the front panel of the R&S CMW. No additional cabling and no external trigger is needed.

The input level ranges of all RF COM connectors are identical.

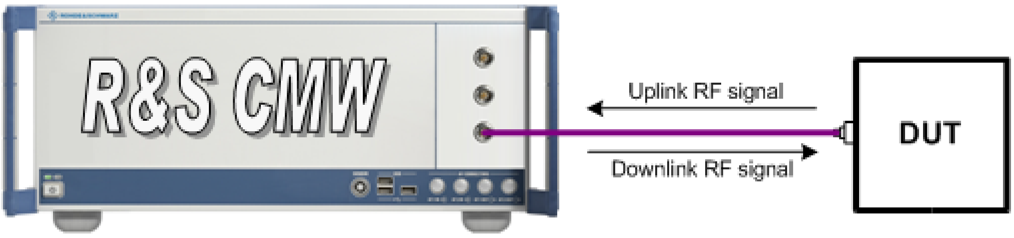


Fig. 3-4: Test setup for RX tests

3.2.2.2 Performing an LTE RX Measurement

The R&S CMW uses the ARB generator to send data to the receiver of the UE under test, transmitting a configurable number of PDSCH subframes. The UE is requested to acknowledge the correct reception of each subframe. The conditions for the ARB file are quite general, however, the UE must return the positive ACKnowledgement (ACK) or Negative ACKnowledgement (NACK) messages over the PUCCH using format F1a.

The R&S CMW calculates the BLER from the received ACKs, NACKs and missing answers (DTX). As the transmit time interval for LTE equals one subframe, a subframe corresponds to one transport block.

To synchronize the measurement to the ARB generator signal, an appropriate marker in the ARB file is recommended as a trigger source.

To perform an LTE BLER test, proceed as follows:

1. Establish the basic test setup for RX tests, connecting the UE under test to an RF COM connector.
2. **Generator:** Open the "GPRF Generator" application and start an LTE ARB file: Select "Baseband Mode: ARB" and press the "ARB > Select ARB File..." hotkey to open a dialog from where you can select the file. Press "ON | OFF" to turn on the RF generator.
3. **Measurement:** Open the "LTE Multi Evaluation" measurement application and enable the BLER measurement ("Multi Evaluation > Assign Views > BLER: ON").
4. Select "Measurement Control > PUCCH Format: F1a". This also ensures that a TX measurement which runs in parallel to the BLER test is configured in accordance with the expected UL signal.

5. Select "Measurement Control > Measurement Subframe > No. of Subframes: 320". This is the maximum value resulting in maximum measurement speed. And it is a multiple of 10, ensuring that the number of scheduled subframes per radio frame can be evaluated correctly.
6. Click "Measurement Control > BLER > No. of Subframes" and configure the number of subframes to be evaluated in total.
7. Click "Measurement Control > BLER > Scheduled Subframes/Frame" and specify the number of scheduled subframes per radio frame according to the generated downlink signal.
8. Click "Trigger > Trigger Source" and select one of the marker signals in the ARB file to trigger the BLER measurement.
9. Select the appropriate view ("Display > Select View: BLER") and press "ON | OFF" to start the measurement.

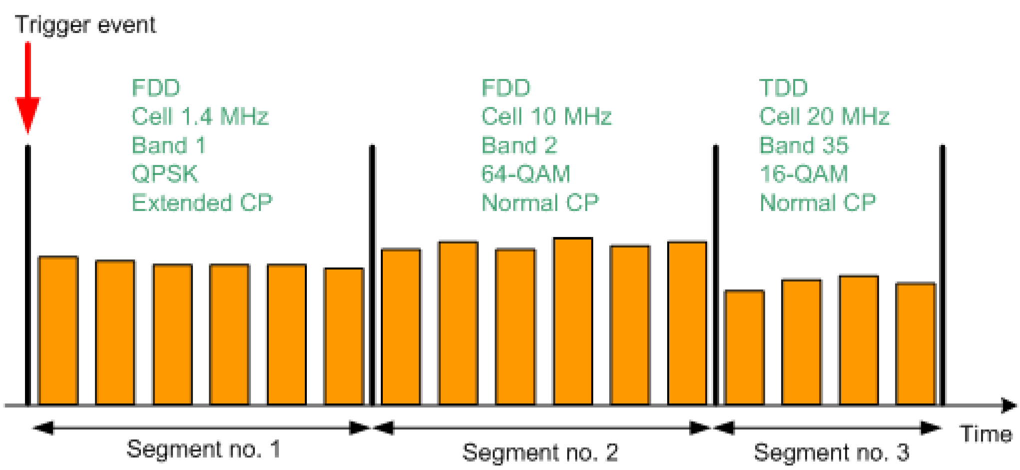
3.2.3 List Mode

The LTE multi evaluation list mode requires option R&S CMW-KM012. In this mode, the measurement interval is subdivided into segments, according to basic uplink signal properties like expected power, frequency, channel bandwidth and type of cyclic prefix.

The list mode is designed for single-carrier measurements. It can only be enabled, if the configured "Carrier Aggregation Mode" equals "Off".

3.2.3.1 List Mode Configuration

Each segment contains an integer number of subframes and is measured at constant analyzer settings. The figure below shows a series of three segments with different lengths, expected powers and the listed signal properties. Orange rectangles depict subframes.



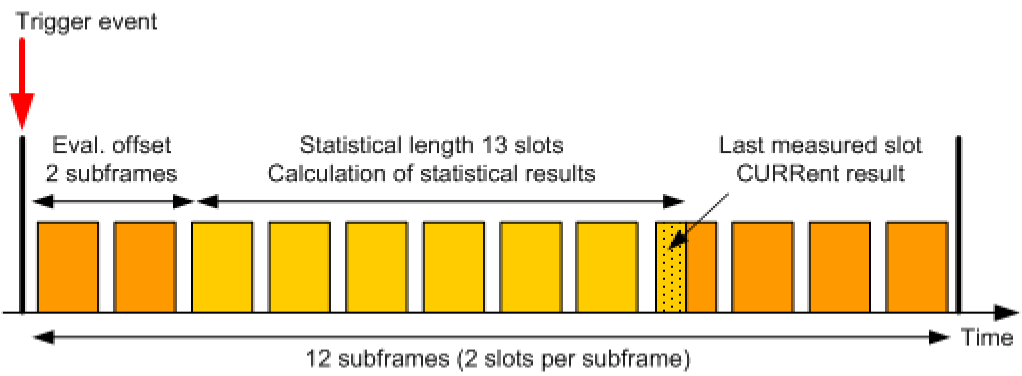
You can configure up to 2000 segments in total as preparation for list mode measurements. One list mode measurement can cover up to 1000 segments with in total up to

4000 measured subframes; for details see Maximum number of measured subframes. That means, for each measurement you select a range of up to 1000 segments to be measured from the total range of up to 2000 configured segments.

In list mode the R&S CMW can measure modulation results (including inband emission and equalizer spectrum flatness results), ACLR, spectrum emission and power monitor results. The measured quantities can be enabled or disabled individually for each segment.

A segment without any enabled measurements is called inactive segment. Inactive segments are useful for time-consuming UE reconfiguration. For that purpose you define alternating active and inactive segments. During the active segments you perform measurements. During the inactive segments you reconfigure the UE for the next measured segment.

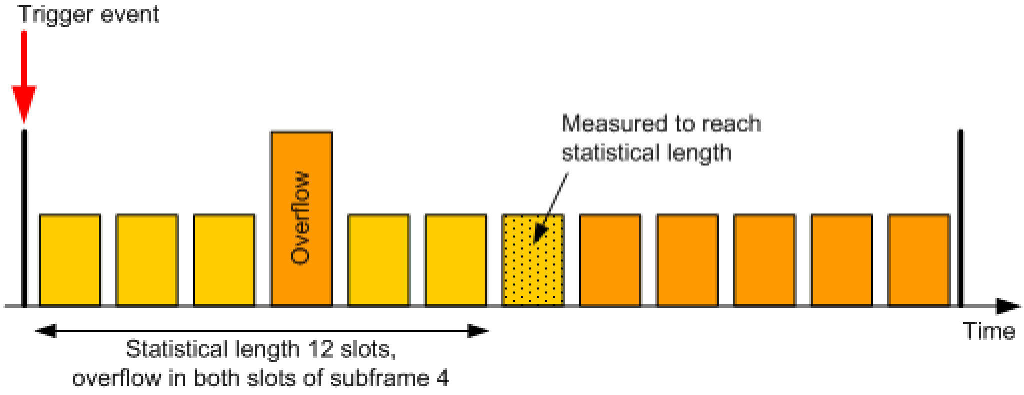
It is possible to measure all subframes of a segment or to exclude subframes/slots at the beginning and/or the end of the segment. The evaluation offset specifies how many subframes are excluded at the beginning of the segment. The statistical length defines the number of slots to be measured. The "current" result of a segment refers to the last measured slot of the statistical length. Additional statistical values (average, minimum, maximum and standard deviation) are calculated for the entire statistical length. Statistical length and statistical values are not relevant for power monitor measurements. The following figure provides a summary.



Two consecutive segments are usually measured at different analyzer settings. The R&S CMW changes the analyzer settings in the last subframes of the first segment, which impairs the accuracy of the measurement results for up to 3 subframes at the end of the segment. The affected subframes/slots are automatically excluded from the measurement.

Results of other slots that can not be measured accurately e.g. because of overflow, low signal or synchronization error can also be discarded automatically (parameter Measure on Exception = Off). In that case the measurement still tries to provide results for the specified statistical length. If not enough slots of the segment can be measured, this results in a shorter statistical length. The reached statistical length, a reliability indicator for the measurement and a reliability indicator for the segment are included in most measurement results. TDD downlink subframes and special subframes are automatically ignored and do not contribute to the (reached) statistical length.

In the example shown below an overflow occurs in the fourth subframe. The samples of this subframe are discarded and subframe number 7 is measured additionally to reach the specified statistical length of 12 slots.



Maximum number of measured subframes

The limit of 4000 measured subframes comprises mainly measured subframes included in a statistical length and subframes measured with the power monitor. The not measured subframes of an active segment do not contribute. Other contributions that "cost" subframes are inactive segments and triggering of a segment.

All segments selected for the measurement are considered. In the worst case, the sum of the following components must not exceed 4000:

- 1 subframe per inactive segment
- 2 times the number of triggered segments
- for each active segment without power monitor:
  subframes in statistic count of the segment + 3 subframes
- for each active segment with power monitor:
  all subframes in the segment

The limit of 4000 measured subframes applies if a BB MEAS with 4 GB memory is installed (R&S CMW-B100D or -U100D). If less memory is installed (R&S CMW-B100A, no -U100D), the limit is 2000 measured subframes.

Trigger modes

A list mode measurement can either be triggered only once, or it can be retriggered at the beginning of specified segments.

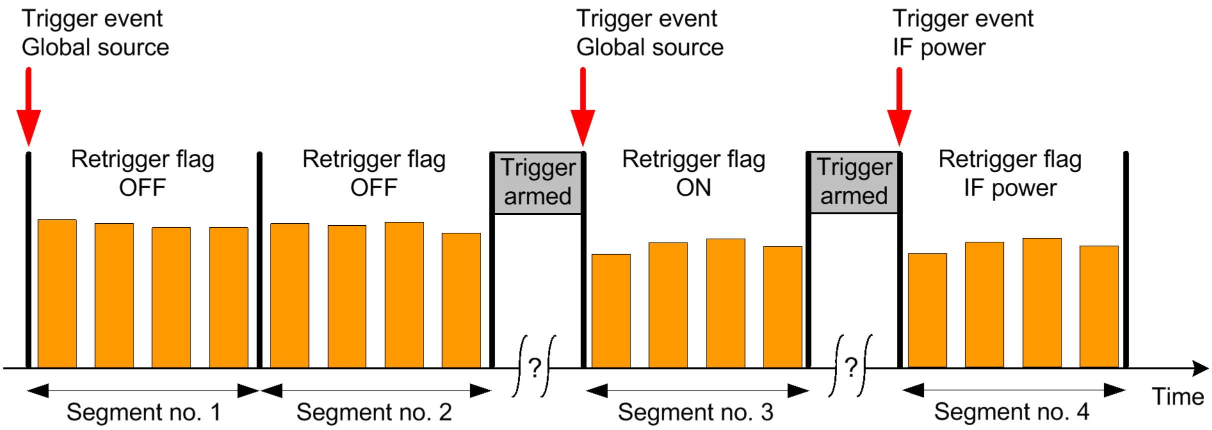
In "Once" mode, a trigger event is only required to start the measurement. As a result, the entire range of segments (up to 1000) is measured without additional trigger event. The trigger is rearmed after the measurement has been finished. The retrigger flag of the first segment specifies which trigger source shall be used (IF power trigger or trigger source configured via global trigger settings). The retrigger flags of subsequent segments are ignored.

The "Once" mode is recommended for UL signals with accurate timing over the entire range of segments.

In "Segment" mode, the retrigger flag of each segment is evaluated. It defines whether the measurement waits for a trigger event before measuring the segment, or not and which trigger source shall be used. For the first segment, the value OFF is interpreted as ON.

Retriggering the measurement is recommended, if the timing of the first subframe of a segment is inaccurate, for example because of signal reconfiguration at the UE. Furthermore, retriggering from time to time can compensate for a possible time drift of the UE.

In the following example, the "Segment" mode is enabled. The measurement stops when the second segment has been captured and waits for a trigger event from the globally configured trigger source, before capturing the third segment. After the third segment, it waits for a trigger event from the IF power trigger source, before capturing the fourth segment.



Spectrum measurements

Segments with active spectrum measurements and channel bandwidths > 10 MHz are divided into three parts. The first part is measured using the nominal carrier frequency and is evaluated for all enabled measurements. The other two parts are only evaluated for spectrum measurements and are used to measure the band edges.

The maximum statistical length reachable in such a segment is only one third of the statistical length reachable with disabled spectrum measurements. Assign more subframes to reach a higher statistical length. The minimum length of such a segment equals 12 subframes. If you configure a shorter statistical length this has the same effect as disabling the spectrum measurements for the segment.

Configuration of segments and measurement

Segment configuration and measurement are independent from each other. To perform a sequence of measurements at maximum speed, proceed as follows:

1. Configure all segments ever needed.

   The R&S CMW supports a range of up to 2000 configured segments.

2. Select up to 1000 consecutive segments within the configured segment range (consider the maximum number of measured subframes).

3. Measure the selected segments.
4. Repeat steps 2 and 3 as often as needed.

The list mode is essentially a single-shot remote control application. When a measurement is initiated in list mode, all defined segments are measured once. Afterwards, the results can be retrieved using `FETCh` commands.

The following remote control commands are used for list mode settings and result retrieval.

Table 3-1: List mode commands

Parameters	SCPI commands
Activate / deactivate list mode	CONFigure:LTE:MEAS<i>:MEValuation:LIST
Range of measured segments	CONFigure:LTE:MEAS<i>:MEValuation:LIST:LRANge
Segment configuration (duplex mode, cell bandwidth, number of subframes, ...)	CONFigure:LTE:MEAS<i>:MEValuation:LIST:SEGMent<no>:SETup CONFigure:LTE:MEAS<i>:MEValuation:LIST:SEGMent<no>:TDD CONFigure:LTE:MEAS<i>:MEValuation:LIST:SEGMent<no>:RBALlocation
Statistical length and result activation	CONFigure:LTE:MEAS<i>:MEValuation:LIST:SEGMent<no>:MODulation etc.
Trigger mode	TRIGger:LTE:MEAS<i>:MEValuation:LIST:MODE
R&S CMWS connector	CONFigure:LTE:MEAS<i>:MEValuation:LIST:CMWS:CMODe CONFigure:LTE:MEAS<i>:MEValuation:LIST:SEGMent<no>:CMWS:CONNector
Retrieve results	FETCh:LTE:MEAS<i>:MEValuation:LIST:SEGMent<no>:... FETCh:LTE:MEAS<i>:MEValuation:LIST:... See: • chapter 3.5.3.32, "List Mode Results (One Segment)", on page 683 • chapter 3.5.3.33, "List Mode Results (All Segments, One Result)", on page 704 Note that the segment number <no> for configure commands is an absolute number (1..2000) while the segment number <no> for result retrieval is a relative number within the range of measured segments (1..1000). Example: Segment 1 to 100 configured. Segment 50 to 59 measured. For result retrieval <no> = 1 refers to segment 50, <no> = 10 to segment 59.

The list mode can be deactivated via command (see table above) and also via the GUI:

1. Go to local using the corresponding hotkey.

   The active list mode is indicated in the upper right corner of the current view by the words "List Mode!".

2. Open the configuration dialog box and select another measurement mode in section "Measurement Control".

Global and list mode parameters

Some settings are available as special list mode settings and as "multi evaluation" settings (e.g. duplex mode, cell bandwidth and modulation scheme). In list mode the R&S CMW ignores these "multi evaluation" parameters. All other settings not available as special list mode settings are taken from the multi evaluation measurement, e.g.:

- External Attenuation
- Measure on Exception
- Subframe Offset, Number of Subframes, Measure Subframe: always use the *RST values (0, 1, 0) for list mode measurements
- Trigger settings
- Limit settings

3.2.3.2 Offline Mode and Offline Segment

In list mode, it is possible to select the results of a single segment for display in the measurement diagram (see also "List Mode > Offline Segment No." on page 558). This "offline mode" offers several advantages:

- Check of the measurement results (e.g. while developing test scripts)
- Calculation and display of additional measurement results (traces). Use the `FETCh:LTE:MEAS:MEValuation:TRACe:...` commands to retrieve these results.

After a list mode measurement is completed, the measurement diagram shows the last segment measured. Calculation of the offline results in an arbitrary segment requires a two-stage measurement:

1. Start a single-shot list mode measurement (`INITiate:LTE:MEAS:MEValuation`) to collect all measurement data.
2. Select the offline segment (`CONFigure:LTE:MEAS:MEValuation:LIST:OSINdex <Segment>`), then initiate a second measurement (repeat `INITiate:LTE:MEAS:MEValuation`) and go to local in order to view the results.

The second measurement stage implies a calculation of all measurement results in the offline segment from the existing raw data; no new measurement data is acquired. By repeating this second stage for different segments, you can obtain a complete set of measurement results over the entire measurement length.

Reconfiguration of the measurement, example

To obtain consistent results in the second measurement stage, the raw data must still correspond to the measurement settings. Avoid any reconfiguration that would require a new measurement, if you wish to re-use your data in offline mode.

3.2.4 LTE UL Signal Properties

This section describes the following selected topics related to LTE UL signal properties.

3.2.4.1 Resources in Time and Frequency Domain

The UL radio resources in an LTE system are divided into time-frequency units called resource elements. In the time domain a resource element corresponds to one SC-FDMA symbol. In the frequency domain it corresponds to one subcarrier.

For the mapping of physical channels to resources, the resource elements are grouped into resource blocks (RB). Each RB consists of 12 consecutive subcarriers (180 kHz) and 6 or 7 consecutive SC-FDMA symbols (0.5 ms).

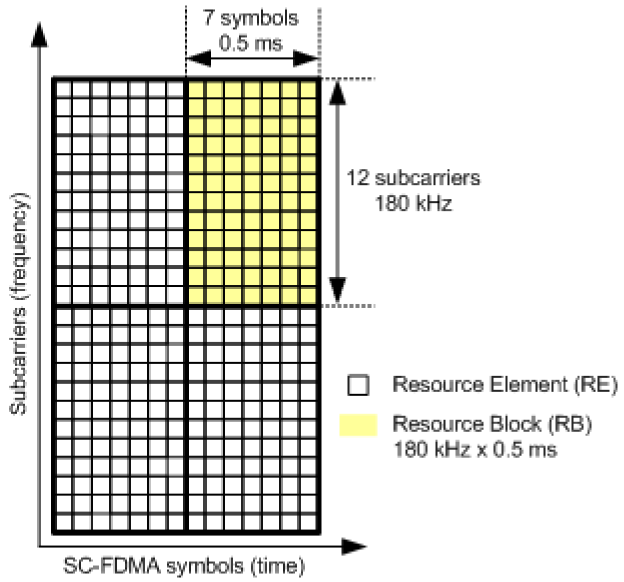


Fig. 3-5: Resource element grid (7 symbols per RB)

The total number of resource blocks available per channel depends on the channel bandwidth as shown in the following table.

Channel Bandwidth [MHz]	1.4	3	5	10	15	20
Resource Blocks (RB)	6	15	25	50	75	100

The number of resource blocks is additionally restricted by 3GPP TS 36.211. Only numbers that can be calculated by the following formula are allowed:

$N_{RB} = 2^i \times 3^j \times 5^k$, with i, j, k being non-negative integer values

Example:

For a channel bandwidth of 3 MHz the following values are allowed in the uplink: 1, 2, 3, 4, 5, 6, 8, 9, 10, 12, 15. Not allowed are 7, 11, 13 and 14.

In the time domain the additional units radio frame, subframe and slot (containing the SC-FDMA symbols) are defined, see figures below. Each SC-FDMA symbol contains a guard time called Cyclic Prefix (CP). Depending on the duration of the guard time, it is either called normal CP or extended CP and a slot contains either 7 SC-FDMA symbols with normal CP or 6 SC-FDMA symbols with extended CP.

The basic time unit in LTE is the sample interval T_s. T_s can be calculated from the sampling frequency 30.72 MHz: 1 T_s = 1/30.72 MHz ≈ 32.55 ns.

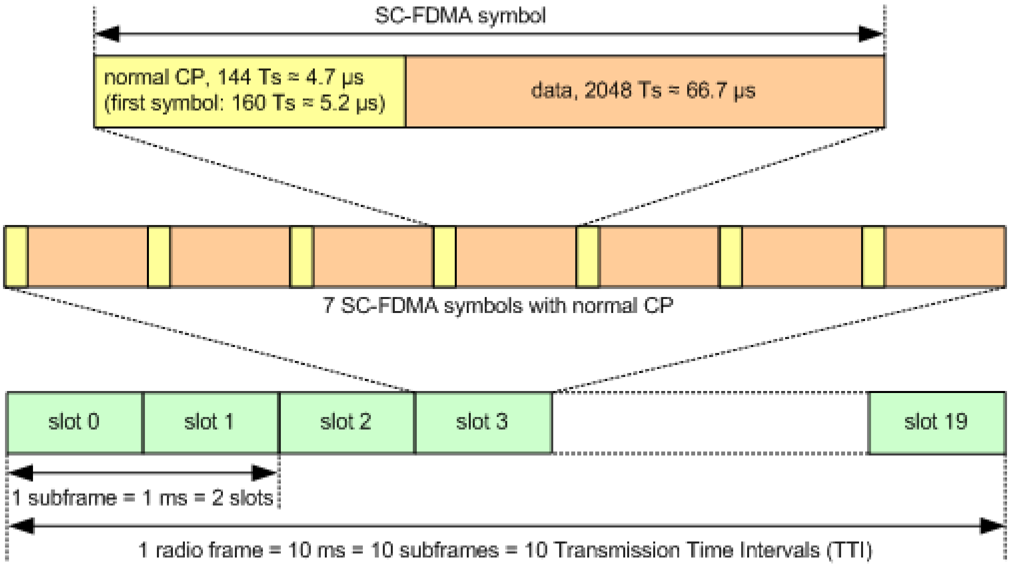


Fig. 3-6: LTE UL frame structure for FDD, normal CP

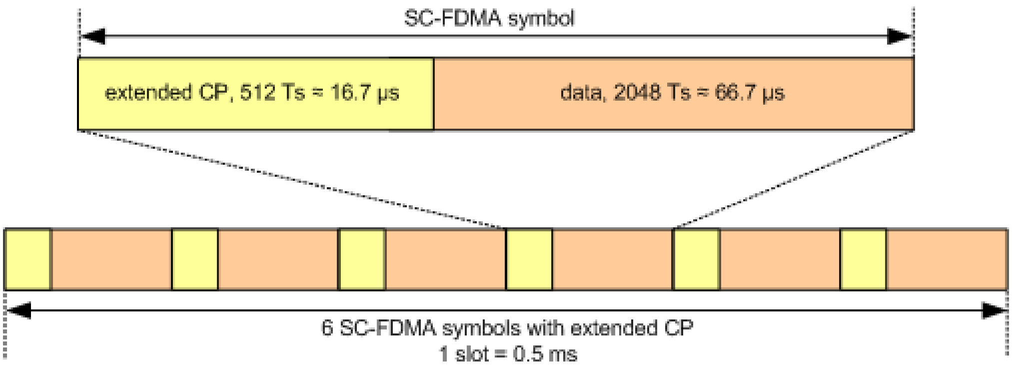


Fig. 3-7: LTE UL slot structure for FDD, extended CP

The figures above are for FDD, but the shown structure of SC-FDMA symbols and UL slots applies also to TDD.

3.2.4.2 Frequency Bands

The carrier frequencies for LTE uplink signals are defined in 3GPP TS 36.101. Each operating band contains a number of uplink carrier frequencies identified by channel numbers (EARFCN, E-UTRA Absolute Radio Frequency Channel Number). The assignment between channel numbers N and carrier center frequencies F is defined as:

$$N = 10 \cdot (F - F_{Offset}) / MHz + N_{Offset}$$

The tables below provide an overview of all uplink channels for FDD and TDD signals. For each band they list the offset frequencies F_{Offset}, channel numbers N, channel number offsets N_{Offset} and carrier center frequencies F. For frequencies above 3.3 GHz option R&S CMW-KB036 is required.

FDD Band	F_{Offset} [MHz]	N_{Offset}	Channel No N	F [MHz]
1	1920	18000	18000 to 18599	1920 to 1979.9
2	1850	18600	18600 to 19199	1850 to 1909.9
3	1710	19200	19200 to 19949	1710 to 1784.9
4	1710	19950	19950 to 20399	1710 to 1754.9
5	824	20400	20400 to 20649	824 to 848.9
6	830	20650	20650 to 20749	830 to 839.9
7	2500	20750	20750 to 21449	2500 to 2569.9
8	880	21450	21450 to 21799	880 to 914.9
9	1749.9	21800	21800 to 22149	1749.9 to 1784.8
10	1710	22150	22150 to 22749	1710 to 1769.9
11	1427.9	22750	22750 to 22949	1427.9 to 1447.8
12	699	23010	23010 to 23179	699 to 715.9
13	777	23180	23180 to 23279	777 to 786.9
14	788	23280	23280 to 23379	788 to 797.9
15	1900	23380	23380 to 23579	1900 to 1919.9
16	2010	23580	23580 to 23729	2010 to 2024.9
17	704	23730	23730 to 23849	704 to 715.9
18	815	23850	23850 to 23999	815 to 829.9
19	830	24000	24000 to 24149	830 to 844.9
20	832	24150	24150 to 24449	832 to 861.9
21	1447.9	24450	24450 to 24599	1447.9 to 1462.8
22	3410	24600	24600 to 25499	3410 to 3499.9
23	2000	25500	25500 to 25699	2000 to 2019.9

FDD Band	F_{Offset} [MHz]	N_{Offset}	Channel No N	F [MHz]
24	1626.5	25700	25700 to 26039	1626.5 to 1660.4
25	1850	26040	26040 to 26689	1850 to 1914.9
26	814	26690	26690 to 27039	814 to 848.9
27	807	27040	27040 to 27209	807 to 823.9
28	703	27210	27210 to 27659	703 to 747.9
30	2305	27660	27660 to 27759	2305 to 2314.9
31	452.5	27760	27760 to 27809	452.5 to 457.4

TDD Band	F_{Offset} [MHz]	N_{Offset}	Channel No N	F [MHz]
33	1900	36000	36000 to 36199	1900 to 1919.9
34	2010	36200	36200 to 36349	2010 to 2024.9
35	1850	36350	36350 to 36949	1850 to 1909.9
36	1930	36950	36950 to 37549	1930 to 1989.9
37	1910	37550	37550 to 37749	1910 to 1929.9
38	2570	37750	37750 to 38249	2570 to 2619.9
39	1880	38250	38250 to 38649	1880 to 1919.9
40	2300	38650	38650 to 39649	2300 to 2399.9
41	2496	39650	39650 to 41589	2496 to 2689.9
42	3400	41590	41590 to 43589	3400 to 3599.9
43	3600	43590	43590 to 45589	3600 to 3799.9
44	703	45590	45590 to 46589	703 to 802.9

3.2.5 Limit Settings and Conformance Requirements

Conformance requirements for LTE UE transmitter tests are specified in 3GPP TS 36.521, section 6, "Transmitter Characteristics".

The following sections give an overview of the "LTE Multi Evaluation" limit settings and the related test requirements.

3.2.5.1 Modulation Limits

All modulation limits can be configured per modulation scheme.

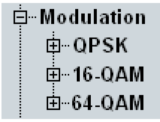


Fig. 3-8: One node per modulation scheme

The individual modulation limits are described in the following sections.

3.2.5.2 Error Vector Magnitude

A poor modulation accuracy of the UE transmitter increases the transmission errors in the uplink channel of the LTE network and decreases the system capacity. The Error Vector Magnitude (EVM) is the critical quantity to assess the modulation accuracy of an LTE UE.

According to 3GPP, the EVM measured at UE output powers ≥ −40 dBm and under normal operating conditions shall not exceed 17.5 % for QPSK-modulated signals and 12.5 % for 16-QAM-modulated signals.

The EVM limits can be set in the configuration dialog, depending on the modulation scheme and along with limits for the other measured quantities.

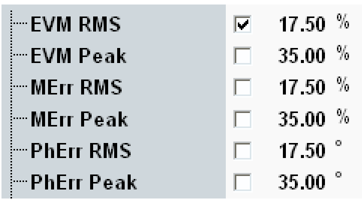


Fig. 3-9: Limit settings for QPSK

Characteristics	Refer to 3GPP TS 36.521 V10.3.0, section...	Specified limit
EVM (RMS)	6.5.2.1 Error Vector Magnitude (EVM) 6.5.2A.1 Error Vector Magnitude (EVM) for CA	≤ 17.5 % (QPSK) ≤ 12.5 % (16-QAM) tbd (64-QAM)

3.2.5.3 Frequency Error Limits

According to 3GPP, the UE modulated carrier frequency shall be accurate within ±0.1 ppm, compared to the nominal carrier frequency. The frequency error can be set in the configuration dialog, depending on the modulation scheme.

Fig. 3-10: Frequency error limit settings

Characteristics	Refer to 3GPP TS 36.521 V10.3.0, section...	Specified limit
Frequency Error	6.5.1 Frequency Error 6.5.1A Frequency Error for CA	< 0.1 ppm

3.2.5.4 I/Q Origin Offset Limits

An I/Q origin offset is due to an additive sinusoid waveform at the frequency of the reference signal. The standard specifies the I/Q origin offset power limit as a function of the output power of the UE transmitter ("TX Power", see table below).

I/Q origin offset limits for three different TX power ranges can be set in the configuration dialog, depending on the modulation scheme.

Fig. 3-11: I/Q origin offset limit settings

Characteristics	Refer to 3GPP TS 36.521 V10.3.0, section...	TX power	Specified limit
I/Q Origin Offset	6.5.2.2 Carrier Leakage 6.5.2A.2 Carrier Leakage for CA	> 0 dBm 0 dBm to -30 dBm < -30 dBm to -40 dBm	-24.2 dBc -19.2 dBc -9.2 dBc

3.2.5.5 Inband Emissions Limits

The inband emission is the relative UE output power of non-allocated resource blocks (RBs). Inband emissions are interferers in the subcarrier range that is potentially used by other connected UEs. 3GPP defines a quite complex combined inband emission limit described below.

The combined limit can be determined via the following rules:

- The minimum of the combined limit is -29.2 dB. In the R&S CMW this general minimum is configurable.
- A general component is considered for all non-allocated RBs.
- For non-allocated RBs at image frequencies of allocated RBs, an IQ image component is added to the general component.
- For RBs at or directly adjacent to the carrier frequency, an IQ offset component is added to the general component.

This means the most complex limit has to be determined for a non-allocated RB located both at an image frequency and directly adjacent to the carrier frequency. In that case the general component, the IQ image component and the IQ offset component have to be added. Then the result has to be compared to the general minimum and the bigger value of both applies.

The following table provides an overview of the three components.

Component	Value	Applicable RBs
General	see formula below table	all non-allocated RBs
IQ Image	-24.2 dB	image frequencies
IQ Offset	-24.2 dBc to -9.2 dBc depending on TX Power see chapter 3.2.5.4, "I/Q Origin Offset Limits", on page 509	carrier frequency

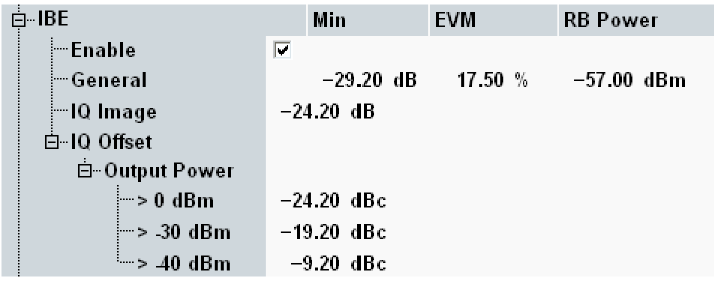
The general limit is derived using the following formula:

$$\text{Limit}_{\text{General}} = \max\left[\begin{array}{l} -25 - 10 * \log_{10}\left(\dfrac{<\text{All RB}>}{<\text{No RB}>}\right), \\ 20 * \log_{10} <\text{EVM}> -3 - \dfrac{5 * (<\text{Offset}> -1)}{<\text{No RB}>}, \\ -<\text{RB Power}> - <\text{RB Power Meas}> \end{array}\right] \text{dB} + 0.8\ \text{dB}$$

The variables are defined as follows:

- <All RB> = total number of RBs within the channel bandwidth of the allocated component carrier (as defined by 3GPP, e.g. 75 RBs for 15 MHz channel bandwidth)
- <No RB> = number of allocated RBs in the slot
- <EVM> = maximum allowed EVM in percent (configurable), see chapter 3.2.5.2, "Error Vector Magnitude", on page 508
- <Offset> = distance of the RB from the closest allocated RB
- <RB Power> = -57 (configurable)
- <RB Power Meas> = arithmetic mean value of the average powers in all allocated resource blocks in dBm/180 kHz

The general minimum, the variables <EVM> and <RB Power>, the IQ image component and the IQ offset component can be set in the configuration dialog, depending on the modulation scheme.



IBE	Min	EVM	RB Power
Enable	☑		
General	−29.20 dB	17.50 %	−57.00 dBm
IQ Image	−24.20 dB		
IQ Offset			
Output Power			
> 0 dBm	−24.20 dBc		
> -30 dBm	−19.20 dBc		
> -40 dBm	−9.20 dBc		

Fig. 3-12: Inband emissions limit settings for QPSK

With carrier aggregation, RBs are allocated for the PCC, but not for the SCC. The limits apply to both component carriers. The measurement displays inband emission result diagrams for both carriers.

Characteristics	Refer to 3GPP TS 36.521 V10.3.0, section...	Specified limit
IBE Min	6.5.2.3 In-band emissions for non allocated RB 6.5.2A.3 In-band emissions for non allocated RB for CA	see table above

3.2.5.6 Equalizer Spectrum Flatness Limits

For EVM measurements, an equalization step has to be performed after the FFT. The spectrum flatness of this equalizer has to be verified to validate the EVM results.

For equalizer spectrum flatness measurements, 3GPP divides each frequency band into two ranges. For normal conditions, range 1 contains the subcarriers with at least 3 MHz distance to the band edges, while range 2 contains all subcarriers within 3 MHz distance to the band edges. For extreme conditions 5 MHz instead of 3 MHz are specified.

The conformance requirements define limits for the maximum power variations within each range and between the ranges. These limits are listed in the table below. The following figure illustrates the limits for normal conditions.

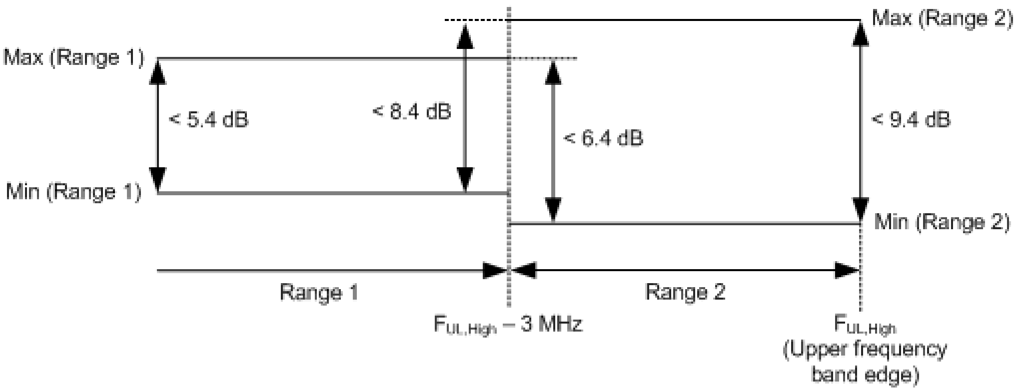


Fig. 3-13: Limits for normal conditions (vertical arrows)

The limits and the band edge distance can be set in the configuration dialog, depending on the modulation scheme.

Fig. 3-14: Spectrum flatness limit settings

Characteristics	Refer to 3GPP TS 36.521 V10.3.0, section...	Specified limit, normal / extreme conditions
Spectrum Flatness	6.5.2.4 / E.4.4 EVM equalizer spectrum flatness	max(range 1) - min(range 1) ≤ 5.4 dB / 5.4 dB max(range 2) - min(range 2) ≤ 9.4 dB / 13.4 dB max(range 1) - min(range 2) ≤ 6.4 dB / 7.4 dB max(range 2) - min(range 1) ≤ 8.4 dB / 11.4 dB

3.2.5.7 Spectrum Limits

Without carrier aggregation, all spectrum limits can be configured per channel bandwidth.

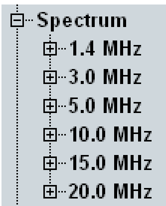


Fig. 3-15: One node per bandwidth, no CA

With carrier aggregation, the spectrum limits can be configured per channel bandwidth combination. There are four nodes for specific channel bandwidth combinations, required for 3GPP tests. If you use another bandwidth combination, the node "Other Combination" applies.

Example: The node "CA 20 MHz + 10 MHz" applies, if the PCC has a bandwidth of 20 MHz and the SCC a bandwidth of 10 MHz, or vice versa. The node "Other Combination" is used for example for 15 MHz + 10 MHz or 1.4 MHz + 5 MHz.

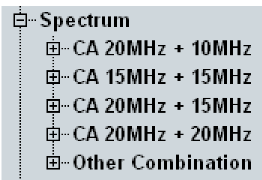


Fig. 3-16: One node per bandwidth combination, with CA

The individual spectrum limits are described in the following sections.

3.2.5.8 Occupied Bandwidth Limits

The occupied bandwidth is the bandwidth that contains 99 % of the total integrated power of the transmitted spectrum. According to 3GPP, the occupied bandwidth shall be less than the theoretical (aggregated) channel bandwidth. The limit for the occupied bandwidth can be set in the configuration dialog.

Without carrier aggregation, the limit can be set per channel bandwidth.

Fig. 3-17: OBW limit setting for 1.4 MHz BW

With carrier aggregation, it can be set per channel bandwidth combination.

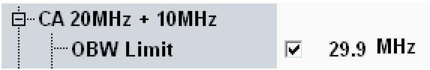


Fig. 3-18: OBW limit setting for 20 MHz + 10 MHz

Characteristics	Refer to 3GPP TS 36.521 V10.3.0, section...	Specified limit
Occupied Bandwidth (OBW)	6.6.1 Occupied bandwidth	< channel bandwidth
	6.6.1A Occupied bandwidth for CA	< aggregated channel bandwidth

3.2.5.9 Spectrum Emission Mask

The energy, that spills outside the designated radio channel, increases the interference with adjacent channels and decreases the system capacity. The amount of unwanted off-carrier energy is assessed by the out-of-band emissions (excluding spurious emissions) that are specified in terms of the spectrum emission mask and the Adjacent Channel Leakage power Ratio (ACLR).

3GPP specifies a general spectrum emission mask and several additional spectrum emission masks. Which of the emission masks is applicable, depends on the parameter Network Signaled Value. The masks differ for signals with and without carrier aggregation.

Both the general requirements and the additional requirements can be defined in the configuration dialog, depending on the channel bandwidth / the channel bandwidth combination. The information displayed above the general limits indicates whether the general limits are applicable, or which set of additional limits applies instead.

The following figure shows the general limits for a signal without carrier aggregation and a channel bandwidth of 1.4 MHz. For each emission mask area, you can define the borders, set an upper power limit and select the resolution bandwidth to be used. Additional limits and limits for other channel bandwidths are configured in the same way.

The start and stop frequencies of each emission mask area are defined relative to the edge of the assigned channel bandwidth. For carrier aggregation, they are defined relative to the edge of the assigned aggregated channel bandwidth.

Example:

Assume 0 MHz as start frequency and 1 MHz as stop frequency for a channel bandwidth of 1.4 MHz. The resulting area ranges from +0.7 MHz to +1.7 MHz relative to the carrier frequency. As all ranges are symmetrical, it ranges also from -0.7 MHz to -1.7 MHz relative to the carrier frequency.

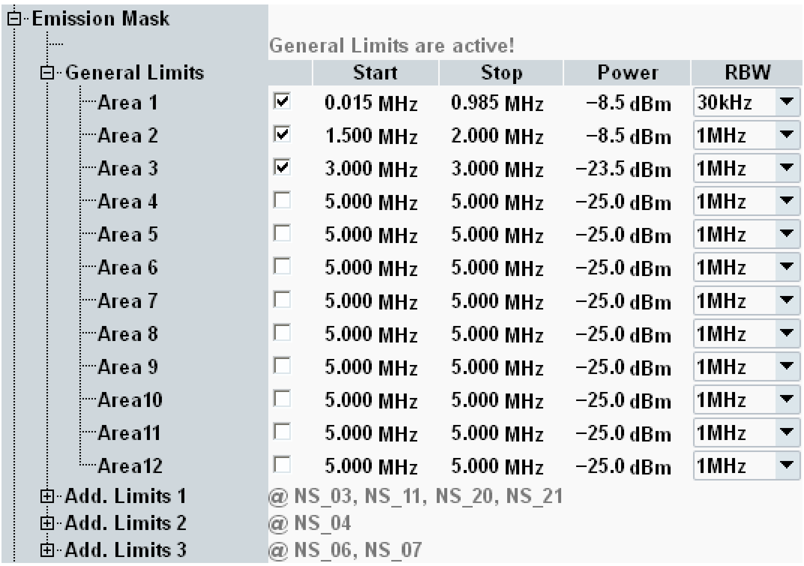


Fig. 3-19: Emission mask settings for 1.4 MHz channel BW, no CA

The default settings are suitable to check the 3GPP requirements.

Characteristics	Refer to 3GPP TS 36.521 V10.3.0, section...
General emission mask	6.6.2.1 Spectrum Emission Mask 6.6.2.1A Spectrum Emission Mask for CA
Additional emission mask requirements	6.6.2.2 Additional Spectrum Emission Mask 6.6.2.2A Additional Spectrum Emission Mask for CA

3.2.5.10 ACLR Limits

The Adjacent Channel Leakage power Ratio (ACLR) limits complement the spectrum emission mask. The limits can be set in the configuration dialog, depending on the channel bandwidth / the channel bandwidth combination.

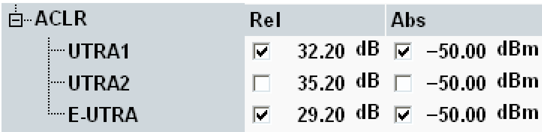


Fig. 3-20: ACLR limit settings for 1.4 MHz channel bandwidth

The default values are identical for all bandwidths and for signals with and without carrier aggregation.

According to 3GPP, the relative limit shall be evaluated only, if the measured adjacent channel power is greater than -50 dBm (absolute limit). In that case, the ACLR (that is, the mean power in the assigned E-UTRA channel divided by the mean power in an adjacent channel) shall be greater than the limits listed in the following table.

The ACLR must be evaluated for the first adjacent UTRA channel (UTRA1) and the first adjacent E-UTRA channel (E-UTRA). For channel bandwidths > 3 MHz, also the ACLR for the second adjacent UTRA channel (UTRA2) must be evaluated.

For carrier aggregation, the term "E-UTRA channel" refers to the aggregated bandwidth. Adjacent E-UTRA channels have the same bandwidth as the assigned E-UTRA channel.

The default settings are suitable to check the 3GPP requirements. The relative limits are only evaluated, if the corresponding absolute limit is exceeded. If you disable an absolute limit, the corresponding enabled relative limit is always evaluated.

Characteristics	Refer to 3GPP TS 36.521 V10.3.0, section...	Relative limit
ACLR	6.6.2.3 Adjacent Channel Leakage power Ratio 6.6.2.3A Adjacent Channel Leakage power Ratio for CA	UTRA1: 32.2 dB UTRA2: 35.2 dB E-UTRA: 29.2 dB

3.2.5.11 Power Dynamics Limits

Transmission at excessive uplink power increases interference to other channels. A too low uplink power increases transmission errors. 3GPP defines the "General ON/OFF Time Mask" to test the UL power in subframes not used for transmission (transmit OFF power), subframes used for transmission (transmit ON power) and the power ramping between them.

The ON power is specified as the mean UE output power within a subframe used for transmission, excluding a transient period of 20 µs at the beginning of the subframe. According to 3GPP, subframe number 3 has to be used. For the measurement, the used subframe is selected via the parameter "Measure Subframe", see "Measurement Subframe" on page 552.

For the OFF power, the mean power has to be measured both in the preceding subframe and in the subsequent subframe, for the latter excluding a transient period of 20 µs at the beginning.

The following figure provides a summary of the time periods relevant for ON and OFF power limits.

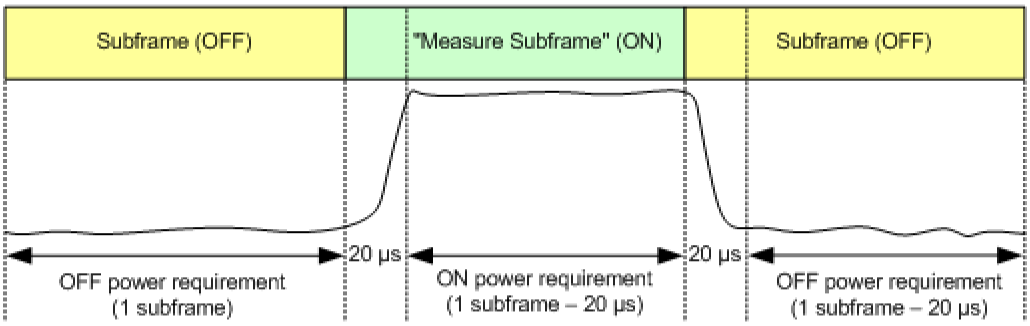


Fig. 3-21: Measurement periods ON/OFF power

The OFF power shall not exceed -48.5 dBm. The ON power limit shall be within a range depending on the channel bandwidth. The limits can be set in the configuration dialog.

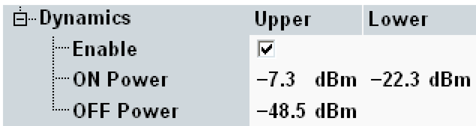


Fig. 3-22: Power dynamics limit settings (1.4 MHz channel)

Characteristics	Refer to 3GPP TS 36.521 V10.3.0, section...	Cell BW	Specified limit
ON power	6.3.4.1 General ON/OFF Time Mask 6.3.4A.1 General ON/OFF Time Mask for CA	1.4 MHz	≥ -22.3 dBm, ≤ -7.3 dBm
		3 MHz	≥ -18.3 dBm, ≤ -3.3 dBm
		5 MHz	≥ -16.1 dBm, ≤ -1.1 dBm
		10 MHz	≥ -13.1 dBm, ≤ 1.9 dBm
		15 MHz	≥ -11.4 dBm, ≤ 3.6 dBm
		20 MHz	≥ -10.1 dBm, ≤ 4.9 dBm
OFF power	6.3.4.1 General ON/OFF Time Mask 6.3.4A.1 General ON/OFF Time Mask for CA	any	≤ -48.5 dBm

The power dynamics measurement supports additional time masks, defined in 3GPP TS 36.101. The following list provides an overview of all supported time masks:

- "General ON/OFF" time mask described in detail in the preceding section and defined in 3GPP TS 36.521, section 6.3.4.1 / 6.3.4A.1
  Three subframes with the power sequence OFF - ON - OFF are measured. Exclusion periods of 20 µs are used. The limits are evaluated for all ON and OFF powers.

<table>
<tr><td colspan="2">Subframe</td><td colspan="2">"Measure Subframe"</td><td colspan="2">Subframe</td></tr>
<tr><td colspan="2">OFF power</td><td>20 µs</td><td>ON power</td><td>20 µs</td><td>OFF power</td></tr>
</table>

- "PUCCH / PUSCH / SRS" time mask with transmission before and after the SRS, see 3GPP TS 36.101, figure 6.3.4.4-2
  Two subframes with ON power are measured. The UE sends an SRS at the end of the first subframe. So the power sequence is ON - SRS ON - ON.

Exclusion periods of 40 µs are used around the SRS. The limits are evaluated for the "ON power", but not for the "SRS ON" power.

"Measure Subframe"				Subframe	
20 µs	ON power	40 µs	SRS ON	40 µs	ON power

- SRS time mask with "SRS blanking", see 3GPP TS 36.101, figure 6.3.4.4-4
  Two subframes with ON power are measured. The UE assumes that another UE sends an SRS at the end of the first subframe. It does not transmit at all during this SRS period. So the power sequence is ON - SRS OFF - ON.
  Exclusion periods of 20 µs are used around the SRS. The limits are evaluated for all ON and OFF powers, including SRS OFF.

"Measure Subframe"				Subframe	
20 µs	ON power	20 µs	SRS OFF	20 µs	ON power

Note that you can shift the borders of all OFF power evaluation periods, see "Add. Excl. OFF Power" on page 556.

3.2.6 Measurement Results

The results of the LTE multi evaluation measurement are displayed in several different views. Use the "Display" parameters to select the views and to change the appearance and contents of the views. The views are described in the following sections.

3.2.6.1 Overview

In the overview, a selection of the following results can be displayed:

- Error Vector Magnitude (vs symbol and vs subcarrier)
- Magnitude Error
- Phase Error
- Inband Emissions
- Equalizer Spectrum Flatness
- Spectrum Emission Mask

- Spectrum ACLR
- I/Q Constellation Diagram
- RB Allocation Table
- Power Monitor
- Most important results of detailed views "TX Measurement" and "BLER"

See also: "TX Measurements" in the R&S CMW user manual, chapter "System Overview"

Fig. 3-23: LTE Multi Evaluation: Overview

The results to be measured and displayed in the overview can be limited using the hotkey "Assign Views", see chapter 3.3.9, "Additional Softkeys and Hotkeys", on page 562.

You can enlarge one of the diagrams in the overview and show a detailed view with additional measurement results, see chapter 3.2.6.12, "Selecting and Modifying Views", on page 534. The traces and bar graphs are described in the "Detailed Views" sections.

3.2.6.2 Detailed Views: EVM, Magnitude Error, Phase Error

This section applies to the following detailed views:

- Error Vector Magnitude (vs symbol and vs subcarrier)
- Magnitude Error
- Phase Error

Each of the detailed views shows a diagram and a statistical overview of results per slot.

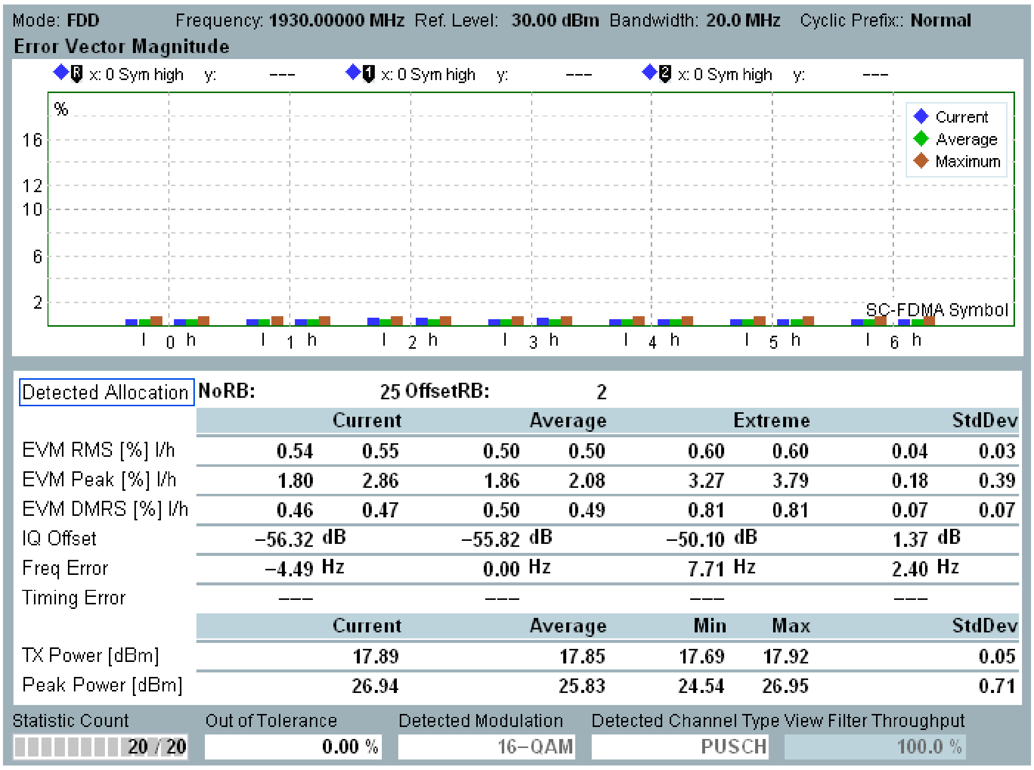


Fig. 3-24: LTE Multi Evaluation: Error Vector Magnitude

- **Error Vector Magnitude, Magnitude Error and Phase Error (vs symbol)**
  The diagrams (bar graphs) show the average EVM, magnitude error, and phase error for each SC-FDMA symbol in the measured slot. The symbols are numbered from 0 to 6 (5) for normal (extended) cyclic prefix duration, with the reference symbol labeled 3 (2).
  The measured slot is located in the configured "Measure Subframe". Only a single carrier is analyzed. For signals with carrier aggregation, you can select which carrier is measured (setting "Measurement Carrier").
  The bar graphs show RMS averaged and therefore positive values. The average runs over all modulation symbols in the SC-FDMA symbol. The R&S CMW calculates two values (e.g. EVM_l and EVM_h) for each SC-FDMA symbol and displays both values; see chapter 3.2.1.7, "Calculation of Modulation Results", on page 495.
- **Error Vector Magnitude vs subcarrier**
  The diagram shows the EVM in all allocated subcarriers of the measured slot. Only a single carrier is analyzed. For signals with carrier aggregation, you can select which carrier is measured (setting "Measurement Carrier").
  The values are RMS averaged over the SC-FDMA data symbols in the subcarrier.

For the table results, see chapter 3.2.6.11, "Detailed Views: TX Measurement and BLER", on page 532.

For the parameters at the bottom, see chapter 3.2.6.14, "Common View Elements", on page 534.

For query of the diagram contents via remote control, see:

- chapter 3.5.3.16, "EVM Results (Traces)", on page 656
- chapter 3.5.3.17, "Magnitude Error Results (Traces)", on page 657
- chapter 3.5.3.18, "Phase Error Results (Traces)", on page 657

3.2.6.3 Detailed Views: Inband Emissions

The inband emissions are displayed in one diagram per component carrier and as a table of statistical results.

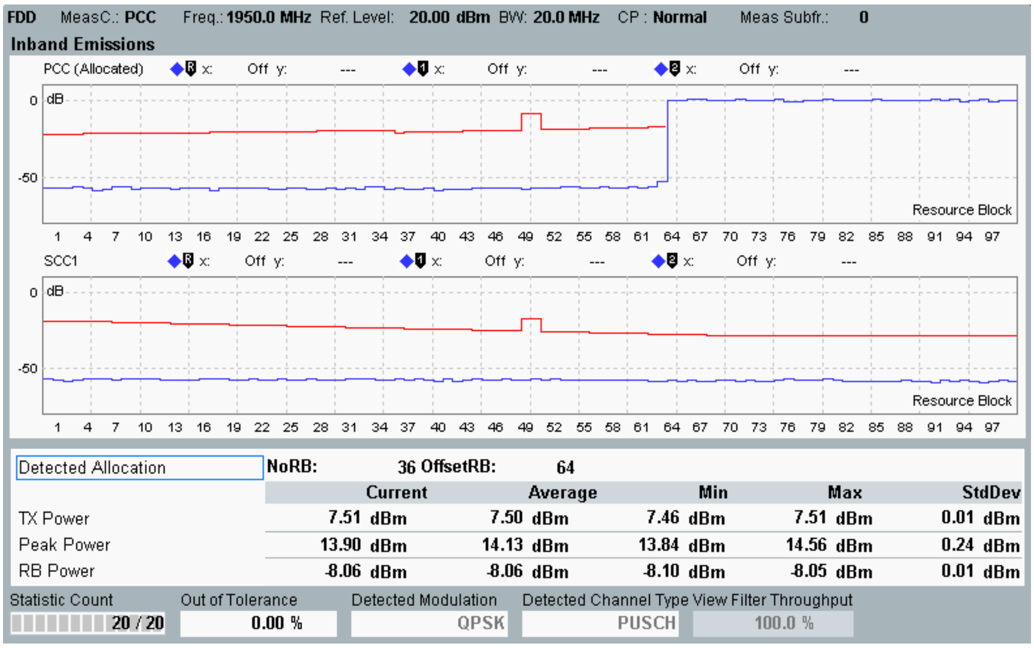


Fig. 3-25: LTE Multi Evaluation: Inband Emissions

For measurements without carrier aggregation, only the PCC is measured and a single diagram is displayed. For measurements with carrier aggregation, the PCC and the SCC are measured and the results are displayed in two diagrams.

Each diagram shows the average power in all resource blocks (RBs) of the measured slot. This corresponds to a power vs. frequency representation where every RB comprises 12 subcarriers. The RB powers are normalized to the current RB Power.

The figure shows a measurement with carrier aggregation. In the PCC diagram, 36 out of 100 resource blocks are allocated. The power of the remaining, non-allocated blocks must be below the red limit line. For the SCC, no resource blocks are allocated. So the entire trace must be below the red limit line.

The carrier currently selected as "Measurement Carrier" is marked by the string "(Allocated)". It must contain allocated resource blocks. Otherwise the measurement fails ("Underdriven" or "Sync Error").

The inband emissions are calculated from the I/Q origin offset-corrected signal, see chapter 3.2.1.7, "Calculation of Modulation Results", on page 495.

NRB View Filter

Resource blocks are allocated dynamically: Their number and position within the sub-carrier range may vary from one measured slot to another. Use filter settings ("Config... > Measurement Control > View Filter") to restrict the measurement to a definite number of allocated RBs.

The table results refer to the configured "Measurement Carrier" (displayed as "MeasC" at the top of the view). For details about the table results, see chapter 3.2.6.11, "Detailed Views: TX Measurement and BLER", on page 532.

For the parameters at the bottom, see chapter 3.2.6.14, "Common View Elements", on page 534.

For query of the diagram contents via remote control, see chapter 3.5.3.23, "Inband Emission Results", on page 661.

3.2.6.4 Detailed Views: Equalizer Spectrum Flatness

The equalizer spectrum flatness is determined for the post FFT equalization step, as specified in the standard. It reflects the spectrum flatness of the equalizer.

The results are displayed in a diagram and as a table of statistical results.

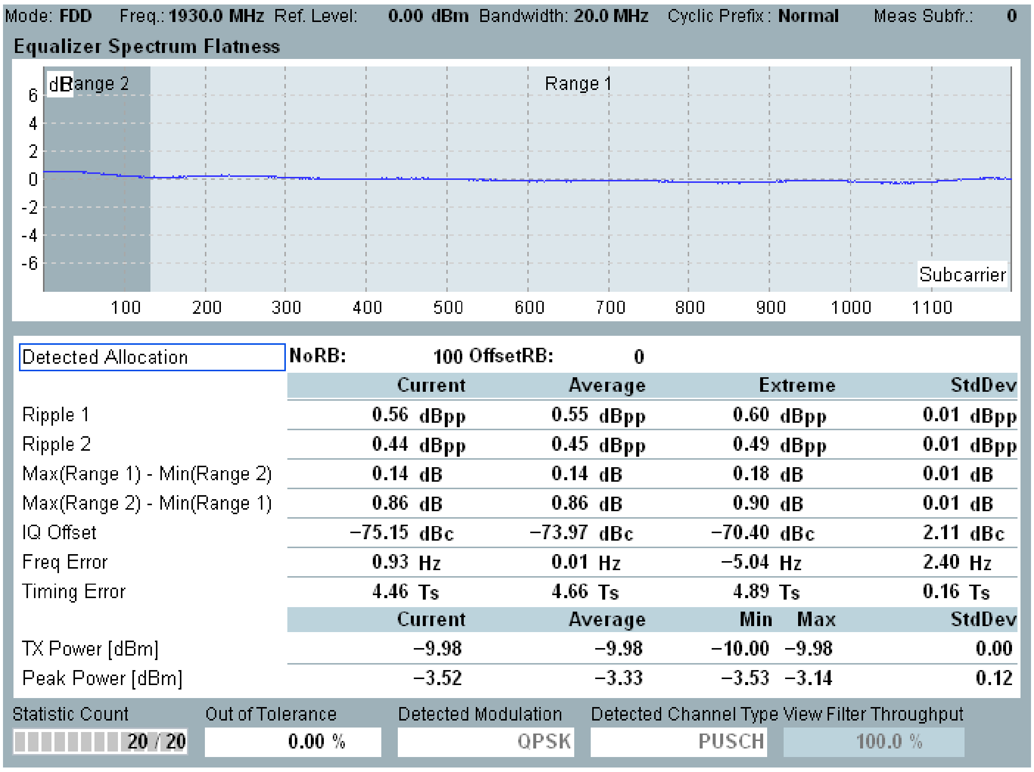


Fig. 3-26: LTE Multi Evaluation: Spectrum Flatness

The diagram shows the power of the equalizer coefficients for all allocated subcarriers of the measured slot. The measured slot is located in the configured "Measure Subframe". Only a single carrier is analyzed. For signals with carrier aggregation, you can select which carrier is measured (setting "Measurement Carrier").

The results are normalized to the arithmetic mean value of all results. Hence the measured curve is centered around the 0 dB line.

The table below the diagram presents statistical values. The first four values are related to the spectrum flatness limits. They indicate the difference between maximum and minimum values within range 1 (Ripple 1), within range 2 (Ripple 2) and between the ranges. For details see chapter 3.2.5.6, "Equalizer Spectrum Flatness Limits", on page 511.

For the other results in the table see chapter 3.2.6.11, "Detailed Views: TX Measurement and BLER", on page 532.

For the parameters at the bottom, see chapter 3.2.6.14, "Common View Elements", on page 534.

For query of the diagram contents and of the first four table rows, see:

- chapter 3.5.3.19, "Equalizer Spectrum Flatness Results (Traces)", on page 658
- chapter 3.5.3.28, "Equalizer Spectrum Flatness Results (Single Values)", on page 674

3.2.6.5 Detailed Views: Spectrum Emission Mask

The spectrum emission mask results are displayed in a diagram and as a table of statistical results. Additional margin results can be shown/hidden via hotkey.

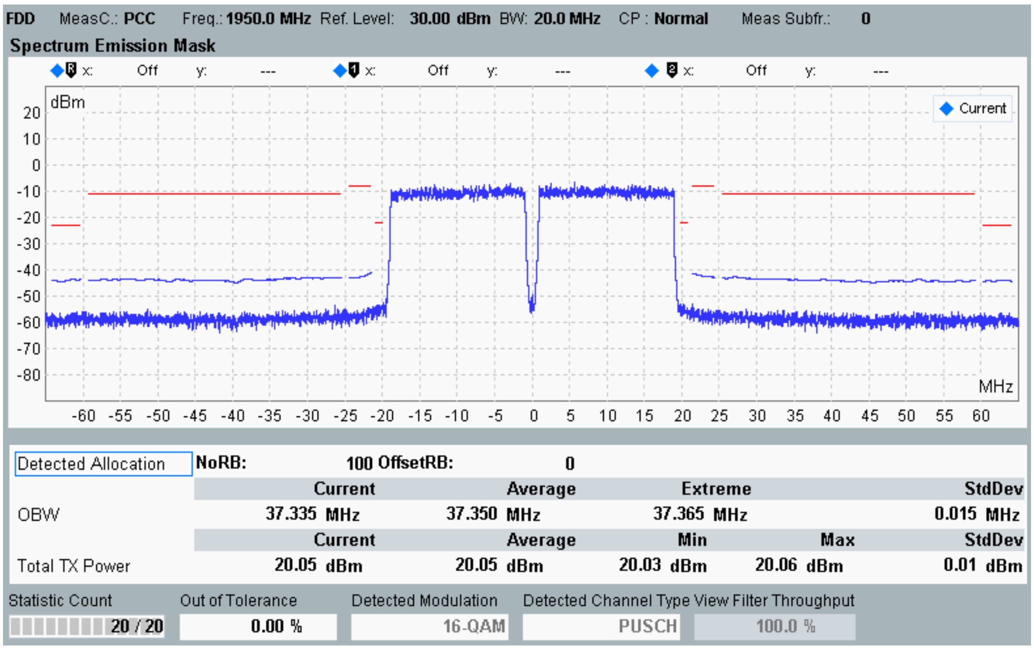


Fig. 3-27: LTE Multi Evaluation: Emission Mask

Without carrier aggregation, the measurement covers a symmetric frequency range around the carrier center frequency. With carrier aggregation, both carriers are measured. So the measurement covers a symmetric frequency range around the center frequency of the aggregated bandwidth.

Resolution filters with bandwidths of 30 kHz, 100 kHz and 1 MHz are available. Traces for all three resolution bandwidths (RBW) can be displayed in parallel, with the 30 kHz continuous trace at the bottom, the 1 MHz trace on top and the 100 kHz trace in-between.

The 100 kHz and 1 MHz traces are only displayed for frequency ranges with active limits. Depending on the limits, the traces are hidden completely, displayed partially or displayed for the entire out-of-band range.

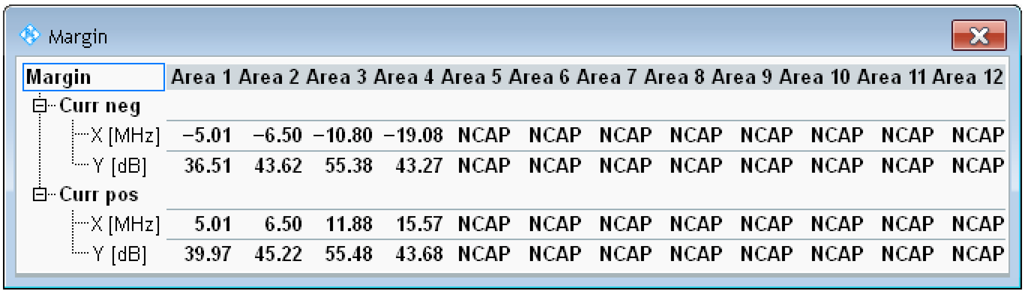
In the figure above, the outer limit lines and traces are for RBW = 1 MHz. The short inner limit lines and the continuous trace correspond to RBW = 30 kHz and the 100 kHz trace is hidden because no limits use it. See also chapter 3.2.5.9, "Spectrum Emission Mask", on page 513.

The shape of the resolution filter is configurable for 100 kHz and 1 MHz bandwidth (gaussian or bandpass). For 30 kHz traces a gaussian filter is used.

According to 3GPP TS 36.521, the measurement must be carried out at maximum output power of the UE.

Margin results

To show/hide the margin results, use the softkey - hotkey combination "Display" - "Margin On | Off".



Margin

Margin	Area 1	Area 2	Area 3	Area 4	Area 5	Area 6	Area 7	Area 8	Area 9	Area 10	Area 11	Area 12
Curr neg												
X [MHz]	−5.01	−6.50	−10.80	−19.08	NCAP	NCAP	NCAP	NCAP	NCAP	NCAP	NCAP	NCAP
Y [dB]	36.51	43.62	55.38	43.27	NCAP	NCAP	NCAP	NCAP	NCAP	NCAP	NCAP	NCAP
Curr pos												
X [MHz]	5.01	6.50	11.88	15.57	NCAP	NCAP	NCAP	NCAP	NCAP	NCAP	NCAP	NCAP
Y [dB]	39.97	45.22	55.48	43.68	NCAP	NCAP	NCAP	NCAP	NCAP	NCAP	NCAP	NCAP

Fig. 3-28: LTE Multi Evaluation: Emission Mask - margin results

A margin indicates the vertical distance between the spectrum emission mask limit line and a trace. For each emission mask area, the margin represents the "worst" value, i.e. the minimum determined for the frequencies of the area:

Margin = minimum $(P(f)_{mask} - P(f)_{trace})$

A negative margin indicates that the trace is located above the limit line, i.e. the limit is exceeded.

The margin result display presents for each active area a "X [MHz]" and a "Y [dB]" value, for negative (neg) and positive (pos) offset frequencies. The Y value indicates the margin (worst value within area), the X value the frequency offset at which the margin value was found. These frequency offsets are indicated relative to the center frequency.

The screenshot above shows margin results for the current trace. Corresponding margin results are displayed for all active traces (Current, Average, Maximum). In this context, "Average" means "margins for average trace" and not "average values of margins for current trace". "Minimum" means "margins for maximum trace" (resulting in minimum margins).

The "Total TX power" in the table indicates the sum of the TX power of all component carriers. For other table results, see chapter 3.2.6.11, "Detailed Views: TX Measurement and BLER", on page 532.

For the parameters at the bottom, see chapter 3.2.6.14, "Common View Elements", on page 534.

For query of the spectrum emission mask results via remote control, see:

- chapter 3.5.3.20, "Spectrum Emission Results (Traces)", on page 659
- chapter 3.5.3.30, "Spectrum Emission Results (Single Values)", on page 678

3.2.6.6 Detailed Views: Spectrum ACLR

The ACLR results are displayed in a diagram and as a table of statistical results.

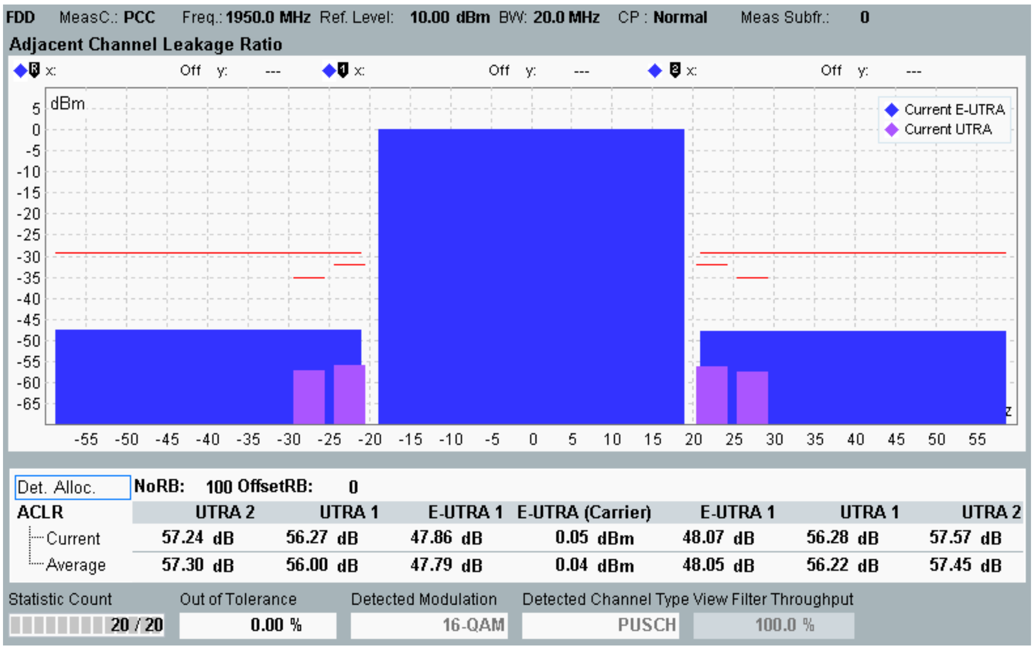


Fig. 3-29: LTE Multi Evaluation: ACLR

The diagram shows the mean power in the assigned E-UTRA channel as central bar. The other bars indicate the mean powers in the first adjacent E-UTRA channels and in the first and second adjacent UTRA channels. All values are absolute power levels in dBm.

With carrier aggregation, an E-UTRA channel comprises the aggregated bandwidth minus a guard band. The figure shows a measurement with carrier aggregation and a channel bandwidth of 20 MHz for PCC and SCC. The width of an E-UTRA bar is 38 MHz.

The displayed absolute limit lines are calculated from the configured relative ACLR limits. They are only displayed for adjacent channels with a power level above the configured absolute limit.

The Adjacent Channel Leakage power Ratios (ACLR) resulting from the measured powers are displayed in the table below the diagram. According to 3GPP TS 36.521, the ACLR is defined as the mean power in the assigned E-UTRA channel divided by the mean power in an adjacent channel. Additionally the mean power in the assigned E-UTRA channel is displayed.

The filters used for the ACLR measurement are compliant with 3GPP TS 36.521. According to this specification, ACLR tests must be carried out at maximum output power of the UE.

For the parameters at the bottom, see chapter 3.2.6.14, "Common View Elements", on page 534.

For query of the ACLR results via remote control, see chapter 3.5.3.24, "ACLR Spectrum Results", on page 664.

3.2.6.7 Detailed Views: I/Q Constellation Diagram

The constellation diagram shows the modulation symbols in the measured slot of the measured component carrier as points in the I/Q plane.

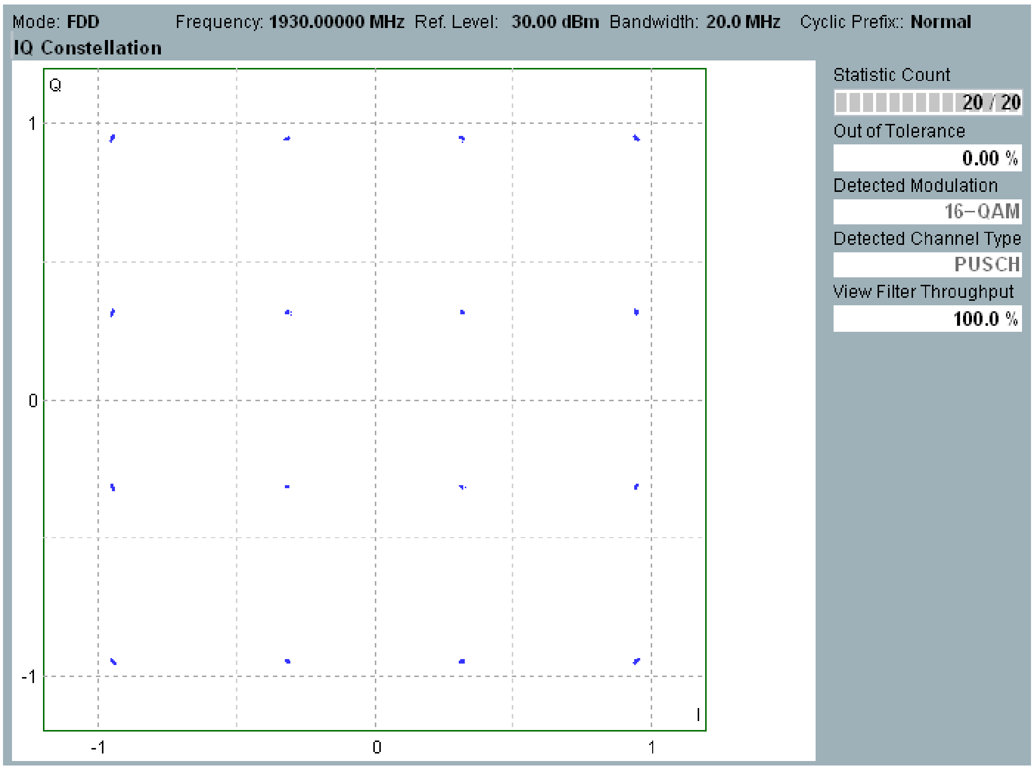


Fig. 3-30: LTE Multi Evaluation: I/Q Constellation diagram

The constellation diagrams depend on the modulation type. For an ideal signal, the QPSK constellation diagram consists of four points, located on a circle around the origin, with relative phase angles of 90 deg. The 16QAM and 64QAM modulation schemes produce rectangular patterns with 16 and 64 points, respectively; see example above.

If channel type PUCCH is detected, the constellation diagram shows the SC-FDMA symbols in the frequency domain.

Constellation diagrams give a graphical representation of the signal quality and can help to reveal typical modulation errors causing signal distortions.

See also: "I/Q Constellation Diagram" in the R&S CMW user manual, chapter "System Overview"

The LTE constellation diagram shows the following peculiarities:

- The I/Q amplitudes correspond to the values that the R&S CMW uses for the EVM calculation: A possible I/Q origin offset is already subtracted out.
- Due to the properties of the UL LTE signal, a pure I/Q imbalance causes circular constellation points.

For the parameters on the right, see chapter 3.2.6.14, "Common View Elements", on page 534.

For query of the diagram contents, see chapter 3.5.3.21, "I/Q Constellation Results (Traces)", on page 659.

3.2.6.8 Detailed Views: RB Allocation Table

The Resource Block (RB) allocation table provides an overview of the detected RB allocation, including the detected channel type as color coded information.

With carrier aggregation, separate tables are displayed for the PCC and the SCC.

Fig. 3-31: LTE Multi Evaluation: RB Allocation Table

Each table presents the time domain on the X-axis (subframes and SC-FDMA symbols) and the frequency domain on the Y-axis (resource blocks). The allocated resource blocks are marked by colored bars. The colors indicate the detected channel type as listed in the legend below the table: Physical Uplink Control Channel (PUCCH) or Physical Uplink Shared Channel (PUSCH).

"DMRS" refers to the demodulation reference signal within PUCCH and PUSCH.

The PUCCH region indicates the resource block regions at the edges of the channel where a PUCCH may be located. Within this region, automatic channel detection distinguishes between PUCCH and PUSCH. Outside of this region, automatic channel detection always assumes PUSCH.

For TDD signals, the downlink subframes and special subframes are also indicated.

Related settings and dependencies:

- The number of subframes to be captured and shown on the X-axis is configurable as well as the offset of subframe 0 relative to the trigger event. One specific subframe can be selected for slot measurements. For settings see "Measurement Subframe" on page 552.
- The number of resource blocks displayed on the Y-axis depends on the channel bandwidth.
- The number of SC-FDMA symbols per slot depends on the cyclic prefix type.
- The automatic detection of the channel type can be disabled for measurements that evaluate the "Measure Subframe". The detected channel type is then set manually as PUCCH or PUSCH irrespective of the PUCCH region and displayed accordingly in the table. For configuration see "Channel Type" on page 549.
  The range of allocated resource blocks in the measured subframe can also be defined manually. For configuration see "RB Allocation" on page 551.
- The location of downlink and special subframes for TDD signals is always defined manually and never detected automatically. For configuration see "Uplink Downlink" on page 548.

For background information on the UL structure, see chapter 3.2.4.1, "Resources in Time and Frequency Domain", on page 504.

For "View Filter Throughput", see chapter 3.2.6.14, "Common View Elements", on page 534.

For query of the table contents, see chapter 3.5.3.25, "RB Allocation Table Results", on page 666.

3.2.6.9 Detailed Views: Power Monitor

The power monitor view displays the power in the captured subframes. With carrier aggregation, the component carriers are measured separately. One curve per carrier is displayed.

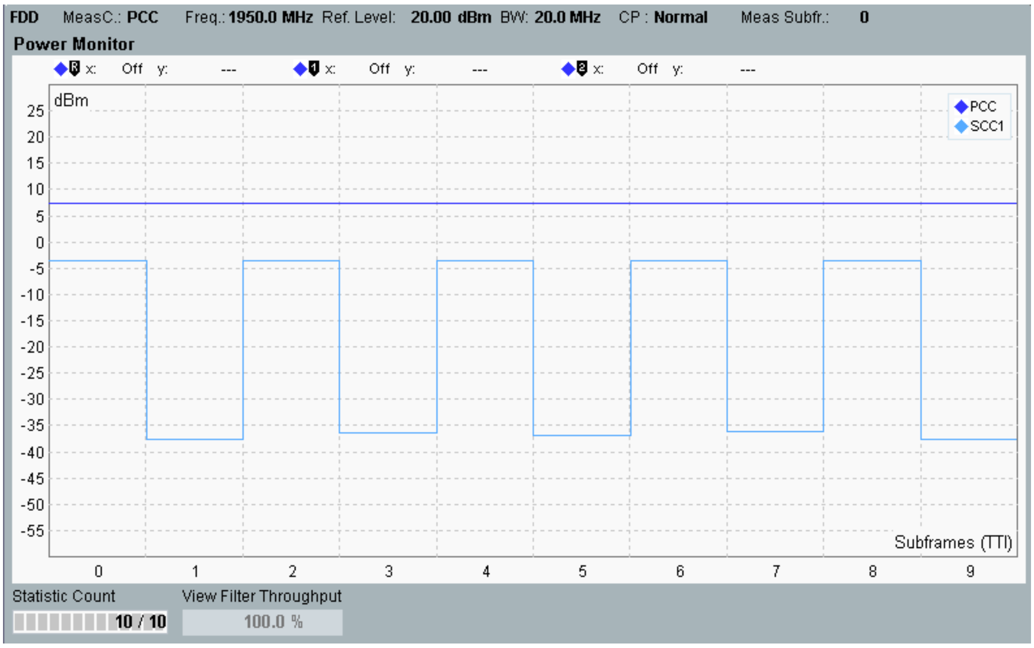


Fig. 3-32: LTE Multi Evaluation: Power Monitor

Each subframe power value is RMS averaged over the entire subframe, excluding 20 µs at each subframe border.

The number of subframes to be captured and shown on the X-axis is configurable as well as the offset of subframe 0 relative to the trigger event, see "Measurement Subframe" on page 552.

The power monitor can be used for power control tests, especially for aggregate power control tests (see 3GPP TS 36.521, 6.3.5 "Power Control").

For the parameters at the bottom, see chapter 3.2.6.14, "Common View Elements", on page 534.

For query of the diagram contents via remote control, see chapter 3.5.3.26, "Power Monitor Results", on page 668.

3.2.6.10 Detailed Views: Power Dynamics

The power dynamics view shows a diagram and a statistical overview of related power results. For signals with carrier aggregation, only the configured "Measurement Carrier" is measured.

The following figure shows measurement results for the general ON/OFF time mask.

	OFF Power (before)	ON Power RMS	ON Power Peak	OFF Power (after)
Current	−57.81 dBm	−7.84 dBm	−1.56 dBm	−57.05 dBm
Average	−57.81 dBm	−7.84 dBm	−1.56 dBm	−57.05 dBm
Min	−58.96 dBm	−7.85 dBm	−1.58 dBm	−58.61 dBm
Max	−57.79 dBm	−7.83 dBm	−1.46 dBm	−56.96 dBm
StdDev	0.00 dBm	0.00 dBm	0.00 dBm	0.00 dBm

Fig. 3-33: LTE Multi Evaluation: Power Dynamics, general time mask

The following statements apply also to power dynamics measurements with other time masks.

The diagram shows the UE output power vs. time, sampled with 48 T_s (1.5625 µs). The measured trace covers the range from -1100 µs to +2098.4375 µs relative to the start of the "Measure Subframe" (see "Measurement Subframe" on page 552). The diagram shows a subsection of the measured trace, depending on the configured time mask.

The individual ON and OFF power areas are labeled in the diagram. ON power periods are marked by a green horizontal bar. The measured subframe and an eventual SRS period at the end of the "Measure Subframe" are indicated. Exclusion periods are marked by gray vertical bars.

The table below the diagram shows a statistical evaluation of the ON power and OFF power values. The table columns are not necessarily ordered in the same way as the related diagram sections.

Depending on the selected time mask, the following results are available:

- "ON Power, RMS/Peak":
  Mean value and peak value of the UE output power over the "Measure Subframe" (minus exclusion period and SRS period)
- "OFF Power (after)", "ON Power (after)":
  Mean power in one subframe after the "Measure Subframe" (minus exclusion period)
- "OFF Power (before)":

Mean power in one subframe before the "Measure Subframe"

- "SRS ON/OFF":
  Mean power in the SRS period at the end of the "Measure Subframe"

For the parameters at the bottom of the view, see chapter 3.2.6.14, "Common View Elements", on page 534.

For query of the diagram and table contents via remote control, see:

- chapter 3.5.3.22, "Power Dynamics Results (Traces)", on page 660
- chapter 3.5.3.29, "Power Dynamics Results (Single Values)", on page 677

Signal configuration for general time mask

The "Measure Subframe" must be on and one subframe before and after the "Measure Subframe" must be off.

However, it is recommended to configure two subframes off before and after the "Measure Subframe" (OFF OFF ON OFF OFF). This guarantees that the measured "OFF Power (before)" is not falsified by power contributions of a preceding ON subframe ramped down too slowly, or the "OFF Power (after)" by a subsequent ON subframe ramped up too early.

The trace sections below -1000 µs and above 2000 µs belong to the second subframes before and after the "Measure Subframe". In the figure above they are on.

Signal configuration for SRS time masks

The "Measure Subframe" and one subframe after the "Measure Subframe" must be on.

At the end of the "Measure Subframe", there must be an SRS. Depending on the time mask, it must be a UE-specific SRS (SRS ON, UE transmitting) or a cell-specific SRS (SRS OFF, another UE assumed to transmit).

For FDD, you can achieve this SRS configuration with the combined signal path scenario. In the signaling application, enable SRS and use the default SRS subframe configuration and SRS configuration index. In the measurement, set the "Measure Subframe" to subframe 0 for SRS ON and to subframe 5 for SRS OFF.

The following figures show measurement results for the PUCCH / PUSCH / SRS time mask and the SRS blanking time mask.

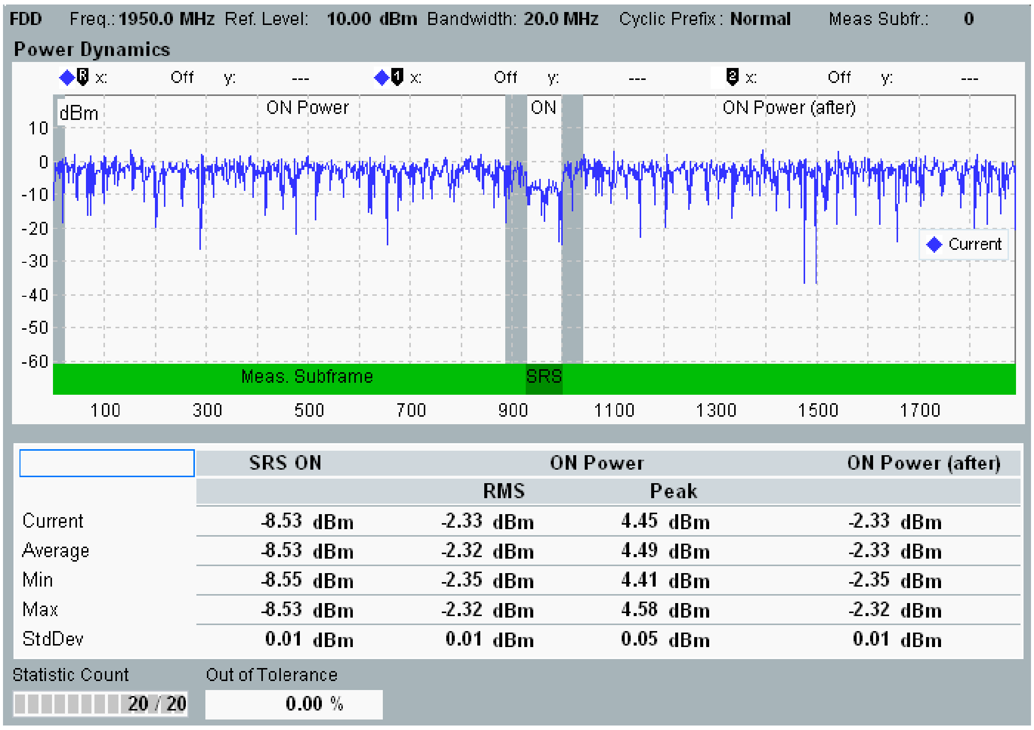


Fig. 3-34: LTE Multi Evaluation: Power Dynamics, PUCCH / PUSCH / SRS time mask

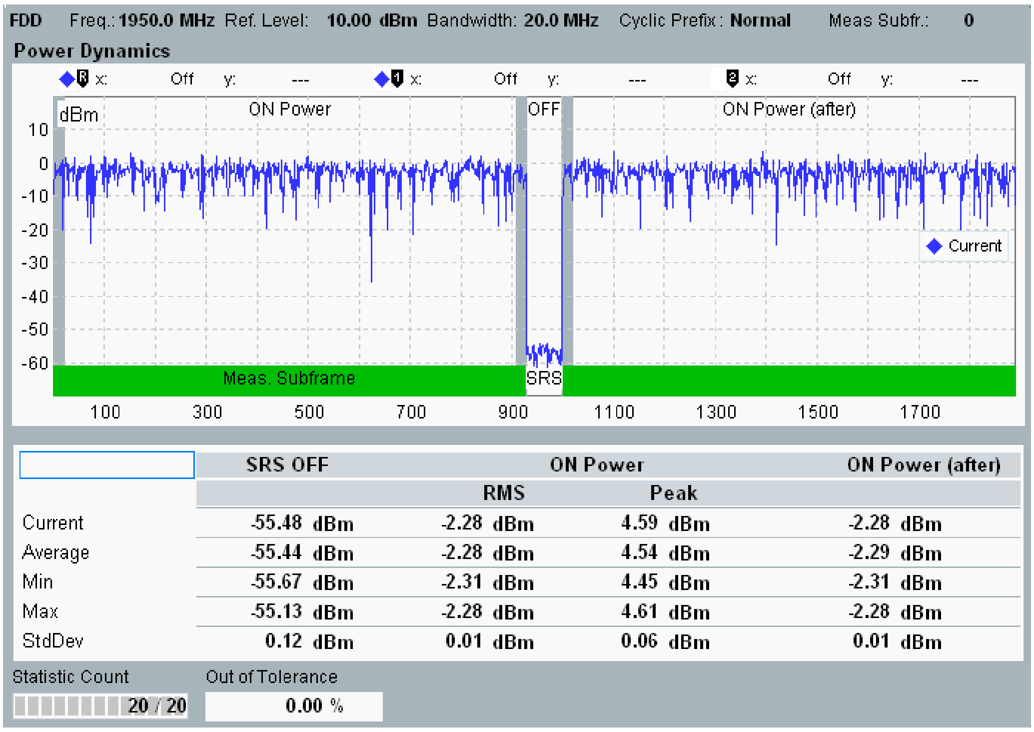


Fig. 3-35: LTE Multi Evaluation: Power Dynamics, SRS blanking time mask

3.2.6.11 Detailed Views: TX Measurement and BLER

This view contains tables of statistical results for the TX and RX measurements.

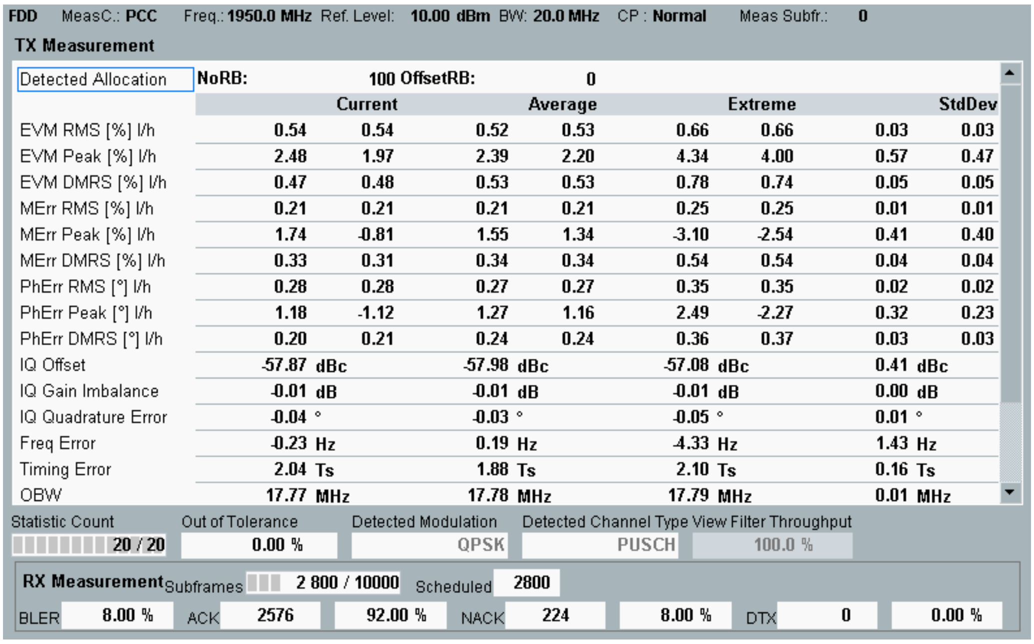


Fig. 3-36: LTE Multi Evaluation: TX Measurement

TX Measurement

The table provides an overview of statistical values obtained in the measured slot. Except for the OBW result, only a single carrier is analyzed. For signals with carrier aggregation, you can select which carrier is measured (setting "Measurement Carrier").

Other detailed views provide a subset of these values:

- Detected Allocation: "NoRB" indicates the number of allocated resource blocks, "OffsetRB" the offset of the first allocated resource block from the edge of the allocated UL transmission bandwidth.
- EVM, Magnitude Error, Phase Error: The R&S CMW calculates and displays two values (l/h) for low and high EVM window position; see chapter 3.2.1.7, "Calculation of Modulation Results", on page 495.
  For the SC-FDMA data symbols (all symbols except reference symbol) RMS and peak values are provided. The DMRS value refers to the reference symbol (Demodulation Reference Signal).
- I/Q Origin Offset: The I/Q offset is estimated from the distribution of the constellation points.
- Gain Imbalance: absolute value of [1 + I/Q Imbalance]
  Quadrature Error: angular component of [1 + I/Q Imbalance]
  These results are only available, if the view "EVM vs. subcarrier" is enabled and the measured carrier has a full resource block allocation (for example 50 RB at 10 MHz bandwidth). Otherwise these results are not calculated, in order to speed up the measurement.

- Carrier Frequency Error: offset between the measured carrier frequency and the nominal RF frequency of the measured radio channel
- Timing Error: Difference between the actual timing and the expected timing. The timing error measurement requires an "external" trigger signal to derive the expected timing. Suitable trigger signals are e.g. the frame trigger signal provided by the signaling application or an external trigger fed in at the TRIG A or TRIG B connector.
  The unit T_s stands for the basic LTE time unit, see chapter 3.2.4.1, "Resources in Time and Frequency Domain", on page 504.
- Occupied Bandwidth (OBW): width of the frequency range that contains 99% of the total integrated power of the transmitted spectrum
  With carrier aggregation, the transmitted spectrum comprises all carriers. The center of the frequency range is the carrier center frequency / the aggregated bandwidth center frequency.
- TX Power: RMS averaged power over all samples in the slot, equivalent to the sum of the powers of all (allocated and non-allocated) RBs
- Peak Power: peak power of all samples in the slot
- RB Power: arithmetic mean value of the average powers in all allocated resource blocks

For query of the results via remote control, see chapter 3.5.3.27, "Modulation Results (Single Values)", on page 669.

For the parameters below the "TX Measurement" table, see chapter 3.2.6.14, "Common View Elements", on page 534.

RX Measurement

For information about this measurement, refer to chapter 3.2.2, "LTE RX Tests", on page 496.

The table provides the following results:

- Subframes: Number of already processed subframes and total number of subframes to be processed. All downlink subframes are counted, scheduled subframes as well as subframes without allocated resource blocks.
- Scheduled: Number of already measured subframes (scheduled downlink subframes). If the measurement is configured correctly, this number equals the sum of the absolute values for ACK, NACK and DTX.
- BLER: Block Error Ratio, percentage of sent scheduled subframes for which no acknowledgment has been received. The result considers received NACK and PDCCH decoding errors (DTX):
  BLER = (#NACK + #DTX) / (#ACK + #NACK + #DTX)
- ACK / NACK / DTX: Number of acknowledgments and negative acknowledgments received over the PUCCH. No answer at all (neither ACK or NACK) is counted as DTX. If a PUSCH is detected instead of a PUCCH, this is counted as NACK.
  The results are presented as absolute number and as percentage relative to the number of sent scheduled subframes.

For query of the results via remote control, see chapter 3.5.3.31, "BLER Results", on page 682.

3.2.6.12 Selecting and Modifying Views

Use the "Display" parameters to select the views and to change the appearance and contents of the views. Depending on the selected view the following "Display" hotkeys are available at the bottom of the GUI:

Hotkey	Description
"Select View ..."	Switch to a certain detailed view or overview. Alternatively select a diagram in the overview and press ENTER or the rotary knob.
"Select Trace ..."	Select the trace types to be displayed in the view.
"X Scale... / Y Scale..."	Modify the ranges of the X-axis and the Y-axis.
"EVM Window Position ..."	Select which of the results calculated at the low and high extremities of the EVM window shall be displayed; see chapter 3.2.1.7, "Calculation of Modulation Results", on page 495.
"Margin On | Off"	For the spectrum emission mask measurement: show or hide margin results

Additional options are available in the "Measurement Control" section of the configuration dialog.

3.2.6.13 Using Markers

Use the "Marker" parameters to activate markers and to modify their position. The following "Marker" hotkeys are available at the bottom of the GUI:

Hotkey	Description
"Ref. Marker ..."	Enable or disable the reference marker and select the marker position. If several traces can be displayed, a trace can also be selected.
"Marker 1 /2 ..."	Enable or disable marker 1 or 2 and define the marker position (absolute or relative to the reference marker). Depending on the trace mode, a trace can also be selected.
"Select Trace Mode"	Define whether marker 1 and 2 are set to the same trace as the reference marker (collective) or to selectable individual traces.

See also: "Markers" in the R&S CMW user manual, chapter "System Overview"

3.2.6.14 Common View Elements

This section describes elements that are displayed in most views.

Tables

Most detailed views show tables providing a statistical evaluation of results obtained in the measured slot. The statistical values in the tables are calculated as follows:

- **Current:** Value of the result obtained in the last measurement interval. For some modulation results, the current RMS value (the average over all samples in the measured slot) and the current peak value (the peak of all samples in the measured slot) are available.
- **Average:** Average of all "Current" values referenced to the last statistics cycle.
- **Extreme, Min, Max:** Largest or smallest "Current" value that the R&S CMW obtained since the start of the measurement. For EVM, Magnitude Error and Phase Error the extreme value of all modulation symbols in the slot; no average over data symbols is involved.
- **StdDev:** Standard deviation of all "Current" values since the start of the measurement.

All statistical results (statistical tables and "Average" or "Max" traces) are calculated according to the general rules for statistical results.

See also: "Statistical Results" in the R&S CMW user manual, chapter "System Overview"

Statistic Count

Progress bar for the measurement. During the first single shot after the start of the measurement, the bar shows the number of elapsed measured slots or subframes relative to the "Statistic Count". A filled progress bar indicates that the first shot is complete and the statistical depth has been reached.

Note that two slots are measured when the defined number of subframes is captured once. For an example see chapter 3.2.1.3, "Defining the Scope of the Measurement", on page 492.

See also: "Statistical Settings" in the R&S CMW user manual, chapter "System Overview"

Out of Tolerance

Percentage of measurement intervals (slots) that were failed because they exceeded the limits in the diagram.

Detected Modulation

Modulation scheme in the measured slot. The modulation scheme is either detected automatically or selected manually (see "Modulation Scheme" on page 553). If channel type PUCCH is detected, QPSK is displayed as modulation type, because the QPSK limits are applied in that case.

Detected Channel Type

Channel type (PUCCH or PUSCH) for the measured slot. The channel type is either detected automatically or selected manually, see "Channel Type" on page 549.

View Filter Throughput

Percentage of measurement intervals where the detected signal configuration was found to correspond to the "View Filter" settings. Only slots which contribute to the "View Filter Throughput" are displayed, counted, and used for the statistical results; other slots are rejected. For filter settings see chapter 3.3.5, "Measurement Control Settings", on page 544.

The "View Filter Throughput" is evaluated in a moving window of 1000 frames. If a non-matching signal configuration is changed according to the "View Filter" settings, the throughput increases linearly from 0 % to 100 %.

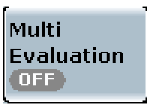
3.3 GUI Reference

The following sections provide detailed reference information on the Graphical User Interface (GUI) and the parameters of the "LTE Multi Evaluation" measurement.

3.3.1 Measurement Control

The measurement is turned on or off using the ON | OFF or RESTART | STOP keys.

See also: "Measurement Control" in the R&S CMW user manual, chapter "System Overview"



Multi Evaluation (Softkey)
The softkey shows the current measurement state. Additional measurement substates can be retrieved via remote control.

Remote command:
INITiate:LTE:MEAS<i>:MEValuation
ABORt:LTE:MEAS<i>:MEValuation
STOP:LTE:MEAS<i>:MEValuation
FETCh:LTE:MEAS<i>:MEValuation:STATe?
FETCh:LTE:MEAS<i>:MEValuation:STATe:ALL?

3.3.2 Accessing Parameters and Settings

The most important settings of the "LTE Multi Evaluation" measurement are displayed at the top of the measurement dialog.

All settings are defined via softkeys and hotkeys or using the "LTE Multi Evaluation Configuration" dialog. The configuration dialog is described in the following sections. To open the dialog, select the "Multi Evaluation" tab and press the "Config" hotkey.

3.3.3 Signal Routing and Analyzer Settings

The parameters at the top of the configuration tree configure the RF input path. Most parameters are common measurement settings. They have the same value in all measurements (e.g. PRACH measurement and multi evaluation measurement).

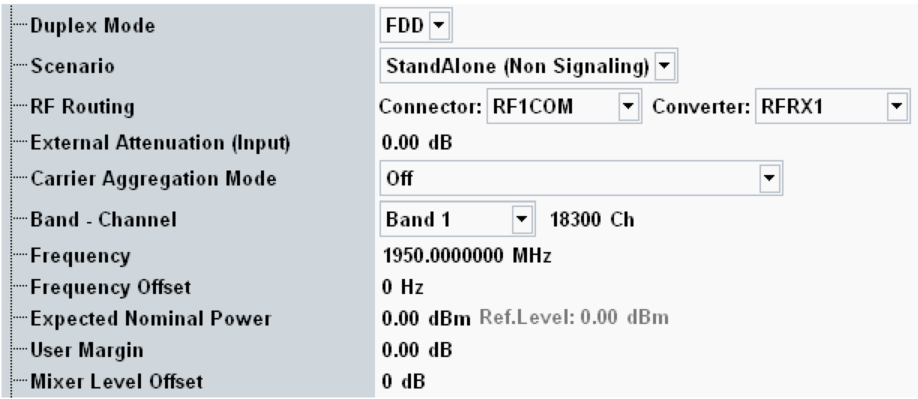


Fig. 3-37: Signal routing and analyzer settings

Duplex Mode

Selects the duplex mode of the LTE signal: FDD or TDD.

In the Standalone (SA) scenario, this parameter is controlled by the measurement. In the Combined Signal Path (CSP) scenario, it is controlled by the signaling application.

Remote command:
`CONFigure:LTE:MEAS<i>:DMODe` (SA)
`CONFigure:LTE:SIGN<i>:DMODe` (CSP)

Scenario = StandAlone
The multi evaluation measurement is used standalone.

Remote command:
`ROUTe:LTE:MEAS<i>:SCENario:SALone`
`ROUTe:LTE:MEAS<i>:SCENario?`
`ROUTe:LTE:MEAS<i>?`

Scenario = Combined Signal Path
Allows to use an LTE signaling application (option R&S CMW-KS500/-KS550) in parallel to the LTE multi evaluation measurement. The signaling application is selected by the additional parameter "Controlled by".

Most parameters described in this section and some parameters described in section Measurement Control Settings display values determined by the signaling application. The corresponding measurement settings are remembered in the background and displayed again when switching back to the standalone scenario.

Connection status information of the signaling application is displayed at the bottom of the measurement views. Softkeys and hotkeys provide access to the settings of the signaling application and allow to switch the downlink signal on or off, see chapter 3.3.9, "Additional Softkeys and Hotkeys", on page 562.

For additional information see chapter 3.2.1.5, "Parallel Signaling and Measurement", on page 494.

Remote command:
`ROUTe:LTE:MEAS<i>:SCENario:CSPath`
`ROUTe:LTE:MEAS<i>:SCENario?`
`ROUTe:LTE:MEAS<i>?`

Scenario = Measure@ProtocolTest
Allows to use an LTE protocol test application in parallel to the LTE multi evaluation measurement. The protocol test application is selected by the additional parameter "Controlled by".

The signal routing and analyzer settings described in this section are ignored by the measurement application. The corresponding settings have to be configured within the protocol test application.

Protocol test applications are available for R&S CMW500, but not for R&S CMW270 and R&S CMW280.

Remote command:
`ROUTe:LTE:MEAS<i>:SCENario:MAPRotocol`
`ROUTe:LTE:MEAS<i>:SCENario?`

RF Routing
Selects the input path for the measured RF signal, i.e. the input connector and the RX module to be used.

Depending on your hardware configuration there may be dependencies between both parameters. Select the RF connector first. The "Converter" parameter offers only values compatible with the selected RF connector.

In the Standalone (SA) scenario, these parameters are controlled by the measurement. In the Combined Signal Path (CSP) scenario, they are controlled by the signaling application.

For connector and converter settings in the combined signal path scenario, use one of the `ROUTe:LTE:SIGN<i>:SCENario:...` signaling commands.

Remote command:
`ROUTe:LTE:MEAS<i>:SCENario:SALone` (SA)
`ROUTe:LTE:SIGN<i>:SCENario:...` (CSP)

External Attenuation (Input)
Defines the value of an external attenuation (or gain, if the value is negative) in the input path. The power readings of the R&S CMW are corrected by the external attenuation value.

The external attenuation value is also used in the calculation of the maximum input power that the R&S CMW can measure.

If a correction table for frequency-dependent attenuation is active for the chosen connector, then the table name and a button are displayed. Press the button to display the table entries.

In the Standalone (SA) scenario, this parameter is controlled by the measurement. In the Combined Signal Path (CSP) scenario, it is controlled by the signaling application.

Remote command:
`CONFigure:LTE:MEAS<i>:RFSettings:EATTenuation` (SA)
`CONFigure:LTE:SIGN<i>:RFSettings[:PCC]:EATTenuation:INPut` (CSP)

Carrier Aggregation Mode
Selects whether the measured signal uses carrier aggregation or not, see chapter 3.3.4, "Carrier Aggregation Settings", on page 541.

The parameter is only visible, if option R&S CMW-KM502/552 is available.

Band / Channel / Frequency
Center frequency of the RF analyzer for measurements without carrier aggregation. Set this frequency to the frequency of the measured RF signal to obtain a meaningful measurement result. The relation between operating band, frequency and channel number is defined by 3GPP (see chapter 3.2.4.2, "Frequency Bands", on page 506).

You can specify the RF frequency in two ways:
- Enter the frequency directly. The band and channel settings can be ignored or used for validation of the entered frequency. For validation select the designated band. The channel number resulting from the selected band and frequency is displayed. For an invalid combination no channel number is displayed.

- Select a band and enter a channel number valid for this band. The R&S CMW calculates the resulting frequency.

In the Standalone (SA) scenario, these parameters are controlled by the measurement. In the Combined Signal Path (CSP) scenario, they are controlled by the signaling application.

Remote command:
`CONFigure:LTE:MEAS<i>:BAND` (SA)
`CONFigure:LTE:MEAS<i>:RFSettings[:PCC]:FREQuency` (SA)
`CONFigure:LTE:SIGN<i>[:PCC]:BAND` (CSP)
`CONFigure:LTE:SIGN<i>:RFSettings[:PCC]:CHANnel:UL` (CSP)

Frequency Offset
Positive or negative frequency offset to be added to the specified center frequency of the RF analyzer.

In the Standalone (SA) scenario, this parameter is controlled by the measurement. In the Combined Signal Path (CSP) scenario, it is controlled by the signaling application.

Remote command:
`CONFigure:LTE:MEAS<i>:RFSettings:FOFFset` (SA)
`CONFigure:LTE:SIGN<i>:RFSettings[:PCC]:FOFFset:UL` (CSP)

Expected Nominal Power
Defines the nominal power of the RF signal to be measured. An appropriate value for LTE signals is the peak output power at the DUT during the measurement. The "Ref. Level" is calculated as follows:

Reference level = Expected Nominal Power + User Margin

Note: The actual input power at the connectors (i.e. the "Reference Level" minus the "External Attenuation (Input)" value, if all power settings are configured correctly) must be within the level range of the selected RF input connector; refer to the data sheet.

In the Standalone (SA) scenario, this parameter is controlled by the measurement. In the Combined Signal Path (CSP) scenario, it is controlled by the signaling application.

Remote command:
`CONFigure:LTE:MEAS<i>:RFSettings:ENPower` (SA)
`CONFigure:LTE:SIGN<i>:RFSettings:ENPMode` (CSP)
`CONFigure:LTE:SIGN<i>:RFSettings:ENPower` (CSP)

User Margin
Margin that the R&S CMW adds to the "Expected Nominal Power" in order to determine its reference power ("Ref. Level"). The "User Margin" is typically used to account for the known variations of the RF input signal power, e.g. the variations due to a specific channel configuration.

The variations (crest factor) depend on the LTE signal parameters, in particular the modulation scheme. If the "Expected Nominal Power" is set to the peak power during the measurement, a 0 dB user margin is sufficient.

In the Standalone (SA) scenario, this parameter is controlled by the measurement. In the Combined Signal Path (CSP) scenario, it is controlled by the signaling application.

Remote command:
CONFigure:LTE:MEAS<i>:RFSettings:UMARgin (SA)
CONFigure:LTE:SIGN<i>:RFSettings:UMARgin (CSP)

Mixer Level Offset
Varies the input level of the mixer in the analyzer path. A negative offset reduces the mixer input level, a positive offset increases it. Optimize the mixer input level according to the properties of the measured signal.

Mixer Level Offset	Advantages	Possible Shortcomings
< 0 dB	Suppression of distortion (e.g. of the intermodulation products generated in the mixer)	Lower dynamic range (due to smaller signal-to-noise ratio)
> 0 dB	High signal-to-noise ratio, higher dynamic range	Risk of intermodulation, smaller overdrive reserve

In the Standalone (SA) scenario, this parameter is controlled by the measurement. In the Combined Signal Path (CSP) scenario, it is controlled by the signaling application.

Remote command:
CONFigure:LTE:MEAS<i>:RFSettings:MLOFfset (SA)
CONFigure:LTE:SIGN<i>:RFSettings:MLOFfset (CSP)

3.3.4 Carrier Aggregation Settings

To measure an UL signal with carrier aggregation, select the corresponding carrier aggregation mode within the analyzer settings at the top of the configuration tree.

As a consequence, an additional node is displayed for configuration of the individual component carriers. The band, channel and frequency settings are moved into this node, as well as the channel bandwidth setting from the "Measurement Control" section.

These settings are described in the following. Other parameters that depend on the carrier aggregation mode are the spectrum limits and the network signaled value. Some measurement result views are also modified depending on the carrier aggregation mode.

Option R&S CMW-KM502/552 is required for FDD/TDD carrier aggregation. Without these options, the parameters in this section are not visible.

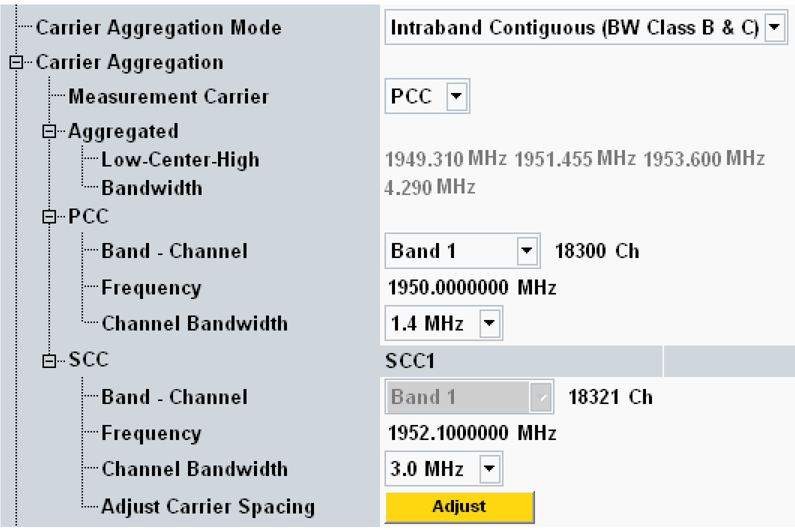


Fig. 3-38: Carrier aggregation settings

Configuring the component carrier frequencies

To ensure that the component carriers are aggregated contiguously, proceed as follows.

1. Select the PCC channel bandwidth and the SCC channel bandwidth.
2. Specify the PCC center frequency (directly or via band plus channel number).
3. Select whether the SCC center frequency shall be lower or higher than the PCC center frequency:
   Specify any SCC frequency above or below the PCC frequency.
4. Press the "Adjust" button.
   The SCC center frequency is adjusted automatically, so that the spacing between SCC and PCC is correct. The channel spacing is defined in 3GPP TS 36.101, section 5.7.1A.

The settings in figure 3-38 are described in the following.

Carrier Aggregation Mode

Selects whether the measured signal uses carrier aggregation or not.

The following modes are supported:

- **Off**:
  The UL signal contains a single carrier, no carrier aggregation.

The node "Carrier Aggregation" is hidden and the remainder of this section is irrelevant.

- **Intraband Contiguous (BW Class B & C)**:
  The UL signal contains one PCC and one SCC. The two carriers use a continuous spectrum in the same operating band. For details about the BW classes, see 3GPP TS 36.101, section 5.6A.
  The node "Carrier Aggregation" is shown and the remaining parameters in this section must be configured.
  UL carrier aggregation is only supported for the standalone scenario. Option R&S CMW-KM502/552 is required for FDD/TDD.

Remote command:
CONFigure:LTE:MEAS<i>:CAGGregation:MODE

Measurement Carrier

Selects a component carrier for single-carrier measurements. If the selected carrier is not available, this results in a "Sync Error" or in an "Underdriven" error.

Single-carrier measurement views, evaluating the "Measurement Carrier":

- EVM vs. symbol / vs. subcarrier, magnitude error, phase error
- Equalizer spectrum flatness
- Power dynamics
- I/Q diagram
- TX measurement

Multi-carrier measurements, evaluating all carriers:

- Inband emission diagrams
- Spectrum ACLR
- Spectrum emission mask
- Power monitor
- RB allocation table

Option R&S CMW-KM502/552 is required for FDD/TDD.

Remote command:
CONFigure:LTE:MEAS<i>:CAGGregation:MCARrier

Aggregated

Displays information about the aggregated bandwidth, resulting from the configured PCC and SCC frequencies and the channel bandwidths.

"Low-Center-High" indicates the lower edge of the aggregated bandwidth, the center frequency and the higher edge. "Bandwidth" indicates the width of the aggregated bandwidth (higher edge minus lower edge).

The displayed bandwidth may be slightly less than the sum of the PCC and SCC channel bandwidths. For details, see 3GPP TS 36.101, sections 5.6A and 5.7.1A.

Option R&S CMW-KM502/552 is required for FDD/TDD.

Remote command:
CONFigure:LTE:MEAS<i>:CAGGregation:FREQuency:AGGRegated:LOW?
CONFigure:LTE:MEAS<i>:CAGGregation:FREQuency:AGGRegated:CENTer?
CONFigure:LTE:MEAS<i>:CAGGregation:FREQuency:AGGRegated:HIGH?
CONFigure:LTE:MEAS<i>:CAGGregation:CBANdwidth:AGGRegated?

Band / Channel / Frequency
The "Frequency" defines the PCC or SCC center frequency. The two component carriers must be aggregated contiguously. The correct channel spacing depends on the bandwidths. For easy configuration, proceed as described in "Configuring the component carrier frequencies" on page 542.

The "Band" setting is identical for the two carriers. Configuring the band and the channel numbers is optional, as for configurations without carrier aggregation.

Option R&S CMW-KM502/552 is required for FDD/TDD.

Remote command:
`CONFigure:LTE:MEAS<i>:BAND`
`CONFigure:LTE:MEAS<i>:RFSettings[:PCC]:FREQuency`
`CONFigure:LTE:MEAS<i>:RFSettings:SCC<no>:FREQuency`

Channel Bandwidth
You can set different channel bandwidths for the PCC and the SCC. Set the bandwidths in accordance with the measured LTE signal.

Option R&S CMW-KM502/552 is required for FDD/TDD.

Remote command:
`CONFigure:LTE:MEAS<i>[:PCC]:CBANdwidth`
`CONFigure:LTE:MEAS<i>:SCC<no>:CBANdwidth`

Adjust Carrier Spacing
Adjusts the SCC frequency, so that the PCC and the SCC are aggregated contiguously. Readjust the SCC frequency after you have changed a channel bandwidth or the PCC frequency.

Option R&S CMW-KM502/552 is required for FDD/TDD.

Remote command:
`CONFigure:LTE:MEAS<i>:CAGGregation:SCC<no>:ACSPacing`

3.3.5 Measurement Control Settings

The "Measurement Control" parameters configure the scope of the LTE multi evaluation measurement.

While the combined signal path scenario is active, some of the measurement control parameters display values determined by the controlling signaling application. This is indicated in the parameter description. See also "Scenario = Combined Signal Path" on page 538.

3.3.5.1 Miscellaneous, Part 1

This section describes the following "Measurement Control" settings.

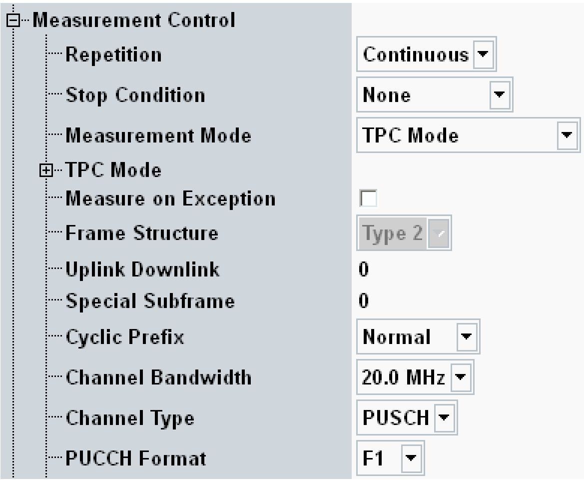


Fig. 3-39: Measurement control settings - part 1

Repetition

Defines how often the measurement is repeated if it is not stopped explicitly or by a failed limit check.

- **Continuous:** The measurement is continued until it is explicitly terminated; the results are periodically updated.
- **Single-Shot:** The measurement is stopped after one statistics cycle.

Single-shot is preferable if only a single measurement result is required under fixed conditions, which is typical for remote-controlled measurements. Continuous mode is suitable for monitoring the evolution of the measurement results in time and observe how they depend on the measurement configuration, which is typically done in manual control. The reset/preset values therefore differ from each other.

Remote command:

`CONFigure:LTE:MEAS<i>:MEValuation:REPetition`

Stop Condition

Specifies the conditions for an early termination of the measurement:

- **None:** The measurement is performed according to its "Repetition" mode and "Statistic Count", irrespective of the limit check results.
- **On Limit Failure:** The measurement is stopped as soon as one of the limits is exceeded, irrespective of the repetition mode set. If no limit failure occurs, it is performed according to its "Repetition" mode and "Statistic Count". Use this setting for measurements that are essentially intended for checking limits, e.g. production tests.

Remote command:
`CONFigure:LTE:MEAS<i>:MEValuation:SCONdition`

Measurement Mode

Selects/displays the measurement mode.

- **Normal**:
  In normal mode, the measurement uses a constant reference level for the entire measurement duration.
  Use the normal mode for the standalone scenario. For the other scenarios, the normal mode is only suitable, if the controlling application does not modify the reference level during the measurement.
- **TPC Mode**:
  In TPC mode, the measurement (re)configures the reference level once per subframe. With the combined signal path scenario, this is done according to the information provided by the controlling application. With the standalone scenario, the reference levels to be used must be configured, see parameter TPC Mode.
  The TPC mode has been designed for TPC measurements where the UE power is ramped up or down over a wide range, exceeding the dynamic range of the measurement. A typical example is a conformance test case according to 3GPP TS 36.521, section "6.3.5.2 Power Control Relative power tolerance".
  Note that for spectrum measurements the normal mode is recommended. For channel bandwidths > 10 MHz, spectrum measurements are not supported in TPC mode.
- **Multi Eval List Mode**:
  The list mode can only be enabled via the remote control command listed below. When it has been enabled, "Multi Eval List Mode" is displayed as measurement mode. You can disable it by selecting one of the other modes.
  For an introduction to the list mode see chapter 3.2.3, "List Mode", on page 498.
  Option R&S CMW-KM012 is required.

While the combined signal path scenario is active, this parameter is not configurable.

Remote command:
`CONFigure:LTE:MEAS<i>:MEValuation:MMODe`
`CONFigure:LTE:MEAS<i>:MEValuation:LIST`

TPC Mode

This node configures a sequence of expected nominal power values to be applied during a measurement in TPC mode, using the standalone scenario. It is only visible, if the measurement mode "TPC Mode" is selected.

For each list entry, you can configure a number of subframes and the expected nominal power applicable to these subframes. The resulting reference level is calculated and displayed for information. The first entry is coupled to the standard expected nominal power setting, see "Expected Nominal Power" on page 540.

TPC Mode	Nr of Subframes	Exp.Nom. Power	Reference Level
[0]	320	0.00 dBm	0.00 dBm
[1]	320	0.00 dBm	0.00 dBm
[2]	320	0.00 dBm	0.00 dBm

The list defines the expected nominal powers to be applied within one sequence of measured subframes, configured via parameter Measurement Subframe > No. of Subframes.

Example:

- configured "No. of Subframes" = 30, to be measured two times (defined via statistic count)
- list entry 0 = 10 subframes, 0 dBm
  list entry 1 = 15 subframes, 10 dBm
  list entry 2 = 10 subframes, 20 dBm
- Resulting used expected nominal power:
  measured subframe 1 to 10: entry 0, 0 dBm
  measured subframe 11 to 25: entry 1, 10 dBm
  measured subframe 26 to 30: entry 2, 20 dBm
  second measurement of 30 subframes: again entry 0 to 2 are applied

If the configured number of subframes to be measured is longer than the sequence defined via the list entries, the last list entry is used for the remaining subframes.

Note: Between two list entries the R&S CMW reconfigures the reference level according to the next entry. This may impair the accuracy of measurement results for the preceding and the subsequent subframe. Consider this when configuring the measurement and evaluating the results. Do not reconfigure the reference level directly before/after the "Measure Subframe".

Remote command:
`CONFigure:LTE:MEAS<i>:MEValuation:TMODe:SCOunt`
`CONFigure:LTE:MEAS<i>:MEValuation:TMODe:ENPower`
`CONFigure:LTE:MEAS<i>:MEValuation:TMODe:RLEVel?`

Measure on Exception

Specifies whether measurement results that the R&S CMW identifies as faulty or inaccurate are rejected. A faulty result occurs e.g. when an overload is detected. In remote control, the cause of the error is indicated by the "reliability indicator".

- **Off:** Faulty results are rejected. The measurement is continued; the statistical counters are not re-set. Use this mode to ensure that a single faulty result does not affect the entire measurement.
- **On:** Results are never rejected. Use this mode e.g. for development purposes, if you want to analyze the reason for occasional wrong transmissions.

Remote command:
`CONFigure:LTE:MEAS<i>:MEValuation:MOEXception`

Frame Structure

Displays the frame structure of the uplink signal as defined in 3GPP TS 36.211. The value is set implicitly via the Duplex Mode (Type 1 = FDD, Type 2 = TDD).

For a TDD signal the additional parameters "Uplink Downlink" and "Special Subframe" have to be set to fully specify the frame structure.

Remote command:
`CONFigure:LTE:MEAS<i>:FSTRucture?`

Uplink Downlink

Uplink-downlink configuration of a TDD signal, as defined in 3GPP TS 36.211, chapter 4, "Frame Structure". Each configuration defines a combination of uplink subframes, downlink subframes and special subframes within a radio frame. The selected configuration is visualized in the "RB Allocation Table".

In the Standalone (SA) scenario, this parameter is controlled by the measurement. In the Combined Signal Path (CSP) scenario, it is controlled by the signaling application.

Remote command:
`CONFigure:LTE:MEAS<i>:MEValuation:ULDL` (SA)
`CONFigure:LTE:SIGN<i>:CELL:ULDL` (CSP)

Special Subframe

Configuration of the special subframes of a TDD signal, as defined in 3GPP TS 36.211, chapter 4, "Frame Structure". Each configuration defines the inner structure of a special subframe, i.e. the lengths of DwPTS, GP and UpPTS.

In the Standalone (SA) scenario, this parameter is controlled by the measurement. In the Combined Signal Path (CSP) scenario, it is controlled by the signaling application.

Remote command:
`CONFigure:LTE:MEAS<i>:MEValuation:SSUBframe` (SA)
`CONFigure:LTE:SIGN<i>:CELL:SSUBframe` (CSP)

Cyclic Prefix

Normal or extended cyclic prefix. Set this parameter in accordance with the cyclic prefix of the measured LTE signal. The number of measured data symbols is 7 (6) for normal (extended) cyclic prefix duration; see chapter 3.2.6.2, "Detailed Views: EVM, Magnitude Error, Phase Error", on page 518.

In the Standalone (SA) scenario, this parameter is controlled by the measurement. In the Combined Signal Path (CSP) scenario, it is controlled by the signaling application.

Remote command:
`CONFigure:LTE:MEAS<i>:MEValuation:CPRefix` (SA)
`CONFigure:LTE:SIGN<i>:CELL:CPRefix` (CSP)

Channel Bandwidth

Channel bandwidth between 1.4 MHz and 20 MHz. Set the bandwidth in accordance with the measured LTE signal.

To configure the channel bandwidth for carrier aggregation, see chapter 3.3.4, "Carrier Aggregation Settings", on page 541.

The parameter is a common measurement setting, i.e. it has the same value in all measurements (e.g. PRACH measurement and multi evaluation measurement).

In the Standalone (SA) scenario, this parameter is controlled by the measurement. In the Combined Signal Path (CSP) scenario, it is controlled by the signaling application.

Remote command:
`CONFigure:LTE:MEAS<i>[:PCC]:CBANdwidth` (SA)
`CONFigure:LTE:SIGN<i>:CELL:BANDwidth[:PCC]:DL` (CSP)

Channel Type

Configures the channel type detection for the measured subframe of the measured carrier. With carrier aggregation, the measured carrier is the configured "Measurement Carrier".

The channel type can usually be detected automatically. If automatic detection fails, e.g. because the signal contains a PUCCH outside of the PUCCH region, select the channel type manually.

- **AUTO**: The channel type is detected automatically. Within the PUCCH region, it can be PUCCH or PUSCH. Outside of the PUCCH region, PUSCH is always assumed.
- **PUSCH**: The measured subframe contains only PUSCH.
- **PUCCH**: The measured subframe contains only PUCCH.

To verify detected channel types, you can use the RB allocation table, see chapter 3.2.6.8, "Detailed Views: RB Allocation Table", on page 526.

Remote command:
`CONFigure:LTE:MEAS<i>:MEValuation:CTYPe`

PUCCH Format

Specifies the format of the PUCCH. With carrier aggregation, only the PUCCH of the "Measurement Carrier" is relevant.

If your signal contains a PUCCH, adjust this value to ensure that the R&S CMW can synchronize to the signal and perform channel estimation.

All PUCCH contained in the measured carrier must have the same format. The PUCCH formats are defined in 3GPP TS 36.211.

Remote command:
`CONFigure:LTE:MEAS<i>:MEValuation:PFORmat`

3.3.5.2 Miscellaneous, Part 2

This section describes the following "Measurement Control" settings.

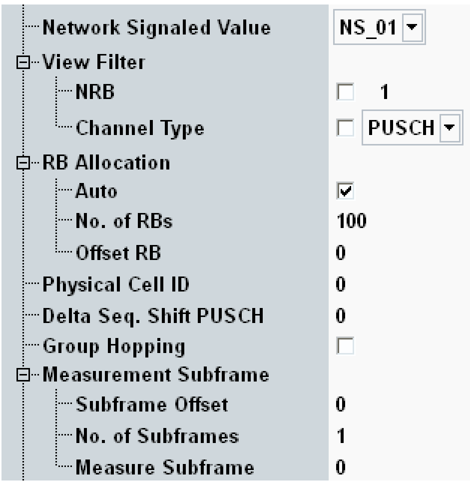


Fig. 3-40: Measurement control settings - part 2

Network Signaled Value

Adjust this value to the "network signaled value" used by the UE. The selected value has impacts on the spectrum emission mask limit check, see chapter 3.2.5.9, "Spectrum Emission Mask", on page 513.

The available values depend on the configured carrier aggregation mode ("NS_xx" values or "CA_NS_xx" values).

In the Standalone (SA) scenario, this parameter is controlled by the measurement. In the Combined Signal Path (CSP) scenario, it is controlled by the signaling application.

Remote command:

CONFigure:LTE:MEAS<i>:MEValuation:NSValue (SA)
CONFigure:LTE:MEAS<i>:MEValuation:NSValue:CAGGregation (SA)
CONFigure:LTE:SIGN<i>:CONNection:ASEMission (CSP)

View Filter > NRB

Specifies a number of allocated resource blocks (RBs) in the measured slot. Slots with a different number of allocated blocks are rejected. Use this setting for signals with a varying number of allocated RBs, if you wish to restrict the measurement to a subset of slots with a specific number of RBs.

With carrier aggregation, the view filter is applied to the "Measurement Carrier".

The allowed values for this parameter are restricted by 3GPP TS 36.211. For details see chapter 3.2.4.1, "Resources in Time and Frequency Domain", on page 504.

Remote command:
CONFigure:LTE:MEAS<i>:MEValuation:NVFilter

View Filter > Channel Type
Allows to measure only slots for which the detected channel type equals Physical Uplink Shared Channel (PUSCH) or only slots with channel type Physical Uplink Control Channel (PUCCH). The detected channel type is influenced by the parameters Channel Type and PUCCH Format.

With carrier aggregation, the view filter is applied to the "Measurement Carrier".

Remote command:
CONFigure:LTE:MEAS<i>:MEValuation:CTVFilter

RB Allocation
If "Auto" is enabled, the RB configuration is detected automatically and the other settings are ignored.

For manual definition of the RB configuration, disable "Auto". Enter the number of allocated RBs in the measured slot (No RB) and the offset of the first allocated resource block from the edge of the allocated UL transmission bandwidth (Offset RB).

With carrier aggregation, this setting applies to the "Measurement Carrier".

The allowed values for "No RB" are restricted by 3GPP TS 36.211. For details see chapter 3.2.4.1, "Resources in Time and Frequency Domain", on page 504.

Remote command:
CONFigure:LTE:MEAS<i>:MEValuation:RBALlocation:AUTO
CONFigure:LTE:MEAS<i>:MEValuation:RBALlocation:NRB
CONFigure:LTE:MEAS<i>:MEValuation:RBALlocation:ORB

Physical Cell ID
Adjust this parameter to the physical cell ID used by the measured LTE signal. This is required to ensure that the R&S CMW can synchronize to the signal and perform channel estimation.

In the Standalone (SA) scenario, this parameter is controlled by the measurement. In the Combined Signal Path (CSP) scenario, it is controlled by the signaling application.

Remote command:
CONFigure:LTE:MEAS<i>:MEValuation:PLCid (SA)
CONFigure:LTE:SIGN<i>:CELL[:PCC]:PCID (CSP)

Delta Seq. Shift PUSCH
Delta sequence shift value (Δ_{ss}) used to calculate the sequence shift pattern for PUSCH from the sequence shift pattern for PUCCH (refer to "group hopping" in 3GPP TS 36.211). Adjust this value to the measured LTE signal to ensure that the R&S CMW can synchronize to the signal and perform channel estimation.

Remote command:
CONFigure:LTE:MEAS<i>:MEValuation:DSSPusch

Group Hopping
Specifies whether group hopping is used or not (refer to "group hopping" in 3GPP TS 36.211). Set this parameter according to the measured LTE signal to ensure that the R&S CMW can synchronize to the signal and perform channel estimation.

Measurements with group hopping require a frame trigger signal.

In the Standalone (SA) scenario, this parameter is controlled by the measurement. In the Combined Signal Path (CSP) scenario, it is controlled by the signaling application.

Remote command:
`CONFigure:LTE:MEAS<i>:MEValuation:GHOPping` (SA)
`CONFigure:LTE:SIGN<i>:CONNection:GHOPping` (CSP)

Measurement Subframe
Configures the scope of the measurement, i.e. which subframes are measured.

- **Subframe Offset**: specifies the start of the measured subframe range relative to the trigger event
- **No. of Subframes**: specifies the length of the measured subframe range, i.e. the number of subframes
  – to be measured and displayed in the views "Power Monitor" and "RB Allocation Table"
  – to be evaluated for BLER measurements (select a high value being a multiple of 10 - to speed up BLER measurements and ensure that the number of scheduled subframes per radio frame can be evaluated correctly)
- **Measure Subframe**: selects one subframe of the measured subframe range containing the measured slots for all other results, e.g. modulation and spectrum results. For "Power Dynamics" measurements the ON power is measured in this subframe.

See also chapter 3.2.1.3, "Defining the Scope of the Measurement", on page 492.

Remote command:
`CONFigure:LTE:MEAS<i>:MEValuation:MSUBframes`

3.3.5.3 Modulation Settings

The following "Measurement Control" parameters configure the modulation measurement settings.

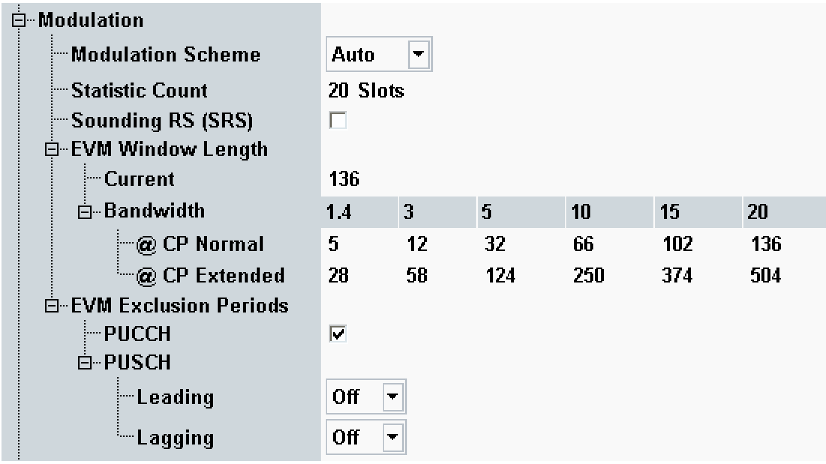


Fig. 3-41: Measurement control settings - modulation

Modulation Scheme

Selects one of the three possible modulation schemes (QPSK, 16-QAM, 64-QAM) for LTE uplink signals. The R&S CMW can also auto-detect the modulation scheme (setting: "Auto").

Auto-detection may fail for signals with a very poor modulation accuracy. In this case, select the modulation scheme in accordance with the measured signal.

For remote operation it is recommended to select the modulation scheme manually to ensure correct detection and speed up the measurement. The reset value differs from the preset value.

Remote command:
CONFigure:LTE:MEAS<i>:MEValuation:MODulation:MSCHeme

Statistic Count

Defines the number of measurement intervals per measurement cycle for modulation measurements. The following result views use this statistic count: EVM, magnitude error, phase error, inband emissions, equalizer spectrum flatness, I/Q diagram and TX measurement.

One measurement interval is completed when the R&S CMW has measured a full slot of the configured "Measure Subframe". The measurement always extends over the whole subcarrier range.

The measurement provides independent statistic counts for different results. In single-shot mode a measurement with a completed statistic count is stopped, even if another measurement with an incomplete statistic count is still running.

Remote command:
CONFigure:LTE:MEAS<i>:MEValuation:SCOunt:MODulation

Sounding RS (SRS)
Indicates whether the uplink signal may contain a Sounding Reference Signal (SRS) or not.

- **Disabled**: The uplink signal must not contain an SRS. Otherwise the modulation results will be distorted.
- **Enabled**: The last SC-FDMA symbol of each subframe is not evaluated for modulation results. So this symbol may be used for SRS signals without distorting the modulation results.

In the Standalone (SA) scenario, this parameter is controlled by the measurement. In the Combined Signal Path (CSP) scenario, this parameter is set by the signaling application. A subsequent modification in the signaling application is also applied to the measurement. But changing the setting in the measurement does not affect the signaling application.

Remote command:
`CONFigure:LTE:MEAS<i>:MEValuation:SRS:ENABle` (SA)
`CONFigure:LTE:SIGN<i>:CELL:SRS:ENABle` (CSP)

EVM Window Length
Length of the EVM window, defined as a number of samples. The standard (3GPP TS 36.101, Annex F) specifies the window length as a function of the bandwidth and the cyclic prefix. The R&S CMW uses the "Current" value. This value is linked to the value in the table, corresponding to the current cyclic prefix and bandwidth settings.

The window length defines the two sets of "l / h" modulation quantities in the result tables; see chapter 3.2.1.7, "Calculation of Modulation Results", on page 495.

The minimum value of 1 FFT symbol actually corresponds to a window of zero length so that $EVM_h = EVM_l$.

Remote command:
`CONFigure:LTE:MEAS<i>:MEValuation:MODulation:EWLength`
`CONFigure:LTE:MEAS<i>:MEValuation:MODulation:EWLength:CBANdwidth<Band>`

EVM Exclusion Periods
Exclusion periods to be considered for calculation of EVM, magnitude error and phase error results (quantities with "low" and "high" values).

Separate settings are available for slots with detected channel type "PUCCH" and "PUSCH":

- **PUCCH**: This parameter affects low and high single value results (tables below bar graphs). If the parameter is enabled, the first and the last SC-FDMA symbol of each slot are excluded from the calculation of these results. If the last symbol of a slot is already excluded because SRS signals are allowed, the second but last symbol is also excluded.
- **PUSCH**: This parameter affects all low and high results (single values and bar graphs). The selected time intervals are excluded from the calculation of these results.
  The "Leading" time interval is excluded at the beginning of each subframe.

The "Lagging" time interval is excluded at the end of each subframe; if SRS signals are allowed, at the end of each shortened subframe.

Remote command:
CONFigure:LTE:MEAS<i>:MEValuation:MODulation:EEPeriods:PUCCh
CONFigure:LTE:MEAS<i>:MEValuation:MODulation:EEPeriods:PUSCh:LEADing
CONFigure:LTE:MEAS<i>:MEValuation:MODulation:EEPeriods:PUSCh:LAGGing

3.3.5.4 Spectrum Settings

The following "Measurement Control" parameters configure the spectrum measurement settings.

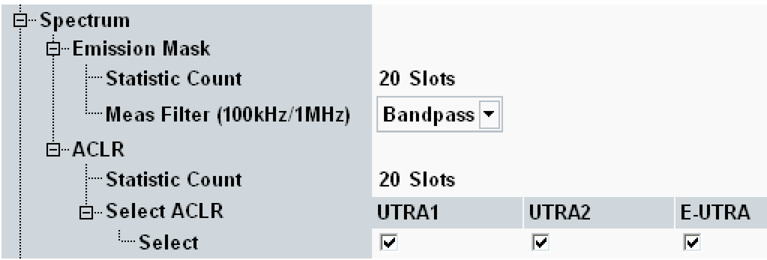


Fig. 3-42: Measurement control settings - spectrum

Emission Mask / ACLR > Statistic Count
Defines the number of measurement intervals per measurement cycle for emission mask and ACLR measurements.

One measurement interval is completed when the R&S CMW has measured a full slot of the configured "Measure Subframe".

Remote command:
CONFigure:LTE:MEAS<i>:MEValuation:SCOunt:SPECtrum:SEMask
CONFigure:LTE:MEAS<i>:MEValuation:SCOunt:SPECtrum:ACLR

Emission Mask > Meas Filter
Selects the resolution filter type for filter bandwidths of 100 kHz and 1 MHz (gaussian or bandpass filter). For 30 kHz filters the type is fixed (gaussian). The filter bandwidth to be used can be configured per emission mask area as part of the limits.

Remote command:
CONFigure:LTE:MEAS<i>:MEValuation:SPECtrum:SEMask:MFILter

ACLR > Select ACLR
Specifies which adjacent channels shall be evaluated: 1st adjacent UTRA channels, 2nd adjacent UTRA channels or 1st adjacent E-UTRA channels. Any combinations are supported, including the activation of all three options in parallel.

Remote command:
`CONFigure:LTE:MEAS<i>:MEValuation:SPECtrum:ACLR:ENABle`

3.3.5.5 Power Settings

The following "Measurement Control" parameters configure the power measurement settings.

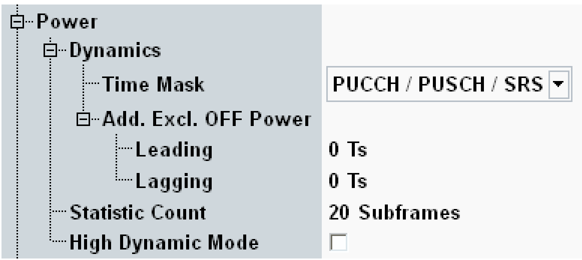


Fig. 3-43: Measurement control settings - power

Dynamics
The following parameters configure the power dynamics measurement.

Time Mask ← Dynamics
Selects the time mask for power dynamics measurements. The time masks are defined by 3GPP. Each mask is designed for a specific sequence of powers.

"ON" and "OFF" indicate the PUCCH/PUSCH power. "SRS ON" and "SRS OFF" indicate the SRS power.

- **General On / Off**: OFF - ON - OFF
  See 3GPP TS 36.521, section 6.3.4.1 / 6.3.4A.1
- **PUCCH / PUSCH / SRS**: ON - SRS ON - ON
  See 3GPP TS 36.101, figure 6.3.4.4-2
- **SRS blanking**: ON - SRS OFF - ON
  See 3GPP TS 36.101, figure 6.3.4.4-4

See also chapter 3.2.5.11, "Power Dynamics Limits", on page 515

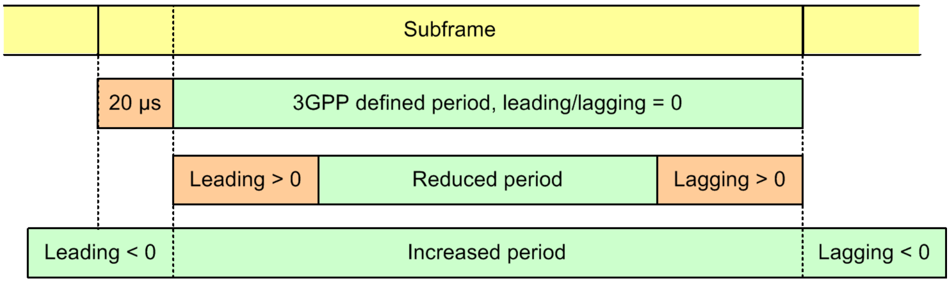
Remote command:
`CONFigure:LTE:MEAS<i>:MEValuation:PDYNamics:TMASk`

Add. Excl. OFF Power ← Dynamics
Shifts the OFF power evaluation periods.

With the default value 0 Ts, the OFF power is measured over the evaluation period defined by 3GPP. The leading value shifts the beginning of the evaluation period, the lagging value shifts the end. Positive values decrease the evaluation period. Negative values increase it.

This setting affects the measurement of PUCCH, PUSCH and SRS OFF powers.

Example, default period is one subframe with 20 µs exclusion at beginning:



Remote command:
`CONFigure:LTE:MEAS<i>:MEValuation:PDYNamics:AEOPower:LEADing`
`CONFigure:LTE:MEAS<i>:MEValuation:PDYNamics:AEOPower:LAGGing`

Statistic Count
Defines the number of measurement intervals per measurement cycle for power measurements. The following result views use this statistic count: power dynamics and power monitor.

For power dynamics results, one measurement interval is completed when the R&S CMW has measured one complete diagram.

For power monitor results, one measurement interval is completed when the number of subframes specified via parameter Measurement Subframe has been captured.

Remote command:
`CONFigure:LTE:MEAS<i>:MEValuation:SCOunt:POWer`

High Dynamic Mode
Enables or disables the high dynamic mode.

The high dynamic mode is suitable for power dynamics measurements involving high ON powers. In that case, the dynamic range of the R&S CMW may not be sufficient to measure both the high ON powers and the low OFF powers accurately.

In high dynamic mode, the dynamic range is increased by measuring the results in two shots. One shot uses the configured settings to measure the ON power. The other shot uses a lower "Expected Nominal Power" value to measure the OFF power results.

Disable the high dynamic mode to optimize the measurement speed, especially if you are not interested in power dynamics results or if you measure low ON powers using a low "Expected Nominal Power" setting.

While the combined signal path scenario is active, this parameter is not configurable.

Remote command:
`CONFigure:LTE:MEAS<i>:MEValuation:POWer:HDMode`

3.3.5.6 BLER and List Mode Settings

This section describes the following "Measurement Control" settings.

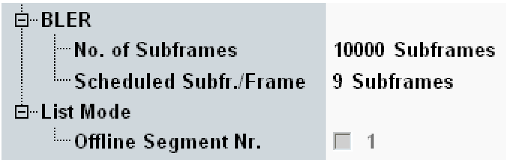


Fig. 3-44: Measurement control settings - BLER, list mode

BLER > No. of Subframes

Defines the number of subframes to be evaluated per measurement cycle (statistics cycle). This value includes all downlink subframes (scheduled and unscheduled). The BLER measurement is a single-shot measurement.

All subframes of the configured subframe range contribute to the measurement, see "Measurement Subframe" on page 552.

Remote command:
CONFigure:LTE:MEAS<i>:MEValuation:BLER:SFRames

BLER > Scheduled Subfr./Frame

Number of scheduled subframes per radio frame. Configure this parameter according to the properties of the generated downlink signal. A wrong value may result in wrong measurement results (BLER, DTX, relative ACK, relative NACK, number of processed scheduled subframes).

Remote command:
CONFigure:LTE:MEAS<i>:MEValuation:BLER:SFRames

List Mode > Offline Segment No.

Selects the list mode segment to be displayed in the measurement diagram. To select a segment number, the list mode must be enabled.

Option R&S CMW-KM012 is required.

Remote command:
CONFigure:LTE:MEAS<i>:MEValuation:LIST:OSINdex

3.3.6 Trigger Settings

The "Trigger" parameters configure the trigger system for the LTE multi evaluation measurement.

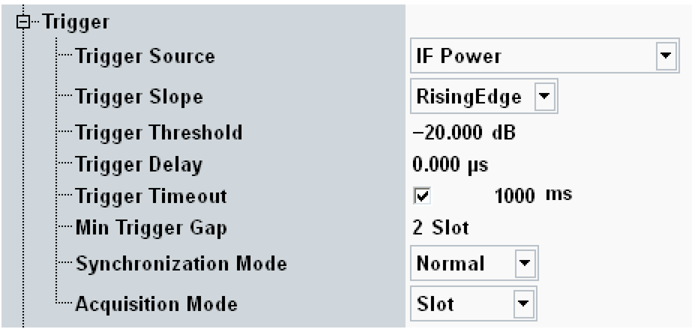


Fig. 3-45: Trigger settings

Trigger Source

Selects the source of the trigger event. Some of the trigger sources require additional options.

- **Free Run (Fast Sync):**
  The measurement starts immediately after it is initiated. The R&S CMW decodes the signal to derive its slot and frame timing. This procedure is repeated after each measurement cycle.
  This value is not suitable for list mode measurements.
- **Free Run (No Sync)**:
  The measurement starts immediately after it is initiated, without any synchronization. This trigger mode can only be used for power monitor, ACLR and emission mask measurements.
- **IF Power:**
  The measurement is triggered by the power of the received signal, converted into an IF signal. The trigger event coincides with the rising or falling edge of the detected LTE burst.
- **…External…:**
  External trigger signal fed in via TRIG A or TRIG B on the rear panel of the instrument.

Remote command:
`TRIGger:LTE:MEAS<i>:MEValuation:SOURce`
`TRIGger:LTE:MEAS<i>:MEValuation:CATalog:SOURce?`

Trigger Slope
Qualifies whether the trigger event is generated at the rising or at the falling edge of the trigger pulse. This setting has no influence on "Free Run" measurements and for evaluation of trigger pulses provided by other firmware applications.

Remote command:
`TRIGger:LTE:MEAS<i>:MEValuation:SLOPe`

Trigger Threshold
Defines the input signal power where the trigger condition is satisfied and a trigger event is generated. The trigger threshold is valid for power trigger sources. It is a dB value, relative to the reference level minus the external attenuation (<Ref. Level> – <External Attenuation (Input)> – <Frequency Dependent External Attenuation>). If the reference level is set to the actual maximum output power of the DUT, and the external attenuation settings are in accordance with the test setup, then the trigger threshold is referenced to the actual maximum RF input power at the R&S CMW.

A low threshold may be required to ensure that the R&S CMW can always detect the input signal. A higher threshold can prevent unintended trigger events.

Remote command:
`TRIGger:LTE:MEAS<i>:MEValuation:THReshold`

Trigger Delay
Defines a time delaying the start of the measurement relative to the trigger event. This setting has no influence on "Free Run" measurements.

Remote command:
`TRIGger:LTE:MEAS<i>:MEValuation:DELay`

Trigger Timeout
Sets a time after which an initiated measurement must have received a trigger event. If no trigger event is received, a trigger timeout is indicated in manual operation mode. In remote control mode the measurement is automatically stopped. The parameter can be disabled so that no timeout occurs.

This setting has no influence on "Free Run" measurements.

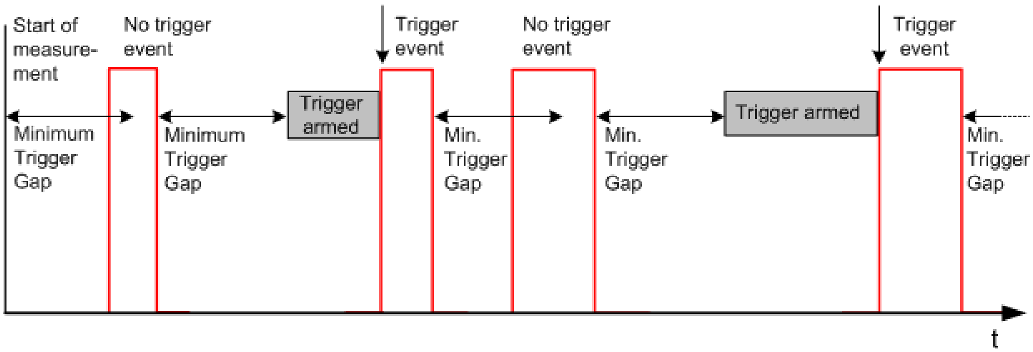
Remote command:
`TRIGger:LTE:MEAS<i>:MEValuation:TOUT`

Min Trigger Gap
Defines a minimum duration of the power-down periods (gaps) between two triggered power pulses. This setting is valid for an "(IF) Power" trigger source.

The trigger system is controlled by means of a timer which is reset to zero in the following instances:

- At the IF power-down ramp of each triggered or untriggered pulse, even though the previous counter may not have elapsed yet. A power-down ramp is detected when the signal power falls below the trigger threshold.
- At the beginning of each measurement: The minimum gap defines the minimum time between the start of the measurement and the first trigger event.

The trigger system is re-armed as soon as the timer has reached the specified minimum gap.



This parameter can be used to prevent unwanted trigger events due to fast power variations.

Remote command:
TRIGger:LTE:MEAS<i>:MEValuation:MGAP

Synchronization Mode
Selects the size of the search window for synchronization - normal or enhanced.

If the trigger signal is timed accurately, the normal synchronization mode is sufficient and should be used for performance reasons. With increasing inaccuracy of the trigger signal timing, the search window in normal mode may be too small, resulting in a "Synchronization Problem". In that case select the enhanced mode to increase the search window size.

For "Free Run (Fast Sync)" an enhanced search window is used irrespective of this parameter.

Remote command:
TRIGger:LTE:MEAS<i>:MEValuation:SMODe

Acquisition Mode
Selects whether the R&S CMW shall synchronize to a slot boundary or to a subframe boundary. The parameter is relevant for "Free Run (Fast Sync)" and for list mode measurements with Synchronization Mode = Enhanced.

Remote command:
TRIGger:LTE:MEAS<i>:MEValuation:AMODe

3.3.7 Limit Settings

The "Limits" in the "Multi Evaluation Configuration" dialog define lower and/or upper limits for the modulation, spectrum and power results. Separate limits can be set for the individual modulation schemes or channel bandwidths.

For details see chapter 3.2.5, "Limit Settings and Conformance Requirements", on page 507.

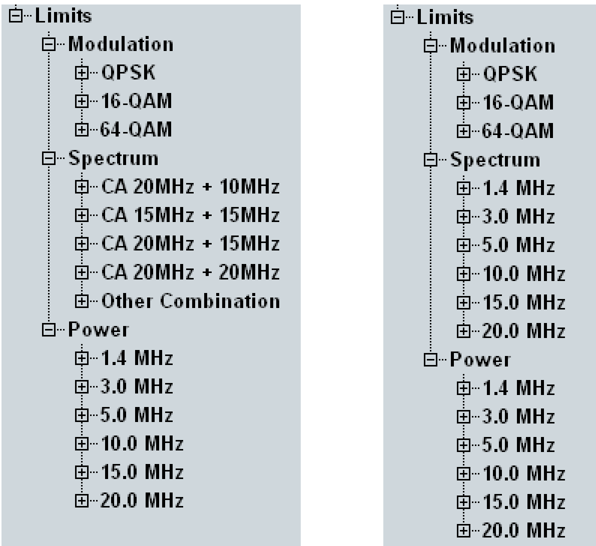


Fig. 3-46: Limit settings with and without carrier aggregation

For limit configuration via remote commands, refer to the following sections:

- chapter 3.5.3.10, "Limits (Modulation, QPSK)", on page 630
- chapter 3.5.3.11, "Limits (Modulation, 16-QAM / 64-QAM)", on page 635
- chapter 3.5.3.12, "Limits (Spectrum, no Carrier Aggregation)", on page 640
- chapter 3.5.3.13, "Limits (Spectrum, with Carrier Aggregation)", on page 644
- chapter 3.5.3.14, "Limits (Power)", on page 653

3.3.8 Shortcut Configuration

This section configures a shortcut softkey that provides a fast way to access the GPRF generator from the measurement.

The setting is a common measurement setting. It has the same value in all measurements (e.g. PRACH measurement and multi evaluation measurement).

Fig. 3-47: Shortcut configuration

Generator Shortcut
Selects a GPRF generator instance. Softkeys for the selected instance are added to the softkey panel.

3.3.9 Additional Softkeys and Hotkeys

The "LTE Multi Evaluation" measurement provides some softkey/hotkey combinations which have no equivalent in the configuration dialog. Most of these hotkeys provide display configurations (like diagram scaling). They are self-explanatory and do not have any remote-control commands assigned.

The remaining softkeys > hotkeys are described below.

The softkeys "Signaling Parameter" and "LTE Signaling" are displayed only if the combined signal path scenario is active and are provided by the "LTE Signaling" application selected as master application. See also "Scenario = Combined Signal Path" on page 538.

The softkeys "ARB / List Mode" and "GPRF Generator" are displayed only if the standalone scenario is active and the generator shortcut is enabled, see chapter 3.3.8, "Shortcut Configuration", on page 562.

While one of the signaling or generator softkeys is selected, the "Config" hotkey opens the configuration dialog of the generator or signaling application, not the configuration dialog of the measurement.

Multi Evaluation > Assign Views

Selects the view types to be displayed in the overview. The R&S CMW does not evaluate the results for disabled views. Therefore, limiting the number of assigned views can speed up the measurement.

Remote command:
`CONFigure:LTE:MEAS<i>:MEValuation:RESult[:ALL]`
`CONFigure:LTE:MEAS<i>:MEValuation:RESult:PDYNamics` etc.

Signaling Parameter > ...

Provides access to the most essential settings of the "LTE Signaling" application.

Remote command:
Use the commands of the signaling application.

LTE Signaling

Select this softkey and press ON | OFF to turn the downlink signal transmission on or off.

Press the softkey two times (select it and press it again) to switch to the signaling application.

Remote command:
Use the commands of the signaling application.

ARB / List Mode > ...

Provides access to the most important ARB and list mode settings of the GPRF generator.

Remote command:
Use the commands of the GPRF generator.

GPRF Generator

Select this softkey and press ON | OFF to turn the GPRF generator on or off.

Press the softkey two times (select it and press it again) to switch to the generator application.

The hotkeys assigned to this softkey provide access to the most important GPRF generator settings.

Remote command:
Use the commands of the GPRF generator.

3.3.10 Measurement Results

The results of the LTE multi evaluation measurement are displayed in a single overview and one detailed view for each part of the overview.

Fig. 3-48: LTE Multi Evaluation: Overview

Most of the detailed views show a diagram and a statistical overview of single-slot results.

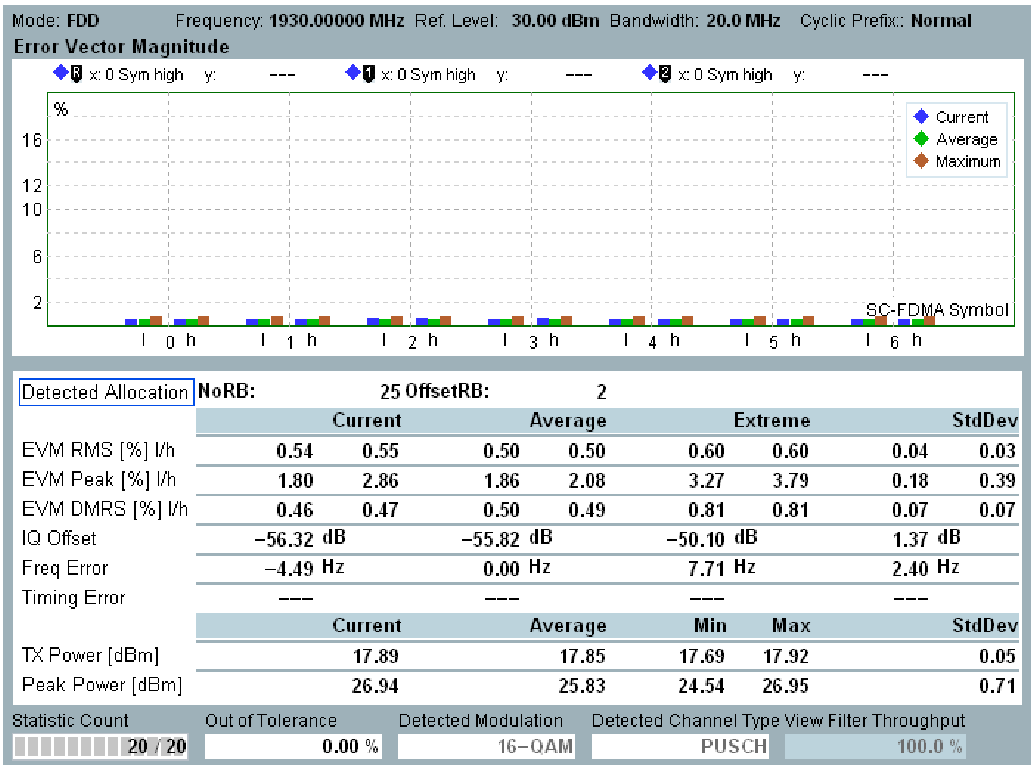


Fig. 3-49: LTE Multi Evaluation: EVM

For a detailed description of all result views, see chapter 3.2.6, "Measurement Results", on page 517.

Query of results via remote control

All commands for result query start with `FETCh`, `READ` or `CALCulate` and continue with `:LTE:MEAS<i>:MEValuation:`. A `TRACE` in the remainder indicates that a measured curve is queried. Bar graphs and tables are queried without `TRACE`.

Examples:

- `FETCh:LTE:MEAS<i>:MEValuation:TRACe:EVMC?`
- `READ:LTE:MEAS<i>:MEValuation:PERRor:CURRent?`
- `CALCulate:LTE:MEAS<i>:MEValuation:ACLR:AVERage?`

For links to the relevant command reference sections, refer to the result view descriptions in chapter 3.2.6, "Measurement Results", on page 517.

3.4 Programming

The following sections provide programming examples for the "LTE Multi Evaluation" measurement.

See also: "Remote Control" in the R&S CMW user manual

3.4.1 General Examples

The LTE multi evaluation measurement is programmed as follows:

- The measurement is controlled by SCPI commands with the following syntax: `...LTE:MEAS:MEValuation...`
- Use general commands of the type `...:LTE:MEAS...` (no `:MEValuation` mnemonic) to define the signal routing and perform RF and analyzer settings.
- After a `*RST`, the measurement is switched off. Use `READ:LTE:MEAS:MEValuation...?` to initiate a single-shot measurement and retrieve the results. You can also start the measurement using `INIT:LTE:MEAS:MEValuation` and retrieve the results using `FETCh:LTE:MEAS:MEValuation...?`.
- For synchronization and proper decoding, some UE signal settings must be in accordance with the measured signal; see chapter 3.4.1.2, "Specifying Required Settings", on page 567.

3.4.1.1 Specifying General and Common Measurement Settings

```
// *****************************************************************************
// System-Reset
// *****************************************************************************
*RST; *OPC?
*CLS; *OPC?

// *****************************************************************************
// Define signal routing and perform RF and analyzer settings:
// PCC center frequency 1850 MHz, frequency offset 1 kHz, peak power 7 dBm,
// 5 dB user margin and 1 dB mixer level offset.
// Specify PCC channel bandwidth 1.4 MHz.
// *****************************************************************************
ROUTe:LTE:MEAS:SCENario:SALone RF1C, RX1
CONFigure:LTE:MEAS:RFSettings:EATTenuation 2
CONFigure:LTE:MEAS:RFSettings:PCC:FREQuency 1850E+6
CONFigure:LTE:MEAS:RFSettings:FOFFset 1000
CONFigure:LTE:MEAS:RFSettings:ENPower 7
CONFigure:LTE:MEAS:RFSettings:UMARgin 5
CONFigure:LTE:MEAS:RFSettings:MLOFfset 1
CONFigure:LTE:MEAS:PCC:CBANdwidth B014

// *****************************************************************************
// Enable carrier aggregation.
// Define the SCC channel bandwidth. Adjust and query the SCC frequency.
```

```
// Query information about the resulting aggregated bandwidth.
// Select the PCC for single-carrier mesaurements.
// *****************************************************************************
CONFigure:LTE:MEAS:CAGGregation:MODE INTRaband
CONFigure:LTE:MEAS:SCC:CBANdwidth B014
CONFigure:LTE:MEAS:CAGGregation:SCC:ACSPacing
CONFigure:LTE:MEAS:RFSettings:SCC:FREQuency?

CONFigure:LTE:MEAS:CAGGregation:FREQuency:AGGRegated:LOW?
CONFigure:LTE:MEAS:CAGGregation:FREQuency:AGGRegated:CENTer?
CONFigure:LTE:MEAS:CAGGregation:FREQuency:AGGRegated:HIGH?
CONFigure:LTE:MEAS:CAGGregation:CBANdwidth:AGGRegated?

CONFigure:LTE:MEAS:CAGGregation:MCARrier PCC

// *****************************************************************************
// Set duplex mode TDD and query the resulting frame structure type (T2).
// *****************************************************************************
CONFigure:LTE:MEAS:DMODe TDD
CONFigure:LTE:MEAS:FSTRucture?
```

3.4.1.2 Specifying Required Settings

```
// *****************************************************************************
// Specify required UE signal settings: UL/DL configuration 1,
// special subframe configuration 1, extended cyclic prefix,
// signal contains PUCCH with format 1a, physical layer cell ID 5,
// delta sequence shift value 10, no group hopping.
// *****************************************************************************
CONFigure:LTE:MEAS:MEValuation:ULDL 1
CONFigure:LTE:MEAS:MEValuation:SSUBframe 1
CONFigure:LTE:MEAS:MEValuation:CPRefix EXTended
CONFigure:LTE:MEAS:MEValuation:PFORmat F1A
CONFigure:LTE:MEAS:MEValuation:PLCid 5
CONFigure:LTE:MEAS:MEValuation:DSSPusch 10
CONFigure:LTE:MEAS:MEValuation:GHOPping OFF
```

3.4.1.3 Specifying Additional Measurement-Specific Settings

```
// *****************************************************************************
// Define stop condition (stop on limit failure), measurement mode and error
// handling, measured subframe contains only PUCCH (no automatic detection),
// network signaled value NS_10 (without CA) and CA_NS_11 (with CA),
// set no. of resource blocks filter to 10, set a channel type filter.
// *****************************************************************************
CONFigure:LTE:MEAS:MEValuation:SCONdition SLFail
CONFigure:LTE:MEAS:MEValuation:MMODe NORMal
CONFigure:LTE:MEAS:MEValuation:MOEXception ON
CONFigure:LTE:MEAS:MEValuation:TOUT 3600
```

```
CONFigure:LTE:MEAS:MEValuation:CTYPe PUCCH
CONFigure:LTE:MEAS:MEValuation:NSValue NS10
CONFigure:LTE:MEAS:MEValuation:NSValue:CAGGregation NS11
CONFigure:LTE:MEAS:MEValuation:NVFilter 10
CONFigure:LTE:MEAS:MEValuation:CTVFilter PUSCh

// *****************************************************************************
// Define the "TPC Mode" list of expected nominal powers.
// *****************************************************************************
CONFigure:LTE:MEAS:MEValuation:TMODe:SCOunt 5,8,4,4,1,1,1,1,1,1,1,1,1,1,1
CONFigure:LTE:MEAS:MEValuation:TMODe:ENPower 3,9,12,15,0,0,0,0,0,0,0,0,0,0,0
CONFigure:LTE:MEAS:MEValuation:TMODe:RLEVel?

// *****************************************************************************
// Disable automatic detection of RB configuration and
// set the number of resource blocks and the RB offset manually.
// *****************************************************************************
CONFigure:LTE:MEAS:MEValuation:RBALlocation:AUTO OFF
CONFigure:LTE:MEAS:MEValuation:RBALlocation:NRB 5
CONFigure:LTE:MEAS:MEValuation:RBALlocation:ORB 2

// *****************************************************************************
// Define the scope of the measurement:
// skip 2 subframes after the trigger event, then capture 20 subframes,
// use subframe number 9 for slot measurements.
// *****************************************************************************
CONFigure:LTE:MEAS:MEValuation:MSUBframes 2, 20, 9

// *****************************************************************************
// Specify modulation measurement settings:
// measurement over 20 statistics cycles, modulation scheme QPSK, no SRS,
// EVM window lengths depending on cyclic prefix length and bandwidth.
// Correct EVM window length for 1.4 MHz BW.
// Enable/specify exclusion periods for PUCCH and PUSCH.
// *****************************************************************************
CONFigure:LTE:MEAS:MEValuation:SCOunt:MODulation 20
CONFigure:LTE:MEAS:MEValuation:MODulation:MSCHeme QPSK
CONFigure:LTE:MEAS:MEValuation:SRS:ENABle OFF
CONF:LTE:MEAS:MEV:MODulation:EWLength 5,12,35,66,102,136,28,58,124,250,374,504
CONFigure:LTE:MEAS:MEValuation:MODulation:EWLength:CBANdwidth14 6,13
CONFigure:LTE:MEAS:MEValuation:MODulation:EEPeriods:PUCCh ON
CONFigure:LTE:MEAS:MEValuation:MODulation:EEPeriods:PUSCh:LEADing MS25
CONFigure:LTE:MEAS:MEValuation:MODulation:EEPeriods:PUSCh:LAGGing MS25

// *****************************************************************************
// Specify spectrum measurement settings:
// select a measurement length of 30 slots, use gaussian resolution filter,
// for ACLR measure all adjacent channels.
// *****************************************************************************
CONFigure:LTE:MEAS:MEValuation:SCOunt:SPECtrum:ACLR 30
```

```
CONFigure:LTE:MEAS:MEValuation:SCOunt:SPECtrum:SEMask 30
CONFigure:LTE:MEAS:MEValuation:SPECtrum:SEMask:MFILter GAUSs
CONFigure:LTE:MEAS:MEValuation:SPECtrum:ACLR:ENABle ON,ON,ON

// *****************************************************************************
// Specify power measurement settings:
// time mask, OFF power exclusion, high dynamic mode, statistic count
// *****************************************************************************
CONFigure:LTE:MEAS:MEValuation:PDYNamics:TMASk SBLanking
CONFigure:LTE:MEAS:MEValuation:PDYNamics:AEOPower:LAGGing -5
CONFigure:LTE:MEAS:MEValuation:PDYNamics:AEOPower:LEADing -5
CONFigure:LTE:MEAS:MEValuation:POWer:HDMode ON
CONFigure:LTE:MEAS:MEValuation:SCOunt:POWer 30

// *****************************************************************************
// Specify BLER measurement settings: number of subframes to be measured
// *****************************************************************************
CONFigure:LTE:MEAS:MEValuation:BLER:SFRames 5000, 10
```

3.4.1.4 Configuring the Trigger System

```
// *****************************************************************************
// Set trigger source, timeout, trigger level, slope, delay,
// minimum trigger gap, synchronization mode and acquisition mode.
// *****************************************************************************
TRIGger:LTE:MEAS:MEValuation:SOURce 'IF Power'
TRIGger:LTE:MEAS:MEValuation:TOUT 1
TRIGger:LTE:MEAS:MEValuation:THReshold -30
TRIGger:LTE:MEAS:MEValuation:SLOPe FEDGe
TRIGger:LTE:MEAS:MEValuation:DELay 0.0001
TRIGger:LTE:MEAS:MEValuation:MGAP 3
TRIGger:LTE:MEAS:MEValuation:SMODe ENHanced
TRIGger:LTE:MEAS:MEValuation:AMODe SLOT
```

3.4.1.5 Specifying Limits

```
// *****************************************************************************
// Define QPSK modulation limits
// Commands for 16-QAM and 64-QAM are analogous with
// mnemonic QAM16 or QAM64 instead of QPSK.
// *****************************************************************************
CONFigure:LTE:MEAS:MEValuation:LIMit:QPSK:EVMagnitude 20, 40
CONFigure:LTE:MEAS:MEValuation:LIMit:QPSK:MERRor 20, OFF
CONFigure:LTE:MEAS:MEValuation:LIMit:QPSK:PERRor 20, OFF
CONFigure:LTE:MEAS:MEValuation:LIMit:QPSK:FERRor 0.15
CONFigure:LTE:MEAS:MEValuation:LIMit:QPSK:IQOFfset ON, -26, -21, -11
CONFigure:LTE:MEAS:MEValuation:LIMit:QPSK:IBE ON, -20, 20, -60, -27
CONFigure:LTE:MEAS:MEValuation:LIMit:QPSK:IBE:IQOFfset -26, -21, -11
CONFigure:LTE:MEAS:MEValuation:LIMit:QPSK:ESFLatness ON, 5, 9, 6, 8, 3MHz
```

```
// *****************************************************************************
// Define ACLR limits for measurements without carrier aggregation
// *****************************************************************************
CONFigure:LTE:MEAS:MEValuation:LIMit:ACLR:UTRA1:CBANdwidth14 35, -50
CONFigure:LTE:MEAS:MEValuation:LIMit:ACLR:EUTRa:CBANdwidth14 32, -50

// *****************************************************************************
// Define ACLR limits for measurements with carrier aggregation
// *****************************************************************************
CONF:LTE:MEAS:MEV:LIMit:ACLR:UTRA1:CAGG:CBANdwidth200:CBANdwidth100 35, -50
CONF:LTE:MEAS:MEV:LIMit:ACLR:UTRA1:CAGG:OCOMbination 35, -50
CONF:LTE:MEAS:MEV:LIMit:ACLR:EUTRa:CAGG:CBANdwidth200:CBANdwidth100 32, -50
CONF:LTE:MEAS:MEV:LIMit:ACLR:EUTRa:CAGG:OCOMbination 32, -50

// *****************************************************************************
// Define spectrum emission limits for measurements without carrier aggregation
// *****************************************************************************
CONF:LTE:MEAS:MEValuation:LIMit:SEMask:OBWLimit:CBANdwidth14 1.2E+6
CONF:LTE:MEAS:MEV:LIMit:SEM:LIMit1:CBANdwidth14 ON,2E+4,1E+6,-15,K030
CONF:LTE:MEAS:MEV:LIMit:SEM:LIMit1:ADD3:CBANdwidth14 ON,2E+4,1E+6,-15,K030

// *****************************************************************************
// Define spectrum emission limits for measurements with carrier aggregation
// *****************************************************************************
CONF:LTE:MEAS:MEV:LIMit:SEMask:OBWLimit:CAGG:CBAN200:CBAN100 29.8E+6
CONF:LTE:MEAS:MEV:LIMit:SEMask:OBWLimit:CAGG:OCOMbination 2.3E+6
CONF:LTE:MEAS:MEV:LIMit:SEMask:LIMit1:CAGG:CBAN200:CBAN100 ON,2E+4,1E+6,-20,K030
CONF:LTE:MEAS:MEV:LIMit:SEMask:LIMit1:CAGG:OCOMbination ON,2E+4,1E+6,-20,K030
CONF:LTE:MEAS:MEV:LIMit:SEMask:LIM1:ADD1:CAGG:CBAN200:CBAN100 ON,2E+4,1E+6,
    -20,K030
CONF:LTE:MEAS:MEV:LIMit:SEMask:LIM1:ADD1:CAGG:OCOMbination ON,2E+4,1E+6,-20,K030

// *****************************************************************************
// Define power dynamics limits
// *****************************************************************************
CONFigure:LTE:MEAS:MEValuation:LIMit:PDYNamics:CBANdwidth14 ON,-7.6,-22.6,-48.8
```

3.4.1.6 Performing Single-Shot Measurements

```
// *****************************************************************************
// Enable all measurements.
// *****************************************************************************
CONF:LTE:MEAS:MEValuation:RESult:ALL ON,ON,ON,ON,ON,ON,ON,ON,ON,ON,ON,ON,ON,ON

// *****************************************************************************
// Start single-shot measurement, return average EVM bar graph values.
// Query the measurement state (should be "RDY").
// *****************************************************************************
```

```
READ:LTE:MEAS:MEValuation:EVMagnitude:AVERage?
FETCh:LTE:MEAS:MEValuation:STATe?

// *****************************************************************************
// Retrieve detected allocation, modulation scheme and channel type for the
// measured slot of modulation measurements.
// Query the View Filter Throughput.
// *****************************************************************************
FETCh:LTE:MEAS:MEValuation:MODulation:DALLocation?
FETCh:LTE:MEAS:MEValuation:MODulation:DMODulation?
FETCh:LTE:MEAS:MEValuation:MODulation:DCHType?
FETCh:LTE:MEAS:MEValuation:VFTHroughput?

// *****************************************************************************
// Query modulation traces, bar graph values and statistical values
// obtained in the last measurement, without re-starting the measurement.
// *****************************************************************************
FETCh:LTE:MEAS:MEValuation:EVMagnitude:MAXimum?
FETCh:LTE:MEAS:MEValuation:TRACe:EVMC?
FETCh:LTE:MEAS:MEValuation:MERRor:AVERage?
FETCh:LTE:MEAS:MEValuation:MERRor:MAXimum?
FETCh:LTE:MEAS:MEValuation:PERRor:AVERage?
FETCh:LTE:MEAS:MEValuation:PERRor:MAXimum?
FETCh:LTE:MEAS:MEValuation:TRACe:IQ:LOW?
FETCh:LTE:MEAS:MEValuation:TRACe:IQ:HIGH?
FETCh:LTE:MEAS:MEValuation:MODulation:CURRent?
FETCh:LTE:MEAS:MEValuation:MODulation:EXTReme?
FETCh:LTE:MEAS:MEValuation:EVMC:PEAK:MAXimum?

// *****************************************************************************
// Query inband emission results for PCC and SCC.
// *****************************************************************************
FETCh:LTE:MEAS:MEValuation:TRACe:IEMissions:PCC?
FETCh:LTE:MEAS:MEValuation:TRACe:IEMissions:SCC?
FETCh:LTE:MEAS:MEValuation:IEMission:PCC:MARGin:AVERage?
FETCh:LTE:MEAS:MEValuation:IEMission:SCC:MARGin:AVERage?
FETCh:LTE:MEAS:MEValuation:IEMission:PCC:MARGin:EXTReme:RBINdex?
FETCh:LTE:MEAS:MEValuation:IEMission:SCC:MARGin:EXTReme:RBINdex?

// *****************************************************************************
// Query equalizer spectrum flatness results.
// *****************************************************************************
FETCh:LTE:MEAS:MEValuation:TRACe:ESFLatness?
FETCh:LTE:MEAS:MEValuation:ESFLatness:AVERage?
FETCh:LTE:MEAS:MEValuation:ESFLatness:CURRent:SCINdex?

// *****************************************************************************
// Query spectrum emission results.
// *****************************************************************************
FETCh:LTE:MEAS:MEValuation:TRACe:SEMask:RBW30:CURRent?
```

```
FETCh:LTE:MEAS:MEValuation:TRACe:SEMask:RBW100:AVERage?
FETCh:LTE:MEAS:MEValuation:TRACe:SEMask:RBW1000:MAXimum?
FETCh:LTE:MEAS:MEValuation:SEMask:CURRent?
FETCh:LTE:MEAS:MEValuation:SEMask:EXTReme?
FETCh:LTE:MEAS:MEValuation:SEMask:MARGin:ALL?
FETCh:LTE:MEAS:MEValuation:SEMask:MARGin:MINimum:POSitiv?
FETCh:LTE:MEAS:MEValuation:SEMask:MARGin:MINimum:NEGativ?

// *****************************************************************************
// Query ACLR results.
// *****************************************************************************
FETCh:LTE:MEAS:MEValuation:TRACe:ACLR:CURRent?
FETCh:LTE:MEAS:MEValuation:TRACe:ACLR:AVERage?
FETCh:LTE:MEAS:MEValuation:ACLR:CURRent?
FETCh:LTE:MEAS:MEValuation:ACLR:AVERage?

// *****************************************************************************
// Query RB allocation table and power monitor results for PCC and SCC.
// *****************************************************************************
FETCh:LTE:MEAS:MEValuation:TRACe:RBATable:PCC?
FETCh:LTE:MEAS:MEValuation:TRACe:RBATable:SCC?
FETCh:LTE:MEAS:MEValuation:TRACe:PMONitor:PCC?
FETCh:LTE:MEAS:MEValuation:TRACe:PMONitor:SCC?

// *****************************************************************************
// Query power dynamics results.
// *****************************************************************************
FETCh:LTE:MEAS:MEValuation:TRACe:PDYNamics:AVERage?
FETCh:LTE:MEAS:MEValuation:TRACe:PDYNamics:MAXimum?
FETCh:LTE:MEAS:MEValuation:PDYNamics:AVERage?
FETCh:LTE:MEAS:MEValuation:PDYNamics:MINimum?
FETCh:LTE:MEAS:MEValuation:PDYNamics:MAXimum?

// *****************************************************************************
// Query BLER results.
// *****************************************************************************
FETCh:LTE:MEAS:MEValuation:BLER?

// *****************************************************************************
// Query limit check results.
// *****************************************************************************
CALCulate:LTE:MEAS:MEValuation:ACLR:CURRent?
CALCulate:LTE:MEAS:MEValuation:SEMask:CURRent?
CALCulate:LTE:MEAS:MEValuation:ESFLatness:CURRent?
CALCulate:LTE:MEAS:MEValuation:MODulation:CURRent?
CALCulate:LTE:MEAS:MEValuation:PDYNamics:AVERage?
CALCulate:LTE:MEAS:MEValuation:PDYNamics:MINimum?
CALCulate:LTE:MEAS:MEValuation:PDYNamics:MAXimum?
```

3.4.1.7 Single-Shot and Continuous Measurements

```
// ******************************************************************************
// Start single-shot measurement, return magnitude error bar graph values.
// Return maximum magnitude error and phase bar graph values
// (without repeating the measurement).
// Query the measurement state (should be "RDY").
// ******************************************************************************
INIT:LTE:MEAS:MEValuation
FETCh:LTE:MEAS:MEValuation:MERRor:CURRent?
FETCh:LTE:MEAS:MEValuation:MERRor:MAXimum?
FETCh:LTE:MEAS:MEValuation:PERRor:MAXimum?
FETCh:LTE:MEAS:MEValuation:STATe?

// ******************************************************************************
// Start continuous measurement and wait for 5 s.
// Return average EVM bar graph results.
// Query measurement state and substates (should be "RUN,ADJ,ACT").
// ******************************************************************************
CONFigure:LTE:MEAS:MEValuation:REPetition CONTinuous
INIT:LTE:MEAS:MEValuation
Pause 5000
FETCh:LTE:MEAS:MEValuation:EVMagnitude:AVERage?
FETCh:LTE:MEAS:MEValuation:STATe:ALL?
```

3.4.2 Using LTE List Mode

The LTE multi evaluation list mode is programmed as follows:

- The measurement is controlled by SCPI commands with the following syntax: `...LTE:MEAS:MEValuation:LIST...`
- Use general commands of the type `...:LTE:MEAS...` (no `:MEValuation` mnemonic) to define the signal routing and perform RF and analyzer settings.
- After a `*RST`, the measurement is switched off and list mode is disabled. Use `CONFigure:LTE:MEAS:MEValuation:LIST ON` to enable the list mode and `INIT:LTE:MEAS:MEValuation` to initiate a single-shot measurement.
- Use `FETCh:LTE:MEAS:MEValuation:LIST:...?` commands to retrieve the results.

Speeding up list mode measurements

List mode tests are often used in production lines. The same tests are repeated again and again for different UEs. Optimizing the test duration is important.

Consider the following rules to minimize the test duration:

- Reduce the number and size of the segments and the statistical length as far as possible for your use case.
- Enable only the results that you need / disable the other result calculations.

- There are two groups of `FETCh` commands. One for result retrieval per segment and one for result retrieval over all segments. Which of the two groups is more effective, depends on the enabled results and on the number of segments. Minimize the number of `FETCh` commands transmitted for result query.
- To reset the system repeatedly, use partial reset commands instead of the global reset command `*RST`.
  Example: Use `SYSTem:RESet 'LTE Meas1'` to reset the LTE measurement instance 1.
- To configure the same list mode settings repeatedly, use partial save/recall commands:
  – Configure all list mode settings once.
  – Save the list mode settings to a file, for example to the file `ListModeLTE1.dfl` located in the directory assigned to the `@SAVE` alias:
    `MMEMory:STORe:ITEM 'LTE Meas:MEV:LIST', '@SAVE\ListModeLTE1.dfl'`
  – If you want to configure the same settings again, recall the stored settings:
    `MMEMory:LOAD:ITEM 'LTE Meas:MEV:LIST', '@SAVE\ListModeLTE1.dfl'`

3.4.2.1 Specifying Global Measurement Settings

```
// *****************************************************************************
// Reset
// *****************************************************************************
SYSTem:RESet 'LTE Meas1'; *OPC?
*CLS; *OPC?

// *****************************************************************************
// Define signal routing and external attenuation
// *****************************************************************************
ROUTe:LTE:MEAS:SCENario:SALone RF1C, RX1
CONFigure:LTE:MEAS:RFSettings:EATTenuation 2

// *****************************************************************************
// Specify required UE signal settings not configurable per segment:
// signal contains PUCCH with format 1a, physical layer cell ID 5,
// delta sequence shift value 10
// *****************************************************************************
CONFigure:LTE:MEAS:MEValuation:PFORmat F1A
CONFigure:LTE:MEAS:MEValuation:PLCid 5
CONFigure:LTE:MEAS:MEValuation:DSSPusch 10
```

3.4.2.2 Specifying List Mode Settings

```
// *****************************************************************************
// Define 2 segments with a length of 10 subframes each (1 radio frame),
// different expected nominal power and identical remaining settings.
// Define RB allocation manually for both segments.
```

```
// *****************************************************************************
CONF:LTE:MEAS:MEV:LIST:SEGM1:SET 10,1,FDD,OB1,2E+9,B030,NORM,AUTO,OFF,0,NS04
CONF:LTE:MEAS:MEV:LIST:SEGM2:SET 10,-19,FDD,OB1,2E+9,B030,NORM,AUTO,OFF,0,NS04
CONFigure:LTE:MEAS:MEValuation:LIST:SEGMent1:RBALlocation OFF, 15, 0
CONFigure:LTE:MEAS:MEValuation:LIST:SEGMent2:RBALlocation OFF, 6, 5

// *****************************************************************************
// Enable modulation results except phase error for both segments. Use
// a statistical length of 10 slots and select automatic detection of the
// modulation scheme.
// *****************************************************************************
CONF:LTE:MEAS:MEValuation:LIST:SEGMent1:MODulation 10,ON,ON,ON,OFF,ON,ON,AUTO
CONF:LTE:MEAS:MEValuation:LIST:SEGMent2:MODulation 10,ON,ON,ON,OFF,ON,ON,AUTO

// *****************************************************************************
// Enable all spectrum emission results for segment 2.
// Enable the E-UTRA ACLR results for segment 2 (no UTRA results).
// Use a statistical length of 10 slots.
// *****************************************************************************
CONFigure:LTE:MEAS:MEValuation:LIST:SEGMent2:SEMask 10,ON,ON,ON
CONFigure:LTE:MEAS:MEValuation:LIST:SEGMent2:ACLR 10,ON,OFF,OFF,ON

// *****************************************************************************
// Enable power monitor results for segment 1 and 2.
// *****************************************************************************
CONFigure:LTE:MEAS:MEValuation:LIST:SEGMent1:PMONitor ON
CONFigure:LTE:MEAS:MEValuation:LIST:SEGMent2:PMONitor ON

// *****************************************************************************
// Select both segments for measurement and select trigger mode "ONCE".
// *****************************************************************************
CONFigure:LTE:MEAS:MEValuation:LIST:LRANge 1,2
TRIGger:LTE:MEAS:MEValuation:LIST:MODE ONCE

// *****************************************************************************
// Only for measurements with R&S CMWS:
// Configure the RF input connector per segment.
// *****************************************************************************
CONFigure:LTE:MEAS:MEValuation:LIST:CMWS:CMODe LIST
CONFigure:LTE:MEAS:MEValuation:LIST:SEGMent1:CMWS:CONNector R11
CONFigure:LTE:MEAS:MEValuation:LIST:SEGMent2:CMWS:CONNector R12

// *****************************************************************************
// Enable the list mode.
// *****************************************************************************
CONFigure:LTE:MEAS:MEValuation:LIST ON
```

3.4.2.3 Performing Single-Shot Measurements

```
// ****************************************************************************
// Start single-shot measurement.
// Return average and extreme modulation results.
// Return extreme inband emission and spectrum flatness results.
// Return limit check results for the average results.
// ****************************************************************************
INIT:LTE:MEAS:MEValuation
FETCh:LTE:MEAS:MEValuation:LIST:SEGMent1:MODulation:AVERage?
FETCh:LTE:MEAS:MEValuation:LIST:SEGMent2:MODulation:AVERage?
FETCh:LTE:MEAS:MEValuation:LIST:SEGMent1:MODulation:EXTReme?
FETCh:LTE:MEAS:MEValuation:LIST:SEGMent2:MODulation:EXTReme?
FETCh:LTE:MEAS:MEValuation:LIST:SEGMent1:IEMission:MARGin:EXTReme?
FETCh:LTE:MEAS:MEValuation:LIST:SEGMent2:IEMission:MARGin:EXTReme?
FETCh:LTE:MEAS:MEValuation:LIST:SEGMent1:IEMission:MARGin:EXTReme:RBINdex?
FETCh:LTE:MEAS:MEValuation:LIST:SEGMent2:IEMission:MARGin:EXTReme:RBINdex?
FETCh:LTE:MEAS:MEValuation:LIST:SEGMent1:ESFLatness:EXTReme?
FETCh:LTE:MEAS:MEValuation:LIST:SEGMent2:ESFLatness:EXTReme?
CALCulate:LTE:MEAS:MEValuation:LIST:SEGMent1:MODulation:AVERage?
CALCulate:LTE:MEAS:MEValuation:LIST:SEGMent2:MODulation:AVERage?
CALCulate:LTE:MEAS:MEValuation:LIST:SEGMent1:ESFLatness:AVERage?
CALCulate:LTE:MEAS:MEValuation:LIST:SEGMent2:ESFLatness:AVERage?

// ****************************************************************************
// Return average and extreme spectrum emission results.
// Return spectrum emission margins: X- and Y-values of minimum margins and
// Y-values of all margins.
// Return limit check results for the average spectrum emission results.
// ****************************************************************************
FETCh:LTE:MEAS:MEValuation:LIST:SEGMent2:SEMask:AVERage?
FETCh:LTE:MEAS:MEValuation:LIST:SEGMent2:SEMask:EXTReme?
FETCh:LTE:MEAS:MEValuation:LIST:SEGMent2:SEMask:MARGin:MINimum:POSitiv?
FETCh:LTE:MEAS:MEValuation:LIST:SEGMent2:SEMask:MARGin:MINimum:NEGativ?
FETCh:LTE:MEAS:MEValuation:LIST:SEGMent2:SEMask:MARGin:ALL?
CALCulate:LTE:MEAS:MEValuation:LIST:SEGMent2:SEMask:AVERage?

// ****************************************************************************
// Return current and average ACLR results.
// Return limit check results for the average ACLR results.
// ****************************************************************************
FETCh:LTE:MEAS:MEValuation:LIST:SEGMent2:ACLR:CURRent?
FETCh:LTE:MEAS:MEValuation:LIST:SEGMent2:ACLR:AVERage?
CALCulate:LTE:MEAS:MEValuation:LIST:SEGMent2:ACLR:AVERage?

// ****************************************************************************
// Return RMS power monitor results for segment 1 and 2, using separate
// commands. Alternatively the same results can be retrieved for all segments
// at once, using only one command without SEGMent mnemonic.
// ****************************************************************************
```

```
FETCh:LTE:MEAS:MEValuation:LIST:SEGMent1:PMONitor:RMS?
FETCh:LTE:MEAS:MEValuation:LIST:SEGMent2:PMONitor:RMS?

// *****************************************************************************
// Query the RMS power monitor results again, using only one command for all
// segments. Query the offset of the first result for segment 2 within the
// returned list of power values. Query the number of power results related
// to segment 2.
// *****************************************************************************
FETCh:LTE:MEAS:MEValuation:LIST:PMONitor:RMS?
FETCh:LTE:MEAS:MEValuation:LIST:SEGMent2:PMONitor:ARRay:STARt?
FETCh:LTE:MEAS:MEValuation:LIST:SEGMent2:PMONitor:ARRay:LENGth?

// *****************************************************************************
// Return detected allocation, modulation scheme and channel type of the
// last slot within the statistical length of the modulation measurement.
// *****************************************************************************
FETCh:LTE:MEAS:MEValuation:LIST:SEGMent1:MODulation:DALLocation?
FETCh:LTE:MEAS:MEValuation:LIST:SEGMent1:MODulation:DMODulation?
FETCh:LTE:MEAS:MEValuation:LIST:SEGMent1:MODulation:DCHType?
FETCh:LTE:MEAS:MEValuation:LIST:SEGMent2:MODulation:DALLocation?
FETCh:LTE:MEAS:MEValuation:LIST:SEGMent2:MODulation:DMODulation?
FETCh:LTE:MEAS:MEValuation:LIST:SEGMent2:MODulation:DCHType?

// *****************************************************************************
// Select segment no. 2 as offline segment (and implicitly enable the
// offline mode). Restart the measurement to calculate all results in
// segment 2. Go to local to view the results.
// *****************************************************************************
CONFigure:LTE:MEAS:MEValuation:LIST:OSINdex 2
INIT:LTE:MEAS:MEValuation
&GTL
```

3.4.2.4 Retrieving Single Results for All Segments

```
// *****************************************************************************
// Return selected modulation results.
// *****************************************************************************
FETCh:LTE:MEAS:MEValuation:LIST:MODulation:EVM:RMS:LOW:AVERage?
FETCh:LTE:MEAS:MEValuation:LIST:MODulation:EVM:PEAK:LOW:AVERage?
FETCh:LTE:MEAS:MEValuation:LIST:MODulation:EVM:DMRS:LOW:EXTReme?
FETCh:LTE:MEAS:MEValuation:LIST:MODulation:MERRor:RMS:LOW:AVERage?
FETCh:LTE:MEAS:MEValuation:LIST:MODulation:MERRor:PEAK:LOW:AVERage?
FETCh:LTE:MEAS:MEValuation:LIST:MODulation:MERRor:DMRS:LOW:EXTReme?
FETCh:LTE:MEAS:MEValuation:LIST:MODulation:PERRor:RMS:LOW:AVERage?
FETCh:LTE:MEAS:MEValuation:LIST:MODulation:PERRor:PEAK:HIGH:CURRent?
FETCh:LTE:MEAS:MEValuation:LIST:MODulation:PERRor:DMRS:HIGH:EXTReme?
FETCh:LTE:MEAS:MEValuation:LIST:MODulation:IQOFfset:EXTReme?
FETCh:LTE:MEAS:MEValuation:LIST:MODulation:FERRor:AVERage?
```

```
FETCh:LTE:MEAS:MEValuation:LIST:MODulation:TERRor:EXTReme?
FETCh:LTE:MEAS:MEValuation:LIST:MODulation:TPOWer:MAXimum?
FETCh:LTE:MEAS:MEValuation:LIST:MODulation:PPOWer:MINimum?
FETCh:LTE:MEAS:MEValuation:LIST:MODulation:PSD:MINimum?

// *****************************************************************************
// Return selected inband emission and spectrum flatness results.
// *****************************************************************************
FETCh:LTE:MEAS:MEValuation:LIST:IEMission:MARGin:EXTReme?
FETCh:LTE:MEAS:MEValuation:LIST:IEMission:MARGin:RBINdex:EXTReme?
FETCh:LTE:MEAS:MEValuation:LIST:ESFLatness:RIPPle1:AVERage?
FETCh:LTE:MEAS:MEValuation:LIST:ESFLatness:DIFFerence2:AVERage?
FETCh:LTE:MEAS:MEValuation:LIST:ESFLatness:MINR1:AVERage?
FETCh:LTE:MEAS:MEValuation:LIST:ESFLatness:MAXR2:AVERage?
FETCh:LTE:MEAS:MEValuation:LIST:ESFLatness:SCINdex:MINimum1:CURRent?

// *****************************************************************************
// Return selected spectrum emission and ACLR results.
// *****************************************************************************
FETCh:LTE:MEAS:MEValuation:LIST:SEMask:OBW:AVERage?
FETCh:LTE:MEAS:MEValuation:LIST:SEMask:TXPower:MAXimum?
FETCh:LTE:MEAS:MEValuation:LIST:SEMask:MARGin:AREA5:NEGativ:MINimum?
FETCh:LTE:MEAS:MEValuation:LIST:ACLR:EUTRa:AVERage?
FETCh:LTE:MEAS:MEValuation:LIST:ACLR:EUTRa:NEGativ:AVERage?
FETCh:LTE:MEAS:MEValuation:LIST:ACLR:UTRA2:POSitiv:AVERage?

// *****************************************************************************
// Return detected allocation, modulation scheme and channel type of the
// last slot within the statistical length of the modulation measurement.
// *****************************************************************************
FETCh:LTE:MEAS:MEValuation:LIST:MODulation:DALLocation?
FETCh:LTE:MEAS:MEValuation:LIST:MODulation:DMODulation?
FETCh:LTE:MEAS:MEValuation:LIST:SEMask:DCHType?

// *****************************************************************************
// Return the individual segment reliability indicators
// *****************************************************************************
FETCh:LTE:MEAS:MEValuation:LIST:SRELiability?
```

3.5 Command Reference

The following sections provide detailed reference information on the remote control commands of the "LTE Multi Evaluation" measurement and the general commands applicable to all LTE measurements.

3.5.1 Conventions and General Information

The following sections describe the most important conventions and general informations concerning the command reference.

3.5.1.1 MEAS<i>

MEAS<i> is used as abbreviation of "MEASurement<instance>". For better readability only the abbreviated form (which is also accepted by the instrument) is given in the command reference.

The <instance> is relevant for instruments supporting several instances of the same firmware application. It can be omitted if the instrument supports only one instance, or to address the first instance.

See also: "Firmware Applications" in the R&S CMW user manual, chapter "Remote Control"

3.5.1.2 FETCh, READ and CALCulate Commands

All commands are used to retrieve measurement results:

- `FETCh...` returns the results of the current measurement cycle (single-shot measurement) after they are valid. `FETCh...` must be used after the measurement has been started (`INITiate...`, measurement states RUN or RDY).
- `READ...` starts a new single-shot measurement and returns the results.
- `CALCulate...` returns one limit check result per `FETCh` result:
  - **OK**: The `FETCh` result is located within the limits or no limit has been defined/ enabled for this result.
  - **ULEU** (User limit exceeded upper): An upper limit is violated. The `FETCh` result is located above the limit.
  - **ULEL** (User limit exceeded lower): A lower limit is violated. The `FETCh` result is located below the limit.

See also: "Retrieving Measurement Results" in the R&S CMW user manual, chapter "Remote Control"

3.5.1.3 Current and Statistical Results

The R&S CMW repeats measurements according to the selected statistic count and repetition mode. Consecutive measurement values are stored and used to calculate statistical results, e.g. average, minimum, maximum and standard deviation.

See also: "Statistical Results" in the R&S CMW user manual, chapter "System Overview"

3.5.1.4 Values for RF Path Selection

To select an RF input path, you must specify an RF connector and an RX module (converter).

Which connectors and modules can be specified in a command, depends on the installed hardware, the test setup and the active sub-instrument or instance <i>.

This section lists all values available for path selection. Depending on your configuration, only a subset is relevant for you. Virtual connector names are only relevant for setting commands. Queries return the physical connector names.

Additional information is available in the base software documentation. It describes typical instrument configurations with the resulting *RST values, allowed connector/module combinations and the mapping of virtual connector names to physical connectors.

See also: "Signal Path Settings" in the R&S CMW user manual, chapter "Remote Control"

Single R&S CMW setup

RF path selection values:

- RX module:
  `RX1 | RX2 | RX3 | RX4`
- RX connector:
  `RF1C | RF2C | RF3C | RF4C | RFAC | RFBC`
  RF 1 COM to RF 4 COM plus virtual connector names

One R&S CMW plus one R&S CMWS

RF path selection values:

- RX module:
  `RX1 | RX2 | RX3 | RX4`
- RX connector:
  `R11 | R12 | R13 | R14 | R15 | R16 | R17 | R18`
  `R21 | R22 | R23 | R24 | R25 | R26 | R27 | R28`
  `R31 | R32 | R33 | R34 | R35 | R36 | R37 | R38`
  `RA1 | RA2 | RA3 | RA4 | RA5 | RA6 | RA7 | RA8`
  `RB1 | RB2 | RB3 | RB4`
  R<m><n>: R&S CMWS connector <m>.<n>
  RA<n>: virtual name for R1<n> / R3<n>
  RB<n>: virtual name for R2<n> / R2<n+4>

3.5.1.5 Keywords

Selected keywords used in the command description are described in the following.

- **Command usage**
  If the usage is not explicitly stated, the command allows you to set parameters and query parameters. Otherwise the command usage is stated as follows:
  – "Setting only": command can only be used to set parameters
  – "Query only": command can only be used to query parameters
  – "Event": command initiates an event
- **Parameter usage**
  The parameter usage is indicated by the keyword preceding the parameter(s):
  – "Parameters" are sent with a setting or query command and are returned as the result of a query
  – "Setting parameters" are only sent with a setting command
  – "Query parameters" are only sent with a query command (to refine the query)
  – "Return values" are only returned as the result of a query
- **Firmware/Software:**
  Indicates the lowest software version supporting the command. Command enhancements in later software versions are also indicated.

3.5.1.6 Reliability Indicator

The first value in the output arrays of `FETCh...?`, `READ...?` and `CALCulate...?` queries indicates the most severe error that has occurred during the measurement.

Example for an output array: 0, 10.22, 10.15, 10.01, 10.29, 100 (reliability = 0, followed by 5 numeric measurement values).

The reliability indicator has one of the following values:

- **0 (OK)**:
  Measurement values available, no error detected.
- **1 (Measurement Timeout)**:
  The measurement has been stopped after the (configurable) measurement timeout. Measurement results may be available, however, at least a part of the measurement provides only INValid results or has not completed the full statistic count.
- **2 (Capture Buffer Overflow)**:
  The measurement configuration results in a capture length, exceeding the available memory.
- **3 (Overdriven) / 4 (Underdriven)**:
  The accuracy of measurement results may be impaired because the input signal level was too high / too low.
- **6 (Trigger Timeout)**:
  The measurement could not be started or continued because no trigger event was detected.
- **7 (Acquisition Error)**:
  The R&S CMW could not properly decode the RF input signal.
- **8 (Sync Error)**:

The R&S CMW could not synchronize to the RF input signal.

- **9 (Uncal)**:
  Due to an inappropriate configuration of resolution bandwidth, video bandwidth or sweep time, the measurement results are not within the specified data sheet limits.
- **15 (Reference Frequency Error)**:
  The instrument has been configured to use an external reference signal but the reference oscillator could not be phase locked to the external signal (e.g. signal level too low, frequency out of range or reference signal not available at all).
- **16 (RF Not Available)**:
  The measurement could not be started because the configured RF input path was not active. This problem may occur e.g. when a measurement is started in combined signal path mode and the master application has not yet activated the input path. The LEDs above the RF connectors indicate whether the input and output paths are active.
- **17 (RF Level not Settled) / 18 (RF Frequency not Settled)**:
  The measurement could not be started because the R&S CMW was not yet ready to deliver stable results after a change of the input signal power / the input signal frequency.
- **19 (Call not Established)**:
  For measurements: The measurement could not be started because no signaling connection to the DUT was established.
  For DAU IMS service: Establishing a voice over IMS call failed.
- **20 (Call Type not Usable)**:
  For measurements: The measurement could not be started because the established signaling connection had wrong properties.
  For DAU IMS service: The voice over IMS settings could not be applied.
- **21 (Call Lost)**:
  For measurements: The measurement was interrupted because the signaling connection to the DUT was lost.
  For DAU IMS service: The voice over IMS call was lost.
- **23 (Missing Option)**:
  The ARB file cannot be played by the GPRF generator due to a missing option.
- **26 (Resource Conflict)**:
  The application could not be started or has been stopped due to a conflicting hardware resource or software option that is allocated by another application.
  Stop the application that has allocated the conflicting resources and try again.
- **27 (No Sensor Connected)**:
  The GPRF External Power Sensor measurement could not be started due to missing power sensor.
- **30 (File not Found)**:
  The specified file could not be found.
- **40 (ARB File CRC Error)**:
  The ARB file CRC check failed. The ARB file is corrupt and not reliable.
- **42 (ARB Header Tag Invalid)**:
  The ARB file selected in the GPRF generator contains an invalid header tag.
- **43 (ARB Segment Overflow)**:

The number of segments in the multi-segment ARB file is higher than the allowed maximum.

- **44 (ARB File not Found)**:
  The selected ARB file could not be found.
- **45 (ARB Memory Overflow)**:
  The ARB file length is greater than the available memory.
- **50 (Startup Error)**:
  The Data Application Unit (DAU), a DAU service or a DAU measurement could not be started. Please execute a DAU selftest.
- **51 (No Reply)**:
  The DAU has received no response, for example for a ping request.
- **52 (Connection Error)**:
  The DAU could not establish a connection to internal components. Please restart the instrument.
- **53 (Configuration Error)**:
  The current DAU configuration by the user is incomplete or wrong and could not be applied. Check especially the IP address configuration.
- **54 (Filesystem Error)**:
  The hard disk of the DAU is full or corrupt. Please execute a DAU selftest.
- **60 (Invalid RF-Connector Setting)**
  The individual segments of a list mode measurement with R&S CMWS use different connector benches. This is not allowed. All segments must use the same bench.
  Check the "Info" dialog for the relevant segment numbers.
- **101 (Firmware Error)**:
  Indicates a firmware or software error. If you encounter this error for the first time, restart the instrument.
  If the error occurs again, consider the following hints:
  – Firmware errors can often be repaired by restoring the factory default settings. To restore these settings, restart your instrument and press the "Factory Default" softkey during startup.
  – If a software package (update) has not been properly installed this is often indicated in the "Setup" dialog, section "SW/HW-Equipment > Installed Software".
  – A software update correcting the error may be available. Updates are e.g. provided in the "CMW Customer Web" on GLORIS (registration required): https://extranet.rohde-schwarz.com.

  If you get firmware errors even with the properly installed latest software version, please send a problem report including log files to Rohde & Schwarz.
- **102 (Unidentified Error)**:
  Indicates an error not covered by other reliability values. For troubleshooting please follow the steps described for "101 (Firmware Error)".
- **103 (Parameter Error)**:
  Indicates that the measurement could not be performed due to internal conflicting parameter settings.

A good approach to localize the conflicting settings is to start with a reset or preset or even restore the factory default settings. Then reconfigure the measurement step by step and check when the error occurs for the first time.
If you need assistance to localize the conflicting parameter settings, please contact Rohde & Schwarz (see http://www.service.rohde-schwarz.com).

3.5.2 General Measurement Settings

The commands valid for all LTE measurements are divided into the groups listed below.

3.5.2.1 Duplex Mode

The following commands select the duplex mode and query the resulting frame structure.

CONFigure:LTE:MEAS<i>:DMODe <Mode>

Selects the duplex mode of the LTE signal: FDD or TDD.

This command is only relevant for the standalone scenario. For the combined signal path scenario, use `CONFigure:LTE:SIGN<i>:DMODe`.

Parameters:
<Mode> FDD | TDD

Example: See Specifying General and Common Measurement Settings

Firmware/Software: V2.0.10

Options: FDD requires R&S CMW-KM500
TDD requires R&S CMW-KM550

Manual operation: See "Duplex Mode" on page 537

CONFigure:LTE:MEAS<i>:FSTRucture?

Queries the frame structure type of the LTE signal. The value depends on the duplex mode (`CONFigure:LTE:MEAS<i>:DMODe`).

Return values:
<FrameStructure> T1 | T2

T1: Type 1, FDD signal
T2: Type 2, TDD signal

Example: See Specifying General and Common Measurement Settings

Usage: Query only

Firmware/Software: V2.0.20

Options: FDD requires R&S CMW-KM500
TDD requires R&S CMW-KM550

Manual operation: See "Frame Structure" on page 548

3.5.2.2 Signal Routing

The following commands configure the scenario, select the input path for the measured signal and define an external attenuation value.

ROUTe:LTE:MEAS<i>:SCENario:SALone <RXConnector>, <RFConverter>

Activates the standalone scenario and selects the RF input path for the measured RF signal.

For possible connector and converter values, see chapter 3.5.1.4, "Values for RF Path Selection", on page 580.

Parameters:

<RXConnector> RF connector for the input path

<RFConverter> RX module for the input path

Example: See Specifying General and Common Measurement Settings

Firmware/Software: V1.0.15.0

Manual operation: See "Scenario = StandAlone" on page 538

ROUTe:LTE:MEAS<i>:SCENario:CSPath <Master>

Activates the combined signal path scenario and selects a master. The master controls most signal routing settings, analyzer settings and some measurement control settings while the combined signal path scenario is active.

Parameters:

<Master> String parameter containing the master application
e.g. `'LTE Sig1'` or `'LTE Sig2'`

Firmware/Software: V1.0.15.20

Manual operation: See "Scenario = Combined Signal Path" on page 538

ROUTe:LTE:MEAS<i>:SCENario:MAPRotocol [<Controler>]

Activates the Measure@ProtocolTest scenario and optionally selects the controlling protocol test application.

The signal routing and analyzer settings are ignored by the measurement application. The corresponding settings have to be configured within the protocol test application used in parallel.

Setting parameters:

<Controler> String parameter selecting the protocol test application
e.g. `'Protocol Test1'`

Usage: Event

Firmware/Software: V1.0.15.20
V2.1.25: added <Controler>

Manual operation: See "Scenario = Measure@ProtocolTest" on page 538

ROUTe:LTE:MEAS<i>:SCENario?

Returns the active scenario.

Return values:

<Scenario> SALone | CSPath | MAPRotocol

SALone: Standalone (Non Signaling)
CSPath: Combined Signal Path
MAPRotocol: Measure@Protocol Test

Usage: Query only

Firmware/Software: V2.0.10

Manual operation: See "Scenario = StandAlone" on page 538

ROUTe:LTE:MEAS<i>?

Returns the configured routing settings.

For possible connector and converter values, see chapter 3.5.1.4, "Values for RF Path Selection", on page 580.

Return values:

<Scenario> SALone | CSPath | MAPRotocol

SALone: Standalone (Non Signaling)
CSPath: Combined Signal Path
MAPRotocol: Measure@Protocol Test

<Controller> Controlling application for scenario CSPath or MAPRotocol

<RXConnector> RF connector for the input path

<RFConverter> RX module for the input path

Usage: Query only

Firmware/Software: V2.0.10

Manual operation: See "Scenario = StandAlone" on page 538

CONFigure:LTE:MEAS<i>:RFSettings:EATTenuation <RFinputExtAtt>

Defines an external attenuation (or gain, if the value is negative), to be applied to the RF input connector.

This command is only relevant for the standalone scenario. For the combined signal path scenario, use `CONFigure:LTE:SIGN<i>:RFSettings[:PCC]:EATTenuation:INPut`.

Parameters:

<RFinputExtAtt> Range: -50 dB to 90 dB
*RST: 0 dB
Default unit: dB

Example: See Specifying General and Common Measurement Settings

Firmware/Software: V1.0.10.1

Manual operation: See "External Attenuation (Input)" on page 539

3.5.2.3 Analyzer Settings

The following commands configure the RF input path.

CONFigure:LTE:MEAS<i>:CAGGregation:MODE <CAmode>

Selects whether the measured signal uses Carrier Aggregation (CA) or not.

Parameters:

<CAmode> OFF | INTRaband

OFF: no carrier aggregation
INTRaband: intra-band contiguous CA (BW class B & C)

*RST: OFF

Example: See Specifying General and Common Measurement Settings

Firmware/Software: V3.2.70

Options: R&S CMW-KM502/-KM552 (FDD/TDD) for INTRaband

Manual operation: See "Carrier Aggregation Mode" on page 542

CONFigure:LTE:MEAS<i>:CAGGregation:FREQuency:AGGRegated:LOW?

Queries the lower edge of the aggregated bandwidth.

Return values:

<FrequencyLow> Range: 70E+6 Hz to 6E+9 Hz
Default unit: Hz

Example: See Specifying General and Common Measurement Settings

Usage: Query only

Firmware/Software: V3.2.70

Options: R&S CMW-KM502/-KM552 for FDD/TDD

Manual operation: See "Aggregated" on page 543

CONFigure:LTE:MEAS<i>:CAGGregation:FREQuency:AGGRegated:CENTer?

Queries the center frequency of the aggregated bandwidth.

Return values:

<FrequencyCenter> Range: 70E+6 Hz to 6E+9 Hz
Default unit: Hz

Example: See Specifying General and Common Measurement Settings

Usage: Query only

Firmware/Software: V3.2.70

Options: R&S CMW-KM502/-KM552 for FDD/TDD

Manual operation: See "Aggregated" on page 543

CONFigure:LTE:MEAS<i>:CAGGregation:FREQuency:AGGRegated:HIGH?

Queries the upper edge of the aggregated bandwidth.

Return values:

<FrequencyHigh> Range: 70E+6 Hz to 6E+9 Hz
Default unit: Hz

Example: See Specifying General and Common Measurement Settings

Usage: Query only

Firmware/Software: V3.2.70

Options: R&S CMW-KM502/-KM552 for FDD/TDD

Manual operation: See "Aggregated" on page 543

CONFigure:LTE:MEAS<i>:CAGGregation:CBANdwidth:AGGRegated?

Queries the width of the aggregated channel bandwidth.

Return values:

<ChBandwidth> Default unit: Hz

Example: See Specifying General and Common Measurement Settings

Usage: Query only

Firmware/Software: V3.2.70

Options: R&S CMW-KM502/-KM552 for FDD/TDD

Manual operation: See "Aggregated" on page 543

CONFigure:LTE:MEAS<i>:BAND <Band>

Selects the Operating Band (OB). The allowed input range depends on the duplex mode (FDD or TDD).

This command is only relevant for the standalone scenario. For the combined signal path scenario, use `CONFigure:LTE:SIGN<i>[:PCC]:BAND`.

Parameters:

<Band> FDD: OB1 | ... | OB28 | OB30 | OB31

TDD: OB33 | ... | OB44

*RST: OB1 (OB33 for TDD)

Firmware/Software: V1.0.10.1
V1.0.15.20: added OB18 to OB21
V1.0.15.21: added OB22
V2.1.20: added OB24, OB25, OB41, removed OB22
V2.1.30: added OB15, OB16, OB22, OB42, OB43
V3.0.10: added OB23, OB26
V3.0.30: added OB27, OB28, OB44
V3.2.70: added OB30, OB31

Options: R&S CMW-KB036 for bands/frequencies above 3.3 GHz

Manual operation: See "Band / Channel / Frequency" on page 539

CONFigure:LTE:MEAS<i>:RFSettings[:PCC]:FREQuency <AnalyzerFreq>

Selects the center frequency of the PCC.

Using the unit CH, the frequency can be set via the channel number. The allowed channel number range depends on the operating band, see chapter 3.2.4.2, "Frequency Bands", on page 506.

This command is only relevant for the standalone scenario. For the combined signal path scenario, use `CONFigure:LTE:SIGN<i>:RFSettings[:PCC]:CHANnel:UL`.

Parameters:

<AnalyzerFreq> Range: 70E+6 Hz to 6E+9 Hz
*RST: 1.95E+9 Hz
Default unit: Hz

Example: See Specifying General and Common Measurement Settings

Firmware/Software: V1.0.10.1

Manual operation: See "Band / Channel / Frequency" on page 539

CONFigure:LTE:MEAS<i>:RFSettings:SCC<no>:FREQuency <AnalyzerFreq>

Selects the center frequency of the SCC.

Using the unit CH, the frequency can be set via the channel number. The allowed channel number range depends on the operating band, see chapter 3.2.4.2, "Frequency Bands", on page 506.

Suffix:

<no> 1
Only SCC1 supported - suffix can be omitted

Parameters:

<AnalyzerFreq> Range: 70E+6 Hz to 6E+9 Hz
*RST: 1.9698E+9 Hz
Default unit: Hz

Example: See Specifying General and Common Measurement Settings

Firmware/Software: V3.2.70

Options: R&S CMW-KM502/-KM552 for FDD/TDD

Manual operation: See "Band / Channel / Frequency" on page 544

CONFigure:LTE:MEAS<i>:CAGGregation:SCC<no>:ACSPacing

Adjusts the SCC frequency, so that the PCC and the SCC are aggregated contiguously.

Suffix:

<no> 1
Only SCC1 supported - suffix can be omitted

Example: See Specifying General and Common Measurement Settings

Usage: Event

Firmware/Software: V3.2.70

Options: R&S CMW-KM502/-KM552 for FDD/TDD

Manual operation: See "Adjust Carrier Spacing" on page 544

CONFigure:LTE:MEAS<i>:RFSettings:FOFFset <Offset>

Specifies a positive or negative frequency offset to be added to the carrier center frequency (`CONFigure:LTE:MEAS<i>:RFSettings[:PCC]:FREQuency`).

This command is only relevant for the standalone scenario. For the combined signal path scenario, use `CONFigure:LTE:SIGN<i>:RFSettings[:PCC]:FOFFset:UL`.

Parameters:

<Offset>
Range: -100E+3 Hz to 100E+3 Hz
*RST: 0 Hz
Default unit: Hz

Example: See Specifying General and Common Measurement Settings

Firmware/Software: V3.2.10

Manual operation: See "Frequency Offset" on page 540

CONFigure:LTE:MEAS<i>:RFSettings:ENPower <ExpNomPow>

Sets the expected nominal power of the measured RF signal.

This command is only relevant for the standalone scenario. For the combined signal path scenario, use:

- `CONFigure:LTE:SIGN<i>:RFSettings:ENPMode`
- `CONFigure:LTE:SIGN<i>:RFSettings:ENPower`

Parameters:

<ExpNomPow>
The range of the expected nominal power can be calculated as follows:
Range (Expected Nominal Power) = Range (Input Power) + External Attenuation - User Margin
Range: -47 dBm to 55 dBm for the input power at the RF COM connectors (please notice also the ranges quoted in the data sheet)
*RST: 0 dBm
Default unit: dBm

Example: See Specifying General and Common Measurement Settings

Firmware/Software: V1.0.10.1
V3.0.10: enhanced range

Manual operation: See "Expected Nominal Power" on page 540

CONFigure:LTE:MEAS<i>:RFSettings:UMARgin <UserMargin>

Sets the margin that the R&S CMW adds to the expected nominal power in order to determine its reference power. The reference power minus the external input attenuation must be within the power range of the selected input connector; refer to the data sheet.

This command is only relevant for the standalone scenario. For the combined signal path scenario, use CONFigure:LTE:SIGN<i>:RFSettings:UMARgin.

Parameters:

<UserMargin>	Range:	0 dB to (55 dB + External Attenuation - Expected Nominal Power)
	*RST:	0 dB
	Default unit:	dB

Example: See Specifying General and Common Measurement Settings

Firmware/Software: V1.0.10.1
V3.0.10: enhanced range

Manual operation: See "User Margin" on page 540

CONFigure:LTE:MEAS<i>:RFSettings:MLOFfset <MixLevOffset>

Varies the input level of the mixer in the analyzer path.

This command is only relevant for the standalone scenario. For the combined signal path scenario, use CONFigure:LTE:SIGN<i>:RFSettings:MLOFfset.

Parameters:

<MixLevOffset>	Range:	-10 dB to 10 dB
	*RST:	0 dB
	Default unit:	dB

Example: See Specifying General and Common Measurement Settings

Firmware/Software: V1.0.15.20

Manual operation: See "Mixer Level Offset" on page 541

3.5.2.4 Common Measurement Control Settings

The following commands configure measurement control settings, valid for all LTE measurements.

CONFigure:LTE:MEAS<i>:CAGGregation:MCARrier <MeasCarrier>

Selects a component carrier for single-carrier measurements.

Parameters:

<MeasCarrier>	PCC | SCC1	
	*RST:	PCC

Example: See Specifying General and Common Measurement Settings

Firmware/Software: V3.2.70

Options: R&S CMW-KM502/-KM552 for FDD/TDD

Manual operation: See "Measurement Carrier" on page 543

CONFigure:LTE:MEAS<i>[:PCC]:CBANdwidth <ChannelBW>

Selects the channel bandwidth of the PCC.

This command is only relevant for the standalone scenario. For the combined signal path scenario, use `CONFigure:LTE:SIGN<i>:CELL:BANDwidth[:PCC]:DL`.

Parameters:

<ChannelBW> B014 | B030 | B050 | B100 | B150 | B200

B014: 1.4 MHz
B030: 3 MHz
B050: 5 MHz
B100: 10 MHz
B150: 15 MHz
B200: 20 MHz

*RST: B200

Example: See Specifying General and Common Measurement Settings

Firmware/Software: V2.0.10

Manual operation: See "Channel Bandwidth" on page 544

CONFigure:LTE:MEAS<i>:SCC<no>:CBANdwidth <ChannelBW>

Selects the channel bandwidth of the SCC.

Suffix:

<no> 1
Only SCC1 supported - suffix can be omitted

Parameters:

<ChannelBW> B014 | B030 | B050 | B100 | B150 | B200

B014: 1.4 MHz
B030: 3 MHz
B050: 5 MHz
B100: 10 MHz
B150: 15 MHz
B200: 20 MHz

*RST: B200

Example: See Specifying General and Common Measurement Settings

Firmware/Software: V3.2.70

Options: R&S CMW-KM502/-KM552 for FDD/TDD

Manual operation: See "Channel Bandwidth" on page 544

3.5.3 Multi Evaluation Measurement Commands

The commands for the LTE "Multi Evaluation" measurement are divided into the groups listed below. The general measurement settings also affect the measurement, see chapter 3.5.2, "General Measurement Settings", on page 584.

3.5.3.1 Measurement Control and States

The following commands control the measurement and return the current measurement state.

INITiate:LTE:MEAS<i>:MEValuation
STOP:LTE:MEAS<i>:MEValuation
ABORt:LTE:MEAS<i>:MEValuation

Starts, stops, or aborts the measurement:

- `INITiate...` starts or restarts the measurement; the R&S CMW enters the "RUN" state.
- `STOP...` causes a running measurement to stop after the current evaluation period is terminated and valid results are available; the R&S CMW enters the "RDY" state.
- `ABORt...` causes a running measurement to stop immediately; the R&S CMW enters the "OFF" state.

Use `FETCh...STATe?` to query the current measurement state.

See also: "Measurement Control" in the R&S CMW user manual, chapter "Remote Control"

Example: See Single-Shot and Continuous Measurements

Usage: Event

Firmware/Software: V1.0.10.1

Manual operation: See "Multi Evaluation (Softkey)" on page 536

FETCh:LTE:MEAS<i>:MEValuation:STATe?

Queries the main measurement state. Use `FETCh:...:STATe:ALL?` to query the measurement state including the substates. Use `INITiate...`, `STOP...`, `ABORt...` to change the measurement state.

See also: "Measurement Control" in the R&S CMW user manual, chapter "Remote Control"

Return values:

<MeasStatus> OFF | RUN | RDY

OFF: measurement switched off, no resources allocated, no results available (when entered after `ABORt...`)
RUN: measurement running (after `INITiate...`, `READ...`), synchronization pending or adjusted, resources active or queued
RDY: measurement has been terminated, valid results may be available

*RST: OFF

Example: See Performing Single-Shot Measurements

Usage: Query only

Firmware/Software: V1.0.10.1

Manual operation: See "Multi Evaluation (Softkey)" on page 536

FETCh:LTE:MEAS<i>:MEValuation:STATe:ALL?

Queries the main measurement state and the measurement substates. Both measurement substates are relevant for running measurements only. Use `FETCh:...:STATe?` to query the main measurement state only. Use `INITiate...`, `STOP...`, `ABORt...` to change the measurement state.

See also: "Measurement Control" in the R&S CMW user manual, chapter "Remote Control"

Return values:

<MainState> OFF | RDY | RUN

OFF: measurement switched off, no resources allocated, no results available (when entered after `STOP...`)
RDY: measurement has been terminated, valid results may be available
RUN: measurement running (after `INITiate...`, `READ...`), synchronization pending or adjusted, resources active or queued

*RST: OFF

<SyncState> PEND | ADJ | INV

PEND: waiting for resource allocation, adjustment, hardware switching ("pending")
ADJ: all necessary adjustments finished, measurement running ("adjusted")
INV: not applicable because <MainState>: OFF or RDY ("invalid")

<ResourceState> QUE | ACT | INV

QUE: measurement without resources, no results available ("queued")
ACT: resources allocated, acquisition of results in progress but not complete ("active")
INV: not applicable because <MainState>: OFF or RDY ("invalid")

Example: See Single-Shot and Continuous Measurements

Usage: Query only

Firmware/Software: V1.0.10.1

Manual operation: See "Multi Evaluation (Softkey)" on page 536

3.5.3.2 Enabling Results and Views

The following commands select the evaluated results and the displayed views.

CONFigure:LTE:MEAS<i>:MEValuation:RESult[:ALL] <EVM>, <MagnitudeError>, <PhaseError>, <InbandEmissions>, <EVMversusC>, <IQ>, <EquSpecFlatness>, <TXMeasurement>, <SpecEmMask>, <ACLR>[, <RBAllocTable>, <PowerMonitor>, <BLER>, <PowerDynamics>]

Enables or disables the evaluation of results and shows or hides the views in the multi evaluation measurement. This command combines all other `CONFigure:LTE:MEAS<i>:MEValuation:RESult...` commands.

Parameters:

<EVM> OFF | ON

Error Vector Magnitude
OFF: Do not evaluate results, hide the view
ON: Evaluate results and show the view

*RST: ON

<MagnitudeError> OFF | ON

Magnitude Error

*RST: OFF

<PhaseError> OFF | ON

Phase Error

*RST: OFF

<InbandEmissions> OFF | ON

Inband Emissions

*RST: ON

<EVMversusC> OFF | ON

EVM vs. Subcarrier

*RST: OFF

<IQ> OFF | ON

I/Q Constellation Diagram

*RST: OFF

<EquSpecFlatness> OFF | ON

Equalizer Spectrum Flatness

*RST: ON

<TXMeasurement>	OFF | ON TX Measurement Statistical Overview *RST: ON
<SpecEmMask>	OFF | ON Spectrum Emission Mask *RST: ON
<ACLR>	OFF | ON Adjacent Channel Leakage Power Ratio *RST: ON
<RBAllocTable>	OFF | ON Resource Block Allocation Table *RST: OFF
<PowerMonitor>	OFF | ON Power Monitor *RST: OFF
<BLER>	OFF | ON Block Error Ratio *RST: OFF
<PowerDynamics>	OFF | ON Power Dynamics *RST: OFF

Example: See Performing Single-Shot Measurements

Firmware/Software: V1.0.10.1
V1.0.15.20: added <RBAllocTable>, <PowerMonitor>
V1.0.15.21: added <BLER>
V2.0.10: added <PowerDynamics>

Manual operation: See "Multi Evaluation > Assign Views" on page 563

CONFigure:LTE:MEAS<i>:MEValuation:RESult:EVMagnitude <Enable>
CONFigure:LTE:MEAS<i>:MEValuation:RESult:MERRor <Enable>
CONFigure:LTE:MEAS<i>:MEValuation:RESult:PERRor <Enable>
CONFigure:LTE:MEAS<i>:MEValuation:RESult:IEMissions <Enable>
CONFigure:LTE:MEAS<i>:MEValuation:RESult:EVMC <Enable>
CONFigure:LTE:MEAS<i>:MEValuation:RESult:IQ <Enable>
CONFigure:LTE:MEAS<i>:MEValuation:RESult:ESFLatness <Enable>
CONFigure:LTE:MEAS<i>:MEValuation:RESult:TXM <Enable>
CONFigure:LTE:MEAS<i>:MEValuation:RESult:SEMask <Enable>
CONFigure:LTE:MEAS<i>:MEValuation:RESult:ACLR <Enable>
CONFigure:LTE:MEAS<i>:MEValuation:RESult:RBATable <Enable>
CONFigure:LTE:MEAS<i>:MEValuation:RESult:PMONitor <Enable>

CONFigure:LTE:MEAS<i>:MEValuation:RESult:BLER <Enable>
CONFigure:LTE:MEAS<i>:MEValuation:RESult:PDYNamics <Enable>

Enables or disables the evaluation of results and shows or hides the views in the multi evaluation measurement.

The mnemonic after "RESult" denotes the view type: Error Vector Magnitude, Magnitude Error, Phase Error, Inband Emissions, EVM vs. Subcarrier, I/Q Constellation Diagram, Equalizer Spectrum Flatness, TX Measurement Statistical Overview, Spectrum Emission Mask, Adjacent Channel Leakage Power Ratio, Resource Block Allocation Table, Power Monitor, Block Error Ratio, Power Dynamics.

For reset values see `CONFigure:LTE:MEAS<i>:MEValuation:RESult[:ALL]`.

Parameters:

<Enable> OFF | ON

OFF: Do not evaluate results, hide the view
ON: Evaluate results and show the view

*RST: Depends on measurement

Firmware/Software: V1.0.10.1
RBATable and PMONitor: V1.0.15.20
BLER: V1.0.15.21
ESFLatness, PDYNamics: V2.0.10

Manual operation: See "Multi Evaluation > Assign Views" on page 563

3.5.3.3 Measurement Parameters - General Part

The following commands define general measurement control parameters for the multi evaluation measurement.

CONFigure:LTE:MEAS<i>:MEValuation:TOUT <Timeout>

Defines a timeout for the measurement. The timer is started when the measurement is initiated via a `READ` or `INIT` command. It is not started if the measurement is initiated manually (ON/OFF key or RESTART/STOP key).

When the measurement has completed the first measurement cycle (first single shot), the statistical depth is reached and the timer is reset.

If the first measurement cycle has not been completed when the timer expires, the measurement is stopped. The measurement state changes to `RDY` and the reliability indicator is set to 1, indicating that a measurement timeout occurred. Still running `READ`, `FETCh` or `CALCulate` commands are completed, returning the available results. At least for some results there are no values at all or the statistical depth has not been reached.

A timeout of 0 s corresponds to an infinite measurement timeout.

Parameters:

<Timeout> Default unit: s

Example: See Specifying Additional Measurement-Specific Settings

Firmware/Software: V2.0.10

CONFigure:LTE:MEAS<i>:MEValuation:REPetition <Repetition>

Specifies the repetition mode of the measurement. The repetition mode specifies whether the measurement is stopped after a single-shot or repeated continuously. Use `CONFigure:..:MEAS<i>:...:SCOunt` to determine the number of measurement intervals per single shot.

See also: "Statistical Settings" in the R&S CMW user manual, chapter "Remote Control"

Parameters:

<Repetition> SINGleshot | CONTinuous

SINGleshot: Single-shot measurement
CONTinuous: Continuous measurement

*RST: SING

Example: See Single-Shot and Continuous Measurements

Firmware/Software: V1.0.10.1

Manual operation: See "Repetition" on page 545

CONFigure:LTE:MEAS<i>:MEValuation:SCONdition <StopCondition>

Qualifies whether the measurement is stopped after a failed limit check or continued. `SLFail` means that the measurement is stopped and reaches the `RDY` state as soon as one of the results exceeds the limits.

Parameters:

<StopCondition> NONE | SLFail

NONE: Continue measurement irrespective of the limit check
SLFail: Stop measurement on limit failure

*RST: NONE

Example: See Specifying Additional Measurement-Specific Settings

Firmware/Software: V1.0.10.1

Manual operation: See "Stop Condition" on page 546

CONFigure:LTE:MEAS<i>:MEValuation:MMODe <MeasurementMode>

Selects the measurement mode.

Parameters:

<MeasurementMode> NORMal | TMODe | MELMode

NORMal: normal mode
TMODe: TPC mode
MELMode: multi evaluation list mode

*RST: NORM

Example: See Specifying Additional Measurement-Specific Settings

Firmware/Software: V2.1.20

Options: R&S CMW-KM012 for MELMode

Manual operation: See "Measurement Mode" on page 546

CONFigure:LTE:MEAS<i>:MEValuation:TMODe:SCOunt <SubframeCount>...

Defines the subframe counts for all entries of the "TPC Mode" list.

For definition of the corresponding expected nominal power values, see `CONFigure:LTE:MEAS<i>:MEValuation:TMODe:ENPower`.

Parameters:

<SubframeCount> Comma separated list of 16 values, for list entry number 0 to 15

Range: 1 to 320
*RST: 320

Example: See Specifying Additional Measurement-Specific Settings

Firmware/Software: V2.1.30

Manual operation: See "TPC Mode" on page 546

CONFigure:LTE:MEAS<i>:MEValuation:TMODe:ENPower <ExpNomPow>...

Defines the expected nominal power values for all entries of the "TPC Mode" list.

For definition of the corresponding subframe count values, see CONFigure:LTE:MEAS<i>:MEValuation:TMODe:SCOunt.

Parameters:

<ExpNomPow> Comma separated list of 16 values, for list entry number 0 to 15
The range of the expected nominal power can be calculated as follows:
Range (Expected Nominal Power) = Range (Input Power) + External Attenuation - User Margin

Range: -47 dBm to 55 dBm for the input power at the RF COM connectors (please notice also the ranges quoted in the data sheet)
*RST: 0 dBm
Default unit: dBm

Example: See Specifying Additional Measurement-Specific Settings

Firmware/Software: V2.1.30

Manual operation: See "TPC Mode" on page 546

CONFigure:LTE:MEAS<i>:MEValuation:TMODe:RLEVel?

Queries the reference level for all entries of the "TPC Mode" list. The reference level is calculated from the expected nominal power of each entry and the user margin.

Return values:

<ReferenceLevel> Comma separated list of 16 values, for list entry number 0 to 15
The range of the reference levels can be calculated as follows:
Range (Reference Level) = Range (Input Power) + External Attenuation

Range: -47 dBm to 55 dBm for the input power at the RF COM connectors (please notice also the ranges quoted in the data sheet)
Default unit: dBm

Example: See Specifying Additional Measurement-Specific Settings

Usage: Query only

Firmware/Software: V2.1.30

Manual operation: See "TPC Mode" on page 546

CONFigure:LTE:MEAS<i>:MEValuation:MOEXception <MeasOnException>

Specifies whether measurement results that the R&S CMW identifies as faulty or inaccurate are rejected.

Parameters:

<MeasOnException> OFF | ON

OFF: Faulty results are rejected
ON: Results are never rejected

*RST: OFF

Example: See Specifying Additional Measurement-Specific Settings

Firmware/Software: V1.0.10.1

Manual operation: See "Measure on Exception" on page 547

CONFigure:LTE:MEAS<i>:MEValuation:ULDL <UplinkDownlink>

Selects an uplink-downlink configuration, defining the combination of uplink, downlink and special subframes within a radio frame. This parameter is only relevant for frame structure "Type 2" (`CONFigure:LTE:MEAS<i>:FSTRucture?`).

The uplink-downlink configurations are defined in 3GPP TS 36.211, chapter 4, "Frame Structure".

This command is only relevant for the standalone scenario. For the combined signal path scenario, use `CONFigure:LTE:SIGN<i>:CELL:ULDL`.

Parameters:

<UplinkDownlink> Range: 0 to 6
*RST: 0

Example: See Specifying Required Settings

Firmware/Software: V1.0.10.1

Options: R&S CMW-KM550

Manual operation: See "Uplink Downlink" on page 548

CONFigure:LTE:MEAS<i>:MEValuation:SSUBframe <SpecialSubframe>

Selects a special subframe configuration, defining the inner structure of special subframes. This parameter is only relevant for frame structure "Type 2" (`CONFigure:LTE:MEAS<i>:FSTRucture?`).

The special subframe configurations are defined in 3GPP TS 36.211, chapter 4, "Frame Structure".

This command is only relevant for the standalone scenario. For the combined signal path scenario, use `CONFigure:LTE:SIGN<i>:CELL:SSUBframe`.

Parameters:

<SpecialSubframe> Range: 0 to 8
*RST: 0

Example: See Specifying Required Settings

Firmware/Software: V1.0.10.1

Options: R&S CMW-KM550

Manual operation: See "Special Subframe" on page 548

CONFigure:LTE:MEAS<i>:MEValuation:CPRefix <CyclicPrefix>

Selects the type of cyclic prefix of the LTE signal.

This command is only relevant for the standalone scenario. For the combined signal path scenario, use `CONFigure:LTE:SIGN<i>:CELL:CPRefix`.

Parameters:

<CyclicPrefix> NORMal | EXTended

*RST: NORM

Example: See Specifying Required Settings

Firmware/Software: V1.0.10.1

Manual operation: See "Cyclic Prefix" on page 548

CONFigure:LTE:MEAS<i>:MEValuation:CTYPe <ChannelType>

Configures the channel type detection for the measured subframe.

Parameters:

<ChannelType> AUTO | PUSCh | PUCCh

AUTO: automatic detection of channel type
PUSCh: only PUSCH in measured subframe
PUCCh: only PUCCH in measured subframe

*RST: PUSC

Example: See Specifying Additional Measurement-Specific Settings

Firmware/Software: V1.0.15.20

Manual operation: See "Channel Type" on page 549

CONFigure:LTE:MEAS<i>:MEValuation:PFORmat <PUCCHFormat>

Specifies the PUCCH format (only relevant for signals containing a PUCCH). The formats 1 to 2b are defined in 3GPP TS 36.211.

Parameters:

<PUCCHFormat> F1 | F1A | F1B | F2 | F2A | F2B

*RST: F1

Example: See Specifying Required Settings

Firmware/Software: V1.0.15.0

Manual operation: See "PUCCH Format" on page 549

CONFigure:LTE:MEAS<i>:MEValuation:NSValue <Value>

Selects the "network signaled value" for measurements without carrier aggregation.

This command is only relevant for the standalone scenario. For the combined signal path scenario, use `CONFigure:LTE:SIGN<i>:CONNection:ASEMission`.

Parameters:

<Value> NS01 | NS02 | NS03 | NS04 | NS05 | NS06 | NS07 | NS08 | NS09 | NS10 | NS11 | NS12 | NS13 | NS14 | NS15 | NS16 | NS17 | NS18 | NS19 | NS20 | NS21 | NS22 | NS23 | NS24

Value NS_01 to NS_24

*RST: NS01

Example: See Specifying Additional Measurement-Specific Settings

Firmware/Software: V2.0.20
V3.2.70: added NS11 to NS18, NS20
V3.2.82: added NS19, NS21 to NS24

Manual operation: See "Network Signaled Value" on page 550

CONFigure:LTE:MEAS<i>:MEValuation:NSValue:CAGGregation <Value>

Selects the "network signaled value" for measurements with carrier aggregation.

Parameters:

<Value> NS01 | NS02 | NS03 | NS04 | NS05 | NS06 | NS07 | NS08 | NS09 | NS10 | NS11 | NS12 | NS13 | NS14 | NS15 | NS16 | NS17 | NS18 | NS19 | NS20 | NS21 | NS22 | NS23 | NS24 | NS25 | NS26 | NS27 | NS28 | NS29 | NS30 | NS31 | NS32

Value CA_NS_01 to CA_NS_32

*RST: NS01

Example: See Specifying Additional Measurement-Specific Settings

Firmware/Software: V3.2.70

Options: R&S CMW-KM502/-KM552 for FDD/TDD

Manual operation: See "Network Signaled Value" on page 550

CONFigure:LTE:MEAS<i>:MEValuation:NVFilter <NRBViewFilter>

Specifies, enables or disables the Number of Resource Blocks (NRB) view filter. If the filter is active, only slots with a matching number of allocated resource blocks are measured.

Within the indicated input range only specific numbers are allowed as defined in 3GPP TS 36.211. For details see chapter 3.2.4.1, "Resources in Time and Frequency Domain", on page 504.

Parameters:

<NRBViewFilter> Number of allocated resource blocks

Range: 1 to 100
*RST: 1, OFF
Additional parameters: OFF | ON (disables | enables the filter)

Example: See Specifying Additional Measurement-Specific Settings

Firmware/Software: V1.0.10.1

Manual operation: See "View Filter > NRB" on page 550

CONFigure:LTE:MEAS<i>:MEValuation:CTVFilter <ChannelType>

Specifies, enables or disables the channel type view filter. If the filter is active, only slots with detected channel type PUSCH or PUCCH are measured.

Parameters:

<ChannelType> PUSCh | PUCCh

PUSCh: measure only physical uplink shared channel
PUCCh: measure only physical uplink control channel

*RST: PUSC, OFF
Additional parameters: OFF | ON (disables | enables the filter)

Example: See Specifying Additional Measurement-Specific Settings

Firmware/Software: V1.0.15.0

Manual operation: See "View Filter > Channel Type" on page 551

CONFigure:LTE:MEAS<i>:MEValuation:RBALlocation:AUTO <Auto>

Enables or disables the automatic detection of the RB configuration. For manual definition of the configuration use `CONFigure:LTE:MEAS<i>:MEValuation:RBALlocation:NRB` and `CONFigure:LTE:MEAS<i>:MEValuation:RBALlocation:ORB`.

Parameters:

<Auto> OFF | ON

OFF: manual definition
ON: automatic detection

*RST: ON

Example: See Specifying Additional Measurement-Specific Settings

Firmware/Software: V1.0.10.1

Manual operation: See "RB Allocation" on page 551

CONFigure:LTE:MEAS<i>:MEValuation:RBALlocation:NRB <NoRB>

Specifies the number of allocated resource blocks in the measured slot. This setting is only relevant if automatic detection of the RB configuration is disabled (`CONFigure:LTE:MEAS<i>:MEValuation:RBALlocation:AUTO`).

For the allowed input range see chapter 3.2.4.1, "Resources in Time and Frequency Domain", on page 504.

Parameters:

<NoRB> Range: Depends on channel bandwidth
*RST: 100

Example: See Specifying Additional Measurement-Specific Settings

Firmware/Software: V1.0.10.1

Manual operation: See "RB Allocation" on page 551

CONFigure:LTE:MEAS<i>:MEValuation:RBALlocation:ORB <OffsetRB>

Specifies the offset of the first allocated resource block from the edge of the allocated UL transmission bandwidth. This setting is only relevant if automatic detection of the RB configuration is disabled (`CONFigure:LTE:MEAS<i>:MEValuation:RBALlocation:AUTO`).

Parameters:

<OffsetRB> Range: see below
*RST: 0

Example: See Specifying Additional Measurement-Specific Settings

Firmware/Software: V1.0.10.1

Manual operation: See "RB Allocation" on page 551

Channel Bandwidth	Range <OffsetRB>
1.4 MHz	0 to 5
3 MHz	0 to 14
5 MHz	0 to 24
10 MHz	0 to 49
15 MHz	0 to 74
20 MHz	0 to 99

CONFigure:LTE:MEAS<i>:MEValuation:PLCid <PhsLayerCellID>

Specifies the physical layer cell ID.

This command is only relevant for the standalone scenario. For the combined signal path scenario, use `CONFigure:LTE:SIGN<i>:CELL[:PCC]:PCID`.

Parameters:

<PhsLayerCellID>	Range:	0 to 503
	*RST:	0

Example: See Specifying Required Settings

Firmware/Software: V1.0.10.1

Manual operation: See "Physical Cell ID" on page 551

CONFigure:LTE:MEAS<i>:MEValuation:DSSPusch <DeltaSeqShift>

Specifies the delta sequence shift value (Δ_{ss}) used to calculate the sequence shift pattern for PUSCH.

Parameters:

<DeltaSeqShift>	Range:	0 to 29
	*RST:	0

Example: See Specifying Required Settings

Firmware/Software: V1.0.10.1

Manual operation: See "Delta Seq. Shift PUSCH" on page 551

CONFigure:LTE:MEAS<i>:MEValuation:GHOPping <Value>

Specifies whether group hopping is used or not.

This command is only relevant for the standalone scenario. For the combined signal path scenario, use `CONFigure:LTE:SIGN<i>:CONNection:GHOPping`.

Parameters:

<Value> OFF | ON

*RST: OFF

Example: See Specifying Required Settings

Firmware/Software: V2.0.20

Manual operation: See "Group Hopping" on page 552

CONFigure:LTE:MEAS<i>:MEValuation:MSUBframes <SubframeOffset>, <SubframeCount>, <MeasSubframe>

Configures the scope of the measurement, i.e. which subframes are measured.

Parameters:

<SubframeOffset> Start of the measured subframe range relative to the trigger event

Range: 0 to 9
*RST: 0

<SubframeCount> Length of the measured subframe range

Range: 1 to 320
*RST: 1

<MeasSubframe> Subframe containing the measured slots for modulation and spectrum results

Range: 0 to <SubframeCount>-1
*RST: 0

Example: See Specifying Additional Measurement-Specific Settings

Firmware/Software: V1.0.15.20
V2.1.10: <SubframeCount> maximum increased to 320

Manual operation: See "Measurement Subframe" on page 552

3.5.3.4 Modulation Measurement Settings

The following commands specify settings for the modulation measurements.

CONFigure:LTE:MEAS<i>:MEValuation:MODulation:MSCHeme <ModScheme>

Selects the modulation scheme used by the LTE uplink signal.

Parameters:

<ModScheme> AUTO | QPSK | Q16 | Q64

AUTO: automatic detection
QPSK: QPSK
Q16: 16-QAM
Q64: 64-QAM

*RST: QPSK

Example: See Specifying Additional Measurement-Specific Settings

Firmware/Software: V1.0.10.1

Manual operation: See "Modulation Scheme" on page 553

CONFigure:LTE:MEAS<i>:MEValuation:SCOunt:MODulation <StatisticCount>

Specifies the statistic count of the measurement. The statistic count is equal to the number of measurement intervals per single shot. Use `CONFigure:...:MEAS<i>:...:REPetition SINGleshot | CONTinuous` to select either single-shot or continuous measurements.

See also: "Statistical Settings" in the R&S CMW user manual, chapter "Remote Control"

Parameters:

<StatisticCount> Number of measurement intervals (slots)

Range: 1 slot to 1000 slots
*RST: 20 slots

Example: See Specifying Additional Measurement-Specific Settings

Firmware/Software: V1.0.10.1

Manual operation: See "Statistic Count" on page 553

CONFigure:LTE:MEAS<i>:MEValuation:SRS:ENABle <Enable>

Specifies whether the uplink signal may contain a sounding reference signal (ON) or not (OFF). As a consequence, the last SC-FDMA symbol of each subframe is ignored or evaluated for modulation results.

For the combined signal path scenario, use `CONFigure:LTE:SIGN<i>:CELL:SRS:ENABle`.

Parameters:

<Enable> OFF | ON

OFF: all SC-FDMA symbols are evaluated
ON: the last SC-FDMA symbol of each subframe is not evaluated

*RST: OFF

Example: See Specifying Additional Measurement-Specific Settings

Firmware/Software: V3.0.10

Manual operation: See "Sounding RS (SRS)" on page 554

CONFigure:LTE:MEAS<i>:MEValuation:MODulation:EWLength <CPnormB014>, <CPnormB030>, <CPnormB050>, <CPnormB100>, <CPnormB150>, <CPnormB200>, <CPextB014>, <CPextB030>, <CPextB050>, <CPextB100>, <CPextB150>, <CPextB200>

Specifies the EVM window length in samples for all channel bandwidths, depending on the cyclic prefix (CP) type.

Parameters:

<CPnormB014> Length for normal CP, BW = 1.4 MHz

Range: 1 to 9
*RST: 5

<CPnormB030> Length for normal CP, BW = 3 MHz

Range: 1 to 18
*RST: 12

<CPnormB050> Length for normal CP, BW = 5 MHz

Range: 1 to 36
*RST: 32

<CPnormB100> Length for normal CP, BW = 10 MHz

Range: 1 to 72
*RST: 66

<CPnormB150> Length for normal CP, BW = 15 MHz

Range: 1 to 108
*RST: 102

<CPnormB200> Length for normal CP, BW = 20 MHz

Range: 1 to 144
*RST: 136

<CPextB014> Length for extended CP, BW = 1.4 MHz

Range: 1 to 32
*RST: 28

<CPextB030> Length for extended CP, BW = 3 MHz

Range: 1 to 64
*RST: 58

<CPextB050> Length for extended CP, BW = 5 MHz

Range: 1 to 128
*RST: 124

<CPextB100> Length for extended CP, BW = 10 MHz

Range: 1 to 256
*RST: 250

<CPextB150> Length for extended CP, BW = 15 MHz

Range: 1 to 384
*RST: 374

<CPextB200> Length for extended CP, BW = 20 MHz

Range: 1 to 512
*RST: 504

Example: See Specifying Additional Measurement-Specific Settings

Firmware/Software: V1.0.10.1

Manual operation: See "EVM Window Length" on page 554

CONFigure:LTE:MEAS<i>:MEValuation:MODulation:EWLength:
CBANdwidth<Band> <CycPrefixNormal>, <CycPrefixExtend>

Specifies the EVM window length in samples for a selected channel bandwidth, depending on the cyclic prefix (CP) type.

Suffix:

<Band> 14,30,50,100,150,200
Channel bandwidth in 0.1 MHz

Parameters:

<CycPrefixNormal> Samples for normal CP
Range: see below
*RST: see below

<CycPrefixExtend> Samples for extended CP
Range: see below
*RST: see below

Example: See Specifying Additional Measurement-Specific Settings

Firmware/Software: V1.0.10.1

Manual operation: See "EVM Window Length" on page 554

<Band>	Range <CycPrefixNormal>	*RST <CycPrefixNormal>	Range <CycPrefixExtend>	*RST <CycPrefixExtend>
14	1 to 9	5	1 to 32	28
30	1 to 18	12	1 to 64	58
50	1 to 36	32	1 to 128	124
100	1 to 72	66	1 to 256	250
150	1 to 108	102	1 to 384	374
200	1 to 144	136	1 to 512	504

CONFigure:LTE:MEAS<i>:MEValuation:MODulation:EEPeriods:PUCCh
<PUCCH>

Enables or disables EVM exclusion periods for slots with detected channel type "PUCCH". If enabled, the first and the last SC-FDMA symbol of each slot are excluded from the calculation of EVM, magnitude error and phase error single value results. If the last symbol of a slot is already excluded because SRS signals are allowed, the second but last symbol is also excluded.

Parameters:

<PUCCH> OFF | ON
*RST: ON

Example: See Specifying Additional Measurement-Specific Settings

Firmware/Software: V2.0.20

Manual operation: See "EVM Exclusion Periods" on page 554

CONFigure:LTE:MEAS<i>:MEValuation:MODulation:EEPeriods:PUSCh:LEADing <Leading>

Specifies an EVM exclusion period at the beginning of a subframe (detected channel type "PUSCH"). The specified period is excluded from the calculation of EVM, magnitude error and phase error results.

Parameters:

<Leading> OFF | MS25

OFF: no exclusion
MS25: 25 µs excluded

*RST: OFF

Example: See Specifying Additional Measurement-Specific Settings

Firmware/Software: V2.0.20

Manual operation: See "EVM Exclusion Periods" on page 554

CONFigure:LTE:MEAS<i>:MEValuation:MODulation:EEPeriods:PUSCh:LAGGing <Lagging>

Specifies an EVM exclusion period at the end of each subframe (detected channel type "PUSCH"); if SRS signals are allowed, at the end of each shortened subframe. The specified period is excluded from the calculation of EVM, magnitude error and phase error results.

Parameters:

<Lagging> OFF | MS05 | MS25

OFF: no exclusion
MS05: 5 µs excluded
MS25: 25 µs excluded

*RST: OFF

Example: See Specifying Additional Measurement-Specific Settings

Firmware/Software: V2.0.20

Manual operation: See "EVM Exclusion Periods" on page 554

3.5.3.5 Spectrum Measurement Settings

The following commands specify settings for the spectrum measurements.

CONFigure:LTE:MEAS<i>:MEValuation:SCOunt:SPECtrum:ACLR <StatisticCount>
CONFigure:LTE:MEAS<i>:MEValuation:SCOunt:SPECtrum:SEMask <StatisticCount>

Specifies the statistic count of the measurement. The statistic count is equal to the number of measurement intervals per single shot. Use `CONFigure:...:MEAS<i>:...:REPetition SINGleshot | CONTinuous` to select either single-shot or continuous measurements.

See also: "Statistical Settings" in the R&S CMW user manual, chapter "Remote Control"

Separate statistic counts for ACLR and spectrum emission mask measurements are supported.

Parameters:

<StatisticCount>	Number of measurement intervals (slots) Range: 1 slot to 1000 slots *RST: 20 slots
Example:	See Specifying Additional Measurement-Specific Settings
Firmware/Software:	V1.0.10.1
Manual operation:	See "Emission Mask / ACLR > Statistic Count" on page 555

CONFigure:LTE:MEAS<i>:MEValuation:SPECtrum:SEMask:MFILter <MeasFilter>

Selects the resolution filter type for filter bandwidths of 100 kHz and 1 MHz. For 30 kHz filters the type is fixed (gaussian shape).

Parameters:

<MeasFilter>	BANDpass | GAUSs *RST: BAND
Example:	See Specifying Additional Measurement-Specific Settings
Firmware/Software:	V1.0.15.20
Manual operation:	See "Emission Mask > Meas Filter" on page 555

CONFigure:LTE:MEAS<i>:MEValuation:SPECtrum:ACLR:ENABle <UTRA1>, <UTRA2>, <EUTRA>

Enables or disables the evaluation of 1st adjacent UTRA channels, 2nd adjacent UTRA channels and 1st adjacent E-UTRA channels.

Parameters:

<UTRA1>	OFF | ON *RST: ON
<UTRA2>	OFF | ON *RST: ON

<EUTRA> OFF | ON
*RST: ON

Example: See Specifying Additional Measurement-Specific Settings

Firmware/Software: V1.0.15.0

Manual operation: See "ACLR > Select ACLR" on page 556

3.5.3.6 Power Measurement Settings

The following commands specify settings for the power measurements.

CONFigure:LTE:MEAS<i>:MEValuation:PDYNamics:TMASk <TimeMask>

Selects the time mask for power dynamics measurements.

Parameters:

<TimeMask> GOO | PPSRs | SBLanking

GOO: General ON/OFF time mask
PPSRs: PUCCH/PUSCH transmission before and after an SRS
SBLanking: SRS blanking time mask

*RST: GOO

Example: See Specifying Additional Measurement-Specific Settings

Firmware/Software: V3.2.70

Manual operation: See "Time Mask" on page 556

CONFigure:LTE:MEAS<i>:MEValuation:PDYNamics:AEOPower:LEADing <Leading>

Shifts the beginning of the evaluation period for OFF power measurements.

Parameters:

<Leading> Positive values reduce the evaluation period (starts later).
Negative values increase the evaluation period (starts earlier).

Range: -1000 Ts to 1000 Ts
*RST: 0 Ts
Default unit: Ts

Example: See Specifying Additional Measurement-Specific Settings

Firmware/Software: V3.2.70

Manual operation: See "Add. Excl. OFF Power" on page 556

CONFigure:LTE:MEAS<i>:MEValuation:PDYNamics:AEOPower:LAGGing <Lagging>

Shifts the end of the evaluation period for OFF power measurements.

Parameters:

<Lagging> Positive values reduce the evaluation period (ends earlier). Negative values increase the evaluation period (ends later).

Range: -1000 Ts to 1000 Ts
*RST: 0 Ts
Default unit: Ts

Example: See Specifying Additional Measurement-Specific Settings

Firmware/Software: V3.2.70

Manual operation: See "Add. Excl. OFF Power" on page 556

CONFigure:LTE:MEAS<i>:MEValuation:SCOunt:POWer <StatisticCount>

Specifies the statistic count of the measurement. The statistic count is equal to the number of measurement intervals per single shot. Use `CONFigure:...:MEAS<i>:...:REPetition SINGleshot | CONTinuous` to select either single-shot or continuous measurements.

See also: "Statistical Settings" in the R&S CMW user manual, chapter "Remote Control"

Parameters:

<StatisticCount> Number of measurement intervals

Range: 1 subframe to 1000 subframes
*RST: 20 subframes

Example: See Specifying Additional Measurement-Specific Settings

Firmware/Software: V2.0.20

Manual operation: See "Statistic Count" on page 557

CONFigure:LTE:MEAS<i>:MEValuation:POWer:HDMode <HighDynamicMode>

Enables or disables the high dynamic mode for power dynamics measurements.

Parameters:

<HighDynamicMode> OFF | ON

*RST: OFF

Example: See Specifying Additional Measurement-Specific Settings

Firmware/Software: V2.1.25

Manual operation: See "High Dynamic Mode" on page 557

3.5.3.7 BLER Measurement Settings

The following commands specify settings for the Block Error Ratio measurement.

CONFigure:LTE:MEAS<i>:MEValuation:BLER:SFRames <Subframes>[, <SchedSubfrPerFr>]

Specifies the statistic count (number of measured subframes) and the number of scheduled subframes per radio frame for the BLER measurement. BLER is a single shot measurement.

See also: "Statistical Settings" in the R&S CMW user manual, chapter "Remote Control"

Parameters:

<Subframes> Number of subframes to be measured

Range: 1 subframe to 200E+3 subframes
*RST: 10E+3 subframes

<SchedSubfrPerFr> Number of scheduled subframes per radio frame in the generated downlink signal

Range: 1 subframe to 10 subframes
*RST: 9 subframes

Example: See Specifying Additional Measurement-Specific Settings

Firmware/Software: V1.0.15.21
V3.0.10: added <SchedSubfrPerFr>

Manual operation: See "BLER > No. of Subframes" on page 558

3.5.3.8 List Mode Settings

The following commands configure the list mode. For retrieving list mode results see chapter 3.5.3.32, "List Mode Results (One Segment)", on page 683 and chapter 3.5.3.33, "List Mode Results (All Segments, One Result)", on page 704.

For a description of the list mode see chapter 3.2.3, "List Mode", on page 498.

The segment number <no> in the following commands refers to the complete range of configured segments (1..2000).

CONFigure:LTE:MEAS<i>:MEValuation:LIST <Enable>

Enables or disables the list mode.

Parameters:

<Enable> OFF | ON

OFF: Disable list mode
ON: Enable list mode

*RST: OFF

Example: See Using LTE List Mode

Firmware/Software: V2.0.10

Options: R&S CMW-KM012

Manual operation: See "Measurement Mode" on page 546

CONFigure:LTE:MEAS<i>:MEValuation:LIST:LRANge <StartIndex>, <NrSegments>

Select a range of measured segments. The segments must be configured using `CONFigure:LTE:MEAS<i>:MEValuation:LIST:SEGMent<no>:SETup`.

Parameters:

<StartIndex> First measured segment in the range of configured segments

Range: 1 to 2000
*RST: 1

<NrSegments> Number of measured segments

Range: 1 to 1000
*RST: 10

Example: See Using LTE List Mode

Firmware/Software: V2.0.10
V2.1.25: increased maximum number of segments to 250
V2.1.30: increased maximum number of segments to 512
V3.0.50: increased maximum number of segments to 1000

Options: R&S CMW-KM012

CONFigure:LTE:MEAS<i>:MEValuation:LIST:OSINdex <OfflineSegIndex>

Selects the number of the segment to be displayed in offline mode. The selected index must be within the range of measured segments (see `CONFigure:LTE:MEAS<i>:MEValuation:LIST:LRANge`).

Setting a value also enables the offline mode.

Parameters:

<OfflineSegIndex> Range: 1 to 1000
*RST: OFF
Additional parameters: OFF (disables offline mode)

Example: See Using LTE List Mode

Firmware/Software: V2.0.10
V2.1.25: increased maximum number of segments to 250
V2.1.30: increased maximum number of segments to 512
V3.0.50: increased maximum number of segments to 1000

Options: R&S CMW-KM012

Manual operation: See "List Mode > Offline Segment No." on page 558

CONFigure:LTE:MEAS<i>:MEValuation:LIST:CMWS:CMODe <ConnectorMode>

Specifies how the input connector is selected for LTE list mode measurements with the R&S CMWS.

Parameters:

<ConnectorMode> GLOBal | LIST

GLOBal: The same input connector is used for all segments. It is selected in the same way as without list mode, for example via `ROUTe:LTE:MEAS<i>:SCENario:SALone`.

LIST: The input connector is configured individually for each segment. See `CONFigure:LTE:MEAS<i>:MEValuation:LIST:SEGMent<no>:CMWS:CONNector`.

*RST: GLOB

Example: See Specifying List Mode Settings

Firmware/Software: V3.2.70

Options: R&S CMW-KM012

CONFigure:LTE:MEAS<i>:MEValuation:LIST:SEGMent<no>:CMWS:CONNector <CMWSConnector>

Selects the RF input connector for segment <no> for LTE list mode measurements with the R&S CMWS. This setting is only relevant for connector mode `LIST`, see `CONFigure:LTE:MEAS<i>:MEValuation:LIST:CMWS:CMODe`.

All segments of a list mode measurement must use connectors of the same bench.

For possible connector values, see chapter 3.5.1.4, "Values for RF Path Selection", on page 580.

Suffix:

<no> 1..2000
Segment number

Parameters:

<CMWSConnector> Selects the input connector of the R&S CMWS

*RST: R11

Example: See Specifying List Mode Settings

Firmware/Software: V3.2.70

Options: R&S CMW-KM012

CONFigure:LTE:MEAS<i>:MEValuation:LIST:SEGMent<no>:SETup <SegmentLength>, <Level>, <DuplexMode>, <Band>, <Frequency>, <ChBandwidth>, <CyclicPrefix>, <ChannelType>, <RetriggerFlag>, <EvaluatOffset>[, <NetworkSigValue>]

Defines the length and analyzer settings of segment <no>. In general this command must be sent for all segments measured (`CONFigure:LTE:MEAS<i>:MEValuation:LIST:LRANge`).

For TDD mode see additionally `CONFigure:LTE:MEAS<i>:MEValuation:LIST:SEGMent<no>:TDD`.

Suffix:

<no> 1..2000
Segment number

Parameters:

<SegmentLength> Number of subframes in the segment

Range: 1 to 2000
*RST: 1

<Level> Expected nominal power in the segment. The range can be calculated as follows:
Range (Expected Nominal Power) = Range (Input Power) + External Attenuation - User Margin

Range: -47 dBm to 55 dBm for the input power at the RF COM connectors (please notice also the ranges quoted in the data sheet)
*RST: 0 dBm
Default unit: dBm

<DuplexMode> FDD | TDD

Duplex mode used in the segment

<Band> FDD: OB1 | ... | OB28 | OB30 | OB31

TDD: OB33 | ... | OB44
Operating Band (OB) used in the segment

*RST: OB1 (OB33 for TDD)

<Frequency> Center frequency of the RF analyzer for the segment

Range: 70E+6 Hz to 6E+9 Hz
*RST: 1.95E+9 Hz
Default unit: Hz

<ChBandwidth> B014 | B030 | B050 | B100 | B150 | B200

Channel bandwidth used in the segment
B014: 1.4 MHz
B030: 3 MHz
B050: 5 MHz
B100: 10 MHz
B150: 15 MHz
B200: 20 MHz

*RST: B200

<CyclicPrefix> NORMal | EXTended

Type of cyclic prefix used in the segment

*RST: NORM

<ChannelType> AUTO | PUSCh | PUCCh

AUTO: automatic detection of channel type
PUSCh: only PUSCH in measured subframe
PUCCh: only PUCCH in measured subframe

*RST: PUSC

<RetriggerFlag> OFF | ON | IFPower

Specifies whether the measurement waits for a trigger event before measuring the segment, or not.
For the first segment, the value OFF is always interpreted as ON.
For subsequent segments, the retrigger flag is ignored for trigger mode ONCE and evaluated for trigger mode SEGMent, see `TRIGger:LTE:MEAS<i>:MEValuation:LIST:MODE` on page 627.
OFF: measure the segment without retrigger
ON: wait for a trigger event from the trigger source configured via `TRIGger:LTE:MEAS<i>:MEValuation:SOURce` on page 628
IFPower: wait for a trigger event from the trigger source "IF Power"

*RST: ON

<EvaluatOffset> Number of subframes at the beginning of the segment that shall not be evaluated

Range: 0 to 1000
*RST: 0

<NetworkSigValue> NS01 | NS02 | NS03 | NS04 | NS05 | NS06 | NS07 | NS08 | NS09 | NS10 | NS11 | NS12 | NS13 | NS14 | NS15 | NS16 | NS17 | NS18 | NS19 | NS20 | NS21 | NS22 | NS23 | NS24

Network signaled value to be used for the segment (NS_01 to NS_24)

*RST: NS01

Example: See Using LTE List Mode

Firmware/Software: V2.0.10
V2.0.20: added <NetworkSigValue>
V2.1.20: added OB24, OB25, OB41, removed OB22
V2.1.30: added OB15, OB16, OB22, OB42, OB43
V3.0.10: added OB23, OB26
V3.0.30: added OB27, OB28, OB44
V3.2.70: added <RetriggerFlag> value IFPower; OB30, OB31; NS11 to NS18, NS20
V3.2.82: added NS19, NS21 to NS24

Options: R&S CMW-KM012
R&S CMW-KM500 for FDD, R&S CMW-KM550 for TDD
R&S CMW-KB036 for bands/frequencies above 3.3 GHz

CONFigure:LTE:MEAS<i>:MEValuation:LIST:SEGMent<no>:TDD <UplinkDownlink>, <SpecialSubframe>

Defines segment settings relevant only for duplex mode TDD. In general this command must be sent for all segments measured (`CONFigure:LTE:MEAS<i>:MEValuation:LIST:LRANge`) if the duplex mode TDD is used.

For general segment configuration see `CONFigure:LTE:MEAS<i>:MEValuation:LIST:SEGMent<no>:SETup`.

Suffix:

<no> 1..2000
Segment number

Parameters:

<UplinkDownlink> Uplink-downlink configuration, defining the combination of uplink, downlink and special subframes within a radio frame

Range: 0 to 6
*RST: 0

<SpecialSubframe> Special subframe configuration, defining the inner structure of special subframes

Range: 0 to 8
*RST: 0

Firmware/Software: V2.0.10

Options: R&S CMW-KM012

CONFigure:LTE:MEAS<i>:MEValuation:LIST:SEGMent<no>:RBALlocation <Auto>, <NoRB>, <Offset>

Allows to define the resource block allocation manually for segment <no>. By default, the RB allocation is detected automatically.

Suffix:

<no> 1..2000
Segment number

Parameters:

<Auto> OFF | ON

OFF: manual definition via <NoRB> and <Offset>
ON: automatic detection of RB allocation

*RST: ON

<NoRB> Number of allocated resource blocks in each measured slot

Range: see table below
*RST: 100

<Offset> Offset of first allocated resource block from edge of allocated UL transmission bandwidth

Range: see table below
*RST: 0

Example: See Using LTE List Mode

Firmware/Software: V3.0.10

Options: R&S CMW-KM012

Channel Bandwidth	Range <NoRB>	Range <Offset>
1.4 MHz	1 to 6	0 to 5
3 MHz	1 to 15	0 to 14
5 MHz	1 to 25	0 to 24
10 MHz	1 to 50	0 to 49
15 MHz	1 to 75	0 to 74
20 MHz	1 to 100	0 to 99

CONFigure:LTE:MEAS<i>:MEValuation:LIST:SEGMent<no>:MODulation <ModStatistics>, <ModEnable>, <EVMenable>, <MagErrorEnable>, <PhaseErrEnable>, <IBEenable>, <EqSpFlatEnable>, <ModScheme>

Defines settings for modulation measurements in list mode for segment <no>.

Suffix:

<no> 1..2000
Segment number

Parameters:

<ModStatistics> Statistical length in slots

Range: 1 to 1000
*RST: 20

<ModEnable> OFF | ON

Enable or disable the measurement of modulation results
ON: Modulation results are measured according to the other enable flags in this command. Modulation results for which there is no explicit enable flag are also measured (e.g. I/Q offset, frequency error and timing error).
OFF: No modulation results at all are measured. The other enable flags in this command are ignored.

*RST: OFF

<EVMenable> OFF | ON

Enable or disable measurement of EVM

*RST: OFF

<MagErrorEnable> OFF | ON

Enable or disable measurement of magnitude error

*RST: OFF

<PhaseErrEnable> OFF | ON

Enable or disable measurement of phase error

*RST: OFF

<IBEenable> OFF | ON

Enable or disable measurement of inband emissions

*RST: OFF

<EqSpFlatEnable> OFF | ON

Enable or disable measurement of equalizer spectrum flatness results

*RST: OFF

<ModScheme> AUTO | QPSK | Q16 | Q64

Modulation scheme used by the LTE uplink signal
AUTO: automatic detection
QPSK: QPSK
Q16: 16-QAM
Q64: 64-QAM

*RST: QPSK

Example: See Using LTE List Mode

Firmware/Software: V2.0.10

Options: R&S CMW-KM012

CONFigure:LTE:MEAS<i>:MEValuation:LIST:SEGMent<no>:SEMask <SEMstatistics>, <SEenable>, <OBWenable>, <SEMenable>

Defines settings for spectrum emission measurements in list mode for segment <no>.

Suffix:

<no> 1..2000
Segment number

Parameters:

<SEMstatistics> Statistical length in slots

Range: 1 to 1000
*RST: 20

<SEenable> OFF | ON

Enable or disable the measurement of spectrum emission results
ON: Spectrum emission results are measured according to the other enable flags in this command. Results for which there is no explicit enable flag are also measured.
OFF: No spectrum emission results at all are measured. The other enable flags in this command are ignored.

*RST: OFF

<OBWenable> OFF | ON

Enable or disable measurement of occupied bandwidth

*RST: OFF

<SEMenable> OFF | ON

Enable or disable measurement of spectrum emission trace and margin results

*RST: OFF

Example: See Using LTE List Mode

Firmware/Software: V2.0.10

Options: R&S CMW-KM012

CONFigure:LTE:MEAS<i>:MEValuation:LIST:SEGMent<no>:ACLR <ACLRstatistics>, <ACLRenable>, <UTRA1enable>, <UTRA2enable>, <EUTRAenable>

Defines settings for ACLR measurements in list mode for segment <no>.

Suffix:

<no> 1..2000
Segment number

Parameters:

<ACLRstatistics> Statistical length in slots

Range: 1 to 1000
*RST: 20

<ACLRenable> OFF | ON

Enable or disable the measurement of ACLR results
ON: ACLR results are measured according to the other enable flags in this command. ACLR results for which there is no explicit enable flag are also measured (e.g. power in assigned E-UTRA channel).
OFF: No ACLR results at all are measured. The other enable flags in this command are ignored.

*RST: OFF

<UTRA1enable> OFF | ON

Enable or disable evaluation of 1st adjacent UTRA channels

*RST: OFF

<UTRA2enable> OFF | ON

Enable or disable evaluation of 2nd adjacent UTRA channels

*RST: OFF

<EUTRAenable> OFF | ON

Enable or disable evaluation of 1st adjacent E-UTRA channels

*RST: OFF

Example: See Using LTE List Mode

Firmware/Software: V2.0.10

Options: R&S CMW-KM012

CONFigure:LTE:MEAS<i>:MEValuation:LIST:SEGMent<no>:PMONitor <Enable>

Enables or disables the measurement of power monitor results for segment <no>.

Suffix:

<no> 1..2000
Segment number

Parameters:

<Enable> OFF | ON

*RST: OFF

Example: See Using LTE List Mode

Firmware/Software: V2.0.20

Options: R&S CMW-KM012

TRIGger:LTE:MEAS<i>:MEValuation:LIST:MODE <Mode>

Specifies the trigger mode for list mode measurements. For configuration of retrigger flags, see `CONFigure:LTE:MEAS<i>:MEValuation:LIST:SEGMent<no>:SETup` on page 620.

Parameters:

<Mode> ONCE | SEGMent

ONCE: A trigger event is only required to start the measurement. As a result, the entire range of segments to be measured is captured without additional trigger event. The retrigger flag of the first segment is evaluated. The other retrigger flags are ignored.
SEGMent: The retrigger flag of each segment is evaluated. It defines whether the measurement waits for a trigger event before capturing the segment, or not.

*RST: ONCE

Example: See Using LTE List Mode

Firmware/Software: V2.0.10

Options: R&S CMW-KM012

3.5.3.9 Trigger Settings

The following commands define the trigger parameters.

TRIGger:LTE:MEAS<i>:MEValuation:CATalog:SOURce?

Lists all trigger source values that can be set using `TRIGger:LTE:MEAS<i>:MEValuation:SOURce`.

Return values:

<Sourcelist> Comma separated list of all supported values. Each value is represented as a string.

Usage: Query only

Firmware/Software: V1.0.10.1

Manual operation: See "Trigger Source" on page 559

TRIGger:LTE:MEAS<i>:MEValuation:SOURce <Source>

Selects the source of the trigger events. Some values are always available in this firmware application. They are listed below. Depending on the installed options additional values may be available. A complete list of all supported values can be displayed using `TRIGger:...:CATalog:SOURce?`.

Parameters:

<Source>
'Free Run (Fast Sync)': Free Run with synchronization
'Free Run (No Sync)': Free Run without synchronization
'IF Power': Power trigger (received RF power)
'Base1: External TRIG A': External trigger fed in at TRIG A connector
'Base1: External TRIG B': External trigger fed in at TRIG B connector
*RST: 'IF Power'

Example: See Configuring the Trigger System

Firmware/Software: V1.0.10.1
V2.0.10: 'Free Run (No Sync)' added

Manual operation: See "Trigger Source" on page 559

TRIGger:LTE:MEAS<i>:MEValuation:SLOPe <Slope>

Qualifies whether the trigger event is generated at the rising or at the falling edge of the trigger pulse (valid for external and power trigger sources).

Parameters:

<Slope> REDGe | FEDGe
REDGe: Rising edge
FEDGe: Falling edge
*RST: REDG

Example: See Configuring the Trigger System

Firmware/Software: V1.0.10.1

Manual operation: See "Trigger Slope" on page 560

TRIGger:LTE:MEAS<i>:MEValuation:THReshold <TrigThreshold>

Defines the trigger threshold for power trigger sources.

Parameters:

<TrigThreshold>
Range: -50 dB to 0 dB
*RST: -20 dB
Default unit: dB (full scale, i.e. relative to reference level minus external attenuation)

Example: See Configuring the Trigger System

Firmware/Software: V1.0.10.1

Manual operation: See "Trigger Threshold" on page 560

TRIGger:LTE:MEAS<i>:MEValuation:DELay <Delay>

Defines a time delaying the start of the measurement relative to the trigger event. This setting has no influence on "Free Run" measurements.

Parameters:

<Delay> Range: -250E-6 s to 250E-6 s
*RST: 0 s
Default unit: s

Example: See Configuring the Trigger System

Firmware/Software: V1.0.10.1
V2.1.20: default unit changed

Manual operation: See "Trigger Delay" on page 560

TRIGger:LTE:MEAS<i>:MEValuation:TOUT <TriggerTimeOut>

Selects the maximum time that the R&S CMW will wait for a trigger event before it stops the measurement in remote control mode or indicates a trigger timeout in manual operation mode. This setting has no influence on "Free Run" measurements.

Parameters:

<TriggerTimeOut> Range: 0.01 s to 167772.15 s
*RST: 0.1 s
Default unit: s
Additional parameters: OFF | ON (disables | enables the timeout)

Example: See Configuring the Trigger System

Firmware/Software: V1.0.10.1

Manual operation: See "Trigger Timeout" on page 560

TRIGger:LTE:MEAS<i>:MEValuation:MGAP <MinTrigGap>

Sets a minimum time during which the IF signal must be below the trigger threshold before the trigger is armed so that an IF power trigger event can be generated.

Parameters:

<MinTrigGap> Range: 0 slots to 20 slots
*RST: 2 slots
Default unit: slots

Example: See Configuring the Trigger System

Firmware/Software: V1.0.10.1

Manual operation: See "Min Trigger Gap" on page 560

TRIGger:LTE:MEAS<i>:MEValuation:SMODe <SyncMode>

Selects the size of the search window for synchronization - normal or enhanced.

Parameters:

<SyncMode> NORMal | ENHanced

*RST: NORM

Example: See Configuring the Trigger System

Firmware/Software: V2.0.10

Manual operation: See "Synchronization Mode" on page 561

TRIGger:LTE:MEAS<i>:MEValuation:AMODe <AcquisitionMode>

Selects whether the R&S CMW synchronizes to a slot boundary or to a subframe boundary. The parameter is relevant for "Free Run (Fast Sync)" and for list mode measurements with Synchronization Mode = Enhanced.

Parameters:

<AcquisitionMode> SLOT | SUBFrame

*RST: SLOT

Example: See Configuring the Trigger System

Firmware/Software: V2.1.25

Manual operation: See "Acquisition Mode" on page 561

3.5.3.10 Limits (Modulation, QPSK)

The following commands define limits for results which characterize the modulation accuracy of signals with modulation scheme QPSK.

CONFigure:LTE:MEAS<i>:MEValuation:LIMit:QPSK:EVMagnitude <RMS>, <Peak>

Defines upper limits for the RMS and peak values of the error vector magnitude (EVM) for QPSK.

Parameters:

<RMS> Range: 0 % to 100 %
*RST: 17.5 %, ON
Default unit: %
Additional parameters: OFF | ON (disables the limit check | enables the limit check using the previous/default limit values)

<Peak> Range: 0 % to 100 %
*RST: 35 %, OFF
Default unit: %
Additional parameters: OFF | ON (disables the limit check | enables the limit check using the previous/default limit values)

Example: See Specifying Limits

Firmware/Software: V1.0.10.1

CONFigure:LTE:MEAS<i>:MEValuation:LIMit:QPSK:MERRor <RMS>, <Peak>

Defines upper limits for the RMS and peak values of the magnitude error for QPSK.

Parameters:

<RMS> Range: 0 % to 100 %
*RST: 17.5 %, OFF
Default unit: %
Additional parameters: OFF | ON (disables the limit check | enables the limit check using the previous/default limit values)

<Peak> Range: 0 % to 100 %
*RST: 35 %, OFF
Default unit: %
Additional parameters: OFF | ON (disables the limit check | enables the limit check using the previous/default limit values)

Example: See Specifying Limits

Firmware/Software: V1.0.10.1

CONFigure:LTE:MEAS<i>:MEValuation:LIMit:QPSK:PERRor <RMS>, <Peak>

Defines symmetric limits for the RMS and peak values of the phase error for QPSK. The limit check fails if the absolute value of the measured phase error exceeds the specified values.

Parameters:

<RMS> Range: 0 deg to 180 deg
*RST: 17.5 deg, OFF
Default unit: deg
Additional parameters: OFF | ON (disables the limit check | enables the limit check using the previous/default limit values)

<Peak>	Range: 0 deg to 180 deg *RST: 35 deg, OFF Default unit: deg Additional parameters: OFF | ON (disables the limit check | enables the limit check using the previous/default limit values)
Example:	See Specifying Limits
Firmware/Software:	V1.0.10.1

CONFigure:LTE:MEAS<i>:MEValuation:LIMit:QPSK:FERRor <FrequencyError>

Defines an upper limit for the carrier frequency error (QPSK modulation).

Parameters:

<FrequencyError>	Range: 0 ppm to 1 ppm *RST: 0.1 ppm, ON Default unit: ppm Additional parameters: OFF | ON (disables the limit check | enables the limit check using the previous/default limit values)
Example:	See Specifying Limits
Firmware/Software:	V1.0.10.1

CONFigure:LTE:MEAS<i>:MEValuation:LIMit:QPSK:IQOFfset <Enable>, <Offset1>, <Offset2>, <Offset3>

Defines upper limits for the I/Q origin offset (QPSK modulation). Three different I/Q origin offset limits can be set for three TX power ranges. For details see chapter 3.2.5.4, "I/Q Origin Offset Limits", on page 509.

Parameters:

<Enable>	OFF | ON **OFF**: disables the limit check **ON**: enables the limit check *RST: ON
<Offset1>	I/Q origin offset limit for high TX power range Range: -256 dBc to 256 dBc *RST: -24.2 dBc Default unit: dBc
<Offset2>	I/Q origin offset limit for intermediate TX power range Range: -256 dBc to 256 dBc *RST: -19.2 dBc Default unit: dBc
<Offset3>	I/Q origin offset limit for low TX power range Range: -256 dBc to 256 dBc *RST: -9.2 dBc Default unit: dBc

Example: See Specifying Limits

Firmware/Software: V1.0.10.1

CONFigure:LTE:MEAS<i>:MEValuation:LIMit:QPSK:IBE <Enable>, <Minimum>, <EVM>, <RBPower>, <IQImage>

Defines parameters used for calculation of an upper limit for the inband emission (QPSK modulation), see chapter 3.2.5.5, "Inband Emissions Limits", on page 509.

Parameters:

<Enable> OFF | ON

OFF: disables the limit check
ON: enables the limit check

*RST: ON

<Minimum> Range: -256 dB to 256 dB
*RST: -29.2 dB
Default unit: dB

<EVM> Range: 0 % to 100 %
*RST: 17.5 %
Default unit: %

<RBPower> Range: -256 dBm to 256 dBm
*RST: -57 dBm
Default unit: dBm

<IQImage> Range: -256 dB to 256 dB
*RST: -24.2 dB
Default unit: dB

Example: See Specifying Limits

Firmware/Software: V1.0.10.1

CONFigure:LTE:MEAS<i>:MEValuation:LIMit:QPSK:IBE:IQOFfset <Offset1>, <Offset2>, <Offset3>

Defines I/Q origin offset values used for calculation of an upper limit for the inband emission (QPSK modulation). Three different values can be set for three TX power ranges, see chapter 3.2.5.5, "Inband Emissions Limits", on page 509.

Parameters:

<Offset1> Offset for high TX power range

Range: -256 dBc to 256 dBc
*RST: -24.2 dBc
Default unit: dBc

<Offset2> Offset for intermediate TX power range

Range: -256 dBc to 256 dBc
*RST: -19.2 dBc
Default unit: dBc

<Offset3> Offset for low TX power range

Range: -256 dBc to 256 dBc
*RST: -9.2 dBc
Default unit: dBc

Example: See Specifying Limits

Firmware/Software: V1.0.10.1

CONFigure:LTE:MEAS<i>:MEValuation:LIMit:QPSK:ESFLatness <Enable>, <Range1>, <Range2>, <Max1Min2>, <Max2Min1>, <EdgeFrequency>

Defines limits for the equalizer spectrum flatness (QPSK modulation).

Parameters:

<Enable> OFF | ON

OFF: disables the limit check
ON: enables the limit check

*RST: ON

<Range1> Upper limit for max(range 1) - min(range 1)

Range: -256 dBpp to 256 dBpp
*RST: 5.4 dBpp
Default unit: dBpp

<Range2> Upper limit for max(range 2) - min(range 2)

Range: -256 dBpp to 256 dBpp
*RST: 9.4 dBpp
Default unit: dBpp

<Max1Min2> Upper limit for max(range 1) - min(range 2)

Range: -256 dB to 256 dB
*RST: 6.4 dB
Default unit: dB

<Max2Min1> Upper limit for max(range 2) - min(range 1)

Range: -256 dB to 256 dB
*RST: 8.4 dB
Default unit: dB

<EdgeFrequency> Frequency band edge distance of border between range 1 and range 2

Range: 0 MHz to 20 MHz
*RST: 3 MHz
Default unit: Hz

Example: See Specifying Limits

Firmware/Software: V2.0.10

3.5.3.11 Limits (Modulation, 16-QAM / 64-QAM)

The following commands define limits for results which characterize the modulation accuracy of signals with modulation scheme 16-QAM or 64-QAM.

CONFigure:LTE:MEAS<i>:MEValuation:LIMit:QAM<ModOrder>:EVMagnitude <RMS>, <Peak>

Defines upper limits for the RMS and peak values of the error vector magnitude (EVM) for 16-QAM or 64-QAM.

Suffix:

<ModOrder> 16,64
16-QAM or 64-QAM

Parameters:

<RMS>
Range: 0 % to 100 %
*RST: 12.5 % (16-QAM) / 7.5 % (64-QAM), ON
Default unit: %
Additional parameters: OFF | ON (disables the limit check | enables the limit check using the previous/default limit values)

<Peak>
Range: 0 % to 100 %
*RST: 25 % (16-QAM) / 15 % (64-QAM), OFF
Default unit: %
Additional parameters: OFF | ON (disables the limit check | enables the limit check using the previous/default limit values)

Example: See Specifying Limits

Firmware/Software: V1.0.10.1

CONFigure:LTE:MEAS<i>:MEValuation:LIMit:QAM<ModOrder>:MERRor <RMS>, <Peak>

Defines upper limits for the RMS and peak values of the magnitude error for 16-QAM or 64-QAM.

Suffix:

<ModOrder> 16,64
16-QAM or 64-QAM

Parameters:

<RMS> Range: 0 % to 100 %
*RST: 12.5 % (16-QAM) / 7.5 % (64-QAM), OFF
Default unit: %
Additional parameters: OFF | ON (disables the limit check | enables the limit check using the previous/default limit values)

<Peak> Range: 0 % to 100 %
*RST: 25 % (16-QAM) / 15 % (64-QAM), OFF
Default unit: %
Additional parameters: OFF | ON (disables the limit check | enables the limit check using the previous/default limit values)

Example: See Specifying Limits

Firmware/Software: V1.0.10.1

CONFigure:LTE:MEAS<i>:MEValuation:LIMit:QAM<ModOrder>:PERRor <RMS>, <Peak>

Defines symmetric limits for the RMS and peak values of the phase error for 16-QAM or 64-QAM. The limit check fails if the absolute value of the measured phase error exceeds the specified values.

Suffix:

<ModOrder> 16,64
16-QAM or 64-QAM

Parameters:

<RMS> Range: 0 deg to 180 deg
*RST: 12.5 deg (16-QAM) / 7.5 deg (64-QAM), OFF
Default unit: deg
Additional parameters: OFF | ON (disables the limit check | enables the limit check using the previous/default limit values)

<Peak> Range: 0 deg to 180 deg
*RST: 25 deg (16-QAM) / 15 deg (64-QAM), OFF
Default unit: deg
Additional parameters: OFF | ON (disables the limit check | enables the limit check using the previous/default limit values)

Example: See Specifying Limits

Firmware/Software: V1.0.10.1

CONFigure:LTE:MEAS<i>:MEValuation:LIMit:QAM<ModOrder>:FERRor <FrequencyError>

Defines an upper limit for the carrier frequency error (16-QAM or 64-QAM modulation).

Suffix:

<ModOrder> 16,64
16-QAM or 64-QAM

Parameters:

<FrequencyError>	Range: 0 ppm to 1 ppm *RST: 0.1 ppm, ON Default unit: ppm Additional parameters: OFF | ON (disables the limit check | enables the limit check using the previous/default limit values)

Example: See Specifying Limits

Firmware/Software: V1.0.10.1

CONFigure:LTE:MEAS<i>:MEValuation:LIMit:QAM<ModOrder>:IQOFfset <Enable>, <Offset1>, <Offset2>, <Offset3>

Defines upper limits for the I/Q origin offset (16-QAM or 64-QAM modulation). Three different I/Q origin offset limits can be set for three TX power ranges. For details see chapter 3.2.5.4, "I/Q Origin Offset Limits", on page 509.

Suffix:

<ModOrder>	16,64 16-QAM or 64-QAM

Parameters:

<Enable>	OFF | ON **OFF**: disables the limit check **ON**: enables the limit check *RST: ON
<Offset1>	I/Q origin offset limit for high TX power range Range: -256 dBc to 256 dBc *RST: -24.2 dBc Default unit: dBc
<Offset2>	I/Q origin offset limit for intermediate TX power range Range: -256 dBc to 256 dBc *RST: -19.2 dBc Default unit: dBc
<Offset3>	I/Q origin offset limit for low TX power range Range: -256 dBc to 256 dBc *RST: -9.2 dBc Default unit: dBc

Example: See Specifying Limits

Firmware/Software: V1.0.10.1

CONFigure:LTE:MEAS<i>:MEValuation:LIMit:QAM<ModOrder>:IBE <Enable>, <Minimum>, <EVM>, <RBPower>, <IQImage>

Defines parameters used for calculation of an upper limit for the inband emission (16-QAM or 64-QAM modulation), see chapter 3.2.5.5, "Inband Emissions Limits", on page 509.

Suffix:

<ModOrder> 16,64
16-QAM or 64-QAM

Parameters:

<Enable> OFF | ON

OFF: disables the limit check
ON: enables the limit check

*RST: ON

<Minimum> Range: -256 dB to 256 dB
*RST: -29.2 dB
Default unit: dB

<EVM> Range: 0 % to 100 %
*RST: 12.5 % (16-QAM) / 7.5 % (64-QAM)
Default unit: %

<RBPower> Range: -256 dBm to 256 dBm
*RST: -57 dBm
Default unit: dBm

<IQImage> Range: -256 dB to 256 dB
*RST: -24.2 dB
Default unit: dB

Example: See Specifying Limits

Firmware/Software: V1.0.10.1

CONFigure:LTE:MEAS<i>:MEValuation:LIMit:QAM<ModOrder>:IBE:IQOFfset <Offset1>, <Offset2>, <Offset3>

Defines I/Q origin offset values used for calculation of an upper limit for the inband emission (16-QAM or 64-QAM modulation). Three different values can be set for three TX power ranges, see chapter 3.2.5.5, "Inband Emissions Limits", on page 509.

Suffix:

<ModOrder> 16,64
16-QAM or 64-QAM

Parameters:

<Offset1> Offset for high TX power range

Range: -256 dBc to 256 dBc
*RST: -24.2 dBc
Default unit: dBc

<Offset2> Offset for intermediate TX power range

Range: -256 dBc to 256 dBc
*RST: -19.2 dBc
Default unit: dBc

<Offset3> Offset for low TX power range

Range: -256 dBc to 256 dBc
*RST: -9.2 dBc
Default unit: dBc

Example: See Specifying Limits

Firmware/Software: V1.0.10.1

CONFigure:LTE:MEAS<i>:MEValuation:LIMit:QAM<ModOrder>:ESFLatness <Enable>, <Range1>, <Range2>, <Max1Min2>, <Max2Min1>, <EdgeFrequency>

Defines limits for the equalizer spectrum flatness (16-QAM or 64-QAM modulation).

Suffix:

<ModOrder> 16,64
16-QAM or 64-QAM

Parameters:

<Enable> OFF | ON

OFF: disables the limit check
ON: enables the limit check

*RST: ON

<Range1> Upper limit for max(range 1) - min(range 1)

Range: -256 dBpp to 256 dBpp
*RST: 5.4 dBpp
Default unit: dBpp

<Range2> Upper limit for max(range 2) - min(range 2)

Range: -256 dBpp to 256 dBpp
*RST: 9.4 dBpp
Default unit: dBpp

<Max1Min2> Upper limit for max(range 1) - min(range 2)

Range: -256 dB to 256 dB
*RST: 6.4 dB
Default unit: dB

<Max2Min1> Upper limit for max(range 2) - min(range 1)

Range: -256 dB to 256 dB
*RST: 8.4 dB
Default unit: dB

<EdgeFrequency> Frequency band edge distance of border between range 1 and range 2

Range: 0 MHz to 20 MHz
*RST: 3 MHz
Default unit: Hz

Example: See Specifying Limits

Firmware/Software: V2.0.10

3.5.3.12 Limits (Spectrum, no Carrier Aggregation)

The following commands define ACLR and spectrum emission limits for measurements without carrier aggregation.

CONFigure:LTE:MEAS<i>:MEValuation:LIMit:ACLR:UTRA<no>:CBANdwidth<Band> <RelativeLevel>, <AbsoluteLevel>

Defines relative and absolute limits for the ACLR measured in the first or second adjacent UTRA channel, depending on <no>. The settings are defined separately for each channel bandwidth.

Suffix:

<Band> 14,30,50,100,150,200
Channel bandwidth in 0.1 MHz

<no> 1..2
Selects first or second adjacent UTRA channel

Parameters:

<RelativeLevel> Range: -256 dB to 256 dB
*RST: 32.2 dB (<no> = 1) / 35.2 dB (<no> = 2, OFF for <Band> = 14 | 30)
Default unit: dB
Additional parameters: OFF | ON (disables the limit check | enables the limit check using the previous/default limit values)

<AbsoluteLevel> Range: -256 dBm to 256 dBm
*RST: -50 dBm (OFF for <no> = 2 and <Band> = 14 | 30)
Default unit: dBm
Additional parameters: OFF | ON (disables the limit check | enables the limit check using the previous/default limit values)

Example: See Specifying Limits

Firmware/Software: V1.0.10.1

CONFigure:LTE:MEAS<i>:MEValuation:LIMit:ACLR:EUTRa:CBANdwidth<Band> <RelativeLevel>, <AbsoluteLevel>

Defines relative and absolute limits for the ACLR measured in an adjacent E-UTRA channel. The settings are defined separately for each channel bandwidth.

Suffix:

<Band> 14,30,50,100,150,200
Channel bandwidth in 0.1 MHz

Parameters:

<RelativeLevel> Range: -256 dB to 256 dB
*RST: 29.2 dB, ON
Default unit: dB
Additional parameters: OFF | ON (disables the limit check | enables the limit check using the previous/default limit values)

<AbsoluteLevel> Range: -256 dBm to 256 dBm
*RST: -50 dBm, ON
Default unit: dBm
Additional parameters: OFF | ON (disables the limit check | enables the limit check using the previous/default limit values)

Example: See Specifying Limits

Firmware/Software: V1.0.10.1

CONFigure:LTE:MEAS<i>:MEValuation:LIMit:SEMask:OBWLimit: CBANdwidth<Band> <OBWlimit>

Defines an upper limit for the occupied bandwidth, depending on the channel bandwidth.

Suffix:

<Band> 14,30,50,100,150,200
Channel bandwidth in 0.1 MHz

Parameters:

<OBWlimit> Range: 0 MHz to 40 MHz
*RST: Equals the channel bandwidth, ON
Default unit: Hz
Additional parameters: OFF | ON (disables the limit check | enables the limit check using the previous/default limit values)

Example: See Specifying Limits

Firmware/Software: V1.0.10.1

CONFigure:LTE:MEAS<i>:MEValuation:LIMit:SEMask:LIMit<no>:CBANdwidth<Band> <Enable>, <FrequencyStart>, <FrequencyEnd>, <Level>, <RBW>

Defines general requirements for the emission mask area <no>. The activation state, the area borders, an upper limit and the resolution bandwidth must be specified.

The emission mask applies to the channel bandwidth <Band>.

Suffix:

<Band> 14,30,50,100,150,200
Channel bandwidth in 0.1 MHz

<no> 1..12
Number of emission mask area

Parameters:

<Enable> OFF | ON

OFF: disables the check of these requirements
ON: enables the check of these requirements

*RST: depends on channel bandwidth and area number

<FrequencyStart> Start frequency of the area, relative to the edges of the channel bandwidth

Range: see table below
*RST: depends on channel bandwidth and area number
Default unit: Hz

<FrequencyEnd> Stop frequency of the area, relative to the edges of the channel bandwidth

Range: see table below
*RST: depends on channel bandwidth and area number
Default unit: Hz

<Level> Upper limit for the area

Range: -256 dBm to 256 dBm
*RST: depends on channel bandwidth and area number
Default unit: dBm

<RBW> K030 | K100 | M1

Resolution bandwidth to be used for the area
K030: 30 kHz
K100: 100 kHz
M1: 1 MHz

*RST: K030 (<no> = 1) / M1 (<no> = 2 to 10)

Example: See Specifying Limits

Firmware/Software: V1.0.10.1
V3.2.80: <no> of areas enhanced to 12

<Band>	Range for <FrequencyStart> and <FrequencyEnd>
14	0 MHz to 5 MHz
30	0 MHz to 6 MHz
50	0 MHz to 10 MHz
100	0 MHz to 15 MHz
150	0 MHz to 20 MHz
200	0 MHz to 25 MHz

CONFigure:LTE:MEAS<i>:MEValuation:LIMit:SEMask:LIMit<no>:ADDitional<Table>:CBANdwidth<Band> <Enable>, <FrequencyStart>, <FrequencyEnd>, <Level>, <RBW>

Defines additional requirements for the emission mask area <no>. The activation state, the area borders, an upper limit and the resolution bandwidth must be specified.

The emission mask applies to the channel bandwidth <Band>. Three tables of additional requirements are available.

Suffix:

<Band> 14,30,50,100,150,200
Channel bandwidth in 0.1 MHz

<no> 1..12
Number of emission mask area

<Table> 1..3
Set of additional requirements
1 = NS_03/11/20/21, 2 = NS_04, 3 = NS_06/07

Parameters:

<Enable> OFF | ON

OFF: disables the check of these requirements
ON: enables the check of these requirements

*RST: depends on channel bandwidth, area number and set of requirements

<FrequencyStart> Start frequency of the area, relative to the edges of the channel bandwidth

Range: see table below
*RST: depends on channel bandwidth, area number and set of requirements
Default unit: Hz

<FrequencyEnd> Stop frequency of the area, relative to the edges of the channel bandwidth

Range: see table below
*RST: depends on channel bandwidth, area number and set of requirements
Default unit: Hz

<Level> Upper limit for the area

Range: -256 dBm to 256 dBm
*RST: depends on channel bandwidth, area number and set of requirements
Default unit: dBm

<RBW> K030 | K100 | M1

Resolution bandwidth to be used for the area
K030: 30 kHz
K100: 100 kHz
M1: 1 MHz

*RST: depends on area number and set of requirements

Example: See Specifying Limits

Firmware/Software: V2.0.20
V3.2.10: table 1 valid for NS_11
V3.2.80: <no> of areas enhanced to 12
V3.2.82: table 1 valid for NS_20 and NS_21

<Band>	Range for <FrequencyStart> and <FrequencyEnd>
14	0 MHz to 5 MHz
30	0 MHz to 6 MHz
50	0 MHz to 10 MHz
100	0 MHz to 15 MHz
150	0 MHz to 20 MHz
200	0 MHz to 25 MHz

3.5.3.13 Limits (Spectrum, with Carrier Aggregation)

The following commands define ACLR and spectrum emission limits for measurements with carrier aggregation.

CONFigure:LTE:MEAS<i>:MEValuation:LIMit:ACLR:UTRA<no>:CAGGregation:CBANdwidth<Band1>:CBANdwidth<Band2> <RelativeLevel>, <AbsoluteLevel>

Defines relative and absolute limits for the ACLR measured in the first or second adjacent UTRA channel, depending on <no>.

The settings are defined separately for each channel bandwidth combination of the aggregated channels.

Suffix:

<no> 1..2
Selects first or second adjacent UTRA channel

<Band1> 150,200
First channel bandwidth in 0.1 MHz

<Band2> 100,150,200
Second channel bandwidth in 0.1 MHz
For <Band1> = 150, only <Band2> = 150 is allowed
For <Band1> = 200, all <Band2> values are allowed

Parameters:

<RelativeLevel> Range: -256 dB to 256 dB
*RST: 32.2 dB (<no> = 1) / 35.2 dB (<no> = 2)
Default unit: dB
Additional parameters: OFF | ON (disables the limit check | enables the limit check using the previous/default limit values)

<AbsoluteLevel> Range: -256 dBm to 256 dBm
*RST: -50 dBm
Default unit: dBm
Additional parameters: OFF | ON (disables the limit check | enables the limit check using the previous/default limit values)

Example: See Specifying Limits

Firmware/Software: V3.2.70

Options: R&S CMW-KM502/-KM552 for FDD/TDD

CONFigure:LTE:MEAS<i>:MEValuation:LIMit:ACLR:UTRA<no>:CAGGregation:OCOMbination <RelativeLevel>, <AbsoluteLevel>

Defines relative and absolute limits for the ACLR measured in the first or second adjacent UTRA channel, depending on <no>.

The settings apply to all channel bandwidth combinations that are not supported by `CONFigure:LTE:MEAS<i>:MEValuation:LIMit:ACLR:UTRA<no>:CAGGregation:CBANdwidth<Band1>:CBANdwidth<Band2>`.

Suffix:

<no> 1..2
Selects first or second adjacent UTRA channel

Parameters:

<RelativeLevel> Range: -256 dB to 256 dB
*RST: 32.2 dB (<no> = 1) / 35.2 dB (<no> = 2)
Default unit: dB
Additional parameters: OFF | ON (disables the limit check | enables the limit check using the previous/default limit values)

<AbsoluteLevel> Range: -256 dBm to 256 dBm
*RST: -50 dBm
Default unit: dBm
Additional parameters: OFF | ON (disables the limit check | enables the limit check using the previous/default limit values)

Example: See Specifying Limits

Firmware/Software: V3.2.70

Options: R&S CMW-KM502/-KM552 for FDD/TDD

CONFigure:LTE:MEAS<i>:MEValuation:LIMit:ACLR:EUTRa:CAGGregation:CBANdwidth<Band1>:CBANdwidth<Band2> <RelativeLevel>, <AbsoluteLevel>

Defines relative and absolute limits for the ACLR measured in an adjacent E-UTRA channel.

The settings are defined separately for each channel bandwidth combination of the aggregated channels.

Suffix:

<Band1> 150,200
First channel bandwidth in 0.1 MHz

<Band2> 100,150,200
Second channel bandwidth in 0.1 MHz
For <Band1> = 150, only <Band2> = 150 is allowed
For <Band1> = 200, all <Band2> values are allowed

Parameters:

<RelativeLevel> Range: -256 dB to 256 dB
*RST: 29.2 dB, ON
Default unit: dB
Additional parameters: OFF | ON (disables the limit check | enables the limit check using the previous/default limit values)

<AbsoluteLevel> Range: -256 dBm to 256 dBm
*RST: -50 dBm, ON
Default unit: dBm
Additional parameters: OFF | ON (disables the limit check | enables the limit check using the previous/default limit values)

Example: See Specifying Limits

Firmware/Software: V3.2.70

Options: R&S CMW-KM502/-KM552 for FDD/TDD

CONFigure:LTE:MEAS<i>:MEValuation:LIMit:ACLR:EUTRa:CAGGregation:OCOMbination <RelativeLevel>, <AbsoluteLevel>

Defines relative and absolute limits for the ACLR measured in an adjacent E-UTRA channel.

The settings apply to all channel bandwidth combinations that are not supported by `CONFigure:LTE:MEAS<i>:MEValuation:LIMit:ACLR:EUTRa:CAGGregation:CBANdwidth<Band1>:CBANdwidth<Band2>`.

Parameters:

<RelativeLevel> Range: -256 dB to 256 dB
*RST: 29.2 dB, ON
Default unit: dB
Additional parameters: OFF | ON (disables the limit check | enables the limit check using the previous/default limit values)

<AbsoluteLevel> Range: -256 dBm to 256 dBm
*RST: -50 dBm, ON
Default unit: dBm
Additional parameters: OFF | ON (disables the limit check | enables the limit check using the previous/default limit values)

Example: See Specifying Limits

Firmware/Software: V3.2.70

Options: R&S CMW-KM502/-KM552 for FDD/TDD

CONFigure:LTE:MEAS<i>:MEValuation:LIMit:SEMask:OBWLimit:CAGGregation:CBANdwidth<Band1>:CBANdwidth<Band2> <OBWlimit>

Defines an upper limit for the occupied bandwidth, depending on the channel bandwidth combination of the aggregated channels.

Suffix:

<Band1> 150,200
First channel bandwidth in 0.1 MHz

<Band2> 100,150,200
Second channel bandwidth in 0.1 MHz
For <Band1> = 150, only <Band2> = 150 is allowed
For <Band1> = 200, all <Band2> values are allowed

Parameters:

<OBWlimit> Range: 0 MHz to 40 MHz
*RST: Depends on the channel bandwidths
Default unit: Hz
Additional parameters: OFF | ON (disables the limit check | enables the limit check using the previous/default limit values)

Example: See Specifying Limits

Firmware/Software: V3.2.70

Options: R&S CMW-KM502/-KM552 for FDD/TDD

CONFigure:LTE:MEAS<i>:MEValuation:LIMit:SEMask:OBWLimit:CAGGregation:OCOMbination <OBWlimit>

Defines an upper limit for the occupied bandwidth.

The settings apply to all channel bandwidth combinations that are not supported by `CONFigure:LTE:MEAS<i>:MEValuation:LIMit:SEMask:OBWLimit:CAGGregation:CBANdwidth<Band1>:CBANdwidth<Band2>`.

Parameters:

<OBWlimit> Range: 0 MHz to 40 MHz
*RST: 0 MHz
Default unit: Hz
Additional parameters: OFF | ON (disables the limit check | enables the limit check using the previous/default limit values)

Example: See Specifying Limits

Firmware/Software: V3.2.70

Options: R&S CMW-KM502/-KM552 for FDD/TDD

CONFigure:LTE:MEAS<i>:MEValuation:LIMit:SEMask:LIMit<no>:CAGGregation:CBANdwidth<Band1>:CBANdwidth<Band2> <Enable>, <FrequencyStart>, <FrequencyEnd>, <Level>, <RBW>

Defines general requirements for the emission mask area <no>. The activation state, the area borders, an upper limit and the resolution bandwidth must be specified.

The settings are defined separately for each channel bandwidth combination of the aggregated channels.

Suffix:

<no> 1..12
Number of the emission mask area

<Band1>	150,200 First channel bandwidth in 0.1 MHz
<Band2>	100,150,200 Second channel bandwidth in 0.1 MHz For <Band1> = 150, only <Band2> = 150 is allowed For <Band1> = 200, all <Band2> values are allowed

Parameters:

<Enable>	OFF | ON **OFF**: disables the check of these requirements **ON**: enables the check of these requirements *RST: ON (<no> = 1 to 4) / OFF (<no> = 5 to 12)
<FrequencyStart>	Start frequency of the area, relative to the edges of the aggregated channel bandwidth Range: 0 MHz to 45 MHz *RST: depends on the suffixes Default unit: Hz
<FrequencyEnd>	Stop frequency of the area, relative to the edges of the aggregated channel bandwidth Range: 0 MHz to 45 MHz *RST: depends on the suffixes Default unit: Hz
<Level>	Upper limit for the area Range: -256 dBm to 256 dBm *RST: depends on the suffixes Default unit: dBm
<RBW>	K030 | K100 | M1 Resolution bandwidth to be used for the area **K030**: 30 kHz **K100**: 100 kHz **M1**: 1 MHz *RST: K030 (<no> = 1) / M1 (<no> = 2 to 12)

Example: See Specifying Limits

Firmware/Software: V3.2.70
V3.2.80: <no> of areas enhanced to 12

Options: R&S CMW-KM502/-KM552 for FDD/TDD

CONFigure:LTE:MEAS<i>:MEValuation:LIMit:SEMask:LIMit<no>:CAGGregation:OCOMbination <Enable>, <FrequencyStart>, <FrequencyEnd>, <Level>, <RBW>

Defines general requirements for the emission mask area <no>. The activation state, the area borders, an upper limit and the resolution bandwidth must be specified.

The settings apply to all channel bandwidth combinations that are not supported by `CONFigure:LTE:MEAS<i>:MEValuation:LIMit:SEMask:LIMit<no>:CAGGregation:CBANdwidth<Band1>:CBANdwidth<Band2>`.

Suffix:

<no> 1..12
Number of the emission mask area

Parameters:

<Enable> OFF | ON

OFF: disables the check of these requirements
ON: enables the check of these requirements

*RST: OFF

<FrequencyStart> Start frequency of the area, relative to the edges of the aggregated channel bandwidth

Range: 0 MHz to 45 MHz
*RST: depends on <no>
Default unit: Hz

<FrequencyEnd> Stop frequency of the area, relative to the edges of the aggregated channel bandwidth

Range: 0 MHz to 45 MHz
*RST: depends on <no>
Default unit: Hz

<Level> Upper limit for the area

Range: -256 dBm to 256 dBm
*RST: depends on <no>
Default unit: dBm

<RBW> K030 | K100 | M1

Resolution bandwidth to be used for the area
K030: 30 kHz
K100: 100 kHz
M1: 1 MHz

*RST: K030 (<no> = 1) / M1 (<no> = 2 to 12)

Example: See Specifying Limits

Firmware/Software: V3.2.70
V3.2.80: <no> of areas enhanced to 12

Options: R&S CMW-KM502/-KM552 for FDD/TDD

CONFigure:LTE:MEAS<i>:MEValuation:LIMit:SEMask:LIMit<no>:ADDitional<Table>:CAGGregation:CBANdwidth<Band1>:CBANdwidth<Band2> <Enable>, <FrequencyStart>, <FrequencyEnd>, <Level>, <RBW>

Defines additional requirements for the emission mask area <no>. The activation state, the area borders, an upper limit and the resolution bandwidth must be specified.

The settings are defined separately for each channel bandwidth combination of the aggregated channels.

Suffix:

<no> 1..12
Number of emission mask area

<Band1> 150,200
First channel bandwidth in 0.1 MHz

<Band2> 100,150,200
Second channel bandwidth in 0.1 MHz
For <Band1> = 150, only <Band2> = 150 is allowed
For <Band1> = 200, all <Band2> values are allowed

<Table> 1
Set of additional requirements
1 = CA_NS_04

Parameters:

<Enable> OFF | ON

OFF: disables the check of these requirements
ON: enables the check of these requirements

*RST: ON (<no> = 1 to 3) / OFF (<no> = 4 to 12)

<FrequencyStart> Start frequency of the area, relative to the edges of the aggregated channel bandwidth

Range: 0 MHz to 45 MHz
*RST: depends on the suffixes
Default unit: Hz

<FrequencyEnd> Stop frequency of the area, relative to the edges of the aggregated channel bandwidth

Range: 0 MHz to 45 MHz
*RST: depends on the suffixes
Default unit: Hz

<Level> Upper limit for the area

Range: -256 dBm to 256 dBm
*RST: depends on the suffixes
Default unit: dBm

<RBW> K030 | K100 | M1

Resolution bandwidth to be used for the area
K030: 30 kHz
K100: 100 kHz
M1: 1 MHz

*RST: K030 (<no> = 1) / M1 (<no> = 2 to 12)

Example: See Specifying Limits

Firmware/Software: V3.2.70
V3.2.80: <no> of areas enhanced to 12

Options: R&S CMW-KM502/-KM552 for FDD/TDD

CONFigure:LTE:MEAS<i>:MEValuation:LIMit:SEMask:LIMit<no>:ADDitional<Table>:CAGGregation:OCOMbination <Enable>, <FrequencyStart>, <FrequencyEnd>, <Level>, <RBW>

Defines additional requirements for the emission mask area <no>. The activation state, the area borders, an upper limit and the resolution bandwidth must be specified.

The settings apply to all channel bandwidth combinations that are not supported by `CONFigure:LTE:MEAS<i>:MEValuation:LIMit:SEMask:LIMit<no>:ADDitional<Table>:CAGGregation:CBANdwidth<Band1>:CBANdwidth<Band2>`.

Suffix:

<no> 1..12
Number of emission mask area

<Table> 1
Set of additional requirements
1 = CA_NS_04

Parameters:

<Enable> OFF | ON

OFF: disables the check of these requirements
ON: enables the check of these requirements

*RST: OFF

<FrequencyStart> Start frequency of the area, relative to the edges of the aggregated channel bandwidth

Range: 0 MHz to 45 MHz
*RST: depends on the suffixes
Default unit: Hz

<FrequencyEnd> Stop frequency of the area, relative to the edges of the aggregated channel bandwidth

Range: 0 MHz to 45 MHz
*RST: depends on the suffixes
Default unit: Hz

<Level> Upper limit for the area

Range: -256 dBm to 256 dBm
*RST: depends on the suffixes
Default unit: dBm

<RBW> K030 | K100 | M1

Resolution bandwidth to be used for the area
K030: 30 kHz
K100: 100 kHz
M1: 1 MHz

*RST: K030 (<no> = 1) / M1 (<no> = 2 to 12)

Example: See Specifying Limits

Firmware/Software: V3.2.70
V3.2.80: <no> of areas enhanced to 12

Options: R&S CMW-KM502/-KM552 for FDD/TDD

3.5.3.14 Limits (Power)

The following command defines limits for results which characterize the power dynamics of the signal.

CONFigure:LTE:MEAS<i>:MEValuation:LIMit:PDYNamics:CBANdwidth<Band> <Enable>, <OnPowerUpper>, <OnPowerLower>, <OffPowerUpper>

Defines limits for the ON power and OFF power determined with the power dynamics measurement. Separate limits can be defined for each channel bandwidth.

Suffix:

<Band> 14,30,50,100,150,200
Channel bandwidth in 0.1 MHz

Parameters:

<Enable> OFF | ON

OFF: disables the limit check
ON: enables the limit check

*RST: ON
Default unit: n/a

<OnPowerUpper> Upper limit for the "ON power"

Range: -256 dBm to 256 dBm
*RST: depends on channel bandwidth, see below
Default unit: dBm

<OnPowerLower> Lower limit for the "ON power"

Range: -256 dBm to 256 dBm
*RST: depends on channel bandwidth, see below
Default unit: dBm

<OffPowerUpper> Upper limit for the "OFF power" and the "SRS OFF" power

Range: -256 dBm to 256 dBm
*RST: -48.5 dBm
Default unit: dBm

Example: See Specifying Limits

Firmware/Software: V2.0.10

<Band>	*RST <OnPowerUpper>	*RST <OnPowerLower>
14	-7.3 dBm	-22.3 dBm
30	-3.3 dBm	-18.3 dBm
50	-1.1 dBm	-16.1 dBm

<Band>	*RST <OnPowerUpper>	*RST <OnPowerLower>
100	1.9 dBm	-13.1 dBm
150	3.6 dBm	-11.4 dBm
200	4.9 dBm	-10.1 dBm

3.5.3.15 Detected Signal Configuration

The following commands return the detected allocation, modulation scheme and channel type and the view filter throughput.

FETCh:LTE:MEAS<i>:MEValuation:MODulation:DMODulation?

Returns the detected modulation scheme in the measured slot. If channel type PUCCH is detected, QPSK is returned as modulation type because the QPSK limits are applied in that case.

Return values:

<Reliability> Reliability Indicator

<Modulation> QPSK | Q16 | Q64
QPSK, 16-QAM, 64-QAM

Example: See Performing Single-Shot Measurements

Usage: Query only

Firmware/Software: V2.0.10

FETCh:LTE:MEAS<i>:MEValuation:MODulation:DCHType?
FETCh:LTE:MEAS<i>:MEValuation:ACLR:DCHType?
FETCh:LTE:MEAS<i>:MEValuation:SEMask:DCHType?

Returns the detected channel type for the measured slot.

If the same slot is measured by the individual measurements, all commands yield the same result. If different statistic counts are defined for the modulation, ACLR and spectrum emission mask measurements, different slots may be measured and different results may be returned by the individual commands.

Return values:

<Reliability> Reliability Indicator

<ChannelType>	PUSCh | PUCCh **PUSCh**: slot contains only PUSCH **PUCCH**: slot contains only PUCCH
Example:	See Performing Single-Shot Measurements
Usage:	Query only
Firmware/Software:	V2.0.10: MODulation command V2.0.20: ACLR and SEMask commands added

---

FETCh:LTE:MEAS<i>:MEValuation:MODulation:DALLocation?
FETCh:LTE:MEAS<i>:MEValuation:ACLR:DALLocation?
FETCh:LTE:MEAS<i>:MEValuation:SEMask:DALLocation?

Returns the detected allocation for the measured slot.

If the same slot is measured by the individual measurements, all commands yield the same result. If different statistic counts are defined for the modulation, ACLR and spectrum emission mask measurements, different slots may be measured and different results may be returned by the individual commands.

Return values:

<Reliability>	Reliability Indicator
<NrResBlocks>	Number of allocated resource blocks Range: 1 to 100
<OffsetResBlocks>	Offset of the first allocated resource block from the edge of the allocated UL transmission bandwidth Range: 0 to 99
Example:	See Performing Single-Shot Measurements
Usage:	Query only
Firmware/Software:	V2.0.10: MODulation command V2.0.20: ACLR and SEMask command

---

FETCh:LTE:MEAS<i>:MEValuation:VFTHroughput?

Queries the "View Filter Throughput", see "View Filter Throughput" on page 536.

Return values:

<Reliability>	Reliability Indicator
<VFThroughput>	Range: 0 % to 100 % Default unit: %
Example:	See Performing Single-Shot Measurements
Usage:	Query only
Firmware/Software:	V3.0.20

3.5.3.16 EVM Results (Traces)

The following commands return the EVM vs SC-FDMA symbol and EVM vs subcarrier results of the multi evaluation measurement.

FETCh:LTE:MEAS<i>:MEValuation:EVMagnitude:CURRent?
FETCh:LTE:MEAS<i>:MEValuation:EVMagnitude:AVERage?
FETCh:LTE:MEAS<i>:MEValuation:EVMagnitude:MAXimum?
READ:LTE:MEAS<i>:MEValuation:EVMagnitude:CURRent?
READ:LTE:MEAS<i>:MEValuation:EVMagnitude:AVERage?
READ:LTE:MEAS<i>:MEValuation:EVMagnitude:MAXimum?

Returns the values of the EVM bar graphs for the SC-FDMA symbols in the measured slot. The results of the current, average and maximum bar graphs can be retrieved.

See also chapter 3.2.6.2, "Detailed Views: EVM, Magnitude Error, Phase Error", on page 518.

Return values:

<Reliability> Reliability Indicator

<EVMlow0>
<EVMhigh0> ...
<EVMlow5/6>
<EVMhigh5/6>

EVM values, low and high EVM window position.
Normal cyclic prefix: values for SC-FDMA symbol 0 to 6, including the reference symbol as symbol number 3.
Extended cyclic prefix: values for SC-FDMA symbol 0 to 5, including the reference symbol as symbol number 2.

Range: 0 % to 100 %
Default unit: %

Example: See Performing Single-Shot Measurements

Usage: Query only

Firmware/Software: V1.0.10.1

FETCh:LTE:MEAS<i>:MEValuation:TRACe:EVMC?
READ:LTE:MEAS<i>:MEValuation:TRACe:EVMC?

Returns the values of the EVM vs subcarrier trace. See also chapter 3.2.6.2, "Detailed Views: EVM, Magnitude Error, Phase Error", on page 518.

The number of results n equals 12 times the number of resource blocks, which depends on the channel bandwidth, see chapter 3.2.4.1, "Resources in Time and Frequency Domain", on page 504.

Return values:

<Reliability>	Reliability Indicator
<EVM_1> ... <EVM_n>	n EVM values, one per subcarrier For not allocated subcarriers NCAP is returned. Range: 0 % to 100 % Default unit: %
Example:	See Performing Single-Shot Measurements
Usage:	Query only
Firmware/Software:	V1.0.10.1

3.5.3.17 Magnitude Error Results (Traces)

The following commands return the magnitude error vs. SC-FDMA symbol results of the multi evaluation measurement.

FETCh:LTE:MEAS<i>:MEValuation:MERRor:CURRent?
FETCh:LTE:MEAS<i>:MEValuation:MERRor:AVERage?
FETCh:LTE:MEAS<i>:MEValuation:MERRor:MAXimum?
READ:LTE:MEAS<i>:MEValuation:MERRor:CURRent?
READ:LTE:MEAS<i>:MEValuation:MERRor:AVERage?
READ:LTE:MEAS<i>:MEValuation:MERRor:MAXimum?

Returns the values of the magnitude error bar graphs for the SC-FDMA symbols in the measured slot. The results of the current, average and maximum bar graphs can be retrieved.

See also chapter 3.2.6.2, "Detailed Views: EVM, Magnitude Error, Phase Error", on page 518.

Return values:

<Reliability>	Reliability Indicator
<MagErrLow0> <MagErrHigh0> ... <MagErrLow5/6> <MagErrHigh5/6>	Magnitude error values, low and high EVM window position. Normal cyclic prefix: values for SC-FDMA symbol 0 to 6, including the reference symbol as symbol number 3. Extended cyclic prefix: values for SC-FDMA symbol 0 to 5, including the reference symbol as symbol number 2. Range: 0 % to 100 % Default unit: %
Example:	See Performing Single-Shot Measurements
Usage:	Query only
Firmware/Software:	V1.0.10.1

3.5.3.18 Phase Error Results (Traces)

The following commands return the phase error vs. SC-FDMA symbol results of the multi evaluation measurement.

FETCh:LTE:MEAS<i>:MEValuation:PERRor:CURRent?
FETCh:LTE:MEAS<i>:MEValuation:PERRor:AVERage?
FETCh:LTE:MEAS<i>:MEValuation:PERRor:MAXimum?
READ:LTE:MEAS<i>:MEValuation:PERRor:CURRent?
READ:LTE:MEAS<i>:MEValuation:PERRor:AVERage?
READ:LTE:MEAS<i>:MEValuation:PERRor:MAXimum?

Returns the values of the phase error bar graphs for the SC-FDMA symbols in the measured slot. The results of the current, average and maximum bar graphs can be retrieved.

See also chapter 3.2.6.2, "Detailed Views: EVM, Magnitude Error, Phase Error", on page 518.

Return values:

<Reliability> Reliability Indicator

<PhaseErrLow0> <PhaseErrHigh0> ... <PhaseErrLow5/6> <PhaseErrHigh5/6>
Phase error values, low and high EVM window position.
Normal cyclic prefix: values for SC-FDMA symbol 0 to 6, including the reference symbol as symbol number 3.
Extended cyclic prefix: values for SC-FDMA symbol 0 to 5, including the reference symbol as symbol number 2.

Range: 0 deg to 180 deg
Default unit: deg

Example: See Performing Single-Shot Measurements

Usage: Query only

Firmware/Software: V1.0.10.1

3.5.3.19 Equalizer Spectrum Flatness Results (Traces)

The following commands return the equalizer spectrum flatness trace results of the multi evaluation measurement.

FETCh:LTE:MEAS<i>:MEValuation:TRACe:ESFLatness?
READ:LTE:MEAS<i>:MEValuation:TRACe:ESFLatness?

Returns the values of the equalizer spectrum flatness trace. See also chapter 3.2.6.4, "Detailed Views: Equalizer Spectrum Flatness", on page 521.

The number of results n equals 12 times the number of resource blocks, which depends on the channel bandwidth, see chapter 3.2.4.1, "Resources in Time and Frequency Domain", on page 504.

Return values:

<Reliability> Reliability Indicator

<Power_1> ... <Power_n>
n power values, one per subcarrier
For not allocated subcarriers NCAP is returned.

Range: -20 dB to 20 dB
Default unit: dB

Example: See Performing Single-Shot Measurements

Usage: Query only

Firmware/Software: V2.0.10

3.5.3.20 Spectrum Emission Results (Traces)

The following commands return the spectrum emission trace results of the multi evaluation measurement.

FETCh:LTE:MEAS<i>:MEValuation:TRACe:SEMask:RBW<kHz>:CURRent?
FETCh:LTE:MEAS<i>:MEValuation:TRACe:SEMask:RBW<kHz>:AVERage?
FETCh:LTE:MEAS<i>:MEValuation:TRACe:SEMask:RBW<kHz>:MAXimum?
READ:LTE:MEAS<i>:MEValuation:TRACe:SEMask:RBW<kHz>:CURRent?
READ:LTE:MEAS<i>:MEValuation:TRACe:SEMask:RBW<kHz>:AVERage?
READ:LTE:MEAS<i>:MEValuation:TRACe:SEMask:RBW<kHz>:MAXimum?

Returns the values of the spectrum emission traces. Separate traces are available for the individual resolution bandwidths (<kHz>). The results of the current, average and maximum traces can be retrieved.

See also chapter 3.2.6.5, "Detailed Views: Spectrum Emission Mask", on page 522.

Suffix:

<kHz> 30,100,1000
Resolution bandwidth in kHz

Return values:

<Reliability> Reliability Indicator

<Power> Comma-separated list of power results
The value in the middle of the result array corresponds to the center frequency.
The test point separation between two results depends on the resolution bandwidth:
`RBW30`: separation 15 kHz
`RBW100`: separation 45 kHz
`RBW1000`: separation 90 kHz
For `RBW100` and `RBW1000`, results are only available for frequencies, for which limits using these RBW have been defined. For other frequencies INV is returned.
Range: -120 dBm to 55 dBm
Default unit: dBm

Example: See Performing Single-Shot Measurements

Usage: Query only

Firmware/Software: V1.0.10.1

3.5.3.21 I/Q Constellation Results (Traces)

The following commands return the results in the I/Q constellation diagram.

FETCh:LTE:MEAS<i>:MEValuation:TRACe:IQ:LOW?
FETCh:LTE:MEAS<i>:MEValuation:TRACe:IQ:HIGH?

Returns the results in the I/Q constellation diagram for low and high EVM window position.

See also chapter 3.2.6.7, "Detailed Views: I/Q Constellation Diagram", on page 525

Return values:

<Reliability>	Reliability Indicator
<I_Phase_1> <Q_Phase_1> ... <I_Phase_n> <Q_Phase_n>	n normalized I and Q amplitudes, one value per modulation symbol Range: -2 to 2
Example:	See Performing Single-Shot Measurements
Usage:	Query only
Firmware/Software:	V1.0.10.1

3.5.3.22 Power Dynamics Results (Traces)

The following commands return the results in the power dynamics diagram.

FETCh:LTE:MEAS<i>:MEValuation:TRACe:PDYNamics:CURRent?
FETCh:LTE:MEAS<i>:MEValuation:TRACe:PDYNamics:AVERage?
FETCh:LTE:MEAS<i>:MEValuation:TRACe:PDYNamics:MAXimum?
READ:LTE:MEAS<i>:MEValuation:TRACe:PDYNamics:CURRent?
READ:LTE:MEAS<i>:MEValuation:TRACe:PDYNamics:AVERage?
READ:LTE:MEAS<i>:MEValuation:TRACe:PDYNamics:MAXimum?

Return the values of the power dynamics traces. Each value is sampled with 48 T_s, corresponding to 1.5625 µs. The results of the current, average and maximum traces can be retrieved.

See also chapter 3.2.6.10, "Detailed Views: Power Dynamics", on page 528.

Return values:

<Reliability>	Reliability Indicator
<Power>	2048 power values, from -1100 µs to +2098.4375 µs relative to the start of the measure subframe. The values have a spacing of 1.5625 µs. The 705th value is located at the start of the "Measure Subframe" (0 µs). The diagram at the display shows only a subsection of this trace, depending on the selected time mask. Range: -100 dBm to 55 dBm Default unit: dBm
Example:	See Performing Single-Shot Measurements
Usage:	Query only
Firmware/Software:	V2.0.10

3.5.3.23 Inband Emission Results

The following commands return the inband emission trace results of the multi evaluation measurement.

FETCh:LTE:MEAS<i>:MEValuation:TRACe:IEMissions[:PCC]?
READ:LTE:MEAS<i>:MEValuation:TRACe:IEMissions[:PCC]?

Returns the values of the PCC inband emissions trace. See also chapter 3.2.6.3, "Detailed Views: Inband Emissions", on page 520.

The number of results n (resource blocks) depends on the channel bandwidth, see chapter 3.2.4.1, "Resources in Time and Frequency Domain", on page 504.

Return values:

<Reliability> Reliability Indicator

<Power> n power values, one value per resource block
Range: -100 dB to 10 dB
Default unit: dB

Example: See Performing Single-Shot Measurements

Usage: Query only

Firmware/Software: V1.0.10.1

FETCh:LTE:MEAS<i>:MEValuation:TRACe:IEMissions:SCC<no>?
READ:LTE:MEAS<i>:MEValuation:TRACe:IEMissions:SCC<no>?

Returns the values of the SCC inband emissions trace. See also chapter 3.2.6.3, "Detailed Views: Inband Emissions", on page 520.

The number of results n (resource blocks) depends on the channel bandwidth, see chapter 3.2.4.1, "Resources in Time and Frequency Domain", on page 504.

Suffix:

<no> 1
Only SCC1 supported - suffix can be omitted

Return values:

<Reliability> Reliability Indicator

<Power> n power values, one value per resource block

Range: -100 dB to 10 dB
Default unit: dB

Example: See Performing Single-Shot Measurements

Usage: Query only

Firmware/Software: V3.2.70

Options: R&S CMW-KM502/-KM552 for FDD/TDD

FETCh:LTE:MEAS<i>:MEValuation:IEMission[:PCC]:MARGin:CURRent?
FETCh:LTE:MEAS<i>:MEValuation:IEMission[:PCC]:MARGin:AVERage?
FETCh:LTE:MEAS<i>:MEValuation:IEMission[:PCC]:MARGin:EXTReme?
FETCh:LTE:MEAS<i>:MEValuation:IEMission[:PCC]:MARGin:SDEViation?

Return the limit line margin results for the PCC diagram. The `CURRent` margin indicates the minimum (vertical) distance between the inband emissions limit line and the current trace. A negative result indicates that the limit is exceeded.

The `AVERage`, `EXTReme` and `SDEViation` values are calculated from the current margins. The margin results cannot be displayed at the GUI.

Return values:

<Reliability> Reliability Indicator

<OutOfTolerance> Out of tolerance result, i.e. percentage of measurement intervals of the statistic count for modulation measurements exceeding the specified inband emission limits.

Range: 0 % to 100 %
Default unit: %

<Margin> Range: -50 dB to 110 dB
Default unit: dB

Example: See Performing Single-Shot Measurements

Usage: Query only

Firmware/Software: V2.0.10

FETCh:LTE:MEAS<i>:MEValuation:IEMission:SCC<no>:MARGin:CURRent?
FETCh:LTE:MEAS<i>:MEValuation:IEMission:SCC<no>:MARGin:AVERage?

FETCh:LTE:MEAS<i>:MEValuation:IEMission:SCC<no>:MARGin:EXTReme?
FETCh:LTE:MEAS<i>:MEValuation:IEMission:SCC<no>:MARGin:SDEViation?

Return the limit line margin results for the SCC diagram. The `CURRent` margin indicates the minimum (vertical) distance between the inband emissions limit line and the current trace. A negative result indicates that the limit is exceeded.

The `AVERage`, `EXTReme` and `SDEViation` values are calculated from the current margins. The margin results cannot be displayed at the GUI.

Suffix:

<no> 1
Only SCC1 supported - suffix can be omitted

Return values:

<Reliability> Reliability Indicator

<OutOfTolerance> Out of tolerance result, i.e. percentage of measurement intervals of the statistic count for modulation measurements exceeding the specified inband emission limits.
Range: 0 % to 100 %
Default unit: %

<Margin> Range: -50 dB to 110 dB
Default unit: dB

Example: See Performing Single-Shot Measurements

Usage: Query only

Firmware/Software: V3.2.70

Options: R&S CMW-KM502/-KM552 for FDD/TDD

FETCh:LTE:MEAS<i>:MEValuation:IEMission[:PCC]:MARGin:CURRent:RBINdex?
FETCh:LTE:MEAS<i>:MEValuation:IEMission[:PCC]:MARGin:EXTReme:RBINdex?

Return resource block indices for PCC inband emission margins. At these RB indices the `CURRent` and `EXTReme` margins have been detected (see `FETCh:LTE:MEAS<i>:MEValuation:IEMission[:PCC]:MARGin:CURRent?` and `...:EXTReme`).

Return values:

<Reliability> Reliability Indicator

<OutOfTolerance> Out of tolerance result, i.e. percentage of measurement intervals of the statistic count for modulation measurements exceeding the specified inband emission limits.
Range: 0 % to 100 %

<RBindex> Resource block index
Range: 0 to 99

Example: See Performing Single-Shot Measurements

Usage: Query only

Firmware/Software: V2.0.10

FETCh:LTE:MEAS<i>:MEValuation:IEMission:SCC<no>:MARGin:CURRent:RBINdex?
FETCh:LTE:MEAS<i>:MEValuation:IEMission:SCC<no>:MARGin:EXTReme:RBINdex?

Return resource block indices for SCC inband emission margins. At these RB indices the `CURRent` and `EXTReme` margins have been detected (see `FETCh:LTE:MEAS<i>:MEValuation:IEMission:SCC<no>:MARGin:CURRent?` and `...:EXTReme`).

Suffix:

<no> 1
Only SCC1 supported - suffix can be omitted

Return values:

<Reliability> Reliability Indicator

<OutOfTolerance> Out of tolerance result, i.e. percentage of measurement intervals of the statistic count for modulation measurements exceeding the specified inband emission limits.
Range: 0 % to 100 %

<RBindex> Resource block index
Range: 0 to 99

Example: See Performing Single-Shot Measurements

Usage: Query only

Firmware/Software: V3.2.70

Options: R&S CMW-KM502/-KM552 for FDD/TDD

3.5.3.24 ACLR Spectrum Results

The following commands return the results of the ACLR spectrum multi evaluation measurement.

FETCh:LTE:MEAS<i>:MEValuation:TRACe:ACLR:CURRent?
FETCh:LTE:MEAS<i>:MEValuation:TRACe:ACLR:AVERage?
READ:LTE:MEAS<i>:MEValuation:TRACe:ACLR:CURRent?
READ:LTE:MEAS<i>:MEValuation:TRACe:ACLR:AVERage?

Returns the absolute powers as displayed in the ACLR diagram. The current and average values can be retrieved. See also chapter 3.2.6.6, "Detailed Views: Spectrum ACLR", on page 524.

The number to the left of each result parameter is provided for easy identification of the parameter position within the result array.

Return values:

<1_Reliability> Reliability Indicator

<2_UTRA2neg>
<3_UTRA1neg> Power in the second and first adjacent UTRA channels with lower frequency

Range: -100 dBm to 55 dBm
Default unit: dBm

<4_EUTRAneg> Power in the first adjacent E-UTRA channel with lower frequency

Range: -100 dBm to 55 dBm
Default unit: dBm

<5_EUTRA> Power in the allocated E-UTRA channel

Range: -100 dBm to 55 dBm
Default unit: dBm

<6_EUTRApos> Power in the first adjacent E-UTRA channel with higher frequency

Range: -100 dBm to 55 dBm
Default unit: dBm

<7_UTRA1pos>
<8_UTRA2pos> Power in the first and second adjacent UTRA channels with higher frequency

Range: -100 dBm to 55 dBm
Default unit: dBm

Example: See Performing Single-Shot Measurements

Usage: Query only

Firmware/Software: V1.0.10.1

FETCh:LTE:MEAS<i>:MEValuation:ACLR:CURRent?
FETCh:LTE:MEAS<i>:MEValuation:ACLR:AVERage?
READ:LTE:MEAS<i>:MEValuation:ACLR:CURRent?
READ:LTE:MEAS<i>:MEValuation:ACLR:AVERage?
CALCulate:LTE:MEAS<i>:MEValuation:ACLR:CURRent?
CALCulate:LTE:MEAS<i>:MEValuation:ACLR:AVERage?

Returns the relative ACLR values as displayed in the table below the ACLR diagram. The current and average values can be retrieved.

See also chapter 3.2.6.6, "Detailed Views: Spectrum ACLR", on page 524.

The values described below are returned by `FETCh` and `READ` commands. `CALCulate` commands return limit check results instead, one value for each result listed below.

Return values:

<1_Reliability> Reliability Indicator

<2_UTRA2neg>
<3_UTRA1neg> ACLR for the second and first adjacent UTRA channels with lower frequency

Range: 0 dB to 100 dB
Default unit: dB

<4_EUTRAneg> ACLR for the first adjacent E-UTRA channel with lower frequency

Range: 0 dB to 100 dB
Default unit: dB

<5_EUTRA> Power in the allocated E-UTRA channel

Range: -100 dBm to 55 dBm
Default unit: dBm

<6_EUTRApos> ACLR for the first adjacent E-UTRA channel with higher frequency

Range: 0 dB to 100 dB
Default unit: dB

<7_UTRA1pos>
<8_UTRA2pos> ACLR for the first and second adjacent UTRA channels with higher frequency

Range: 0 dB to 100 dB
Default unit: dB

Example: See Performing Single-Shot Measurements

Usage: Query only

Firmware/Software: V1.0.10.1

3.5.3.25 RB Allocation Table Results

The following commands return the RB allocation table of the multi evaluation measurement.

FETCh:LTE:MEAS<i>:MEValuation:TRACe:RBATable[:PCC]?
READ:LTE:MEAS<i>:MEValuation:TRACe:RBATable[:PCC]?

Returns the information of the PCC RB allocation table. See also chapter 3.2.6.8, "Detailed Views: RB Allocation Table", on page 526.

For each captured slot, three results are returned:

<Reliability>, {<ChannelType>, <OffsetRB>, <NoRB>}$_{slot\ 1}$, ..., {<ChannelType>, <OffsetRB>, <NoRB>}$_{slot\ n}$

n equals two times the number of captured subframes (see `CONFigure:LTE:MEAS<i>:MEValuation:MSUBframes`).

Return values:

<Reliability>	Reliability Indicator
<ChannelType>	PUSCh | PUCCh | NONE | DL | SSUB Detected channel type for the first captured slot **PUSCh**: slot contains only PUSCH **PUCCH**: slot contains only PUCCH **NONE**: slot contains no allocated RBs at all **DL**: downlink slot (only relevant for TDD) **SSUB**: part of special subframe (only relevant for TDD)
<OffsetRB>	Offset of first allocated RB in the first captured slot Range: 0 to 99
<NoRB>	Number of allocated RBs in the first captured slot Range: 0 to 100
Example:	See Performing Single-Shot Measurements
Usage:	Query only
Firmware/Software:	V1.0.15.20 V2.0.20: DL and SSUB added to <ChannelType>

FETCh:LTE:MEAS<i>:MEValuation:TRACe:RBATable:SCC<no>?
READ:LTE:MEAS<i>:MEValuation:TRACe:RBATable:SCC<no>?

Returns the information of the SCC RB allocation table. See also chapter 3.2.6.8, "Detailed Views: RB Allocation Table", on page 526.

For each captured slot, three results are returned:

<Reliability>, {<ChannelType>, <OffsetRB>, <NoRB>}$_{slot\ 1}$, ..., {<ChannelType>, <OffsetRB>, <NoRB>}$_{slot\ n}$

n equals two times the number of captured subframes (see `CONFigure:LTE:MEAS<i>:MEValuation:MSUBframes`).

Suffix:

<no>	1 Only SCC1 supported - suffix can be omitted

Return values:

<Reliability>	Reliability Indicator

<ChannelType>	PUSCh | PUCCh | NONE | DL | SSUB Detected channel type for the first captured slot **PUSCh**: slot contains only PUSCH **PUCCH**: slot contains only PUCCH **NONE**: slot contains no allocated RBs at all **DL**: downlink slot (only relevant for TDD) **SSUB**: part of special subframe (only relevant for TDD)
<OffsetRB>	Offset of first allocated RB in the first captured slot Range: 0 to 99
<NoRB>	Number of allocated RBs in the first captured slot Range: 0 to 100
Example:	See Performing Single-Shot Measurements
Usage:	Query only
Firmware/Software:	V3.2.70
Options:	R&S CMW-KM502/-KM552 for FDD/TDD

3.5.3.26 Power Monitor Results

The following commands return the power monitor results of the multi evaluation measurement.

FETCh:LTE:MEAS<i>:MEValuation:TRACe:PMONitor[:PCC]?
READ:LTE:MEAS<i>:MEValuation:TRACe:PMONitor[:PCC]?

Returns the power monitor results for all captured PCC subframes. The number of subframes can be configured, see `CONFigure:LTE:MEAS<i>:MEValuation:MSUBframes`.

Return values:

<Reliability>	Reliability Indicator
<Power>	n power values, one per subframe Range: -100 dBm to 55 dBm Default unit: dBm
Example:	See Performing Single-Shot Measurements
Usage:	Query only
Firmware/Software:	V1.0.15.20

FETCh:LTE:MEAS<i>:MEValuation:TRACe:PMONitor:SCC<no>?
READ:LTE:MEAS<i>:MEValuation:TRACe:PMONitor:SCC<no>?

Returns the power monitor results for all captured SCC subframes. The number of subframes can be configured, see `CONFigure:LTE:MEAS<i>:MEValuation:MSUBframes`.

Suffix:

<no>	1 Only SCC1 supported - suffix can be omitted

Return values:

<Reliability>	Reliability Indicator
<Power>	n power values, one per subframe Range: -100 dBm to 55 dBm Default unit: dBm

Example:	See Performing Single-Shot Measurements
Usage:	Query only
Firmware/Software:	V3.2.70
Options:	R&S CMW-KM502/-KM552 for FDD/TDD

3.5.3.27 Modulation Results (Single Values)

The following commands return the statistical modulation results.

FETCh:LTE:MEAS<i>:MEValuation:MODulation:CURRent?
FETCh:LTE:MEAS<i>:MEValuation:MODulation:AVERage?
FETCh:LTE:MEAS<i>:MEValuation:MODulation:SDEViation?

READ:LTE:MEAS<i>:MEValuation:MODulation:CURRent?
READ:LTE:MEAS<i>:MEValuation:MODulation:AVERage?
READ:LTE:MEAS<i>:MEValuation:MODulation:SDEViation?
CALCulate:LTE:MEAS<i>:MEValuation:MODulation:CURRent?
CALCulate:LTE:MEAS<i>:MEValuation:MODulation:AVERage?

Return the current, average and standard deviation single value results.

The values described below are returned by `FETCh` and `READ` commands. `CALCulate` commands return limit check results instead, one value for each result listed below.

The ranges indicated below apply to all results except standard deviation results. The minimum for standard deviation results equals 0. The maximum equals the width of the indicated range divided by two. Exceptions are explicitly stated.

The number to the left of each result parameter is provided for easy identification of the parameter position within the result array.

Return values:

<1_Reliability> Reliability Indicator

<2_OutOfTol> Out of tolerance result, i.e. percentage of measurement intervals of the statistic count for modulation measurements exceeding the specified modulation limits.
Range: 0 % to 100 %
Default unit: %

<3_EVM_RMSlow>
<4_EVM_RMShigh>
<5_EVMpeakLow>
<6_EVMpeakHigh> Error vector magnitude RMS and peak values for low and high EVM window position
Range: 0 % to 100 %
Default unit: %

<7_MErr_RMSlow>
<8_MErr_RMShigh> Magnitude error RMS value for low and high EVM window position
Range: 0 % to 100 %
Default unit: %

<9_MErrPeakLow>
<10_MErrPeakHigh> Magnitude error peak value for low and high EVM window position
Range: -100 % to 100 % (AVERage: 0 % to 100 %, SDEViation: 0 % to 50 %)
Default unit: %

<11_PErr_RMSlow>
<12_PErr_RMSh> Phase error RMS value for low and high EVM window position
Range: 0 deg to 180 deg
Default unit: deg

<13_PErrPeakLow>
<14_PErrPeakHigh> Phase error peak value for low and high EVM window position
Range: -180 deg to 180 deg (AVERage: 0 deg to 180 deg, SDEViation: 0 deg to 90 deg)
Default unit: deg

<15_IQoffset> I/Q origin offset
Range: -100 dBc to 0 dBc
Default unit: dBc

<16_FreqError> Carrier frequency error
Range: -80000 Hz to 80000 Hz
Default unit: Hz

<17_TimingError> Transmit time error
Range: -32000 Ts to 32000 Ts
Default unit: Ts (basic LTE time unit)

<18_TXpower> User equipment power
Range: -100 dBm to 55 dBm
Default unit: dBm

<19_PeakPower> User equipment peak power
Range: -100 dBm to 55 dBm
Default unit: dBm

<20_RBpower> RB power
Range: -100 dBm to 55 dBm
Default unit: dBm

<21_EVM_DMRSl>
<22_EVM_DMRSh> Error vector magnitude DMRS values for low and high EVM window position
Range: 0 % to 100 %
Default unit: %

<23_MErr_DMRSl>
<24_MErr_DMRSh> Magnitude error DMRS values for low and high EVM window position
Range: 0 % to 100 %
Default unit: %

<25_PErr_DMRS>
<26_PErr_DMRSh> Phase error DMRS values for low and high EVM window position
Range: 0 deg to 180 deg
Default unit: deg

<27_GainImbal> Gain imbalance
Range: -256 dB to 256 dB
Default unit: dB

<28_QuadError> Quadrature error
Range: -180 deg to 180 deg
Default unit: deg

Example: See Performing Single-Shot Measurements

Usage: Query only

Firmware/Software: V1.0.10.1
V3.2.70: added <27_GainImbal> and <28_QuadError>

FETCh:LTE:MEAS<i>:MEValuation:MODulation:EXTReme?
READ:LTE:MEAS<i>:MEValuation:MODulation:EXTReme?
CALCulate:LTE:MEAS<i>:MEValuation:MODulation:EXTReme?

Returns the extreme single value results.

The values described below are returned by `FETCh` and `READ` commands. `CALCulate` commands return limit check results instead, one value for each result listed below.

The number to the left of each result parameter is provided for easy identification of the parameter position within the result array.

Return values:

<1_Reliability>	Reliability Indicator
<2_OutOfTol>	Out of tolerance result, i.e. percentage of measurement intervals of the statistic count for modulation measurements exceeding the specified modulation limits. Range: 0 % to 100 % Default unit: %
<3_EVM_RMSlow> <4_EVM_RMShigh> <5_EVMpeakLow> <6_EVMpeakHigh>	Error vector magnitude RMS and peak values for low and high EVM window position Range: 0 % to 100 % Default unit: %
<7_MErr_RMSlow> <8_MErr_RMShigh>	Magnitude error RMS value for low and high EVM window position Range: 0 % to 100 % Default unit: %
<9_MErrPeakLow> <10_MErrPeakHigh>	Magnitude error peak value for low and high EVM window position Range: -100 % to 100 % Default unit: %
<11_PErr_RMSlow> <12_PErr_RMSh>	Phase error RMS value for low and high EVM window position Range: 0 deg to 180 deg Default unit: deg
<13_PErrPeakLow> <14_PErrPeakHigh>	Phase error peak value for low and high EVM window position Range: -180 deg to 180 deg Default unit: deg
<15_IQoffset>	I/Q origin offset Range: -100 dBc to 0 dBc Default unit: dBc
<16_FreqError>	Carrier frequency error Range: -80000 Hz to 80000 Hz Default unit: Hz

<17_TimingError>	Transmit time error Range: -32000 Ts to 32000 Ts Default unit: Ts (basic LTE time unit)
<18_TXpowerMin> <19_TXpowerMax>	Minimum and maximum user equipment power Range: -100 dBm to 55 dBm Default unit: dBm
<20_PeakPowMin> <21_PeakPowMax>	Minimum and maximum user equipment peak power Range: -100 dBm to 55 dBm Default unit: dBm
<22_RBpowMin> <23_RBpowMax>	Minimum and maximum RB power Range: -100 dBm to 55 dBm Default unit: dBm
<24_EVM_DMRSl> <25_EVM_DMRSh>	Error vector magnitude DMRS values for low and high EVM window position Range: 0 % to 100 % Default unit: %
<26_MErr_DMRSl> <27_MErr_DMRSh>	Magnitude error DMRS values for low and high EVM window position Range: 0 % to 100 % Default unit: %
<28_PErr_DMRS> <29_PErr_DMRSh>	Phase error DMRS values for low and high EVM window position Range: 0 deg to 180 deg Default unit: deg
<30_GainImbal>	Gain imbalance Range: -256 dB to 256 dB Default unit: dB
<31_QuadError>	Quadrature error Range: -180 deg to 180 deg Default unit: deg
Example:	See Performing Single-Shot Measurements
Usage:	Query only
Firmware/Software:	V1.0.10.1

V3.2.70: added <30_GainImbal> and <31_QuadError>

FETCh:LTE:MEAS<i>:MEValuation:EVMC:PEAK:CURRent?
FETCh:LTE:MEAS<i>:MEValuation:EVMC:PEAK:AVERage?
FETCh:LTE:MEAS<i>:MEValuation:EVMC:PEAK:MAXimum?
FETCh:LTE:MEAS<i>:MEValuation:EVMC:PEAK:SDEViation?
READ:LTE:MEAS<i>:MEValuation:EVMC:PEAK:CURRent?
READ:LTE:MEAS<i>:MEValuation:EVMC:PEAK:AVERage?

READ:LTE:MEAS<i>:MEValuation:EVMC:PEAK:MAXimum?
READ:LTE:MEAS<i>:MEValuation:EVMC:PEAK:SDEViation?

The `CURRent` command returns the maximum value of the EVM vs subcarrier trace.

The `AVERage`, `MAXimum` and `SDEViation` values are calculated from the `CURRent` values.

The peak results cannot be displayed at the GUI.

Return values:

<Reliability>	Reliability Indicator
<EVM>	Range: 0 % to 100 % Default unit: %
Example:	See Performing Single-Shot Measurements
Usage:	Query only
Firmware/Software:	V3.2.80

3.5.3.28 Equalizer Spectrum Flatness Results (Single Values)

The following commands return the statistical results of the equalizer spectrum flatness measurement.

FETCh:LTE:MEAS<i>:MEValuation:ESFLatness:CURRent?
FETCh:LTE:MEAS<i>:MEValuation:ESFLatness:AVERage?
FETCh:LTE:MEAS<i>:MEValuation:ESFLatness:EXTReme?
FETCh:LTE:MEAS<i>:MEValuation:ESFLatness:SDEViation?
READ:LTE:MEAS<i>:MEValuation:ESFLatness:CURRent?
READ:LTE:MEAS<i>:MEValuation:ESFLatness:AVERage?
READ:LTE:MEAS<i>:MEValuation:ESFLatness:EXTReme?
READ:LTE:MEAS<i>:MEValuation:ESFLatness:SDEViation?

Return current, average, extreme and standard deviation single value results of the equalizer spectrum flatness measurement. See also chapter 3.2.5.6, "Equalizer Spectrum Flatness Limits", on page 511.

The ranges indicated below apply to all results except standard deviation results. The minimum for standard deviation results equals 0. The maximum equals the width of the indicated range divided by two. Exceptions are explicitly stated.

The number to the left of each result parameter is provided for easy identification of the parameter position within the result array.

Return values:

<1_Reliability> Reliability Indicator

<2_OutOfTol> Out of tolerance result, i.e. percentage of measurement intervals of the statistic count for modulation measurements exceeding the specified equalizer spectrum flatness limits.
Range: 0 % to 100 %
Default unit: %

<3_Ripple1> Max (Range 1) - Min (Range 1)
Range: 0 dB to 40 dB
Default unit: dB

<4_Ripple2> Max (Range 2) - Min (Range 2)
Range: 0 dB to 40 dB
Default unit: dB

<5_MaxR1MinR2> Max (Range 1) - Min (Range 2)
Range: -40 dB to 40 dB
Default unit: dB

<6_MaxR2MinR1> Max (Range 2) - Min (Range 1)
Range: -40 dB to 40 dB
Default unit: dB

<7_MinR1> Min (Range 1)
Range: -20 dB to 20 dB
Default unit: dB

<8_MaxR1> Max (Range 1)
Range: -20 dB to 20 dB
Default unit: dB

<9_MinR2> Min (Range 2)
Range: -20 dB to 20 dB
Default unit: dB

<10_MaxR2> Max (Range 2)
Range: -20 dB to 20 dB
Default unit: dB

Example: See Performing Single-Shot Measurements

Usage: Query only

Firmware/Software: V2.0.10
V2.1.25: added <7_MinR1> to <10_MaxR2>

CALCulate:LTE:MEAS<i>:MEValuation:ESFLatness:CURRent?
CALCulate:LTE:MEAS<i>:MEValuation:ESFLatness:AVERage?
CALCulate:LTE:MEAS<i>:MEValuation:ESFLatness:EXTReme?

Return current, average and extreme single value results of the equalizer spectrum flatness measurement. See also chapter 3.2.5.6, "Equalizer Spectrum Flatness Limits", on page 511.

The values described below are returned by `FETCh` and `READ` commands. `CALCulate` commands return limit check results instead, one value for each result listed below.

Return values:

<Reliability> Reliability Indicator

<OutOfTolerance> Out of tolerance result, i.e. percentage of measurement intervals of the statistic count for modulation measurements exceeding the specified equalizer spectrum flatness limits.
Range: 0 % to 100 %
Default unit: %

<Ripple1> Max (Range 1) - Min (Range 1)
Range: 0 dB to 40 dB
Default unit: dB

<Ripple2> Max (Range 2) - Min (Range 2)
Range: 0 dB to 40 dB
Default unit: dB

<MaxR1MinR2> Max (Range 1) - Min (Range 2)
Range: -40 dB to 40 dB
Default unit: dB

<MaxR2MinR1> Max (Range 2) - Min (Range 1)
Range: -40 dB to 40 dB
Default unit: dB

Example: See Performing Single-Shot Measurements

Usage: Query only

Firmware/Software: V2.0.20

FETCh:LTE:MEAS<i>:MEValuation:ESFLatness:CURRent:SCINdex?

Returns subcarrier indices of the equalizer spectrum flatness measurement. At these SC indices the current minimum and maximum power of the equalizer coefficients have been detected within range 1 and range 2.

Return values:

<Reliability> Reliability Indicator

<OutOfTolerance> Out of tolerance result, i.e. percentage of measurement intervals of the statistic count for modulation measurements exceeding the specified equalizer spectrum flatness limits.

Range: 0 % to 100 %

<Maximum1> SC index of Max (Range 1)

Range: 0 to 1199

<Minimum1> SC index of Min (Range 1)

Range: 0 to 1199

<Maximum2> SC index of Max (Range 2)

Range: 0 to 1199

<Minimum2> SC index of Min (Range 2)

Range: 0 to 1199

Example: See Performing Single-Shot Measurements

Usage: Query only

Firmware/Software: V2.0.10

3.5.3.29 Power Dynamics Results (Single Values)

The following commands return the statistical results of the power dynamics measurement.

FETCh:LTE:MEAS<i>:MEValuation:PDYNamics:CURRent?
FETCh:LTE:MEAS<i>:MEValuation:PDYNamics:AVERage?
FETCh:LTE:MEAS<i>:MEValuation:PDYNamics:MINimum?
FETCh:LTE:MEAS<i>:MEValuation:PDYNamics:MAXimum?
FETCh:LTE:MEAS<i>:MEValuation:PDYNamics:SDEViation?
READ:LTE:MEAS<i>:MEValuation:PDYNamics:CURRent?
READ:LTE:MEAS<i>:MEValuation:PDYNamics:AVERage?
READ:LTE:MEAS<i>:MEValuation:PDYNamics:MINimum?
READ:LTE:MEAS<i>:MEValuation:PDYNamics:MAXimum?
READ:LTE:MEAS<i>:MEValuation:PDYNamics:SDEViation?
CALCulate:LTE:MEAS<i>:MEValuation:PDYNamics:CURRent?
CALCulate:LTE:MEAS<i>:MEValuation:PDYNamics:AVERage?
CALCulate:LTE:MEAS<i>:MEValuation:PDYNamics:MINimum?
CALCulate:LTE:MEAS<i>:MEValuation:PDYNamics:MAXimum?

Return the current, average, minimum, maximum and standard deviation single value results of the power dynamics measurement.

A single result table row is returned, from left to right. The meaning of the values depends on the selected time mask, as follows:

Time Mask	Power1	Power2	Power3	Power4
General On / Off	OFF Power (before)	ON Power RMS	ON Power Peak	OFF Power (after)
PUCCH / PUSCH / SRS	SRS ON	ON Power RMS	ON Power Peak	ON Power (after)
SRS blanking	SRS OFF	ON Power RMS	ON Power Peak	ON Power (after)

The values described below are returned by `FETCh` and `READ` commands. `CALCulate` commands return limit check results instead, one value for each result listed below.

The ranges indicated below apply to all results except standard deviation results. The minimum for standard deviation results equals 0. The maximum equals the width of the indicated range divided by two. Exceptions are explicitly stated.

Return values:

<Reliability> Reliability Indicator

<OutOfTolerance> Out of tolerance result, i.e. percentage of measurement intervals of the statistic count for power dynamics measurements exceeding the specified power dynamics limits.
Range: 0 % to 100 %
Default unit: %

<Power1> Range: -100 dBm to 55 dBm
Default unit: dBm

<Power2> Range: -100 dBm to 55 dBm
Default unit: dBm

<Power3> Range: -100 dBm to 55 dBm
Default unit: dBm

<Power4> Range: -100 dBm to 55 dBm
Default unit: dBm

Example: See Performing Single-Shot Measurements

Usage: Query only

Firmware/Software: V2.0.10

3.5.3.30 Spectrum Emission Results (Single Values)

The following commands return the statistical results of the spectrum emission multi evaluation measurement.

FETCh:LTE:MEAS<i>:MEValuation:SEMask:CURRent?
FETCh:LTE:MEAS<i>:MEValuation:SEMask:AVERage?
FETCh:LTE:MEAS<i>:MEValuation:SEMask:SDEViation?
READ:LTE:MEAS<i>:MEValuation:SEMask:CURRent?
READ:LTE:MEAS<i>:MEValuation:SEMask:AVERage?
READ:LTE:MEAS<i>:MEValuation:SEMask:SDEViation?
CALCulate:LTE:MEAS<i>:MEValuation:SEMask:CURRent?
CALCulate:LTE:MEAS<i>:MEValuation:SEMask:AVERage?

Return the current, average and standard deviation single value results of the spectrum emission measurement.

The values described below are returned by `FETCh` and `READ` commands. `CALCulate` commands return limit check results instead, one value for each result listed below.

The ranges indicated below apply to all results except standard deviation results. The minimum for standard deviation results equals 0. The maximum equals the width of the indicated range divided by two. Exceptions are explicitly stated.

Return values:

<Reliability> Reliability Indicator

<OutOfTolerance> Out of tolerance result, i.e. percentage of measurement intervals of the statistic count for spectrum emission measurements exceeding the specified spectrum emission mask limits.

Range: 0 % to 100 %
Default unit: %

<OBW> Occupied bandwidth

Range: 0 MHz to 40 MHz
Default unit: Hz

<TXpower> Total TX power in the slot over all component carriers

Range: -100 dBm to 55 dBm
Default unit: dBm

Example: See Performing Single-Shot Measurements

Usage: Query only

Firmware/Software: V1.0.10.1

FETCh:LTE:MEAS<i>:MEValuation:SEMask:EXTReme?
READ:LTE:MEAS<i>:MEValuation:SEMask:EXTReme?
CALCulate:LTE:MEAS<i>:MEValuation:SEMask:EXTReme?

Return the extreme single value results of the spectrum emission measurement.

The values described below are returned by `FETCh` and `READ` commands. `CALCulate` commands return limit check results instead, one value for each result listed below.

Return values:

<Reliability> Reliability Indicator

<OutOfTolerance> Out of tolerance result, i.e. percentage of measurement intervals of the statistic count for spectrum emission measurements exceeding the specified spectrum emission mask limits.
Range: 0 % to 100 %
Default unit: %

<OBW> Occupied bandwidth
Range: 0 MHz to 40 MHz
Default unit: Hz

<TXpowerMin> Minimum total TX power in the slot
Range: -100 dBm to 55 dBm
Default unit: dBm

<TXpowerMax> Maximum total TX power in the slot
Range: -100 dBm to 55 dBm
Default unit: dBm

Example: See Performing Single-Shot Measurements

Usage: Query only

Firmware/Software: V2.0.10

FETCh:LTE:MEAS<i>:MEValuation:SEMask:MARGin:ALL?

Returns spectrum emission mask margin results. A negative margin indicates that the trace is located above the limit line, i.e. the limit is exceeded.

Results are provided for the current, average and maximum traces. For each trace, 24 values related to the negative (Neg) and positive (Pos) offset frequencies of emission mask areas 1 to 12 are provided. For inactive areas, NCAP is returned.

The number to the left of each result parameter is provided for easy identification of the parameter position within the result array.

Return values:

<1_Reliability> Reliability Indicator

<2_OutOfTol>	Out of tolerance result, i.e. percentage of measurement intervals of the statistic count for spectrum emission measurements exceeding the specified spectrum emission mask limits. Range: 0 % to 100 % Default unit: %
<3_CurrNeg1> ... <14_CurrNeg12> <15_CurrPos1> ... <26_CurrPos12>	Margin results for current trace Range: -160 dB to 160 dB Default unit: dB
<27_AvgNeg1> ... <38_AvgNeg12> <39_AvgPos1> ... <50_AvgPos12>	Margin results for average trace Range: -160 dB to 160 dB Default unit: dB
<51_MinNeg1> ... <62_MinNeg12> <63_MinPos1> ... <74_MinPos12>	Margin results for maximum trace (resulting in minimum margins) Range: -160 dB to 160 dB Default unit: dB

Example: See Performing Single-Shot Measurements

Usage: Query only

Firmware/Software: V3.2.80

FETCh:LTE:MEAS<i>:MEValuation:SEMask:MARGin:CURRent:NEGativ?
FETCh:LTE:MEAS<i>:MEValuation:SEMask:MARGin:CURRent:POSitiv?
FETCh:LTE:MEAS<i>:MEValuation:SEMask:MARGin:AVERage:NEGativ?
FETCh:LTE:MEAS<i>:MEValuation:SEMask:MARGin:AVERage:POSitiv?
FETCh:LTE:MEAS<i>:MEValuation:SEMask:MARGin:MINimum:NEGativ?
FETCh:LTE:MEAS<i>:MEValuation:SEMask:MARGin:MINimum:POSitiv?

Returns spectrum emission mask margin results. A negative margin indicates that the trace is located above the limit line, i.e. the limit is exceeded.

The individual commands provide results for the `CURRent`, `AVERage` and maximum traces (resulting in `MINimum` margins). For each trace, the X and Y values of the margins for emission mask areas 1 to 12 are provided for `NEGative` and `POSitive` offset frequencies. For inactive areas, NCAP is returned.

The number to the left of each result parameter is provided for easy identification of the parameter position within the result array.

Return values:

<1_Reliability>	Reliability Indicator
<2_OutOfTol>	Out of tolerance result, i.e. percentage of measurement intervals of the statistic count for spectrum emission measurements exceeding the specified spectrum emission mask limits. Range: 0 % to 100 % Default unit: %

<3_MarginX1>	X-position of margin for area 1 Range: -35 MHz to 35 MHz Default unit: Hz
<4_MarginY1>	Y-value of margin for area 1 Range: -160 dB to 160 dB Default unit: dB
<5_MarginX2> <6_MarginY2> ... <25_MarginX12> <26_MarginY12>	X-position and Y-value of margin for area 2 to 12
Example:	See Performing Single-Shot Measurements
Usage:	Query only
Firmware/Software:	V2.0.10 V3.2.80: increased number of areas to 12

3.5.3.31 BLER Results

The following commands return the results of the Block Error Ratio measurement.

FETCh:LTE:MEAS<i>:MEValuation:BLER?
READ:LTE:MEAS<i>:MEValuation:BLER?

Returns the Block Error Ratio results determined from all captured subframes. To configure which subframes are measured see `CONFigure:LTE:MEAS<i>:MEValuation:MSUBframes`.

Return values:

<Reliability>	Reliability Indicator
<ACK>	Received acknowledgments (percentage of sent scheduled subframes) Range: 0 % to 100 % Default unit: %
<NACK>	Received negative acknowledgments (percentage of sent scheduled subframes) Range: 0 % to 100 % Default unit: %
<BLER>	Block error ratio (percentage of sent scheduled subframes for which no ACK has been received) Range: 0 % to 100 % Default unit: %
<DTX>	Percentage of sent scheduled subframes for which neither ACK nor NACK has been received Range: 0 % to 100 % Default unit: %

Example: See Performing Single-Shot Measurements

Usage: Query only

Firmware/Software: V1.0.15.21
V3.0.10: added <DTX>

For additional information concerning syntax elements and returned values refer to Conventions and General Information.

3.5.3.32 List Mode Results (One Segment)

The following commands return the list mode results for a selected segment.

To configure the list mode use the commands described in chapter 3.5.3.8, "List Mode Settings", on page 617.

For a description of the list mode see chapter 3.2.3, "List Mode", on page 498.

The segment number <no> in the following commands refers to the range of measured segments (1..1000), see `CONFigure:LTE:MEAS<i>:MEValuation:LIST:LRANge` on page 618. It may differ from the absolute segment number used for segment configuration.

Indicated ranges apply to all statistical results except standard deviation results. The minimum for standard deviation results equals 0. The maximum equals the width of the indicated range divided by two. Exceptions are explicitly stated.

FETCh:LTE:MEAS<i>:MEValuation:LIST:SEGMent<no>:MODulation:CURRent?
FETCh:LTE:MEAS<i>:MEValuation:LIST:SEGMent<no>:MODulation:AVERage?
FETCh:LTE:MEAS<i>:MEValuation:LIST:SEGMent<no>:MODulation:SDEViation?
CALCulate:LTE:MEAS<i>:MEValuation:LIST:SEGMent<no>:MODulation:CURRent?
CALCulate:LTE:MEAS<i>:MEValuation:LIST:SEGMent<no>:MODulation:AVERage?

Returns modulation single value results for segment <no> in list mode.

The values described below are returned by FETCh commands. The first four values (Reliability to Out of Tolerance result) are also returned by CALCulate commands. The remaining values returned by CALCulate commands are limit check results, one value for each result listed below.

Suffix:

<no>	1..1000

Return values:

<1_Reliability>	Reliability Indicator In list mode, a zero reliability indicator indicates that the results in all measured segments are valid. A non-zero value indicates that an error occurred in at least one of the measured segments.
<2_SegReliability>	Reliability indicator for the segment. The meaning of the returned values is the same as for the common reliability indicator, see previous parameter.
<3_StatistExpired>	Reached statistical length in slots Range: 0 to 1000
<4_OutOfTol>	Percentage of measured subframes with failed limit check Range: 0 % to 100 % Default unit: %
<5_EVM_RMSlow> <6_EVM_RMShigh> <7_EVMpeakLow> <8_EVMpeakHigh>	Error vector magnitude RMS and peak values for low and high EVM window position Range: 0 % to 100 % Default unit: %
<9_MErr_RMSlow> <10_MErr_RMShigh>	Magnitude error RMS value for low and high EVM window position Range: 0 % to 100 % Default unit: %
<11_MErrPeakLow> <12_MErrPeakHigh>	Magnitude error peak value for low and high EVM window position Range: -100 % to 100 % (AVERage: 0 % to 100 %, SDEViation: 0 % to 50 %) Default unit: %
<13_PErr_RMSlow> <14_PErr_RMSh>	Phase error RMS value for low and high EVM window position Range: 0 deg to 180 deg Default unit: deg
<15_PErrPeakLow> <16_PErrPeakHigh>	Phase error peak value for low and high EVM window position Range: -180 deg to 180 deg (AVERage: 0 deg to 180 deg, SDEViation: 0 deg to 90 deg) Default unit: deg
<17_IQoffset>	I/Q origin offset Range: -100 dBc to 0 dBc Default unit: dBc

<18_FreqError>	Carrier frequency error Range: -80000 Hz to 80000 Hz Default unit: Hz
<19_TimingError>	Transmit time error Range: -32000 Ts to 32000 Ts Default unit: Ts (basic LTE time unit)
<20_TXpower>	User equipment power Range: -100 dBm to 55 dBm Default unit: dBm
<21_PeakPower>	User equipment peak power Range: -100 dBm to 55 dBm Default unit: dBm
<22_RBpower>	RB power Range: -100 dBm to 55 dBm Default unit: dBm
<23_EVM_DMRSl> <24_EVM_DMRSh>	Error vector magnitude DMRS values for low and high EVM window position Range: 0 % to 100 % Default unit: %
<25_MErr_DMRSl> <26_MErr_DMRSh>	Magnitude error DMRS values for low and high EVM window position Range: 0 % to 100 % Default unit: %
<27_PErr_DMRS> <28_PErr_DMRSh>	Phase error DMRS values for low and high EVM window position Range: 0 deg to 180 deg Default unit: deg
Example:	See Using LTE List Mode
Usage:	Query only
Firmware/Software:	V2.0.10 V2.0.20: CALCulate commands V2.1.25: increased maximum number of segments to 250 V2.1.30: increased maximum number of segments to 512 V3.0.50: increased maximum number of segments to 1000
Options:	R&S CMW-KM012

FETCh:LTE:MEAS<i>:MEValuation:LIST:SEGMent<no>:MODulation:EXTReme?
CALCulate:LTE:MEAS<i>:MEValuation:LIST:SEGMent<no>:MODulation:EXTReme?

Return modulation single value results for segment <no> in list mode.

The values described below are returned by FETCh commands. The first four values (Reliability to Out of Tolerance result) are also returned by CALCulate commands. The remaining values returned by CALCulate commands are limit check results, one value for each result listed below.

Suffix:

<no>	1..1000

Return values:

<1_Reliability>	Reliability Indicator In list mode, a zero reliability indicator indicates that the results in all measured segments are valid. A non-zero value indicates that an error occurred in at least one of the measured segments.
<2_SegReliability>	Reliability indicator for the segment. The meaning of the returned values is the same as for the common reliability indicator, see previous parameter.
<3_StatistExpired>	Reached statistical length in slots Range: 0 to 1000
<4_OutOfTol>	Percentage of measured subframes with failed limit check Range: 0 % to 100 % Default unit: %
<5_EVM_RMSlow> <6_EVM_RMShigh> <7_EVMpeakLow> <8_EVMpeakHigh>	Error vector magnitude RMS and peak values for low and high EVM window position Range: 0 % to 100 % Default unit: %
<9_MErr_RMSlow> <10_MErr_RMShigh>	Magnitude error RMS value for low and high EVM window position Range: 0 % to 100 % Default unit: %
<11_MErrPeakLow> <12_MErrPeakHigh>	Magnitude error peak value for low and high EVM window position Range: -100 % to 100 % Default unit: %
<13_PErr_RMSlow> <14_PErr_RMSh>	Phase error RMS value for low and high EVM window position Range: 0 deg to 180 deg Default unit: deg
<15_PErrPeakLow> <16_PErrPeakHigh>	Phase error peak value for low and high EVM window position Range: -180 deg to 180 deg Default unit: deg
<17_IQoffset>	I/Q origin offset Range: -100 dBc to 0 dBc Default unit: dBc

<18_FreqError> Carrier frequency error

Range: -80000 Hz to 80000 Hz
Default unit: Hz

<19_TimingError> Transmit time error

Range: -32000 Ts to 32000 Ts
Default unit: Ts (basic LTE time unit)

<20_TXpowerMin>
<21_TXpowerMax> Minimum and maximum user equipment power

Range: -100 dBm to 55 dBm
Default unit: dBm

<22_PeakPowMin>
<23_PeakPowMax> Minimum and maximum user equipment peak power

Range: -100 dBm to 55 dBm
Default unit: dBm

<24_RBpowMin>
<25_RBpowMax> Minimum and maximum RB power

Range: -100 dBm to 55 dBm
Default unit: dBm

<26_EVM_DMRSl>
<27_EVM_DMRSh> Error vector magnitude DMRS values for low and high EVM window position

Range: 0 % to 100 %
Default unit: %

<28_MErr_DMRSl>
<29_MErr_DMRSh> Magnitude error DMRS values for low and high EVM window position

Range: 0 % to 100 %
Default unit: %

<30_PErr_DMRS>
<31_PErr_DMRSh> Phase error DMRS values for low and high EVM window position

Range: 0 deg to 180 deg
Default unit: deg

Example: See Using LTE List Mode

Usage: Query only

Firmware/Software: V2.0.10
V2.0.20: CALCulate command
V2.1.25: increased maximum number of segments to 250
V2.1.30: increased maximum number of segments to 512
V3.0.50: increased maximum number of segments to 1000

Options: R&S CMW-KM012

FETCh:LTE:MEAS<i>:MEValuation:LIST:SEGMent<no>:IEMission:MARGin:CURRent?
FETCh:LTE:MEAS<i>:MEValuation:LIST:SEGMent<no>:IEMission:MARGin:AVERage?

FETCh:LTE:MEAS<i>:MEValuation:LIST:SEGMent<no>:IEMission:MARGin: EXTReme?
FETCh:LTE:MEAS<i>:MEValuation:LIST:SEGMent<no>:IEMission:MARGin: SDEViation?

Return the inband emission limit line margin results for segment <no> in list mode.

The `CURRent` margins indicate the minimum (vertical) distance between the limit line and the current trace. A negative result indicates that the limit is exceeded.

The `AVERage`, `EXTReme` and `SDEViation` values are calculated from the current margins.

Suffix:

<no> 1..1000

Return values:

<Reliability> Reliability Indicator
In list mode, a zero reliability indicator indicates that the results in all measured segments are valid. A non-zero value indicates that an error occurred in at least one of the measured segments.

<SegReliability> Reliability indicator for the segment. The meaning of the returned values is the same as for the common reliability indicator, see previous parameter.

<StatistExpired> Reached statistical length in slots
Range: 0 to 1000

<OutOfTolerance> Percentage of measured subframes with failed limit check
Range: 0 % to 100 %
Default unit: %

<Margin> Range: -50 dB to 110 dB
Default unit: dB

Example: See Using LTE List Mode

Usage: Query only

Firmware/Software: V2.0.10
V2.1.25: increased maximum number of segments to 250
V2.1.30: increased maximum number of segments to 512
V3.0.50: increased maximum number of segments to 1000

Options: R&S CMW-KM012

FETCh:LTE:MEAS<i>:MEValuation:LIST:SEGMent<no>:IEMission:MARGin: CURRent:RBINdex?
FETCh:LTE:MEAS<i>:MEValuation:LIST:SEGMent<no>:IEMission:MARGin: EXTReme:RBINdex?

Return resource block indices of the inband emission measurement for segment <no> in list mode. At these RB indices the `CURRent` and `EXTReme` margins have been detected.

Suffix:
<no> 1..1000

Return values:

<Reliability> Reliability Indicator
In list mode, a zero reliability indicator indicates that the results in all measured segments are valid. A non-zero value indicates that an error occurred in at least one of the measured segments.

<SegReliability> Reliability indicator for the segment. The meaning of the returned values is the same as for the common reliability indicator, see previous parameter.

<StatistExpired> Reached statistical length in slots
Range: 0 to 1000

<OutOfTolerance> Percentage of measured subframes with failed limit check
Range: 0 % to 100 %
Default unit: %

<RBindex> Resource block index of margin
Range: 0 to 99

Example: See Using LTE List Mode

Usage: Query only

Firmware/Software: V2.0.10
V2.1.25: increased maximum number of segments to 250
V2.1.30: increased maximum number of segments to 512
V3.0.50: increased maximum number of segments to 1000

Options: R&S CMW-KM012

FETCh:LTE:MEAS<i>:MEValuation:LIST:SEGMent<no>:ESFLatness:CURRent?
FETCh:LTE:MEAS<i>:MEValuation:LIST:SEGMent<no>:ESFLatness:AVERage?
FETCh:LTE:MEAS<i>:MEValuation:LIST:SEGMent<no>:ESFLatness:EXTReme?
FETCh:LTE:MEAS<i>:MEValuation:LIST:SEGMent<no>:ESFLatness:SDEViation?

Return equalizer spectrum flatness single value results for segment <no> in list mode.

Suffix:
<no> 1..1000

Return values:

<1_Reliability> Reliability Indicator
In list mode, a zero reliability indicator indicates that the results in all measured segments are valid. A non-zero value indicates that an error occurred in at least one of the measured segments.

<2_SegReliability> Reliability indicator for the segment. The meaning of the returned values is the same as for the common reliability indicator, see previous parameter.

<3_StatistExpired>	Reached statistical length in slots Range: 0 to 1000
<4_OutOfTol>	Percentage of measured subframes with failed limit check Range: 0 % to 100 % Default unit: %
<5_Ripple1>	Max (Range 1) - Min (Range 1) Range: 0 dB to 40 dB Default unit: dB
<6_Ripple2>	Max (Range 2) - Min (Range 2) Range: 0 dB to 40 dB Default unit: dB
<7_MaxR1MinR2>	Max (Range 1) - Min (Range 2) Range: -40 dB to 40 dB Default unit: dB
<8_MaxR2MinR1>	Max (Range 2) - Min (Range 1) Range: -40 dB to 40 dB Default unit: dB
<9_MinR1>	Min (Range 1) Range: -20 dB to 20 dB Default unit: dB
<10_MaxR1>	Max (Range 1) Range: -20 dB to 20 dB Default unit: dB
<11_MinR2>	Min (Range 2) Range: -20 dB to 20 dB Default unit: dB
<12_MaxR2>	Max (Range 2) Range: -20 dB to 20 dB Default unit: dB
Example:	See Using LTE List Mode
Usage:	Query only
Firmware/Software:	V2.0.10 V2.0.20: CALCulate commands V2.1.25: increased maximum number of segments to 250, added <9_MinR1> to <12_MaxR2> V2.1.30: increased maximum number of segments to 512 V3.0.50: increased maximum number of segments to 1000
Options:	R&S CMW-KM012

CALCulate:LTE:MEAS<i>:MEValuation:LIST:SEGMent<no>:ESFLatness:CURRent?
CALCulate:LTE:MEAS<i>:MEValuation:LIST:SEGMent<no>:ESFLatness:AVERage?
CALCulate:LTE:MEAS<i>:MEValuation:LIST:SEGMent<no>:ESFLatness:EXTReme?

Return equalizer spectrum flatness single value results for segment <no> in list mode.

To define the statistical length for `AVERage` and `EXTReme` calculation and enable the calculation of the results see `CONFigure:LTE:MEAS<i>:MEValuation:LIST:SEGMent<no>:MODulation` on page 623.

The values described below are returned by `FETCh` commands. The first four values (Reliability to Out of Tolerance result) are also returned by `CALCulate` commands. The remaining values returned by `CALCulate` commands are limit check results, one value for each result listed below.

Suffix:

<no>	1..1000

Return values:

<1_Reliability>	Reliability Indicator In list mode, a zero reliability indicator indicates that the results in all measured segments are valid. A non-zero value indicates that an error occurred in at least one of the measured segments.
<2_SegReliability>	Reliability indicator for the segment. The meaning of the returned values is the same as for the common reliability indicator, see previous parameter.
<3_StatistExpired>	Reached statistical length in slots Range: 0 to 1000
<4_OutOfTol>	Percentage of measured subframes with failed limit check Range: 0 % to 100 % Default unit: %
<5_Ripple1>	Max (Range 1) - Min (Range 1) Range: 0 dB to 40 dB Default unit: dB
<6_Ripple2>	Max (Range 2) - Min (Range 2) Range: 0 dB to 40 dB Default unit: dB
<7_MaxR1MinR2>	Max (Range 1) - Min (Range 2) Range: -40 dB to 40 dB Default unit: dB
<8_MaxR2MinR1>	Max (Range 2) - Min (Range 1) Range: -40 dB to 40 dB Default unit: dB

Example: See Using LTE List Mode

Usage: Query only

Firmware/Software: V2.0.10
V2.0.20: CALCulate commands
V2.1.25: increased maximum number of segments to 250
V2.1.30: increased maximum number of segments to 512
V3.0.50: increased maximum number of segments to 1000

Options: R&S CMW-KM012

FETCh:LTE:MEAS<i>:MEValuation:LIST:SEGMent<no>:ESFLatness:CURRent:SCINdex?

Return subcarrier indices of the equalizer spectrum flatness measurement for segment <no> in list mode. At these SC indices the current minimum and maximum power of the equalizer coefficients have been detected within range 1 and range 2.

Suffix:

<no> 1..1000

Return values:

<Reliability> Reliability Indicator
In list mode, a zero reliability indicator indicates that the results in all measured segments are valid. A non-zero value indicates that an error occurred in at least one of the measured segments.

<SegReliability> Reliability indicator for the segment. The meaning of the returned values is the same as for the common reliability indicator, see previous parameter.

<StatistExpired> Reached statistical length in slots
Range: 0 to 1000

<OutOfTolerance> Percentage of measured subframes with failed limit check
Range: 0 % to 100 %
Default unit: %

<Maximum1> SC index of Max (Range 1)
Range: 0 to 1199

<Minimum1> SC index of Min (Range 1)
Range: 0 to 1199

<Maximum2> SC index of Max (Range 2)
Range: 0 to 1199

<Minimum2> SC index of Min (Range 2)
Range: 0 to 1199

Usage: Query only

Firmware/Software: V2.0.10
V2.1.25: increased maximum number of segments to 250
V2.1.30: increased maximum number of segments to 512
V3.0.50: increased maximum number of segments to 1000

Options: R&S CMW-KM012

FETCh:LTE:MEAS<i>:MEValuation:LIST:SEGMent<no>:SEMask:CURRent?
FETCh:LTE:MEAS<i>:MEValuation:LIST:SEGMent<no>:SEMask:AVERage?
FETCh:LTE:MEAS<i>:MEValuation:LIST:SEGMent<no>:SEMask:SDEViation?
CALCulate:LTE:MEAS<i>:MEValuation:LIST:SEGMent<no>:SEMask:CURRent?
CALCulate:LTE:MEAS<i>:MEValuation:LIST:SEGMent<no>:SEMask:AVERage?

Return spectrum emission single value results for segment <no> in list mode.

The values described below are returned by `FETCh` commands. The first four values (Reliability to Out of Tolerance result) are also returned by `CALCulate` commands. The remaining values returned by `CALCulate` commands are limit check results, one value for each result listed below.

Suffix:

<no> 1..1000

Return values:

<Reliability> Reliability Indicator
In list mode, a zero reliability indicator indicates that the results in all measured segments are valid. A non-zero value indicates that an error occurred in at least one of the measured segments.

<SegReliability> Reliability indicator for the segment. The meaning of the returned values is the same as for the common reliability indicator, see previous parameter.

<StatistExpired> Reached statistical length in slots
Range: 0 to 1000

<OutOfTolerance> Percentage of measured subframes with failed limit check
Range: 0 % to 100 %
Default unit: %

<OBW> Occupied bandwidth
Range: 0 MHz to 40 MHz
Default unit: Hz

<TXpower> Total TX power in the slot
Range: -100 dBm to 55 dBm
Default unit: dBm

Example: See Using LTE List Mode

Usage: Query only

Firmware/Software: V2.0.10
V2.0.20: CALCulate commands
V2.1.25: increased maximum number of segments to 250
V2.1.30: increased maximum number of segments to 512
V3.0.50: increased maximum number of segments to 1000

Options: R&S CMW-KM012

FETCh:LTE:MEAS<i>:MEValuation:LIST:SEGMent<no>:SEMask:EXTReme?
CALCulate:LTE:MEAS<i>:MEValuation:LIST:SEGMent<no>:SEMask:EXTReme?

Return spectrum emission extreme results for segment <no> in list mode.

The values described below are returned by `FETCh` commands. The first four values (Reliability to Out of Tolerance result) are also returned by `CALCulate` commands. The remaining values returned by `CALCulate` commands are limit check results, one value for each result listed below.

Suffix:
<no> 1..1000

Return values:

<1_Reliability> Reliability Indicator
In list mode, a zero reliability indicator indicates that the results in all measured segments are valid. A non-zero value indicates that an error occurred in at least one of the measured segments.

<2_SegReliability> Reliability indicator for the segment. The meaning of the returned values is the same as for the common reliability indicator, see previous parameter.

<3_StatistExpired> Reached statistical length in slots
Range: 0 to 1000

<4_OutOfTol> Percentage of measured subframes with failed limit check
Range: 0 % to 100 %
Default unit: %

<5_OBW> Occupied bandwidth
Range: 0 MHz to 40 MHz
Default unit: Hz

<6_TXpowerMin> Minimum total TX power in the slot
Range: -100 dBm to 55 dBm
Default unit: dBm

<7_TXpowerMax> Maximum total TX power in the slot
Range: -100 dBm to 55 dBm
Default unit: dBm

Example: See Using LTE List Mode

Usage: Query only

Firmware/Software: V2.0.10
V2.0.20: CALCulate command
V2.1.25: increased maximum number of segments to 250
V2.1.30: increased maximum number of segments to 512
V3.0.50: increased maximum number of segments to 1000

Options: R&S CMW-KM012

FETCh:LTE:MEAS<i>:MEValuation:LIST:SEGMent<no>:SEMask:MARGin:ALL?

Return limit line margin values, i.e. vertical distances between the spectrum emission mask limit line and a trace, for segment <no> in list mode.

Suffix:

<no> 1..1000

Return values:

<1_Reliability> Reliability Indicator
In list mode, a zero reliability indicator indicates that the results in all measured segments are valid. A non-zero value indicates that an error occurred in at least one of the measured segments.

<2_SegReliability> Reliability indicator for the segment. The meaning of the returned values is the same as for the common reliability indicator, see previous parameter.

<3_StatistExpired> Reached statistical length in slots
Range: 0 to 1000

<4_OutOfTol> Percentage of measured subframes with failed limit check
Range: 0 % to 100 %
Default unit: %

<5_CurrNeg1> ... <16_CurrNeg12> <17_CurrPos1> ... <28_CurrPos12>
Margin results for current trace
Range: -160 dB to 160 dB
Default unit: dB

<29_AvgNeg1> ... <40_AvgNeg12> <41_AvgPos1> ... <52_AvgPos12>
Margin results for average trace
Range: -160 dB to 160 dB
Default unit: dB

<53_MinNeg1> ... <64_MinNeg12> <65_MinPos1> ... <76_MinPos12>
Margin results for maximum trace (i.e. minimum margins)
Range: -160 dB to 160 dB
Default unit: dB

Example: See Using LTE List Mode

Usage: Query only

Firmware/Software: V3.2.80

Options: R&S CMW-KM012

FETCh:LTE:MEAS<i>:MEValuation:LIST:SEGMent<no>:SEMask:MARGin: CURRent:NEGativ?
FETCh:LTE:MEAS<i>:MEValuation:LIST:SEGMent<no>:SEMask:MARGin: CURRent:POSitiv?
FETCh:LTE:MEAS<i>:MEValuation:LIST:SEGMent<no>:SEMask:MARGin: AVERage:NEGativ?
FETCh:LTE:MEAS<i>:MEValuation:LIST:SEGMent<no>:SEMask:MARGin: AVERage:POSitiv?
FETCh:LTE:MEAS<i>:MEValuation:LIST:SEGMent<no>:SEMask:MARGin: MINimum:NEGativ?
FETCh:LTE:MEAS<i>:MEValuation:LIST:SEGMent<no>:SEMask:MARGin: MINimum:POSitiv?

Return spectrum emission mask margin results for segment <no> in list mode.

The individual commands provide results for the `CURRent`, `AVERage` and maximum traces (resulting in `MINimum` margins) for `NEGative` and `POSitive` offset frequencies.

Suffix:

<no> 1..1000

Return values:

<1_Reliability> Reliability Indicator
In list mode, a zero reliability indicator indicates that the results in all measured segments are valid. A non-zero value indicates that an error occurred in at least one of the measured segments.

<2_SegReliability> Reliability indicator for the segment. The meaning of the returned values is the same as for the common reliability indicator, see previous parameter.

<3_StatistExpired> Reached statistical length in slots
Range: 0 to 1000

<4_OutOfTol> Percentage of measured subframes with failed limit check
Range: 0 % to 100 %
Default unit: %

<5_MarginX1> X-position of margin for area 1
Range: -35 MHz to 35 MHz
Default unit: Hz

<6_MarginY1> Y-value of margin for area 1
Range: -160 dB to 160 dB
Default unit: dB

<7_MarginX2>
<8_MarginY2> ...
<27_MarginX12>
<28_MarginY12> X-position and Y-value for area 2 to 12

Example: See Using LTE List Mode

Usage: Query only

Firmware/Software: V2.0.10
V2.1.25: increased maximum number of segments to 250
V2.1.30: increased maximum number of segments to 512
V3.0.50: increased maximum number of segments to 1000
V3.2.80: increased number of areas to 12

Options: R&S CMW-KM012

FETCh:LTE:MEAS<i>:MEValuation:LIST:SEGMent<no>:ACLR:CURRent?
FETCh:LTE:MEAS<i>:MEValuation:LIST:SEGMent<no>:ACLR:AVERage?
CALCulate:LTE:MEAS<i>:MEValuation:LIST:SEGMent<no>:ACLR:CURRent?
CALCulate:LTE:MEAS<i>:MEValuation:LIST:SEGMent<no>:ACLR:AVERage?

Return ACLR single value results for segment <no> in list mode.

The values described below are returned by `FETCh` commands. The first four values (Reliability to Out of Tolerance result) are also returned by `CALCulate` commands. The remaining values returned by `CALCulate` commands are limit check results, one value for each result listed below.

Suffix:
<no> 1..1000

Return values:

<1_Reliability> Reliability Indicator
In list mode, a zero reliability indicator indicates that the results in all measured segments are valid. A non-zero value indicates that an error occurred in at least one of the measured segments.

<2_SegReliability> Reliability indicator for the segment. The meaning of the returned values is the same as for the common reliability indicator, see previous parameter.

<3_StatistExpired> Reached statistical length in slots
Range: 0 to 1000

<4_OutOfTol> Percentage of measured subframes with failed limit check
Range: 0 % to 100 %
Default unit: %

<5_UTRA2neg>
<6_UTRA1neg> ACLR for the second and first adjacent UTRA channels below the carrier frequency
Range: 0 dB to 100 dB
Default unit: dB

<7_EUTRAneg> ACLR for the first adjacent E-UTRA channel below the carrier frequency
Range: 0 dB to 100 dB
Default unit: dB

<8_EUTRA> Power in the allocated E-UTRA channel
Range: -100 dBm to 55 dBm
Default unit: dBm

<9_EUTRApos> ACLR for the first adjacent E-UTRA channel above the carrier frequency
Range: 0 dB to 100 dB
Default unit: dB

<10_UTRA1pos>
<11_UTRA2pos> ACLR for the first and second adjacent UTRA channels above the carrier frequency
Range: 0 dB to 100 dB
Default unit: dB

Example: See Using LTE List Mode

Usage: Query only

Firmware/Software: V2.0.10
V2.0.20: CALCulate commands
V2.1.25: increased maximum number of segments to 250
V2.1.30: increased maximum number of segments to 512
V3.0.50: increased maximum number of segments to 1000

Options: R&S CMW-KM012

FETCh:LTE:MEAS<i>:MEValuation:LIST:SEGMent<no>:PMONitor:RMS?
FETCh:LTE:MEAS<i>:MEValuation:LIST:SEGMent<no>:PMONitor:PEAK?

Return the power monitor results for segment <no> in list mode. The commands return one power result for each subframe of the segment. The power values are RMS averaged over the subframe or represent the peak value within the subframe.

To configure the number of subframes within the segment see `CONFigure:LTE:MEAS<i>:MEValuation:LIST:SEGMent<no>:SETup` on page 620.

Suffix:
<no> 1..1000

Return values:
<Reliability> Reliability Indicator
In list mode, a zero reliability indicator indicates that the results in all measured segments are valid. A non-zero value indicates that an error occurred in at least one of the measured segments.

<SegReliability> Reliability indicator for the segment. The meaning of the returned values is the same as for the common reliability indicator, see previous parameter.

<Power_1> ... <Power_n>
n power values, one per subframe, from first to last subframe of the segment
For an inactive segment only one INV is returned, independent of the number of configured subframes.
Range: -100 dBm to 55 dBm
Default unit: dBm

Example: See Using LTE List Mode

Usage: Query only

Firmware/Software: V2.0.20
V2.1.25: increased maximum number of segments to 250
V2.1.30: increased maximum number of segments to 512
V3.0.50: increased maximum number of segments to 1000

Options: R&S CMW-KM012

FETCh:LTE:MEAS<i>:MEValuation:LIST:PMONitor:RMS?
FETCh:LTE:MEAS<i>:MEValuation:LIST:PMONitor:PEAK?

Return the power monitor results for all measured segments in list mode. The commands return one power result per subframe. The power values are RMS averaged over the subframe or represent the peak value within the subframe.

Related commands:

- To find out where the power results related to a certain subframe are located in the result list:
  `FETCh:LTE:MEAS<i>:MEValuation:LIST:SEGMent<no>:PMONitor:ARRay:STARt?`
  `FETCh:LTE:MEAS<i>:MEValuation:LIST:SEGMent<no>:PMONitor:ARRay:LENGth?`
- To configure which segments are measured:
  `CONFigure:LTE:MEAS<i>:MEValuation:LIST:LRANge`
- To configure the number of subframes within a segment:
  `CONFigure:LTE:MEAS<i>:MEValuation:LIST:SEGMent<no>:SETup`
- To enable the calculation of the results:
  `CONFigure:LTE:MEAS<i>:MEValuation:LIST:SEGMent<no>:PMONitor`

Return values:

<Reliability>
Reliability Indicator
In list mode, a zero reliability indicator indicates that the results in all measured segments are valid. A non-zero value indicates that an error occurred in at least one of the measured segments.

<Power_1> ... <Power_n>
n power values, one per subframe, from first subframe of first measured segment to last subframe of last measured segment
For an inactive segment only one INV is returned, independent of the number of configured subframes.
Range: -100 dBm to 55 dBm
Default unit: dBm

Example: See Using LTE List Mode

Usage: Query only

Firmware/Software: V2.0.20

Options: R&S CMW-KM012

FETCh:LTE:MEAS<i>:MEValuation:LIST:SEGMent<no>:PMONitor:ARRay:STARt?

Returns the offset of the first power monitor result for segment <no> within a result list for all measured segments. Such a result list is e.g. returned by the command `FETCh:LTE:MEAS<i>:MEValuation:LIST:PMONitor:RMS?`.

A returned <Start> value n indicates that the result for the first subframe of the segment is the $(n+1)^{th}$ result in the power result list over all segments.

Suffix:
<no> 1..1000

Return values:
<Reliability> Reliability Indicator
In list mode, a zero reliability indicator indicates that the results in all measured segments are valid. A non-zero value indicates that an error occurred in at least one of the measured segments.

<Start> Range: 0 to 3999

Example: See Using LTE List Mode

Usage: Query only

Firmware/Software: V2.0.20
V2.1.25: increased maximum number of segments to 250
V2.1.30: increased maximum number of segments to 512
V3.0.50: increased maximum number of segments to 1000
V3.2.70: increased maximum start value to 3999

Options: R&S CMW-KM012

FETCh:LTE:MEAS<i>:MEValuation:LIST:SEGMent<no>:PMONitor:ARRay:LENGth?

Returns the number of power monitor results for segment <no> contained in a result list for all measured segments. Such a result list is e.g. returned by the command `FETCh:LTE:MEAS<i>:MEValuation:LIST:PMONitor:RMS?`.

Suffix:
<no> 1..1000

Return values:

<Reliability> Reliability Indicator
In list mode, a zero reliability indicator indicates that the results in all measured segments are valid. A non-zero value indicates that an error occurred in at least one of the measured segments.

<Length> Range: 0 to 2000

Example: See Using LTE List Mode

Usage: Query only

Firmware/Software: V2.0.20
V2.1.25: increased maximum number of segments to 250
V2.1.30: increased maximum number of segments to 512
V3.0.50: increased maximum number of segments to 1000

Options: R&S CMW-KM012

FETCh:LTE:MEAS<i>:MEValuation:LIST:SEGMent<no>:SEMask:DALLocation?
FETCh:LTE:MEAS<i>:MEValuation:LIST:SEGMent<no>:ACLR:DALLocation?
FETCh:LTE:MEAS<i>:MEValuation:LIST:SEGMent<no>:MODulation:DALLocation?

Return the detected allocation for segment <no> in list mode.

The result is determined from the last measured slot of the statistical length. The individual measurements provide identical detected allocation results when measuring the same slot. However different statistical lengths can be defined for the measurements so that the measured slots and returned results may differ.

Suffix:

<no> 1..1000

Return values:

<Reliability> Reliability Indicator
In list mode, a zero reliability indicator indicates that the results in all measured segments are valid. A non-zero value indicates that an error occurred in at least one of the measured segments.

<SegReliability> Reliability indicator for the segment. The meaning of the returned values is the same as for the common reliability indicator, see previous parameter.

<NrResBlocks> Number of allocated resource blocks
Range: 1 to 100

<OffsetResBlocks> Offset of the first allocated resource block from the edge of the allocated UL transmission bandwidth
Range: 0 to 99

Example: See Using LTE List Mode

Usage: Query only

Firmware/Software: V2.0.10
V2.1.25: increased maximum number of segments to 250
V2.1.30: increased maximum number of segments to 512
V3.0.50: increased maximum number of segments to 1000

Options: R&S CMW-KM012

FETCh:LTE:MEAS<i>:MEValuation:LIST:SEGMent<no>:MODulation:DMODulation?

Return the detected modulation scheme for segment <no> in list mode.

The result is determined from the last measured slot of the statistical length.

If channel type PUCCH is detected, QPSK is returned as modulation type because the QPSK limits are applied in that case.

Suffix:
<no> 1..1000

Return values:
<Reliability> Reliability Indicator
In list mode, a zero reliability indicator indicates that the results in all measured segments are valid. A non-zero value indicates that an error occurred in at least one of the measured segments.

<SegReliability> Reliability indicator for the segment. The meaning of the returned values is the same as for the common reliability indicator, see previous parameter.

<Modulation> QPSK | Q16 | Q64
QPSK, 16-QAM, 64-QAM

Example: See Using LTE List Mode

Usage: Query only

Firmware/Software: V2.0.10
V2.1.25: increased maximum number of segments to 250
V2.1.30: increased maximum number of segments to 512
V3.0.50: increased maximum number of segments to 1000

Options: R&S CMW-KM012

FETCh:LTE:MEAS<i>:MEValuation:LIST:SEGMent<no>:SEMask:DCHType?
FETCh:LTE:MEAS<i>:MEValuation:LIST:SEGMent<no>:ACLR:DCHType?
FETCh:LTE:MEAS<i>:MEValuation:LIST:SEGMent<no>:MODulation:DCHType?

Return the detected channel type for segment <no> in list mode.

The result is determined from the last measured slot of the statistical length. The individual measurements provide identical detected channel type results when measuring the same slot. However different statistical lengths can be defined for the measurements so that the measured slots and returned results may differ.

Suffix:

<no> 1..1000

Return values:

<Reliability> Reliability Indicator
In list mode, a zero reliability indicator indicates that the results in all measured segments are valid. A non-zero value indicates that an error occurred in at least one of the measured segments.

<SegReliability> Reliability indicator for the segment. The meaning of the returned values is the same as for the common reliability indicator, see previous parameter.

<ChannelType> PUSCh | PUCCh

Example: See Using LTE List Mode

Usage: Query only

Firmware/Software: V2.0.10
V2.1.25: increased maximum number of segments to 250
V2.1.30: increased maximum number of segments to 512
V3.0.50: increased maximum number of segments to 1000

Options: R&S CMW-KM012

3.5.3.33 List Mode Results (All Segments, One Result)

Each of the following commands returns a selected list mode result for all measured segments. The number of returned results depends on the number of measured segments, see `CONFigure:LTE:MEAS<i>:MEValuation:LIST:LRANge` on page 618.

To configure the list mode use the commands described in chapter 3.5.3.8, "List Mode Settings", on page 617.

For a description of the list mode see chapter 3.2.3, "List Mode", on page 498.

Indicated ranges apply to all statistical results except standard deviation results. The minimum for standard deviation results equals 0. The maximum equals the width of the indicated range divided by two. Exceptions are explicitly stated.

FETCh:LTE:MEAS<i>:MEValuation:LIST:SRELiability?

Returns the segment reliability for all measured list mode segments.

A common reliability indicator of zero indicates that the results in all measured segments are valid. A non-zero value indicates that an error occurred in at least one of the measured segments. If you get a non-zero common reliability indicator, you can use this command to retrieve the individual reliability values of all measured segments for further analysis.

Return values:

<Reliability> Reliability Indicator

<SegReliability> Comma separated list of values, one per measured segment
The meaning of the returned values is the same as for the common reliability indicator, see previous parameter.

Example: See Using LTE List Mode

Usage: Query only

Firmware/Software: V3.0.10

Options: R&S CMW-KM012

FETCh:LTE:MEAS<i>:MEValuation:LIST:MODulation:EVM:RMS:LOW:CURRent?
FETCh:LTE:MEAS<i>:MEValuation:LIST:MODulation:EVM:RMS:LOW:AVERage?
FETCh:LTE:MEAS<i>:MEValuation:LIST:MODulation:EVM:RMS:LOW:EXTReme?
FETCh:LTE:MEAS<i>:MEValuation:LIST:MODulation:EVM:RMS:LOW:SDEViation?
FETCh:LTE:MEAS<i>:MEValuation:LIST:MODulation:EVM:RMS:HIGH:CURRent?
FETCh:LTE:MEAS<i>:MEValuation:LIST:MODulation:EVM:RMS:HIGH:AVERage?
FETCh:LTE:MEAS<i>:MEValuation:LIST:MODulation:EVM:RMS:HIGH:EXTReme?
FETCh:LTE:MEAS<i>:MEValuation:LIST:MODulation:EVM:RMS:HIGH:SDEViation?
CALCulate:LTE:MEAS<i>:MEValuation:LIST:MODulation:EVM:RMS:LOW:CURRent?
CALCulate:LTE:MEAS<i>:MEValuation:LIST:MODulation:EVM:RMS:LOW:AVERage?
CALCulate:LTE:MEAS<i>:MEValuation:LIST:MODulation:EVM:RMS:LOW:EXTReme?
CALCulate:LTE:MEAS<i>:MEValuation:LIST:MODulation:EVM:RMS:HIGH:CURRent?
CALCulate:LTE:MEAS<i>:MEValuation:LIST:MODulation:EVM:RMS:HIGH:AVERage?
CALCulate:LTE:MEAS<i>:MEValuation:LIST:MODulation:EVM:RMS:HIGH:EXTReme?

Return error vector magnitude RMS values for low and high EVM window position, for all measured list mode segments.

The values described below are returned by `FETCh` commands. `CALCulate` commands return limit check results instead, one value for each result listed below.

Return values:

<Reliability> Reliability Indicator

<EVM_RMS> Comma separated list of values, one per measured segment
Range: 0 % to 100 %
Default unit: %

Example: See Using LTE List Mode

Usage: Query only

Firmware/Software: V2.1.30

Options: R&S CMW-KM012

FETCh:LTE:MEAS<i>:MEValuation:LIST:MODulation:EVM:PEAK:LOW:CURRent?
FETCh:LTE:MEAS<i>:MEValuation:LIST:MODulation:EVM:PEAK:LOW:AVERage?
FETCh:LTE:MEAS<i>:MEValuation:LIST:MODulation:EVM:PEAK:LOW:EXTReme?
FETCh:LTE:MEAS<i>:MEValuation:LIST:MODulation:EVM:PEAK:LOW:SDEViation?
FETCh:LTE:MEAS<i>:MEValuation:LIST:MODulation:EVM:PEAK:HIGH:CURRent?
FETCh:LTE:MEAS<i>:MEValuation:LIST:MODulation:EVM:PEAK:HIGH:AVERage?
FETCh:LTE:MEAS<i>:MEValuation:LIST:MODulation:EVM:PEAK:HIGH:EXTReme?
FETCh:LTE:MEAS<i>:MEValuation:LIST:MODulation:EVM:PEAK:HIGH:SDEViation?
CALCulate:LTE:MEAS<i>:MEValuation:LIST:MODulation:EVM:PEAK:LOW:CURRent?
CALCulate:LTE:MEAS<i>:MEValuation:LIST:MODulation:EVM:PEAK:LOW:AVERage?
CALCulate:LTE:MEAS<i>:MEValuation:LIST:MODulation:EVM:PEAK:LOW:EXTReme?
CALCulate:LTE:MEAS<i>:MEValuation:LIST:MODulation:EVM:PEAK:HIGH:CURRent?
CALCulate:LTE:MEAS<i>:MEValuation:LIST:MODulation:EVM:PEAK:HIGH:AVERage?
CALCulate:LTE:MEAS<i>:MEValuation:LIST:MODulation:EVM:PEAK:HIGH:EXTReme?

Return error vector magnitude peak values for low and high EVM window position, for all measured list mode segments.

The values described below are returned by `FETCh` commands. `CALCulate` commands return limit check results instead, one value for each result listed below.

Return values:

<Reliability> Reliability Indicator

<EVMpeak> Comma separated list of values, one per measured segment
Range: 0 % to 100 %
Default unit: %

Example: See Using LTE List Mode

Usage: Query only

Firmware/Software: V2.1.30

Options: R&S CMW-KM012

FETCh:LTE:MEAS<i>:MEValuation:LIST:MODulation:EVM:DMRS:LOW:CURRent?
FETCh:LTE:MEAS<i>:MEValuation:LIST:MODulation:EVM:DMRS:LOW:AVERage?
FETCh:LTE:MEAS<i>:MEValuation:LIST:MODulation:EVM:DMRS:LOW:EXTReme?
FETCh:LTE:MEAS<i>:MEValuation:LIST:MODulation:EVM:DMRS:LOW:SDEViation?
FETCh:LTE:MEAS<i>:MEValuation:LIST:MODulation:EVM:DMRS:HIGH:CURRent?
FETCh:LTE:MEAS<i>:MEValuation:LIST:MODulation:EVM:DMRS:HIGH:AVERage?
FETCh:LTE:MEAS<i>:MEValuation:LIST:MODulation:EVM:DMRS:HIGH:EXTReme?
FETCh:LTE:MEAS<i>:MEValuation:LIST:MODulation:EVM:DMRS:HIGH:SDEViation?
CALCulate:LTE:MEAS<i>:MEValuation:LIST:MODulation:EVM:DMRS:LOW:CURRent?
CALCulate:LTE:MEAS<i>:MEValuation:LIST:MODulation:EVM:DMRS:LOW:AVERage?
CALCulate:LTE:MEAS<i>:MEValuation:LIST:MODulation:EVM:DMRS:LOW:EXTReme?
CALCulate:LTE:MEAS<i>:MEValuation:LIST:MODulation:EVM:DMRS:HIGH:CURRent?
CALCulate:LTE:MEAS<i>:MEValuation:LIST:MODulation:EVM:DMRS:HIGH:AVERage?
CALCulate:LTE:MEAS<i>:MEValuation:LIST:MODulation:EVM:DMRS:HIGH:EXTReme?

Return error vector magnitude DMRS values for low and high EVM window position, for all measured list mode segments.

The values described below are returned by `FETCh` commands. `CALCulate` commands return limit check results instead, one value for each result listed below.

Return values:

<Reliability> Reliability Indicator

<EVM_DMRS> Comma separated list of values, one per measured segment
Range: 0 % to 100 %
Default unit: %

Example: See Using LTE List Mode

Usage: Query only

Firmware/Software: V2.1.30

Options: R&S CMW-KM012

FETCh:LTE:MEAS<i>:MEValuation:LIST:MODulation:MERRor:RMS:LOW:CURRent?
FETCh:LTE:MEAS<i>:MEValuation:LIST:MODulation:MERRor:RMS:LOW:AVERage?
FETCh:LTE:MEAS<i>:MEValuation:LIST:MODulation:MERRor:RMS:LOW:EXTReme?
FETCh:LTE:MEAS<i>:MEValuation:LIST:MODulation:MERRor:RMS:LOW:SDEViation?
FETCh:LTE:MEAS<i>:MEValuation:LIST:MODulation:MERRor:RMS:HIGH:CURRent?
FETCh:LTE:MEAS<i>:MEValuation:LIST:MODulation:MERRor:RMS:HIGH:AVERage?
FETCh:LTE:MEAS<i>:MEValuation:LIST:MODulation:MERRor:RMS:HIGH:EXTReme?
FETCh:LTE:MEAS<i>:MEValuation:LIST:MODulation:MERRor:RMS:HIGH:SDEViation?
CALCulate:LTE:MEAS<i>:MEValuation:LIST:MODulation:MERRor:RMS:LOW:CURRent?
CALCulate:LTE:MEAS<i>:MEValuation:LIST:MODulation:MERRor:RMS:LOW:AVERage?
CALCulate:LTE:MEAS<i>:MEValuation:LIST:MODulation:MERRor:RMS:LOW:EXTReme?
CALCulate:LTE:MEAS<i>:MEValuation:LIST:MODulation:MERRor:RMS:HIGH:CURRent?
CALCulate:LTE:MEAS<i>:MEValuation:LIST:MODulation:MERRor:RMS:HIGH:AVERage?
CALCulate:LTE:MEAS<i>:MEValuation:LIST:MODulation:MERRor:RMS:HIGH:EXTReme?

Return magnitude error RMS values for low and high EVM window position, for all measured list mode segments.

The values described below are returned by `FETCh` commands. `CALCulate` commands return limit check results instead, one value for each result listed below.

Return values:

<Reliability> Reliability Indicator

<MagErrorRMS> Comma separated list of values, one per measured segment
Range: 0 % to 100 %
Default unit: %

Example: See Using LTE List Mode

Usage: Query only

Firmware/Software: V2.1.30

Options: R&S CMW-KM012

FETCh:LTE:MEAS<i>:MEValuation:LIST:MODulation:MERRor:PEAK:LOW:CURRent?
FETCh:LTE:MEAS<i>:MEValuation:LIST:MODulation:MERRor:PEAK:LOW:AVERage?
FETCh:LTE:MEAS<i>:MEValuation:LIST:MODulation:MERRor:PEAK:LOW:EXTReme?
FETCh:LTE:MEAS<i>:MEValuation:LIST:MODulation:MERRor:PEAK:LOW:SDEViation?
FETCh:LTE:MEAS<i>:MEValuation:LIST:MODulation:MERRor:PEAK:HIGH:CURRent?
FETCh:LTE:MEAS<i>:MEValuation:LIST:MODulation:MERRor:PEAK:HIGH:AVERage?
FETCh:LTE:MEAS<i>:MEValuation:LIST:MODulation:MERRor:PEAK:HIGH:EXTReme?
FETCh:LTE:MEAS<i>:MEValuation:LIST:MODulation:MERRor:PEAK:HIGH:SDEViation?
CALCulate:LTE:MEAS<i>:MEValuation:LIST:MODulation:MERRor:PEAK:LOW:CURRent?
CALCulate:LTE:MEAS<i>:MEValuation:LIST:MODulation:MERRor:PEAK:LOW:AVERage?
CALCulate:LTE:MEAS<i>:MEValuation:LIST:MODulation:MERRor:PEAK:LOW:EXTReme?
CALCulate:LTE:MEAS<i>:MEValuation:LIST:MODulation:MERRor:PEAK:HIGH:CURRent?
CALCulate:LTE:MEAS<i>:MEValuation:LIST:MODulation:MERRor:PEAK:HIGH:AVERage?
CALCulate:LTE:MEAS<i>:MEValuation:LIST:MODulation:MERRor:PEAK:HIGH:EXTReme?

Return magnitude error peak values for low and high EVM window position, for all measured list mode segments.

The values described below are returned by `FETCh` commands. `CALCulate` commands return limit check results instead, one value for each result listed below.

Return values:

<Reliability> Reliability Indicator

<MagErrPeak> Comma separated list of values, one per measured segment
Range: -100 % to 100 % (AVERage: 0 % to 100 %, SDEViation: 0 % to 50 %)
Default unit: %

Example: See Using LTE List Mode

Usage: Query only

Firmware/Software: V2.1.30

Options: R&S CMW-KM012

FETCh:LTE:MEAS<i>:MEValuation:LIST:MODulation:MERRor:DMRS:LOW:CURRent?
FETCh:LTE:MEAS<i>:MEValuation:LIST:MODulation:MERRor:DMRS:LOW:AVERage?
FETCh:LTE:MEAS<i>:MEValuation:LIST:MODulation:MERRor:DMRS:LOW:EXTReme?
FETCh:LTE:MEAS<i>:MEValuation:LIST:MODulation:MERRor:DMRS:LOW:SDEViation?
FETCh:LTE:MEAS<i>:MEValuation:LIST:MODulation:MERRor:DMRS:HIGH:CURRent?
FETCh:LTE:MEAS<i>:MEValuation:LIST:MODulation:MERRor:DMRS:HIGH:AVERage?
FETCh:LTE:MEAS<i>:MEValuation:LIST:MODulation:MERRor:DMRS:HIGH:EXTReme?
FETCh:LTE:MEAS<i>:MEValuation:LIST:MODulation:MERRor:DMRS:HIGH:SDEViation?
CALCulate:LTE:MEAS<i>:MEValuation:LIST:MODulation:MERRor:DMRS:LOW:CURRent?
CALCulate:LTE:MEAS<i>:MEValuation:LIST:MODulation:MERRor:DMRS:LOW:AVERage?
CALCulate:LTE:MEAS<i>:MEValuation:LIST:MODulation:MERRor:DMRS:LOW:EXTReme?
CALCulate:LTE:MEAS<i>:MEValuation:LIST:MODulation:MERRor:DMRS:HIGH:CURRent?
CALCulate:LTE:MEAS<i>:MEValuation:LIST:MODulation:MERRor:DMRS:HIGH:AVERage?
CALCulate:LTE:MEAS<i>:MEValuation:LIST:MODulation:MERRor:DMRS:HIGH:EXTReme?

Return magnitude error DMRS values for low and high EVM window position, for all measured list mode segments.

The values described below are returned by `FETCh` commands. `CALCulate` commands return limit check results instead, one value for each result listed below.

Return values:

<Reliability> Reliability Indicator

<MagErrDMRS> Comma separated list of values, one per measured segment
Range: 0 % to 100 %
Default unit: %

Example: See Using LTE List Mode

Usage: Query only

Firmware/Software: V2.1.30

Options: R&S CMW-KM012

FETCh:LTE:MEAS<i>:MEValuation:LIST:MODulation:PERRor:RMS:LOW:CURRent?
FETCh:LTE:MEAS<i>:MEValuation:LIST:MODulation:PERRor:RMS:LOW:AVERage?
FETCh:LTE:MEAS<i>:MEValuation:LIST:MODulation:PERRor:RMS:LOW:EXTReme?
FETCh:LTE:MEAS<i>:MEValuation:LIST:MODulation:PERRor:RMS:LOW:SDEViation?
FETCh:LTE:MEAS<i>:MEValuation:LIST:MODulation:PERRor:RMS:HIGH:CURRent?
FETCh:LTE:MEAS<i>:MEValuation:LIST:MODulation:PERRor:RMS:HIGH:AVERage?
FETCh:LTE:MEAS<i>:MEValuation:LIST:MODulation:PERRor:RMS:HIGH:EXTReme?
FETCh:LTE:MEAS<i>:MEValuation:LIST:MODulation:PERRor:RMS:HIGH:SDEViation?
CALCulate:LTE:MEAS<i>:MEValuation:LIST:MODulation:PERRor:RMS:LOW:CURRent?
CALCulate:LTE:MEAS<i>:MEValuation:LIST:MODulation:PERRor:RMS:LOW:AVERage?
CALCulate:LTE:MEAS<i>:MEValuation:LIST:MODulation:PERRor:RMS:LOW:EXTReme?
CALCulate:LTE:MEAS<i>:MEValuation:LIST:MODulation:PERRor:RMS:HIGH:CURRent?
CALCulate:LTE:MEAS<i>:MEValuation:LIST:MODulation:PERRor:RMS:HIGH:AVERage?
CALCulate:LTE:MEAS<i>:MEValuation:LIST:MODulation:PERRor:RMS:HIGH:EXTReme?

Return phase error RMS values for low and high EVM window position, for all measured list mode segments.

The values described below are returned by `FETCh` commands. `CALCulate` commands return limit check results instead, one value for each result listed below.

Return values:

<Reliability> Reliability Indicator

<PhErrorRMS> Comma separated list of values, one per measured segment
Range: 0 deg to 180 deg
Default unit: deg

Example: See Using LTE List Mode

Usage: Query only

Firmware/Software: V2.1.30

Options: R&S CMW-KM012

FETCh:LTE:MEAS<i>:MEValuation:LIST:MODulation:PERRor:PEAK:LOW:CURRent?
FETCh:LTE:MEAS<i>:MEValuation:LIST:MODulation:PERRor:PEAK:LOW:AVERage?
FETCh:LTE:MEAS<i>:MEValuation:LIST:MODulation:PERRor:PEAK:LOW:EXTReme?
FETCh:LTE:MEAS<i>:MEValuation:LIST:MODulation:PERRor:PEAK:LOW:SDEViation?
FETCh:LTE:MEAS<i>:MEValuation:LIST:MODulation:PERRor:PEAK:HIGH:CURRent?
FETCh:LTE:MEAS<i>:MEValuation:LIST:MODulation:PERRor:PEAK:HIGH:AVERage?
FETCh:LTE:MEAS<i>:MEValuation:LIST:MODulation:PERRor:PEAK:HIGH:EXTReme?
FETCh:LTE:MEAS<i>:MEValuation:LIST:MODulation:PERRor:PEAK:HIGH:SDEViation?
CALCulate:LTE:MEAS<i>:MEValuation:LIST:MODulation:PERRor:PEAK:LOW:CURRent?
CALCulate:LTE:MEAS<i>:MEValuation:LIST:MODulation:PERRor:PEAK:LOW:AVERage?
CALCulate:LTE:MEAS<i>:MEValuation:LIST:MODulation:PERRor:PEAK:LOW:EXTReme?
CALCulate:LTE:MEAS<i>:MEValuation:LIST:MODulation:PERRor:PEAK:HIGH:CURRent?
CALCulate:LTE:MEAS<i>:MEValuation:LIST:MODulation:PERRor:PEAK:HIGH:AVERage?
CALCulate:LTE:MEAS<i>:MEValuation:LIST:MODulation:PERRor:PEAK:HIGH:EXTReme?

Return phase error peak values for low and high EVM window position, for all measured list mode segments.

The values described below are returned by `FETCh` commands. `CALCulate` commands return limit check results instead, one value for each result listed below.

Return values:

<Reliability> Reliability Indicator

<PhErrorPeak> Comma separated list of values, one per measured segment
Range: -180 deg to 180 deg (AVERage: 0 deg to 180 deg, SDEViation: 0 deg to 90 deg)
Default unit: deg

Example: See Using LTE List Mode

Usage: Query only

Firmware/Software: V2.1.30

Options: R&S CMW-KM012

FETCh:LTE:MEAS<i>:MEValuation:LIST:MODulation:PERRor:DMRS:LOW:CURRent?
FETCh:LTE:MEAS<i>:MEValuation:LIST:MODulation:PERRor:DMRS:LOW:AVERage?
FETCh:LTE:MEAS<i>:MEValuation:LIST:MODulation:PERRor:DMRS:LOW:EXTReme?
FETCh:LTE:MEAS<i>:MEValuation:LIST:MODulation:PERRor:DMRS:LOW:SDEViation?
FETCh:LTE:MEAS<i>:MEValuation:LIST:MODulation:PERRor:DMRS:HIGH:CURRent?
FETCh:LTE:MEAS<i>:MEValuation:LIST:MODulation:PERRor:DMRS:HIGH:AVERage?
FETCh:LTE:MEAS<i>:MEValuation:LIST:MODulation:PERRor:DMRS:HIGH:EXTReme?
FETCh:LTE:MEAS<i>:MEValuation:LIST:MODulation:PERRor:DMRS:HIGH:SDEViation?
CALCulate:LTE:MEAS<i>:MEValuation:LIST:MODulation:PERRor:DMRS:LOW:CURRent?
CALCulate:LTE:MEAS<i>:MEValuation:LIST:MODulation:PERRor:DMRS:LOW:AVERage?
CALCulate:LTE:MEAS<i>:MEValuation:LIST:MODulation:PERRor:DMRS:LOW:EXTReme?
CALCulate:LTE:MEAS<i>:MEValuation:LIST:MODulation:PERRor:DMRS:HIGH:CURRent?
CALCulate:LTE:MEAS<i>:MEValuation:LIST:MODulation:PERRor:DMRS:HIGH:AVERage?
CALCulate:LTE:MEAS<i>:MEValuation:LIST:MODulation:PERRor:DMRS:HIGH:EXTReme?

Return phase error DMRS values for low and high EVM window position, for all measured list mode segments.

The values described below are returned by `FETCh` commands. `CALCulate` commands return limit check results instead, one value for each result listed below.

Return values:

<Reliability>	Reliability Indicator
<PhErrorDMRS>	Comma separated list of values, one per measured segment Range: 0 deg to 180 deg Default unit: deg
Example:	See Using LTE List Mode
Usage:	Query only
Firmware/Software:	V2.1.30
Options:	R&S CMW-KM012

FETCh:LTE:MEAS<i>:MEValuation:LIST:MODulation:IQOFfset:CURRent?
FETCh:LTE:MEAS<i>:MEValuation:LIST:MODulation:IQOFfset:AVERage?

FETCh:LTE:MEAS<i>:MEValuation:LIST:MODulation:IQOFfset:EXTReme?
FETCh:LTE:MEAS<i>:MEValuation:LIST:MODulation:IQOFfset:SDEViation?
CALCulate:LTE:MEAS<i>:MEValuation:LIST:MODulation:IQOFfset:CURRent?
CALCulate:LTE:MEAS<i>:MEValuation:LIST:MODulation:IQOFfset:AVERage?
CALCulate:LTE:MEAS<i>:MEValuation:LIST:MODulation:IQOFfset:EXTReme?

Return I/Q origin offset values for all measured list mode segments.

The values described below are returned by `FETCh` commands. `CALCulate` commands return limit check results instead, one value for each result listed below.

Return values:

<Reliability> Reliability Indicator

<IQOffset> Comma separated list of values, one per measured segment

Range: -100 dBc to 0 dBc
Default unit: dBc

Example: See Using LTE List Mode

Usage: Query only

Firmware/Software: V2.1.30

Options: R&S CMW-KM012

FETCh:LTE:MEAS<i>:MEValuation:LIST:MODulation:FERRor:CURRent?
FETCh:LTE:MEAS<i>:MEValuation:LIST:MODulation:FERRor:AVERage?
FETCh:LTE:MEAS<i>:MEValuation:LIST:MODulation:FERRor:EXTReme?
FETCh:LTE:MEAS<i>:MEValuation:LIST:MODulation:FERRor:SDEViation?
CALCulate:LTE:MEAS<i>:MEValuation:LIST:MODulation:FERRor:CURRent?
CALCulate:LTE:MEAS<i>:MEValuation:LIST:MODulation:FERRor:AVERage?
CALCulate:LTE:MEAS<i>:MEValuation:LIST:MODulation:FERRor:EXTReme?

Return carrier frequency error values for all measured list mode segments.

The values described below are returned by `FETCh` commands. `CALCulate` commands return limit check results instead, one value for each result listed below.

Return values:

<Reliability> Reliability Indicator

<FrequencyError> Comma separated list of values, one per measured segment

Range: -80000 Hz to 80000 Hz
Default unit: Hz

Example: See Using LTE List Mode

Usage: Query only

Firmware/Software: V2.1.30

Options: R&S CMW-KM012

FETCh:LTE:MEAS<i>:MEValuation:LIST:MODulation:TERRor:CURRent?
FETCh:LTE:MEAS<i>:MEValuation:LIST:MODulation:TERRor:AVERage?

FETCh:LTE:MEAS<i>:MEValuation:LIST:MODulation:TERRor:EXTReme?
FETCh:LTE:MEAS<i>:MEValuation:LIST:MODulation:TERRor:SDEViation?
CALCulate:LTE:MEAS<i>:MEValuation:LIST:MODulation:TERRor:CURRent?
CALCulate:LTE:MEAS<i>:MEValuation:LIST:MODulation:TERRor:AVERage?
CALCulate:LTE:MEAS<i>:MEValuation:LIST:MODulation:TERRor:EXTReme?

Return transmit time error values for all measured list mode segments.

The values described below are returned by `FETCh` commands. `CALCulate` commands return limit check results instead, one value for each result listed below.

Return values:

<Reliability> Reliability Indicator

<TimingError> Comma separated list of values, one per measured segment
Range: -32000 Ts to 32000 Ts
Default unit: Ts (basic LTE time unit)

Example: See Using LTE List Mode

Usage: Query only

Firmware/Software: V2.1.30

Options: R&S CMW-KM012

FETCh:LTE:MEAS<i>:MEValuation:LIST:MODulation:TPOWer:CURRent?
FETCh:LTE:MEAS<i>:MEValuation:LIST:MODulation:TPOWer:AVERage?
FETCh:LTE:MEAS<i>:MEValuation:LIST:MODulation:TPOWer:MINimum?
FETCh:LTE:MEAS<i>:MEValuation:LIST:MODulation:TPOWer:MAXimum?
FETCh:LTE:MEAS<i>:MEValuation:LIST:MODulation:TPOWer:SDEViation?
CALCulate:LTE:MEAS<i>:MEValuation:LIST:MODulation:TPOWer:CURRent?
CALCulate:LTE:MEAS<i>:MEValuation:LIST:MODulation:TPOWer:AVERage?
CALCulate:LTE:MEAS<i>:MEValuation:LIST:MODulation:TPOWer:MINimum?
CALCulate:LTE:MEAS<i>:MEValuation:LIST:MODulation:TPOWer:MAXimum?

Return user equipment power values for all measured list mode segments.

The values described below are returned by `FETCh` commands. `CALCulate` commands return limit check results instead, one value for each result listed below.

Return values:

<Reliability> Reliability Indicator

<TXpower> Comma separated list of values, one per measured segment
Range: -100 dBm to 55 dBm
Default unit: dBm

Example: See Using LTE List Mode

Usage: Query only

Firmware/Software: V2.1.30

Options: R&S CMW-KM012

FETCh:LTE:MEAS<i>:MEValuation:LIST:MODulation:PPOWer:CURRent?
FETCh:LTE:MEAS<i>:MEValuation:LIST:MODulation:PPOWer:AVERage?
FETCh:LTE:MEAS<i>:MEValuation:LIST:MODulation:PPOWer:MINimum?
FETCh:LTE:MEAS<i>:MEValuation:LIST:MODulation:PPOWer:MAXimum?
FETCh:LTE:MEAS<i>:MEValuation:LIST:MODulation:PPOWer:SDEViation?
CALCulate:LTE:MEAS<i>:MEValuation:LIST:MODulation:PPOWer:CURRent?
CALCulate:LTE:MEAS<i>:MEValuation:LIST:MODulation:PPOWer:AVERage?
CALCulate:LTE:MEAS<i>:MEValuation:LIST:MODulation:PPOWer:MINimum?
CALCulate:LTE:MEAS<i>:MEValuation:LIST:MODulation:PPOWer:MAXimum?

Return user equipment peak power values for all measured list mode segments.

The values described below are returned by `FETCh` commands. `CALCulate` commands return limit check results instead, one value for each result listed below.

Return values:

<Reliability> Reliability Indicator

<PeakPower> Comma separated list of values, one per measured segment
Range: -100 dBm to 55 dBm
Default unit: dBm

Example: See Using LTE List Mode

Usage: Query only

Firmware/Software: V2.1.30

Options: R&S CMW-KM012

FETCh:LTE:MEAS<i>:MEValuation:LIST:MODulation:PSD:CURRent?
FETCh:LTE:MEAS<i>:MEValuation:LIST:MODulation:PSD:AVERage?
FETCh:LTE:MEAS<i>:MEValuation:LIST:MODulation:PSD:MINimum?
FETCh:LTE:MEAS<i>:MEValuation:LIST:MODulation:PSD:MAXimum?
FETCh:LTE:MEAS<i>:MEValuation:LIST:MODulation:PSD:SDEViation?
CALCulate:LTE:MEAS<i>:MEValuation:LIST:MODulation:PSD:CURRent?
CALCulate:LTE:MEAS<i>:MEValuation:LIST:MODulation:PSD:AVERage?
CALCulate:LTE:MEAS<i>:MEValuation:LIST:MODulation:PSD:MINimum?
CALCulate:LTE:MEAS<i>:MEValuation:LIST:MODulation:PSD:MAXimum?

Return RB power values (power spectral density) for all measured list mode segments.

The values described below are returned by `FETCh` commands. `CALCulate` commands return limit check results instead, one value for each result listed below.

Return values:

<Reliability> Reliability Indicator

<PSD> Comma separated list of values, one per measured segment
Range: -100 dBm to 55 dBm
Default unit: dBm

Example: See Using LTE List Mode

Usage: Query only

Firmware/Software: V2.1.30

Options: R&S CMW-KM012

FETCh:LTE:MEAS<i>:MEValuation:LIST:IEMission:MARGin:CURRent?
FETCh:LTE:MEAS<i>:MEValuation:LIST:IEMission:MARGin:AVERage?
FETCh:LTE:MEAS<i>:MEValuation:LIST:IEMission:MARGin:EXTReme?
FETCh:LTE:MEAS<i>:MEValuation:LIST:IEMission:MARGin:SDEViation?

Return the inband emission limit line margin results for all measured list mode segments.

The `CURRent` margins indicate the minimum (vertical) distance between the limit line and the current trace. A negative result indicates that the limit is exceeded.

The `AVERage`, `EXTReme` and `SDEViation` values are calculated from the current margins.

Return values:

<Reliability> Reliability Indicator

<Margin> Comma separated list of values, one per measured segment
Range: -50 dB to 110 dB
Default unit: dB

Example: See Using LTE List Mode

Usage: Query only

Firmware/Software: V2.1.30

Options: R&S CMW-KM012

FETCh:LTE:MEAS<i>:MEValuation:LIST:IEMission:MARGin:RBINdex:CURRent?
FETCh:LTE:MEAS<i>:MEValuation:LIST:IEMission:MARGin:RBINdex:EXTReme?

Return resource block indices of the inband emission measurement for all measured list mode segments. At these RB indices the `CURRent` and `EXTReme` margins have been detected.

Return values:

<Reliability> Reliability Indicator

<RBindex> Comma separated list of values, one per measured segment
Range: 0 to 99

Example: See Using LTE List Mode

Usage: Query only

Firmware/Software: V2.1.30

Options: R&S CMW-KM012

FETCh:LTE:MEAS<i>:MEValuation:LIST:ESFLatness:RIPPle<no>:CURRent?
FETCh:LTE:MEAS<i>:MEValuation:LIST:ESFLatness:RIPPle<no>:AVERage?
FETCh:LTE:MEAS<i>:MEValuation:LIST:ESFLatness:RIPPle<no>:EXTReme?
FETCh:LTE:MEAS<i>:MEValuation:LIST:ESFLatness:RIPPle<no>:SDEViation?
CALCulate:LTE:MEAS<i>:MEValuation:LIST:ESFLatness:RIPPle<no>:CURRent?
CALCulate:LTE:MEAS<i>:MEValuation:LIST:ESFLatness:RIPPle<no>:AVERage?
CALCulate:LTE:MEAS<i>:MEValuation:LIST:ESFLatness:RIPPle<no>:EXTReme?

Return equalizer spectrum flatness single value results ("Ripple 1" or "Ripple 2") for all measured list mode segments.

The values described below are returned by `FETCh` commands. `CALCulate` commands return limit check results instead, one value for each result listed below.

Suffix:

<no> 1..2
`RIPPle1` = Max (Range 1) - Min (Range 1)
`RIPPle2` = Max (Range 2) - Min (Range 2)

Return values:

<Reliability> Reliability Indicator

<Ripple> Comma separated list of values, one per measured segment
Range: 0 dB to 40 dB
Default unit: dB

Example: See Using LTE List Mode

Usage: Query only

Firmware/Software: V2.1.30

Options: R&S CMW-KM012

FETCh:LTE:MEAS<i>:MEValuation:LIST:ESFLatness:DIFFerence<no>:CURRent?
FETCh:LTE:MEAS<i>:MEValuation:LIST:ESFLatness:DIFFerence<no>:AVERage?
FETCh:LTE:MEAS<i>:MEValuation:LIST:ESFLatness:DIFFerence<no>:EXTReme?
FETCh:LTE:MEAS<i>:MEValuation:LIST:ESFLatness:DIFFerence<no>:SDEViation?
CALCulate:LTE:MEAS<i>:MEValuation:LIST:ESFLatness:DIFFerence<no>:CURRent?
CALCulate:LTE:MEAS<i>:MEValuation:LIST:ESFLatness:DIFFerence<no>:AVERage?
CALCulate:LTE:MEAS<i>:MEValuation:LIST:ESFLatness:DIFFerence<no>:EXTReme?

Return equalizer spectrum flatness single value results (differences between ranges) for all measured list mode segments.

The values described below are returned by `FETCh` commands. `CALCulate` commands return limit check results instead, one value for each result listed below.

Suffix:
<no> 1..2
`DIFFerence1` = Max (Range 1) - Min (Range 2)
`DIFFerence2` = Max (Range 2) - Min (Range 1)

Return values:
<Reliability> Reliability Indicator

<Difference> Comma separated list of values, one per measured segment
Range: -40 dB to 40 dB
Default unit: dB

Example: See Using LTE List Mode

Usage: Query only

Firmware/Software: V2.1.30

Options: R&S CMW-KM012

FETCh:LTE:MEAS<i>:MEValuation:LIST:ESFLatness:MINR<no>:CURRent?
FETCh:LTE:MEAS<i>:MEValuation:LIST:ESFLatness:MINR<no>:AVERage?
FETCh:LTE:MEAS<i>:MEValuation:LIST:ESFLatness:MINR<no>:EXTReme?
FETCh:LTE:MEAS<i>:MEValuation:LIST:ESFLatness:MINR<no>:SDEViation?
CALCulate:LTE:MEAS<i>:MEValuation:LIST:ESFLatness:MINR<no>:CURRent?
CALCulate:LTE:MEAS<i>:MEValuation:LIST:ESFLatness:MINR<no>:AVERage?
CALCulate:LTE:MEAS<i>:MEValuation:LIST:ESFLatness:MINR<no>:EXTReme?

Return equalizer spectrum flatness single value results (minimum within a range) for all measured list mode segments.

The values described below are returned by `FETCh` commands. `CALCulate` commands return limit check results instead, one value for each result listed below.

Suffix:
<no> 1..2
Selects the range for which the minimum is returned

Return values:
<Reliability> Reliability Indicator

<MinR> Comma separated list of values, one per measured segment
Range: -20 dB to 20 dB
Default unit: dB

Example: See Using LTE List Mode

Usage: Query only

Firmware/Software: V2.1.30

Options: R&S CMW-KM012

FETCh:LTE:MEAS<i>:MEValuation:LIST:ESFLatness:MAXR<no>:CURRent?
FETCh:LTE:MEAS<i>:MEValuation:LIST:ESFLatness:MAXR<no>:AVERage?

FETCh:LTE:MEAS<i>:MEValuation:LIST:ESFLatness:MAXR<no>:EXTReme?
FETCh:LTE:MEAS<i>:MEValuation:LIST:ESFLatness:MAXR<no>:SDEViation?
CALCulate:LTE:MEAS<i>:MEValuation:LIST:ESFLatness:MAXR<no>:CURRent?
CALCulate:LTE:MEAS<i>:MEValuation:LIST:ESFLatness:MAXR<no>:AVERage?
CALCulate:LTE:MEAS<i>:MEValuation:LIST:ESFLatness:MAXR<no>:EXTReme?

Return equalizer spectrum flatness single value results (maximum within a range) for all measured list mode segments.

The values described below are returned by `FETCh` commands. `CALCulate` commands return limit check results instead, one value for each result listed below.

Suffix:
<no> 1..2
Selects the range for which the maximum is returned

Return values:
<Reliability> Reliability Indicator

<MaxR> Comma separated list of values, one per measured segment
Range: -20 dB to 20 dB
Default unit: dB

Example: See Using LTE List Mode

Usage: Query only

Firmware/Software: V2.1.30

Options: R&S CMW-KM012

FETCh:LTE:MEAS<i>:MEValuation:LIST:ESFLatness:SCINdex:MINimum<no>:CURRent?
FETCh:LTE:MEAS<i>:MEValuation:LIST:ESFLatness:SCINdex:MAXimum<no>:CURRent?

Return subcarrier indices of the equalizer spectrum flatness measurement for all measured list mode segments.

At these SC indices the current `MINimum` or `MAXimum` power of the equalizer coefficients has been detected within the selected range.

Suffix:
<no> 1..2
Selects the range

Return values:
<Reliability> Reliability Indicator

<Index> Comma separated list of values, one per measured segment
Range: 0 to 1199

Example: See Using LTE List Mode

Usage: Query only

Firmware/Software: V2.1.30

Options: R&S CMW-KM012

FETCh:LTE:MEAS<i>:MEValuation:LIST:SEMask:OBW:CURRent?
FETCh:LTE:MEAS<i>:MEValuation:LIST:SEMask:OBW:AVERage?
FETCh:LTE:MEAS<i>:MEValuation:LIST:SEMask:OBW:EXTReme?
FETCh:LTE:MEAS<i>:MEValuation:LIST:SEMask:OBW:SDEViation?
CALCulate:LTE:MEAS<i>:MEValuation:LIST:SEMask:OBW:CURRent?
CALCulate:LTE:MEAS<i>:MEValuation:LIST:SEMask:OBW:AVERage?
CALCulate:LTE:MEAS<i>:MEValuation:LIST:SEMask:OBW:EXTReme?

Return the occupied bandwidth for all measured list mode segments.

The values described below are returned by `FETCh` commands. `CALCulate` commands return limit check results instead, one value for each result listed below.

Return values:

<Reliability> Reliability Indicator

<OBW> Comma separated list of values, one per measured segment
Range: 0 MHz to 40 MHz
Default unit: Hz

Example: See Using LTE List Mode

Usage: Query only

Firmware/Software: V2.1.30

Options: R&S CMW-KM012

FETCh:LTE:MEAS<i>:MEValuation:LIST:SEMask:TXPower:CURRent?
FETCh:LTE:MEAS<i>:MEValuation:LIST:SEMask:TXPower:AVERage?
FETCh:LTE:MEAS<i>:MEValuation:LIST:SEMask:TXPower:MINimum?
FETCh:LTE:MEAS<i>:MEValuation:LIST:SEMask:TXPower:MAXimum?
FETCh:LTE:MEAS<i>:MEValuation:LIST:SEMask:TXPower:SDEViation?
CALCulate:LTE:MEAS<i>:MEValuation:LIST:SEMask:TXPower:CURRent?
CALCulate:LTE:MEAS<i>:MEValuation:LIST:SEMask:TXPower:AVERage?
CALCulate:LTE:MEAS<i>:MEValuation:LIST:SEMask:TXPower:MINimum?
CALCulate:LTE:MEAS<i>:MEValuation:LIST:SEMask:TXPower:MAXimum?

Return the total TX power in the slot for all measured list mode segments.

The values described below are returned by `FETCh` commands. `CALCulate` commands return limit check results instead, one value for each result listed below.

Return values:

<Reliability> Reliability Indicator

<TXpower> Comma separated list of values, one per measured segment
Range: -100 dBm to 55 dBm
Default unit: dBm

Example: See Using LTE List Mode

Usage: Query only

Firmware/Software: V2.1.30

Options: R&S CMW-KM012

FETCh:LTE:MEAS<i>:MEValuation:LIST:SEMask:MARGin:AREA<no>:NEGativ:CURRent?
FETCh:LTE:MEAS<i>:MEValuation:LIST:SEMask:MARGin:AREA<no>:NEGativ:AVERage?
FETCh:LTE:MEAS<i>:MEValuation:LIST:SEMask:MARGin:AREA<no>:NEGativ:MINimum?
FETCh:LTE:MEAS<i>:MEValuation:LIST:SEMask:MARGin:AREA<no>:POSitiv:AVERage?
FETCh:LTE:MEAS<i>:MEValuation:LIST:SEMask:MARGin:AREA<no>:POSitiv:CURRent?
FETCh:LTE:MEAS<i>:MEValuation:LIST:SEMask:MARGin:AREA<no>:POSitiv:MINimum?

Return spectrum emission mask margin positions for all measured list mode segments.

The individual commands provide results for the `CURRent`, `AVERage` and maximum traces (resulting in `MINimum` margins) for `NEGative` and `POSitive` offset frequencies.

The results are returned as pairs per segment: `<Reliability>`, {`<MarginPosX>`, `<MarginPosY>`}$_{\text{Seg 1}}$, {`<MarginPosX>`, `<MarginPosY>`}$_{\text{Seg 2}}$, ...

Suffix:

<no> 1..12
Selects the emission mask area

Return values:

<Reliability> Reliability Indicator

<MarginPosX> X-position of margin for selected area
Range: -35 MHz to 35 MHz
Default unit: Hz

<MarginPosY> Y-position of margin for selected area
Range: -160 dB to 160 dB
Default unit: dB

Example: See Using LTE List Mode

Usage: Query only

Firmware/Software: V2.1.30
V3.2.80: increased <no> of areas to 12

Options: R&S CMW-KM012

FETCh:LTE:MEAS<i>:MEValuation:LIST:ACLR:EUTRa:CURRent?
FETCh:LTE:MEAS<i>:MEValuation:LIST:ACLR:EUTRa:AVERage?

CALCulate:LTE:MEAS<i>:MEValuation:LIST:ACLR:EUTRa:CURRent?
CALCulate:LTE:MEAS<i>:MEValuation:LIST:ACLR:EUTRa:AVERage?

Return the power in the allocated E-UTRA channel for all measured list mode segments.

The values described below are returned by `FETCh` commands. `CALCulate` commands return limit check results instead, one value for each result listed below.

Return values:

<Reliability> Reliability Indicator

<EUTRA> Comma separated list of values, one per measured segment
Range: -100 dBm to 55 dBm
Default unit: dBm

Example: See Using LTE List Mode

Usage: Query only

Firmware/Software: V2.1.30

Options: R&S CMW-KM012

FETCh:LTE:MEAS<i>:MEValuation:LIST:ACLR:EUTRa:NEGativ:CURRent?
FETCh:LTE:MEAS<i>:MEValuation:LIST:ACLR:EUTRa:NEGativ:AVERage?
FETCh:LTE:MEAS<i>:MEValuation:LIST:ACLR:EUTRa:POSitiv:CURRent?
FETCh:LTE:MEAS<i>:MEValuation:LIST:ACLR:EUTRa:POSitiv:AVERage?
CALCulate:LTE:MEAS<i>:MEValuation:LIST:ACLR:EUTRa:NEGativ:CURRent?
CALCulate:LTE:MEAS<i>:MEValuation:LIST:ACLR:EUTRa:NEGativ:AVERage?
CALCulate:LTE:MEAS<i>:MEValuation:LIST:ACLR:EUTRa:POSitiv:CURRent?
CALCulate:LTE:MEAS<i>:MEValuation:LIST:ACLR:EUTRa:POSitiv:AVERage?

Return the ACLR for the first adjacent E-UTRA channel above (`POSitiv`) or below (`NEGativ`) the carrier frequency for all measured list mode segments.

The values described below are returned by `FETCh` commands. `CALCulate` commands return limit check results instead, one value for each result listed below.

Return values:

<Reliability> Reliability Indicator

<EUTRA> Comma separated list of values, one per measured segment
Range: 0 dB to 100 dB
Default unit: dB

Example: See Using LTE List Mode

Usage: Query only

Firmware/Software: V2.1.30

Options: R&S CMW-KM012

FETCh:LTE:MEAS<i>:MEValuation:LIST:ACLR:UTRA<no>:NEGativ:CURRent?
FETCh:LTE:MEAS<i>:MEValuation:LIST:ACLR:UTRA<no>:NEGativ:AVERage?

FETCh:LTE:MEAS<i>:MEValuation:LIST:ACLR:UTRA<no>:POSitiv:CURRent?
FETCh:LTE:MEAS<i>:MEValuation:LIST:ACLR:UTRA<no>:POSitiv:AVERage?
CALCulate:LTE:MEAS<i>:MEValuation:LIST:ACLR:UTRA<no>:NEGativ:CURRent?
CALCulate:LTE:MEAS<i>:MEValuation:LIST:ACLR:UTRA<no>:NEGativ:AVERage?
CALCulate:LTE:MEAS<i>:MEValuation:LIST:ACLR:UTRA<no>:POSitiv:CURRent?
CALCulate:LTE:MEAS<i>:MEValuation:LIST:ACLR:UTRA<no>:POSitiv:AVERage?

Return the ACLR for the first or second adjacent UTRA channel above (`POSitiv`) or below (`NEGativ`) the carrier frequency for all measured list mode segments.

The values described below are returned by `FETCh` commands. `CALCulate` commands return limit check results instead, one value for each result listed below.

Suffix:

<no> 1..2
Selects first or second adjacent UTRA channel

Return values:

<Reliability> Reliability Indicator

<UTRA> Comma separated list of values, one per measured segment
Range: 0 dB to 100 dB
Default unit: dB

Example: See Using LTE List Mode

Usage: Query only

Firmware/Software: V2.1.30

Options: R&S CMW-KM012

FETCh:LTE:MEAS<i>:MEValuation:LIST:SEMask:DALLocation?
FETCh:LTE:MEAS<i>:MEValuation:LIST:ACLR:DALLocation?
FETCh:LTE:MEAS<i>:MEValuation:LIST:MODulation:DALLocation?

Return the detected allocation for all measured list mode segments.

The result is determined from the last measured slot of the statistical length of a segment. The individual measurements provide identical detected allocation results when measuring the same slot. However different statistical lengths can be defined for the measurements so that the measured slots and returned results may differ.

The results are returned as pairs per segment: `<Reliability>`, {`<NrResBlocks>`, `<OffsetResBlocks>`}$_{\text{Seg 1}}$, {`<NrResBlocks>`, `<OffsetResBlocks>`}$_{\text{Seg 2}}$, ...

Return values:

<Reliability> Reliability Indicator

<NrResBlocks> Number of allocated resource blocks
Range: 1 to 100

<OffsetResBlocks> Offset of the first allocated resource block from the edge of the allocated UL transmission bandwidth

Range: 0 to 99

Example: See Using LTE List Mode

Usage: Query only

Firmware/Software: V2.1.30

Options: R&S CMW-KM012

FETCh:LTE:MEAS<i>:MEValuation:LIST:MODulation:DMODulation?

Return the detected modulation scheme for all measured list mode segments.

The result is determined from the last measured slot of the statistical length of a segment.

If channel type PUCCH is detected, QPSK is returned as modulation type because the QPSK limits are applied in that case.

Return values:

<Reliability> Reliability Indicator

<Modulation> QPSK | Q16 | Q64

Comma separated list of values, one per measured segment
QPSK, 16-QAM, 64-QAM

Example: See Using LTE List Mode

Usage: Query only

Firmware/Software: V2.1.30

Options: R&S CMW-KM012

FETCh:LTE:MEAS<i>:MEValuation:LIST:SEMask:DCHType?
FETCh:LTE:MEAS<i>:MEValuation:LIST:ACLR:DCHType?
FETCh:LTE:MEAS<i>:MEValuation:LIST:MODulation:DCHType?

Return the detected channel type for all measured list mode segments.

The result is determined from the last measured slot of the statistical length of a segment. The individual measurements provide identical detected channel type results when measuring the same slot. However different statistical lengths can be defined for the measurements so that the measured slots and returned results may differ.

Return values:

<Reliability> Reliability Indicator

<ChannelType> PUSCh | PUCCh

Comma separated list of values, one per measured segment

Example: See Using LTE List Mode

Usage: Query only

Firmware/Software: V2.1.30

Options: R&S CMW-KM012

3.5.4 Combined Signal Path Commands

For some settings, the command to be used depends on the active scenario. While the Combined Signal Path (CSP) scenario is active, these settings are configured via commands of the signaling application. While the Standalone (SA) scenario is active, they are configured via measurement commands.

The following mapping tables provide an overview for general measurement settings and for multi evaluation measurement commands.

Table 3-2: Mapping for general measurement settings

Setting	Commands for SA scenario	Commands for CSP scenario
Duplex mode	CONFigure:LTE:MEAS<i>:DMODe	CONFigure:LTE:SIGN<i>:DMODe
Connector, converter	ROUTe:LTE:MEAS<i>:SCENario:SALone	ROUTe:LTE:MEAS<i>:SCENario:CSPath ROUTe:LTE:SIGN<i>:SCENario:... See "Scenario, Fading" on page 122.
External attenuation	CONFigure:LTE:MEAS<i>:RFSettings:EATTenuation	CONFigure:LTE:SIGN<i>:RFSettings[:PCC]:EATTenuation:INPut
Band	CONFigure:LTE:MEAS<i>:BAND	CONFigure:LTE:SIGN<i>[:PCC]:BAND
Frequency, channel	CONFigure:LTE:MEAS<i>:RFSettings[:PCC]:FREQuency	CONFigure:LTE:SIGN<i>:RFSettings[:PCC]:CHANnel:UL
Frequency offset	CONFigure:LTE:MEAS<i>:RFSettings:FOFFset	CONFigure:LTE:SIGN<i>:RFSettings[:PCC]:FOFFset:UL
Expected nominal power	CONFigure:LTE:MEAS<i>:RFSettings:ENPower	CONFigure:LTE:SIGN<i>:RFSettings:ENPMode CONFigure:LTE:SIGN<i>:RFSettings:ENPower
User margin	CONFigure:LTE:MEAS<i>:RFSettings:UMARgin	CONFigure:LTE:SIGN<i>:RFSettings:UMARgin
Mixer level offset	CONFigure:LTE:MEAS<i>:RFSettings:MLOFfset	CONFigure:LTE:SIGN<i>:RFSettings:MLOFfset
Channel bandwidth	CONFigure:LTE:MEAS<i>[:PCC]:CBANdwidth	CONFigure:LTE:SIGN<i>:CELL:BANDwidth[:PCC]:DL

Table 3-3: Mapping for multi evaluation measurement commands

Setting	Commands for SA scenario	Commands for CSP scenario
Measurement mode	CONFigure:LTE:MEAS<i>:MEValuation:MMODe	Fixed value TMODe
TPC mode settings	CONFigure:LTE:MEAS<i>:MEValuation:TMODe:SCOunt CONFigure:LTE:MEAS<i>:MEValuation:TMODe:ENPower CONFigure:LTE:MEAS<i>:MEValuation:TMODe:RLEVel?	Automatic configuration
UL-DL configuration	CONFigure:LTE:MEAS<i>:MEValuation:ULDL	CONFigure:LTE:SIGN<i>:CELL:ULDL
Special subframe	CONFigure:LTE:MEAS<i>:MEValuation:SSUBframe	CONFigure:LTE:SIGN<i>:CELL:SSUBframe
Cyclic prefix	CONFigure:LTE:MEAS<i>:MEValuation:CPRefix	CONFigure:LTE:SIGN<i>:CELL:CPRefix
Network signaled value	CONFigure:LTE:MEAS<i>:MEValuation:NSValue	CONFigure:LTE:SIGN<i>:CONNection:ASEMission
Physical cell ID	CONFigure:LTE:MEAS<i>:MEValuation:PLCid	CONFigure:LTE:SIGN<i>:CELL[:PCC]:PCID
Group hopping	CONFigure:LTE:MEAS<i>:MEValuation:GHOPping	CONFigure:LTE:SIGN<i>:CONNection:GHOPping
Sounding RS	CONFigure:LTE:MEAS<i>:MEValuation:SRS:ENABle	CONFigure:LTE:SIGN<i>:CELL:SRS:ENABle modifies signaling and measurement setting CONFigure:LTE:MEAS<i>:MEValuation:SRS:ENABle modifies only measurement setting
High dynamic mode	CONFigure:LTE:MEAS<i>:MEValuation:POWer:HDMode	Fixed value OFF

3.6 List of Commands

4 LTE PRACH Measurement

The "LTE PRACH" measurement provides quick and flexible tests on LTE FDD and TDD random access preambles. The tests cover the following UE transmitter properties:

- Modulation accuracy for each PRACH subcarrier (EVM, Magnitude Error, Phase Error)
- Transmit OFF power, transmit ON power and power ramping between them (Power Dynamics)
- I/Q Constellation diagram

The PRACH measurement requires option R&S CMW-KM500 for FDD signals and R&S CMW-KM550 for TDD signals.

4.1 What's New in this Revision

This revision describes version 3.2.82 and later of the "LTE PRACH Measurement" firmware application. Compared to version 3.2.10, it provides the following new features:

- Shortcut softkey to the GPRF generator, see Shortcut Configuration

Software Version

To check your R&S CMW software version, open the "Setup" dialog and click "HW/SW Equipment". The initial software version for each remote control command is quoted in the reference description.

4.2 General Description

The LTE PRACH measurement captures an uplink (UL) LTE PRACH signal and provides TX measurement results for the random access preambles. Both FDD signals (option R&S CMW-KM500) and TDD signals (option R&S CMW-KM550) can be measured.

The following sections describe how to perform and configure the measurement.

4.2.1 Test Setup

The external RF signal source (mobile station, signal generator etc.) is connected to one of the RF input connectors (RF COM) at the front panel of the R&S CMW. No additional cabling and no external trigger is needed.

The input level ranges of all RF COM connectors are identical.

See also: "RF Connectors" in the R&S CMW user manual, chapter "Getting Started"

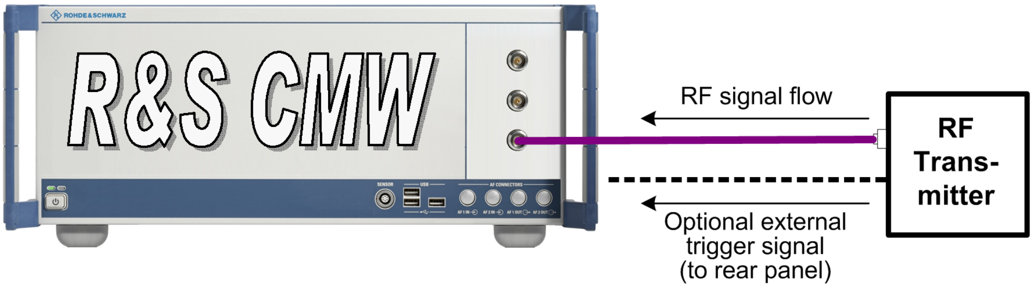


Fig. 4-1: Connecting an RF transmitter to the instrument

4.2.2 How to Measure an Uplink PRACH Signal

The measurement expects an LTE PRACH UL signal. Any other signals, e.g. an LTE UL signal without preambles (established connection) will not yield measurement results.

After connecting your LTE UE to the R&S CMW, you have to adjust at least the following analyzer settings to the properties of the analyzed PRACH signal:

- Duplex mode
- Analyzer "Frequency"
- "Expected Nominal Power", (optional) "User Margin" and "External Attenuation (Input)".
  Recommended values: "Expected Nominal Power" = peak power of the UE signal during the measurement; "User Margin" = 0 dB. The smallest possible value of the "Expected Nominal Power" plus the "User Margin" ensures maximum dynamic range.

A number of "Measurement Control" settings in the configuration dialog must be in accordance with the measured signal, the transmitted preambles and especially the used Zadoff-Chu sequence. This is required for synchronization to the received signal and proper decoding. Ensure that the following parameters match up:

- "Channel Bandwidth"
- "PRACH Configuration Index"
- "High Speed Flag": this software version supports only the value FALSE, i.e. the unrestricted set of N_{CS} must be used
- "Logical Root Sequence Index"
- "Zero Correlation Zone Config"

The R&S CMW can auto-detect the location of the used resource blocks in the frequency domain ("PRACH Frequency Offset"). It can also auto-detect which of the 64 preamble sequences defined by the parameters above is used ("Sequence Index").

Non-matching "Measurement Control" settings generally result in large EVM results and/or a "Sequence Correlation" much smaller than 1 (result presented in each view).

The default trigger settings are usually appropriate and don't need to be modified, see chapter 4.2.5, "Trigger Modes", on page 743.

4.2.3 Defining the Scope of the Measurement

A single shot LTE PRACH measurement comprises one measurement cycle which comprises a configurable number of measurement intervals (statistic count).

In this context two types of result views must be distinguished:

- "Single Preamble" measurements evaluate one preamble per measurement interval. The related views display results for the current measurement interval (one preamble) and provide a statistical evaluation for the already measured preambles (e.g. average within measurement cycle, extreme value since start of measurement).
  Examples for "Single Preamble" result views are "Error Vector Magnitude" and "Power Dynamics".
- "Multi Preamble" measurements evaluate up to 16 consecutive preambles per measurement interval. The related views present the results per preamble, for all preambles of the current measurement interval. No statistical evaluation over several measurement intervals is performed.
  The preambles captured within one measurement interval are labeled 1 to n, with n ≤ 16. "Single Preamble" measurements evaluate the preamble labeled 1.
  A sequence of preambles to be captured in a single measurement interval must have a periodicity of 20 ms, i.e. each 20 ms a preamble starts.
  Examples for "Multi Preamble" result views are "EVM vs Preamble" and "Power vs Preamble".

The scope of the measurement is configured in section "Measurement Control" of the configuration tree. The most important parameters are:

- "Repetition" on page 763
- "Number of Preambles" on page 765
- "Statistic Count" on page 766
- "Dynamics > Statistic Count" on page 768

Example: Limited sequence of preambles with increasing power

Scenario: A sequence of 10 preambles with increasing power shall be measured. Main result of interest is the TX power of the individual preambles (verify correct ramping up of preamble power by UE).

Used view: "Power vs Preamble"

Settings: statistic count = 1, number of preambles = 10, repetition = single shot

Example: Statistical evaluation for preambles with constant power

Scenario: The EVM shall be measured for 100 preambles, so that the average and the maximum value can be evaluated.

Used view: "EVM"

Settings: statistic count = 100, number of preambles = 1, repetition = single shot

4.2.4 Parallel Signaling and Measurement

The PRACH measurement can be used in parallel to the LTE signaling application (option R&S CMW-KS500/-KS550). The signaling application emulates an LTE cell signal so that the UE tries to attach and sends random access preambles. These preambles can then be measured using the PRACH measurement. You can configure the signaling application so that it does not answer the received preambles.

To use both applications in parallel, the combined signal path scenario must be activated (see "Scenario = Combined Signal Path" on page 760). Most signal routing and analyzer settings and some measurement control settings are then configured by the signaling application. The PRACH measurement displays the corresponding signaling settings instead of its own settings. These signaling settings can be configured both in the measurement GUI and in the GUI of the signaling application.

To configure these settings via remote commands, the commands of the signaling application must be used. For a command mapping table, see chapter 4.5.4, "Combined Signal Path Commands", on page 813.

The most important signaling parameters not relevant for standalone measurements can nevertheless be configured both in the measurement GUI and in the GUI of the signaling application. In the measurement GUI they can be accessed via hotkeys.

Whenever the combined signal path scenario is activated or the controlling application is changed, the PRACH trigger signal provided by the controlling signaling application is selected automatically as trigger source.

4.2.5 Trigger Modes

The LTE PRACH measurement requires a trigger event for each preamble to be measured. It can be performed in the following trigger modes:

- IF Power (default mode): With an internal IF power trigger, the measurement is triggered by the power ramp of the received preambles. The default value of the minimum trigger gap is usually big enough to ensure that the measurement is not retriggered within a preamble and small enough to ensure that the trigger system is re-armed before the next preamble starts.
- External Trigger A/B: External trigger signal fed in via TRIG A or TRIG B on the rear panel of the instrument.
- Additional trigger modes: Other firmware applications, e.g. the LTE signaling application (option R&S CMW-KS500/-KS550) or the GPRF generator may provide additional trigger modes. Refer to the documentation of the corresponding firmware application for a description of these trigger modes.

For configuration see chapter 4.3.2.5, "Trigger Settings", on page 768.

4.2.6 Calculation of Modulation Results

Modulation results are based on a comparison between the measured signal, corrected by the average frequency and timing offset for each measured subframe, and an ideal reference waveform.

See also: "Modulation Accuracy" in the R&S CMW user manual, chapter "System Overview"

3GPP TS 36.101, Annex F, specifies the following additional conditions:

- The I/Q origin offset shall be removed from the evaluated signal before calculating the EVM.
- The EVM calculation shall be based on two different FFT processing windows in time domain, separated by the "EVM window length" W. The minimum test requirement applies to the larger of the two obtained EVM values.

The definition of the EVM window and the two FFT processing windows is shown below.

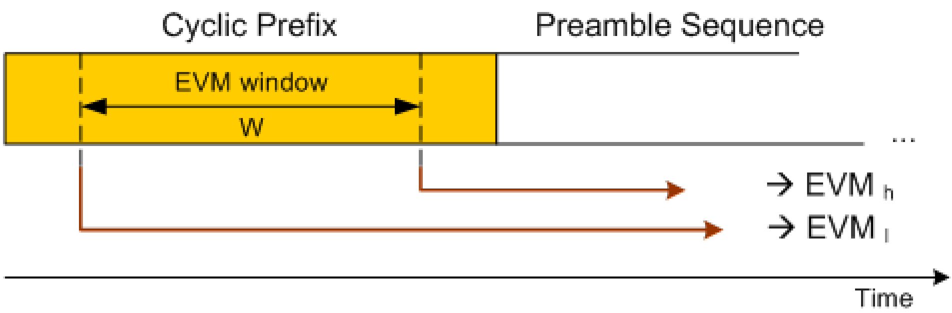


Fig. 4-2: EVM window definition

The EVM window is centered on the cyclic prefix (CP) at the beginning of the preamble. Its length is specified in the standard, depending on the preamble format (see 3GPP TS 36.101, table F.5.5-1).

The CP is a cyclic extension of the preamble sequence. As a consequence the EVM for a signal with good modulation accuracy is expected to be largely independent of the EVM window size. Differences between EVM_h and EVM_l arise e.g. due to the effects of time domain windowing of FIR pulse shaping.

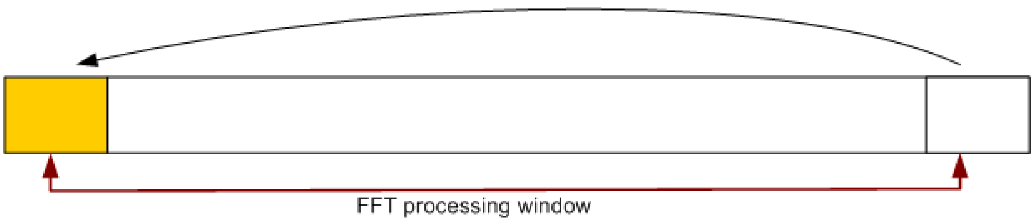


Fig. 4-3: Cyclic prefix

EVM window settings

Use the settings in the "Config... > Measurement Control > Modulation > EVM Window Length" section to adjust the length of the EVM window (see "EVM Window Length" on page 767). The minimum value of 1 FFT symbol actually corresponds to a window of zero length so that $EVM_h = EVM_l$.

Use the setting "Config... > Measurement Control > Modulation > EVM Window Position" to select whether the result diagrams (traces) are calculated for low or high EVM window position (see "EVM Window Position" on page 767). Statistical tables provide results for both window positions.

4.2.7 LTE PRACH UL Signal Properties

This section describes the following selected topics related to LTE UL PRACH signal properties. For a description of the frequency bands see chapter 3.2.4.2, "Frequency Bands", on page 506.

4.2.7.1 Preambles in the Frequency Domain

There are five preamble formats defined by 3GPP, see table below. For preamble format 0 to 3 a preamble occupies 839 adjacent subcarriers with a spacing of 1.25 kHz, in total 1.04875 MHz. For preamble format 4 there are 139 subcarriers with a spacing of 7.5 kHz, in total 1.0425 MHz. In both cases 6 Resource Blocks (RB) are reserved in the frequency domain for the preamble.

Table 4-1: Preambles in the frequency domain

Preamble format	Subcarriers (SC)	SC spacing
0 to 3	839	1.25 kHz
4	139	7.5 kHz

The location of the 6 RBs within the channel bandwidth, i.e. the number of the first RB to be used, is determined by higher layers. For FDD it equals a parameter called PRACH frequency offset, for TDD it is calculated from this parameter and the parameter frequency resource index (determined by the PRACH configuration index). For details see 3GPP TS 36.211 section 5.7.1 "Time and frequency structure". Both the PRACH frequency offset and the PRACH configuration index can be configured for the PRACH measurement.

The total number of resource blocks available per channel depends on the channel bandwidth as shown in the following table.

Channel Bandwidth [MHz]	1.4	3	5	10	15	20
Resource Blocks (RB)	6	15	25	50	75	100

4.2.7.2 Preambles in the Time Domain

In the time domain a preamble consists of a Cyclic Prefix (CP) and the preamble sequence.

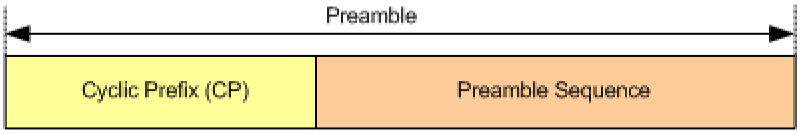


Fig. 4-4: Preamble structure

The length of CP and preamble sequence depend on the preamble format as shown in the following table, where T_s is the basic LTE time unit (1 T_s = 1/30.72 MHz ≈ 32.55 ns).

Table 4-2: Preambles in the time domain

Preamble format	CP length [T_s]	Sequence length [T_s]	Preamble length [T_s]
0	3168	24576	27744
1	21024	24576	45600
2	6240	2*24576	55392
3	21024	2*24576	70176
4	448	4096	4544

Thus a preamble with format 0 to 3 requires between 2 and 6 UL timeslots for transmission. A preamble with format 4 is only relevant for TDD and is transmitted in uplink pilot timeslots (UpPTS).

The time resources allowed for transmission of preambles are restricted by 3GPP. There are 64 configurations for FDD and 58 configurations for TDD, identified via the PRACH configuration index. The index defines which radio frames, subframes etc. can be used and which preamble format is used. For details refer to 3GPP TS 36.211 section 5.7.1.

4.2.7.3 Preamble Sequences

Random access preambles are generated from Zadoff-Chu sequences with zero correlation zone. For each cell a set of 64 preamble sequences is generated from one or several root Zadoff-Chu sequences via cyclic shift. The UE decides which of these 64 preamble sequences it uses for the PRACH procedure.

A logical root sequence index is broadcasted within the system information as RACH_ROOT_SEQUENCE. The UE uses the logical root sequence index to determine the physical root sequence number u as defined in table 5.7.2-4 and 5.7.2-5 in 3GPP TS 36.211.

From the u^{th} root Zadoff-Chu sequence, random access preambles with zero correlation zones of length $N_{CS}-1$ are generated by cyclic shift. The parameter N_{CS} depends on the parameters Zero Correlation Zone Config and High Speed Flag, both provided by higher layers. It is also used for calculation of the cyclic shift.

If the root sequence allows less than 64 cyclic shifts, the next root sequence is used to generate additional preambles via cyclic shift, and so on until the set of 64 preambles is complete.

To allow the R&S CMW to determine the used preamble sequence, the parameters "Logical Root Sequence Index" and "Zero Correlation Zone Config" must be configured correctly. In this software version the "High Speed Flag" is fix so that only the unrestricted set of N_{CS} values can be used. Which of the 64 preamble sequences has been selected by the UE can be determined automatically by the R&S CMW or configured manually as "Sequence Index".

For a detailed mathematical description of preamble sequence generation please refer to 3GPP TS 36.211 section 5.7.2 "Preamble sequence generation".

4.2.8 Limit Settings and Conformance Requirements

Conformance requirements for LTE transmitter tests are specified in 3GPP TS 36.521, section 6, "Transmitter Characteristics".

The following sections give an overview of the PRACH measurement limit settings and the related test requirements.

4.2.8.1 Transmit Modulation Limits

A poor modulation accuracy of the UE transmitter increases the transmission errors in the uplink channel of the LTE network and decreases the system capacity. The Error Vector Magnitude (EVM) is the critical quantity to assess the modulation accuracy of an LTE UE.

According to 3GPP, the EVM measured at UE output powers ≥ −40 dBm and under normal operating conditions shall not exceed 17.5 % for random access preambles.

The EVM limits can be set in the configuration dialog, depending on the modulation scheme and along with limits for the other measured quantities.

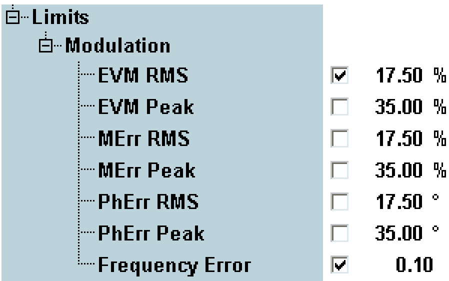


Fig. 4-5: Modulation limit settings

Characteristics	Refer to 3GPP TS 36.521 V9.3.0, section...	Specified Limit
EVM (RMS)	6.5.2.1 Error Vector Magnitude (EVM)	≤ 17.5 %

4.2.8.2 Power Dynamics Limits

Transmission at excessive uplink power increases interference to other channels while a too low uplink power increases transmission errors. For PRACH transmission 3GPP defines a time mask to verify the UL power while a preamble is transmitted (transmit ON power), the UL power in the adjacent subframes (transmit OFF power) and the power ramping in between.

The ON power is specified as the mean UE output power over the preamble (more exactly, over the PRACH measurement period, see table 4-3). For the OFF power the mean power has to be measured both in the preceding subframe and in the subsequent subframe, excluding a transient period of 20 µs adjacent to the PRACH measurement period.

The following figure provides a summary of the time periods relevant for ON and OFF power limits.

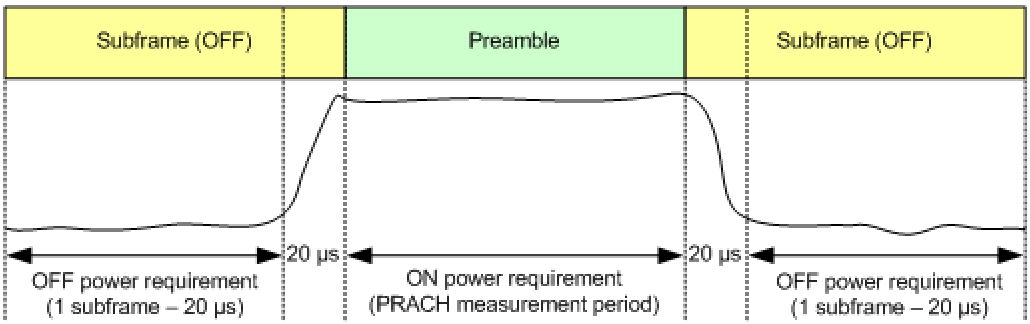


Fig. 4-6: Measurement periods ON/OFF power

The OFF power shall not exceed -48.5 dBm. The ON power shall be between -8.5 dBm and 6.5 dBm. The limits for ON and OFF power can be set in the configuration dialog.

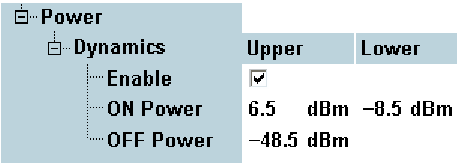


Fig. 4-7: Power dynamics limit settings

Characteristics	Refer to 3GPP TS 36.521 V9.3.0, section...	Specified Limit
ON power	6.3.4.2 PRACH and SRS Time Mask	≥ -8.5 dBm, ≤ 6.5 dBm
OFF power	6.3.4.2 PRACH and SRS Time Mask	≤ -48.5 dBm

4.2.9 Measurement Results

The results of the LTE PRACH measurement are displayed in several different views. Use the "Display" parameters to select the views and to change the appearance and contents of the views. The views are described in the following sections.

4.2.9.1 Overview

In the overview a selection of the following results can be displayed:

- Error Vector Magnitude
- Magnitude Error
- Phase Error
- Error Vector Magnitude vs Preamble
- Power vs Preamble
- I/Q Constellation Diagram
- Power Dynamics
- Most important results of detailed view "TX Measurement"

See also: "TX Measurements" in the R&S CMW user manual, chapter "System Overview"

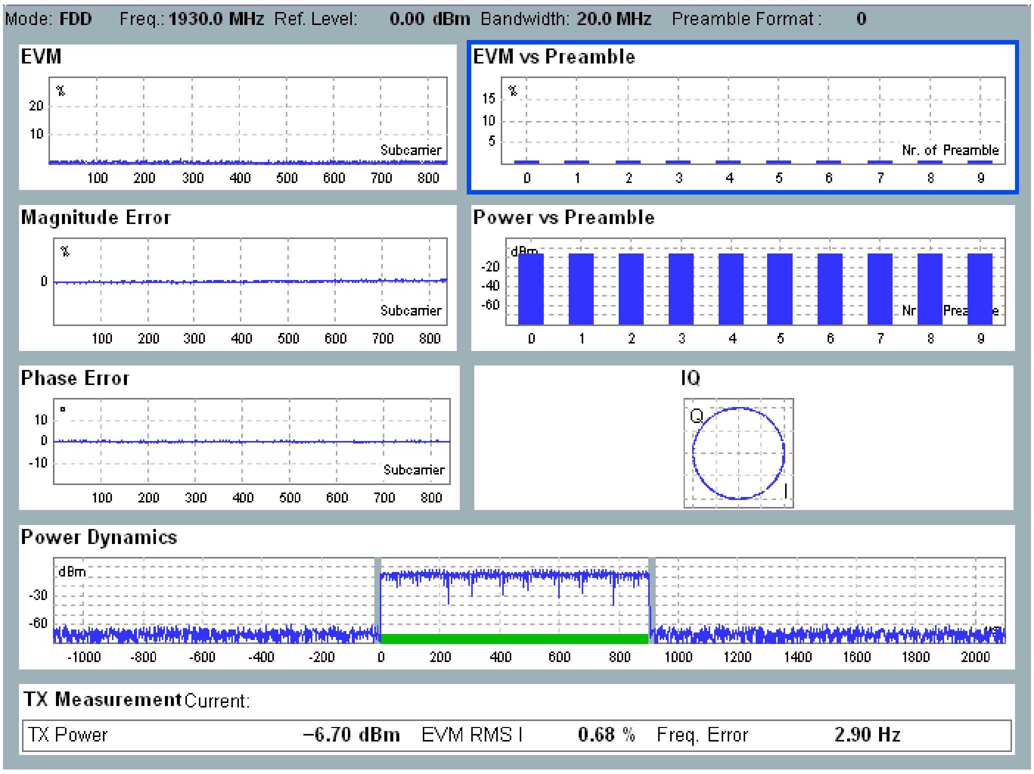


Fig. 4-8: LTE PRACH: Overview

The results to be measured and displayed in the overview can be limited using the hotkey "Assign Views", see chapter 4.3.2.8, "Additional Softkeys and Hotkeys", on page 771.

You can enlarge one of the diagrams in the overview and show a detailed view with additional measurement results, see chapter 4.2.9.7, "Selecting and Modifying Views", on page 756. The traces are described in the "Detailed Views" sections.

4.2.9.2 Detailed Views: EVM, Magnitude Error, Phase Error

This section applies to the following detailed views:

- Error Vector Magnitude
- Magnitude Error
- Phase Error

Each of these "single preamble" views shows a diagram and a statistical overview of results.

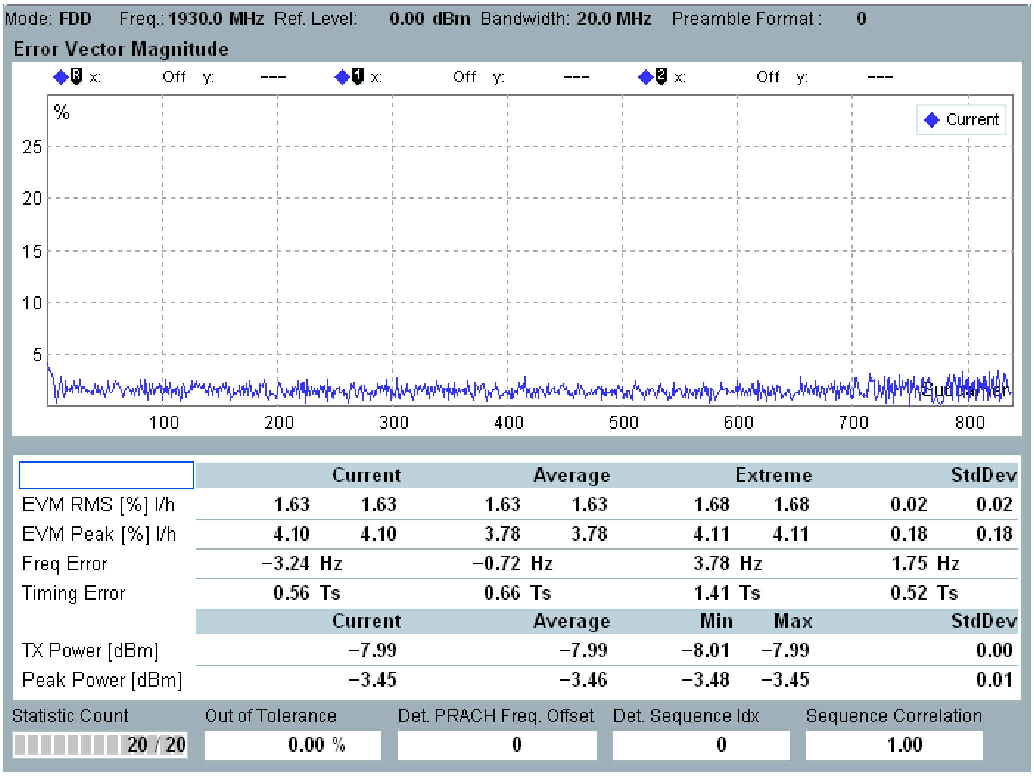


Fig. 4-9: LTE PRACH: Error Vector Magnitude

The diagram shows the EVM in all preamble subcarriers. For preamble format 0 to 3 there are 839 subcarriers with a spacing of 1.25 kHz. For preamble format 4 there are 139 subcarriers with a spacing of 7.5 kHz. The values are RMS averaged over the samples in each subcarrier.

For description of the table rows see chapter 4.2.9.6, "Detailed Views: TX Measurement", on page 755.

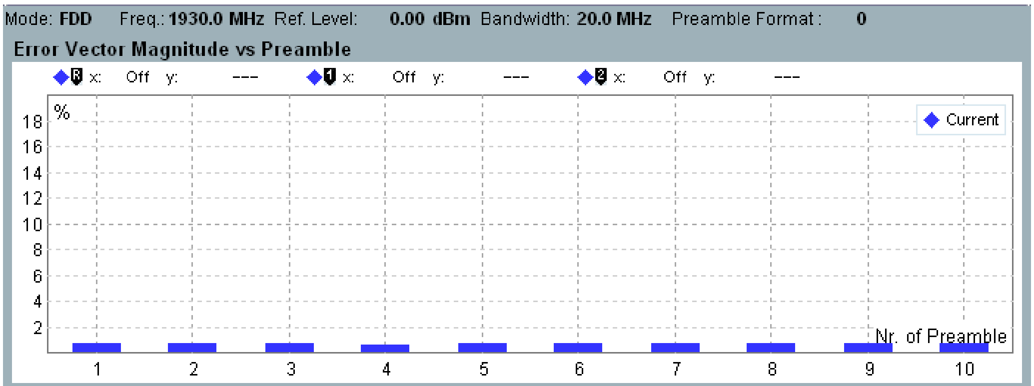
For table columns and other elements refer to chapter 4.2.9.9, "Common View Elements", on page 757.

4.2.9.3 Detailed Views: EVM vs Preamble, Power vs Preamble

This section applies to the following detailed views:

- Error Vector Magnitude vs Preamble
- Power vs Preamble

Each of these "multi preamble" views shows a diagram and a statistical overview of results.



Nr of Preambles	1	2	3	4	5	6
EVM RMS [%] low	0.73	0.71	0.66	0.63	0.64	0.68
EVM RMS [%] high	0.74	0.71	0.66	0.63	0.65	0.69
EVM Peak [%] low	1.76	1.71	1.87	1.47	1.81	1.88
EVM Peak [%] high	1.72	1.70	1.74	1.71	1.92	1.75
Freq Error [Hz]	-0.34	-0.92	-1.72	-2.02	-0.08	-2.14
Timing Error [Ts]	0.61	0.56	0.56	0.56	0.56	0.61
Det. PRACH Freq. Offset	19	19	19	19	19	19
Det. Sequence Idx	0	0	0	0	0	0
Sequence Correlation	1.00	1.00	1.00	1.00	1.00	1.00
Reliability	0	0	0	0	0	0

Fig. 4-10: LTE PRACH: EVM vs Preamble

The diagram shows results for a configurable number of preambles (up to 16), labeled 1 to n. The preambles are captured within one measurement interval and must have a periodicity of 20 ms, so each 20 ms the start of a preamble is expected.

- Error Vector Magnitude vs Preamble:
  The diagram displays EVM RMS values. For each preamble either the result determined for low EVM window position or the result determined for high EVM window position is shown - whichever is the higher. Thus for this diagram the setting EVM Window Position is ignored.
- Power vs Preamble:
  The diagram displays TX power values (received power, RMS averaged over all samples within the preamble duration).

Table

The table below the diagram shows additional results. Each column corresponds to one preamble with the preamble label indicated as column title.

The upper rows correspond to the results presented in the "TX Measurement" view. For a description see chapter 4.2.9.6, "Detailed Views: TX Measurement", on page 755.

The row "Reliability" provides a reliability indicator for each preamble. For a description of the individual values see chapter 4.5.1.5, "Reliability Indicator", on page 781.

For a description of the lower rows see chapter 4.2.9.9, "Common View Elements", on page 757.

4.2.9.4 Detailed Views: I/Q Constellation Diagram

This "single preamble" view shows the modulation symbols as points in the I/Q plane.

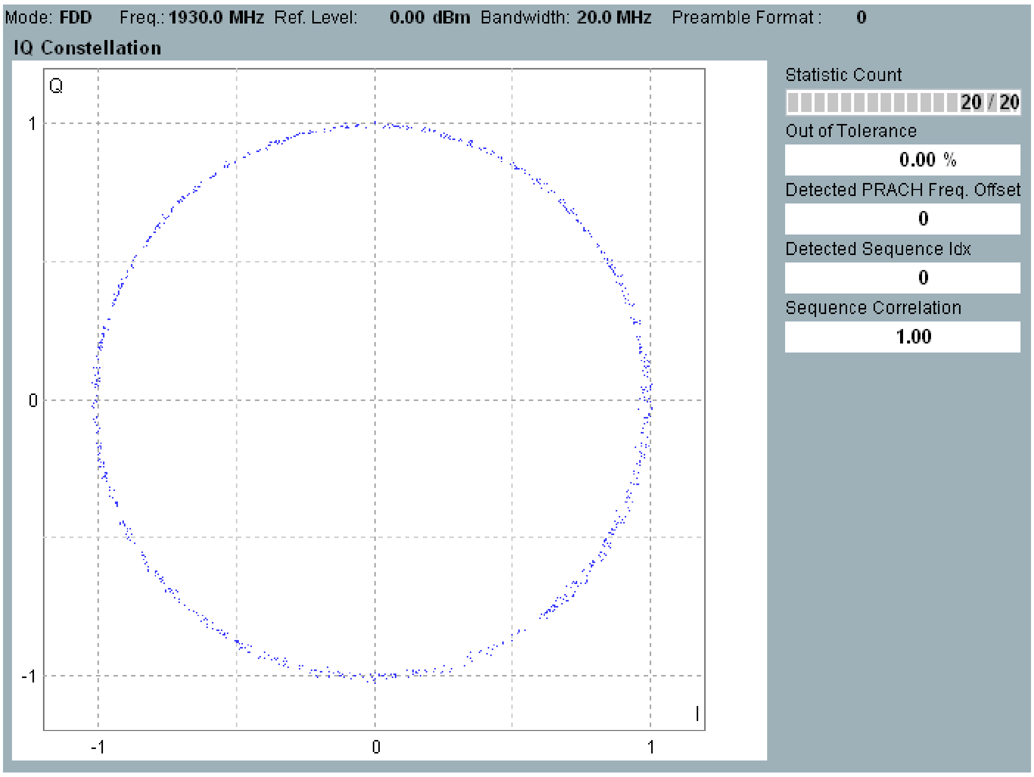


Fig. 4-11: LTE PRACH: I/Q Constellation diagram

The typical constellation diagram of a random access preamble shows 839 points (preamble format 4: 139 points) evenly distributed on a circle around the origin. The I/Q amplitudes correspond to the values that the R&S CMW uses for the EVM calculation: A possible I/Q origin offset is already subtracted out.

See also: "I/Q Constellation Diagram" in the R&S CMW user manual, chapter "System Overview"

For additional information refer to chapter 4.2.9.9, "Common View Elements", on page 757.

4.2.9.5 Detailed Views: Power Dynamics

This "single preamble" view shows a diagram and a statistical overview of related power results.

Fig. 4-12: LTE PRACH: Power Dynamics

The diagram shows the UE output power vs. time, sampled with 48 T_s (1.5625 µs). The trace covers the range from -1100 µs to +2098.4375 µs relative to the start of the preamble.

The table below the diagram shows ON power and OFF power values. According to 3GPP the ON power is the mean UE output power over the preamble, i.e. over the PRACH measurement period - see table 4-3. In addition to this mean value the table lists also the peak power within the measurement period. The ON power measurement period is marked by a green horizontal bar in the diagram.

The OFF power is the mean power in one subframe (1 ms) before and after the ON power measurement period, excluding a transient period of 20 µs adjacent to the ON power measurement period. These transient periods are indicated by gray vertical bars in the diagram.

Table 4-3: Measurement period for ON power

Preamble format	Measurement period ON power (µs)
0	903.1
1	1484.4
2	1803.1
3	2284.4
4	147.9

Signal configuration

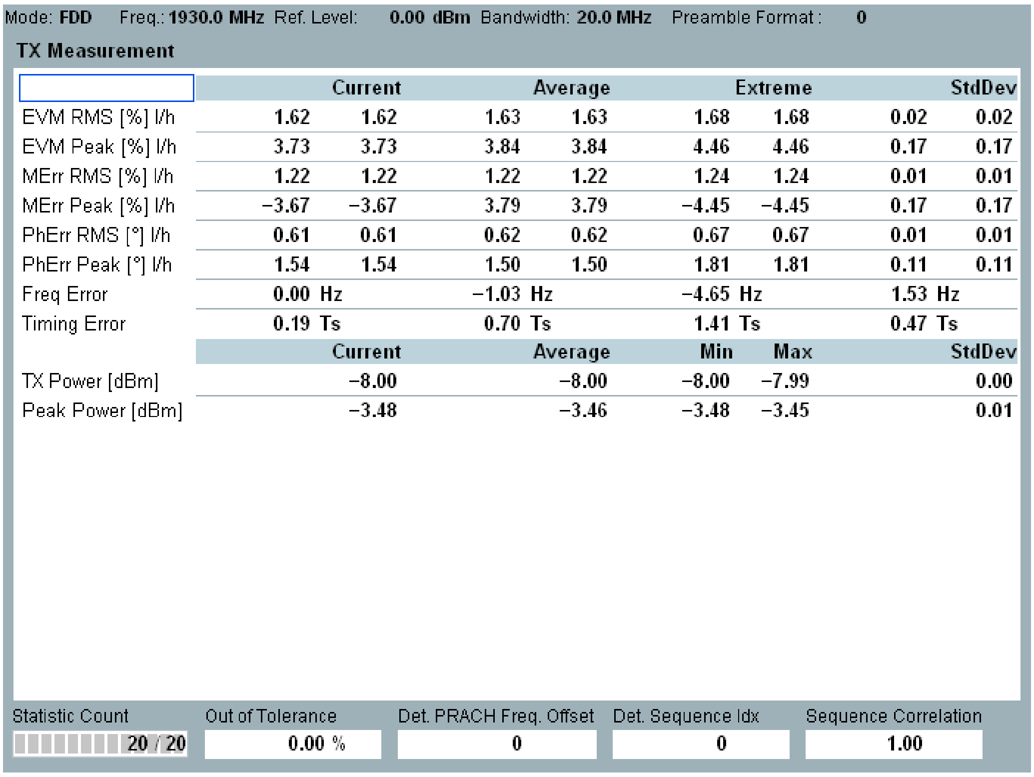
Ensure that two subframes before and after the preamble are off (OFF OFF preamble OFF OFF). This guarantees that the measured "OFF Power (before)" is not falsified by power contributions of a preceding ON subframe ramped down too slowly, or the "OFF Power (after)" by a subsequent ON subframe ramped up too early.

You can check the first 100 µs of the trace to ensure that the second subframe before the preamble is off. For preamble formats 0 and 4 you can also check the end of the trace to ensure that the second subframe after the preamble is off.

For additional information refer to chapter 4.2.9.9, "Common View Elements", on page 757.

4.2.9.6 Detailed Views: TX Measurement

This "single preamble" view contains tables of statistical results for the PRACH measurement.



Mode: FDD Freq.: 1930.0 MHz Ref. Level: 0.00 dBm Bandwidth: 20.0 MHz Preamble Format : 0

TX Measurement

	Current		Average		Extreme		StdDev	
EVM RMS [%] l/h	1.62	1.62	1.63	1.63	1.68	1.68	0.02	0.02
EVM Peak [%] l/h	3.73	3.73	3.84	3.84	4.46	4.46	0.17	0.17
MErr RMS [%] l/h	1.22	1.22	1.22	1.22	1.24	1.24	0.01	0.01
MErr Peak [%] l/h	−3.67	−3.67	3.79	3.79	−4.45	−4.45	0.17	0.17
PhErr RMS [°] l/h	0.61	0.61	0.62	0.62	0.67	0.67	0.01	0.01
PhErr Peak [°] l/h	1.54	1.54	1.50	1.50	1.81	1.81	0.11	0.11
Freq Error	0.00 Hz		−1.03 Hz		−4.65 Hz		1.53 Hz	
Timing Error	0.19 Ts		0.70 Ts		1.41 Ts		0.47 Ts	
	Current		Average		Min	Max	StdDev	
TX Power [dBm]	−8.00		−8.00		−8.00	−7.99	0.00	
Peak Power [dBm]	−3.48		−3.46		−3.48	−3.45	0.01	

Statistic Count	Out of Tolerance	Det. PRACH Freq. Offset	Det. Sequence Idx	Sequence Correlation
20 / 20	0.00 %	0	0	1.00

Fig. 4-13: LTE PRACH: TX Measurement

The table provides an overview of statistical values obtained from the measured preamble. Other detailed views provide a subset of these values:

- EVM, Magnitude Error, Phase Error: The R&S CMW calculates RMS and peak values for low and high EVM window position (l/h); see chapter 4.2.6, "Calculation of Modulation Results", on page 744.

- Carrier Frequency Error: offset between the measured carrier frequency and the nominal RF frequency of the measured radio channel
- Timing Error: Difference between the actual timing and the expected timing. The timing error measurement requires an "external" trigger signal to derive the expected timing.
  Suitable trigger signals are e.g. the PRACH trigger signal provided by the signaling application or an external trigger fed in at the TRIG A or TRIG B connector.
  The unit T_s stands for the basic LTE time unit, see chapter 4.2.7.2, "Preambles in the Time Domain", on page 746.
- TX Power: received power, RMS averaged over all samples within the preamble duration
- Peak Power: peak power of all samples within the preamble duration

For additional information refer to chapter 4.2.9.9, "Common View Elements", on page 757.

4.2.9.7 Selecting and Modifying Views

Use the "Display" parameters to select the views and to change the appearance and contents of the views. Depending on the selected view the following "Display" hotkeys are available at the bottom of the GUI:

Hotkey	Description
"Select View ..."	Switch to a certain detailed view or overview. Alternatively select a diagram in the overview and press ENTER or the rotary knob.
"Select Trace ..."	Select the trace types to be displayed in the view.
"X Scale... / Y Scale..."	Modify the ranges of the X-axis and the Y-axis.

Additional options are available in the "Measurement Control" section of the configuration dialog.

4.2.9.8 Using Markers

Use the "Marker" parameters to activate markers and to modify their position. The following "Marker" hotkeys are available at the bottom of the GUI:

Hotkey	Description
"Ref. Marker ..."	Enable or disable the reference marker and select the marker position. If several traces can be displayed, a trace can also be selected.
"Marker 1 /2 ..."	Enable or disable marker 1 or 2 and define the marker position (absolute or relative to the reference marker). Depending on the trace mode, a trace can also be selected.
"Select Trace Mode"	Define whether marker 1 and 2 are set to the same trace as the reference marker (collective) or to selectable individual traces.

See also: "Markers" in the R&S CMW user manual, chapter "System Overview"

4.2.9.9 Common View Elements

This section describes elements that are displayed in most views.

Tables

Most detailed views show tables providing a statistical evaluation of results obtained from the measured preamble. The statistical values in the tables are calculated as follows:

- **Current:** Value of the result obtained in the last measurement interval. For some modulation results the current RMS value (the average over all samples in the measured preamble) and the current peak value (the peak of all samples in the measured preamble) are available.
- **Average:** Average of all "Current" values referenced to the last statistics cycle.
- **Extreme, Min, Max:** Largest or smallest "Current" value that the R&S CMW obtained since the start of the measurement.
- **StdDev:** Standard deviation of all "Current" values since the start of the measurement.

All statistical results (statistical tables and "Average" or "Max" traces) are calculated according to the general rules for statistical results.

See also: "Statistical Results" in the R&S CMW user manual, chapter "System Overview"

For description of individual table rows see chapter 4.2.9.5, "Detailed Views: Power Dynamics", on page 753.

Statistic Count

Progress bar for the measurement. During the first single shot after the start of the measurement, the bar shows the number of measured preambles relative to the "Statistic Count". A filled progress bar indicates that the first shot is complete and the statistical depth has been reached.

See also: "Statistical Settings" in the R&S CMW user manual, chapter "System Overview"

Out of Tolerance

Percentage of measurement intervals (preambles) that were failed because they exceeded the limits in the diagram.

Detected PRACH Frequency Offset

The PRACH frequency offset determines the position of the 6 preamble RBs within the channel bandwidth. It is either detected automatically or selected manually, see "PRACH Frequency Offset" on page 765.

Detected Sequence Index

The sequence index identifies which of the 64 preamble sequences defined for the cell is used by the UE. It is either detected automatically or selected manually, see "Sequence Index" on page 767.

Sequence Correlation

The sequence correlation indicates the correlation between the ideal preamble sequence determined from the parameter settings and the measured preamble sequence. A value of 1 corresponds to perfect correlation. A value much smaller than 1 indicates that the searched preamble sequence was not found. In the latter case please check the parameter settings related to the preamble, see also chapter 4.2.2, "How to Measure an Uplink PRACH Signal", on page 741.

4.3 GUI Reference

The following sections provide detailed reference information on the Graphical User Interface (GUI) and the parameters of the "LTE PRACH" measurement.

4.3.1 Measurement Control

The measurement is turned on or off using the ON | OFF or RESTART | STOP keys.

See also: "Measurement Control" in the R&S CMW user manual, chapter "System Overview"

PRACH (Softkey)
The softkey shows the current measurement state. Additional measurement substates can be retrieved via remote control.

Remote command:
`INITiate:LTE:MEAS<i>:PRACh`
`STOP:LTE:MEAS<i>:PRACh`
`ABORt:LTE:MEAS<i>:PRACh`
`FETCh:LTE:MEAS<i>:PRACh:STATe?`
`FETCh:LTE:MEAS<i>:PRACh:STATe:ALL?`

4.3.2 Parameters and Settings

The most important settings of the "LTE PRACH" measurement are displayed in the measurement dialog.

All settings are defined via softkeys and hotkeys or using the "LTE PRACH Configuration" dialog. The configuration dialog is described in the following sections. To open the dialog, select the "PRACH" tab and press the "Config" hotkey.

4.3.2.1 Signal Routing and Analyzer Settings

The following parameters configure the RF input path. All parameters are common measurement settings, i.e. they have the same value in all measurements (e.g. PRACH measurement and multi evaluation measurement).

See also: "Connection Control (Measurements)" in the R&S CMW user manual, chapter "System Overview"

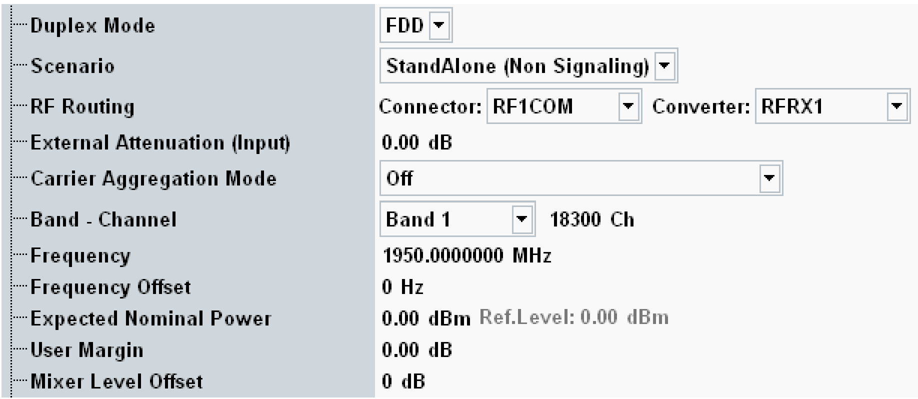


Fig. 4-14: Signal routing and analyzer settings

Duplex Mode

Selects the duplex mode of the LTE signal: FDD or TDD.

In the Standalone (SA) scenario, this parameter is controlled by the measurement. In the Combined Signal Path (CSP) scenario, it is controlled by the signaling application.

Remote command:
`CONFigure:LTE:MEAS<i>:DMODe` (SA)
`CONFigure:LTE:SIGN<i>:DMODe` (CSP)

Scenario = StandAlone

The PRACH measurement is used standalone.

Remote command:
`ROUTe:LTE:MEAS<i>:SCENario:SALone`
`ROUTe:LTE:MEAS<i>:SCENario?`
`ROUTe:LTE:MEAS<i>?`

Scenario = Combined Signal Path
Allows to use an LTE signaling application (option R&S CMW-KS500/-KS550) in parallel to the LTE PRACH measurement. The signaling application is selected by the additional parameter "Controlled by".

Most parameters described in this section and some parameters described in section Measurement Control Settings display values determined by the signaling application. The corresponding measurement settings are remembered in the background and displayed again when switching back to the standalone scenario.

Connection status information of the signaling application is displayed at the bottom of the measurement views. Softkeys and hotkeys provide access to the settings of the signaling application and allow to switch the downlink signal on or off, see chapter 4.3.2.8, "Additional Softkeys and Hotkeys", on page 771.

For additional information see chapter 4.2.4, "Parallel Signaling and Measurement", on page 743.

Remote command:
`ROUTe:LTE:MEAS<i>:SCENario:CSPath`
`ROUTe:LTE:MEAS<i>:SCENario?`
`ROUTe:LTE:MEAS<i>?`

Scenario = Measure@ProtocolTest
Allows to use an LTE protocol test application in parallel to the LTE measurement. The protocol test application is selected by the additional parameter "Controlled by".

The signal routing and analyzer settings described in this section are ignored by the measurement application. The corresponding settings have to be configured within the protocol test application.

Protocol test applications are available for R&S CMW500, but not for R&S CMW270 and R&S CMW280.

Remote command:
`ROUTe:LTE:MEAS<i>:SCENario:MAPRotocol`
`ROUTe:LTE:MEAS<i>:SCENario?`

RF Routing
Selects the input path for the measured RF signal, i.e. the input connector and the RX module to be used.

Depending on your hardware configuration there may be dependencies between both parameters. Select the RF connector first. The "Converter" parameter offers only values compatible with the selected RF connector.

In the Standalone (SA) scenario, these parameters are controlled by the measurement. In the Combined Signal Path (CSP) scenario, they are controlled by the signaling application.

For connector and converter settings in the combined signal path scenario, use one of the `ROUTe:LTE:SIGN<i>:SCENario:...` signaling commands.

Remote command:
`ROUTe:LTE:MEAS<i>:SCENario:SALone` (SA)
`ROUTe:LTE:SIGN<i>:SCENario:...` (CSP)

External Attenuation (Input)
Defines the value of an external attenuation (or gain, if the value is negative) in the input path. The power readings of the R&S CMW are corrected by the external attenuation value.

The external attenuation value is also used in the calculation of the maximum input power that the R&S CMW can measure.

If a correction table for frequency-dependent attenuation is active for the chosen connector, then the table name and a button are displayed. Press the button to display the table entries.

In the Standalone (SA) scenario, this parameter is controlled by the measurement. In the Combined Signal Path (CSP) scenario, it is controlled by the signaling application.

Remote command:
`CONFigure:LTE:MEAS<i>:RFSettings:EATTenuation` (SA)
`CONFigure:LTE:SIGN<i>:RFSettings[:PCC]:EATTenuation:INPut` (CSP)

Carrier Aggregation Mode
This setting has no effect for PRACH measurements. Only the PCC is evaluated, even if carrier aggregation is active.

The parameter is only visible, if option R&S CMW-KM502/552 is available.

Band / Channel / Frequency
Center frequency of the RF analyzer. Set this frequency to the frequency of the measured RF signal to obtain a meaningful measurement result. The relation between operating band, frequency and channel number is defined by 3GPP (see chapter 3.2.4.2, "Frequency Bands", on page 506).

You can specify the RF frequency in two ways:
- Enter the frequency directly. The band and channel settings can be ignored or used for validation of the entered frequency. For validation select the designated band. The channel number resulting from the selected band and frequency is displayed. For an invalid combination no channel number is displayed.
- Select a band and enter a channel number valid for this band. The R&S CMW calculates the resulting frequency.

In the Standalone (SA) scenario, these parameters are controlled by the measurement. In the Combined Signal Path (CSP) scenario, they are controlled by the signaling application.

Remote command:
`CONFigure:LTE:MEAS<i>:BAND` (SA)
`CONFigure:LTE:MEAS<i>:RFSettings[:PCC]:FREQuency` (SA)
`CONFigure:LTE:SIGN<i>[:PCC]:BAND` (CSP)
`CONFigure:LTE:SIGN<i>:RFSettings[:PCC]:CHANnel:UL` (CSP)

Frequency Offset
Positive or negative frequency offset to be added to the specified center frequency of the RF analyzer.

In the Standalone (SA) scenario, this parameter is controlled by the measurement. In the Combined Signal Path (CSP) scenario, it is controlled by the signaling application.

Remote command:
`CONFigure:LTE:MEAS<i>:RFSettings:FOFFset` (SA)
`CONFigure:LTE:SIGN<i>:RFSettings[:PCC]:FOFFset:UL` (CSP)

Expected Nominal Power
Defines the nominal power of the RF signal to be measured. An appropriate value for LTE signals is the peak output power at the DUT during the measurement. The "Ref. Level" is calculated as follows:

Reference power = Expected Nominal Power + User Margin

Note: The actual input power at the connectors (i.e. the "Reference Level" minus the "External Attenuation (Input)" value, if all power settings are configured correctly) must be within the level range of the selected RF input connector; refer to the data sheet.

In the Standalone (SA) scenario, this parameter is controlled by the measurement. In the Combined Signal Path (CSP) scenario, it is controlled by the signaling application.

Remote command:
`CONFigure:LTE:MEAS<i>:RFSettings:ENPower` (SA)
`CONFigure:LTE:SIGN<i>:RFSettings:ENPMode` (CSP)
`CONFigure:LTE:SIGN<i>:RFSettings:ENPower` (CSP)

User Margin
Margin that the R&S CMW adds to the "Expected Nominal Power" in order to determine its reference power ("Ref. Level"). The "User Margin" is typically used to account for the known variations of the RF input signal power, e.g. the variations due to a specific channel configuration.

The variations (crest factor) depend on the LTE signal parameters, in particular the modulation scheme. If the "Expected Nominal Power" is set to the peak power during the measurement, a 0 dB user margin is sufficient.

In the Standalone (SA) scenario, this parameter is controlled by the measurement. In the Combined Signal Path (CSP) scenario, it is controlled by the signaling application.

Remote command:
`CONFigure:LTE:MEAS<i>:RFSettings:UMARgin` (SA)
`CONFigure:LTE:SIGN<i>:RFSettings:UMARgin` (CSP)

Mixer Level Offset
Varies the input level of the mixer in the analyzer path. A negative offset reduces the mixer input level, a positive offset increases it. Optimize the mixer input level according to the properties of the measured signal.

Mixer Level Offset	Advantages	Possible Shortcomings
< 0 dB	Suppression of distortion (e.g. of the intermodulation products generated in the mixer)	Lower dynamic range (due to smaller signal-to-noise ratio)
> 0 dB	High signal-to-noise ratio, higher dynamic range	Risk of intermodulation, smaller overdrive reserve

In the Standalone (SA) scenario, this parameter is controlled by the measurement. In the Combined Signal Path (CSP) scenario, it is controlled by the signaling application.

Remote command:
CONFigure:LTE:MEAS<i>:RFSettings:MLOFfset (SA)
CONFigure:LTE:SIGN<i>:RFSettings:MLOFfset (CSP)

4.3.2.2 Measurement Control Settings

The "Measurement Control" parameters configure the scope of the LTE PRACH measurement and inform the measurement about preamble-related signal properties normally determined by higher layers.

The "Measurement Control" section consists of a general part (see below), a part with Modulation Settings and a part with Power Settings.

While the combined signal path scenario is active, some of the measurement control parameters display values determined by the controlling signaling application. This is indicated in the parameter description. See also "Scenario = Combined Signal Path" on page 760.

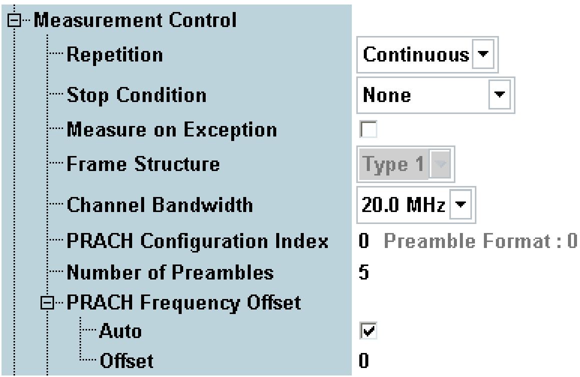


Fig. 4-15: LTE PRACH: Measurement Control settings - general part

Repetition

Defines how often the measurement is repeated if it is not stopped explicitly or by a failed limit check.

- **Continuous:** The measurement is continued until it is explicitly terminated; the results are periodically updated.
- **Single-Shot:** The measurement is stopped after one statistics cycle.

Single-shot is preferable if only a single measurement result is required under fixed conditions, which is typical for remote-controlled measurements. Continuous mode is suitable for monitoring the evolution of the measurement results in time and observe how they depend on the measurement configuration, which is typically done in manual control. The reset/preset values therefore differ from each other.

Remote command:
CONFigure:LTE:MEAS<i>:PRACh:REPetition

Stop Condition

Specifies the conditions for an early termination of the measurement:

- **None:** The measurement is performed according to its "Repetition" mode and "Statistic Count", irrespective of the limit check results.
- **On Limit Failure:** The measurement is stopped as soon as one of the limits is exceeded, irrespective of the repetition mode set. If no limit failure occurs, it is performed according to its "Repetition" mode and "Statistic Count". Use this setting for measurements that are essentially intended for checking limits, e.g. production tests.

Remote command:

`CONFigure:LTE:MEAS<i>:PRACh:SCONdition`

Measure on Exception

Specifies whether measurement results that the R&S CMW identifies as faulty or inaccurate are rejected. A faulty result occurs e.g. when an overload is detected. In remote control, the cause of the error is indicated by the "reliability indicator".

- **Off:** Faulty results are rejected. The measurement is continued; the statistical counters are not re-set. Use this mode to ensure that a single faulty result does not affect the entire measurement.
- **On:** Results are never rejected. Use this mode e.g. for development purposes, if you want to analyze the reason for occasional wrong transmissions.

Remote command:

`CONFigure:LTE:MEAS<i>:PRACh:MOEXception`

Frame Structure

Displays the frame structure of the uplink signal as defined in 3GPP TS 36.211. The value is set implicitly via the Duplex Mode (Type 1 = FDD, Type 2 = TDD).

Remote command:

`CONFigure:LTE:MEAS<i>:FSTRucture?`

Channel Bandwidth

Channel bandwidth between 1.4 MHz and 20 MHz. Set the bandwidth in accordance with the measured LTE signal.

The parameter is a common measurement setting, i.e. it has the same value in all measurements (e.g. PRACH measurement and multi evaluation measurement).

In the Standalone (SA) scenario, this parameter is controlled by the measurement. In the Combined Signal Path (CSP) scenario, it is controlled by the signaling application.

Remote command:

`CONFigure:LTE:MEAS<i>[:PCC]:CBANdwidth` (SA)

`CONFigure:LTE:SIGN<i>:CELL:BANDwidth[:PCC]:DL` (CSP)

PRACH Configuration Index

Specifies the PRACH configuration used by the UE. The PRACH configuration defines the preamble format and other signal properties, e.g. which resources in the time domain are allowed for transmission of preambles. The resulting preamble format is displayed for information.

In the Standalone (SA) scenario, this parameter is controlled by the measurement. In the Combined Signal Path (CSP) scenario, it is controlled by the signaling application.

For background information see chapter 4.2.7, "LTE PRACH UL Signal Properties", on page 745.

Remote command:
`CONFigure:LTE:MEAS<i>:PRACh:PCINdex` (SA)
`CONFigure:LTE:SIGN<i>:CELL:PRACh:PCINdex:FDD` (CSP)
`CONFigure:LTE:SIGN<i>:CELL:PRACh:PCINdex:TDD` (CSP)

Number of Preambles
Specifies the number of preambles to be captured per measurement interval and to be presented in "multi preamble" result views, e.g. "EVM vs Preamble" and "Power vs Preamble".

"Single Preamble" views evaluate only one preamble per measurement interval. To achieve maximum measurement speed for these views, set this parameter to 1.

Remote command:
`CONFigure:LTE:MEAS<i>:PRACh:NOPReambles`

PRACH Frequency Offset
Enable "Auto" to detect the frequency offset automatically or disable "Auto" and specify the frequency offset used by the UE. A manual configuration of the frequency offset may speed up the measurement.

The frequency offset is required to calculate the location of the 6 preamble Resource Blocks (RB) within the channel bandwidth. For FDD the number of the first RB equals the offset, for TDD it is calculated from this parameter and the parameter frequency resource index as described in 3GPP TS 36.211 section 5.7.1 "Time and frequency structure".

In the Standalone (SA) scenario, this parameter is controlled by the measurement. In the Combined Signal Path (CSP) scenario, it is controlled by the signaling application.

For background information see chapter 4.2.7.1, "Preambles in the Frequency Domain", on page 745.

Remote command:
`CONFigure:LTE:MEAS<i>:PRACh:PFOFfset:AUTO`
`CONFigure:LTE:MEAS<i>:PRACh:PFOFfset` (SA)
`CONFigure:LTE:SIGN<i>:CELL:PRACh:PFOFfset` (CSP)

4.3.2.3 Modulation Settings

The following parameters configure the modulation settings of the LTE PRACH measurement.

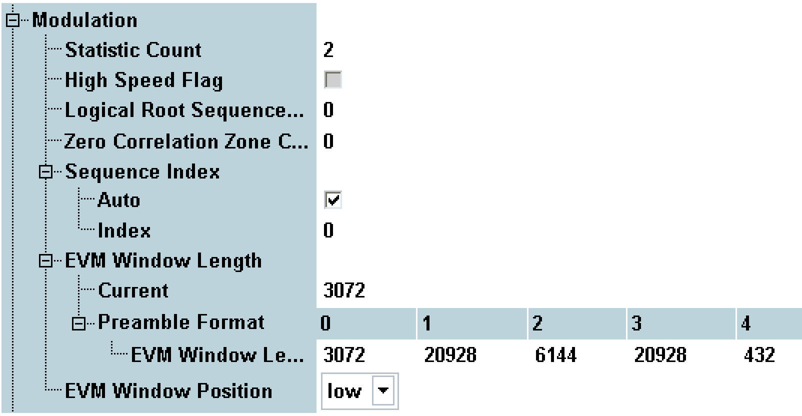


Fig. 4-16: Modulation settings

Statistic Count

Defines the number of measurement intervals per measurement cycle (statistics cycle, single-shot measurement). This value is also relevant for continuous measurements, because the averaging procedures depend on the statistic count.

For "single preamble" modulation measurements the measurement interval is completed when the R&S CMW has measured one full preamble (cyclic prefix + preamble sequence). The preamble length depends on the preamble format, see chapter 4.2.7.2, "Preambles in the Time Domain", on page 746.

For "multi preamble" measurements the measurement interval is completed when the configured number of preambles has been measured, see "Number of Preambles" on page 765.

The measurement provides independent statistic counts for modulation results and power dynamics results. In single-shot mode and with a shorter modulation statistic count, the modulation evaluation is stopped while the R&S CMW still continues providing new power dynamics results.

Remote command:
`CONFigure:LTE:MEAS<i>:PRACh:SCOunt:MODulation`

High Speed Flag

Determines whether the restricted or the unrestricted set of N_{CS} values is used for preamble generation. This software version supports only the unrestricted set (high speed flag disabled).

For background information see chapter 4.2.7.3, "Preamble Sequences", on page 746.

Remote command:
n/a

Logical Root Sequence Index

Specifies the logical root sequence index to be used for generation of the preamble sequence. Set this parameter to the value used by the UE.

In the Standalone (SA) scenario, this parameter is controlled by the measurement. In the Combined Signal Path (CSP) scenario, it is controlled by the signaling application.

For background information see chapter 4.2.7.3, "Preamble Sequences", on page 746.

Remote command:
`CONFigure:LTE:MEAS<i>:PRACh:MODulation:LRSindex` (SA)
`CONFigure:LTE:SIGN<i>:CELL:PRACh:LRSindex` (CSP)

Zero Correlation Zone Config
This parameter determines which N_{CS} value of an N_{CS} set is used for generation of the preamble sequence. Set this parameter to the value used by the UE.

In the Standalone (SA) scenario, this parameter is controlled by the measurement. In the Combined Signal Path (CSP) scenario, it is controlled by the signaling application.

For background information see chapter 4.2.7.3, "Preamble Sequences", on page 746.

Remote command:
`CONFigure:LTE:MEAS<i>:PRACh:MODulation:ZCZConfig` (SA)
`CONFigure:LTE:SIGN<i>:CELL:PRACh:ZCZConfig` (CSP)

Sequence Index
Enable "Auto" to detect the sequence index automatically or disable "Auto" and specify the sequence index used by the UE. A manual configuration of the sequence index may speed up the measurement.

The sequence index specifies which of the 64 preamble sequences of the cell is used by the UE.

For background information see chapter 4.2.7.3, "Preamble Sequences", on page 746.

Remote command:
`CONFigure:LTE:MEAS<i>:PRACh:MODulation:SINDex:AUTO`
`CONFigure:LTE:MEAS<i>:PRACh:MODulation:SINDex`

EVM Window Length
Length of the EVM window, defined as a number of samples. The standard (3GPP TS 36.101, Annex F) specifies the window length as a function of the preamble format.

The R&S CMW uses the "Current" value. This value is linked to the value in the table, corresponding to the current preamble format.

The window length defines the two sets of "l / h" modulation quantities in the result tables; see chapter 4.2.6, "Calculation of Modulation Results", on page 744.

The minimum value of 1 FFT symbol actually corresponds to a window of zero length so that $EVM_h = EVM_l$.

Remote command:
`CONFigure:LTE:MEAS<i>:PRACh:MODulation:EWLength`

EVM Window Position
Position of the EVM window used for calculation of the trace results. While result tables show both the results for low and high EVM window position, the diagram results are only determined for the selected window position.

Remote command:
`CONFigure:LTE:MEAS<i>:PRACh:MODulation:EWPosition`

4.3.2.4 Power Settings

The following parameters configure the power settings of the LTE PRACH measurement.

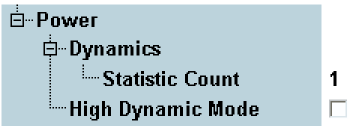


Fig. 4-17: Power settings

Dynamics > Statistic Count

Defines the number of measurement intervals per measurement cycle (statistics cycle, single-shot measurement). This value is also relevant for continuous measurements, because the averaging procedures depend on the statistic count.

For power dynamics measurements the measurement interval is completed when the R&S CMW has measured one preamble plus the preceding and the following power OFF time.

The measurement provides independent statistic counts for modulation results and power dynamics results. In single-shot mode and with a shorter modulation statistic count, the modulation evaluation is stopped while the R&S CMW still continues providing new power dynamics results.

Remote command:
`CONFigure:LTE:MEAS<i>:PRACh:SCOunt:PDYNamics`

High Dynamic Mode

Enables or disables the high dynamic mode.

The high dynamic mode is suitable for power dynamics measurements involving high ON powers. In that case the dynamic range of the R&S CMW may not be sufficient to measure both the high ON powers and the low OFF powers accurately.

In high dynamic mode the dynamic range is increased by measuring the results in two shots. One shot uses the configured settings to measure the ON power. The other shot uses a lower "Expected Nominal Power" value to measure the OFF power results.

Disable the high dynamic mode to optimize the measurement speed, especially when you are not interested in power dynamics results or measure low ON powers using a low "Expected Nominal Power" setting.

While the combined signal path scenario is active, this parameter is not configurable.

Remote command:
`CONFigure:LTE:MEAS<i>:PRACh:POWer:HDMode`

4.3.2.5 Trigger Settings

The "Trigger" parameters configure the trigger system for the LTE PRACH measurement.

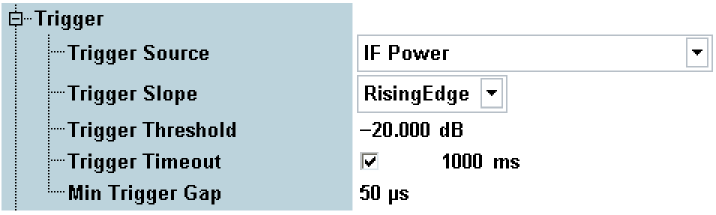


Fig. 4-18: Trigger settings

Trigger Source

Selects the source of the trigger event. Some of the trigger sources require additional options.

- **IF Power:**
  The measurement is triggered by the power of the received signal, converted into an IF signal. The trigger event coincides with the rising or falling edge of the detected LTE burst (i.e. the start or end of the preamble for a PRACH UL signal). Parameter Min Trigger Gap is also relevant.
- **...External...:**
  External trigger signal fed in via TRIG A or TRIG B on the rear panel of the instrument.

Remote command:
`TRIGger:LTE:MEAS<i>:PRACh:SOURce`
`TRIGger:LTE:MEAS<i>:PRACh:CATalog:SOURce?`

Trigger Slope

Qualifies whether the trigger event is generated at the rising or at the falling edge of the trigger pulse. This setting has no influence on the evaluation of trigger pulses provided by other firmware applications.

Remote command:
`TRIGger:LTE:MEAS<i>:PRACh:SLOPe`

Trigger Threshold

Defines the input signal power where the trigger condition is satisfied and a trigger event is generated. The trigger threshold is valid for power trigger sources. It is a dB value, relative to the reference level minus the external attenuation (<Ref. Level> – <External Attenuation (Input)> – <Frequency Dependent External Attenuation>). If the reference level is set to the actual maximum output power of the DUT, and the external attenuation settings are in accordance with the test setup, then the trigger threshold is referenced to the actual maximum RF input power at the R&S CMW.

A low threshold may be required to ensure that the R&S CMW can always detect the input signal. A higher threshold can prevent unintended trigger events.

Remote command:
`TRIGger:LTE:MEAS<i>:PRACh:THReshold`

Trigger Timeout

Sets a time after which an initiated measurement must have received a trigger event. If no trigger event is received, a trigger timeout is indicated in manual operation mode. In remote control mode the measurement is automatically stopped.

This setting has no influence on "Free Run" measurements.

Remote command:
`TRIGger:LTE:MEAS<i>:PRACh:TOUT`

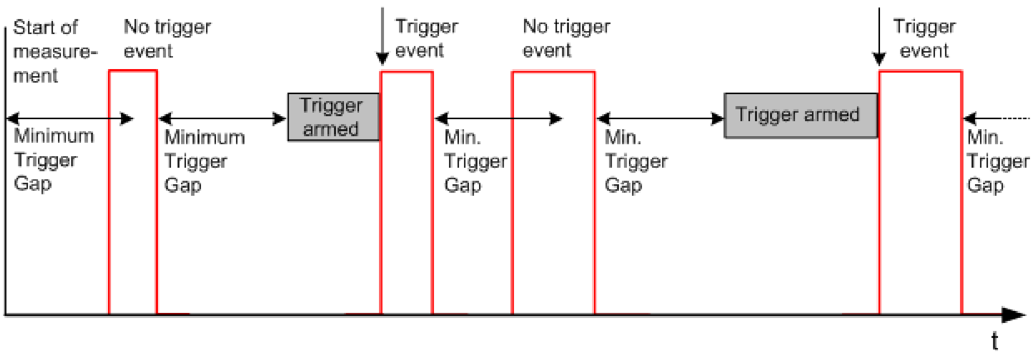
Min Trigger Gap

Defines a minimum duration of the power-down periods (gaps) between two triggered power pulses. This setting is valid for an "(IF) Power" trigger source.

The trigger system is controlled by means of a timer which is reset to zero in the following instances:

- At the IF power-down ramp of each triggered or untriggered pulse, even though the previous counter may not have elapsed yet. A power-down ramp is detected when the signal power falls below the trigger threshold.
- At the beginning of each measurement: The minimum gap defines the minimum time between the start of the measurement and the first trigger event.

The trigger system is re-armed as soon as the timer has reached the specified minimum gap.



This parameter can be used to prevent unwanted trigger events due to fast power variations within a preamble. The default value is usually big enough to ensure that the measurement is not re-triggered within a preamble and small enough to ensure that the trigger system is re-armed before the next preamble starts.

Remote command:
`TRIGger:LTE:MEAS<i>:PRACh:MGAP`

4.3.2.6 Limit Settings

The "Limits" in the "LTE PRACH Configuration" dialog define upper limits for the modulation and power results.

For details see chapter 4.2.8, "Limit Settings and Conformance Requirements", on page 747.

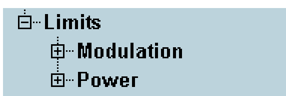


Fig. 4-19: Limit settings

Limits

The limits can be configured via the following remote commands.

Remote command:
CONFigure:LTE:MEAS<i>:PRACh:LIMit:EVMagnitude
CONFigure:LTE:MEAS<i>:PRACh:LIMit:MERRor
CONFigure:LTE:MEAS<i>:PRACh:LIMit:PERRor
CONFigure:LTE:MEAS<i>:PRACh:LIMit:FERRor
CONFigure:LTE:MEAS<i>:PRACh:LIMit:PDYNamics

4.3.2.7 Shortcut Configuration

This section configures a shortcut softkey that provides a fast way to access the GPRF generator from the measurement.

The setting is a common measurement setting. It has the same value in all measurements (e.g. PRACH measurement and multi evaluation measurement).

Fig. 4-20: Shortcut configuration

Generator Shortcut

Selects a GPRF generator instance. Softkeys for the selected instance are added to the softkey panel.

4.3.2.8 Additional Softkeys and Hotkeys

The "LTE PRACH" measurement provides some softkey/hotkey combinations which have no equivalent in the configuration dialog. Most of these hotkeys provide display configurations (like diagram scaling). They are self-explanatory and do not have any remote-control commands assigned.

The remaining softkeys > hotkeys are described below.

The softkeys "Signaling Parameter" and "LTE Signaling" are displayed only if the combined signal path scenario is active and are provided by the "LTE Signaling" application selected as master application. See also "Scenario = Combined Signal Path" on page 760.

The softkeys "ARB / List Mode" and "GPRF Generator" are displayed only if the standalone scenario is active and the generator shortcut is enabled, see chapter 3.3.8, "Shortcut Configuration", on page 562.

While one of the signaling or generator softkeys is selected, the "Config" hotkey opens the configuration dialog of the generator or signaling application, not the configuration dialog of the measurement.

PRACH > Assign Views
Selects the view types to be displayed in the overview. The R&S CMW does not evaluate the results for disabled views. Therefore, limiting the number of assigned views can speed up the measurement.

Remote command:
`CONFigure:LTE:MEAS<i>:PRACh:RESult[:ALL]`
`CONFigure:LTE:MEAS<i>:PRACh:RESult:PVPReamble` etc.

Signaling Parameter > ...
Provides access to the most essential settings of the "LTE Signaling" application.

Remote command:
Use the commands of the signaling application.

LTE Signaling
Select this softkey and press ON | OFF to turn the downlink signal transmission on or off.

Press the softkey two times (select it and press it again) to switch to the signaling application.

Remote command:
Use the commands of the signaling application.

ARB / List Mode > ...
Provides access to the most important ARB and list mode settings of the GPRF generator.

Remote command:
Use the commands of the GPRF generator.

GPRF Generator
Select this softkey and press ON | OFF to turn the GPRF generator on or off.

Press the softkey two times (select it and press it again) to switch to the generator application.

The hotkeys assigned to this softkey provide access to the most important GPRF generator settings.

Remote command:
Use the commands of the GPRF generator.

4.3.3 Measurement Results

The results of the LTE PRACH measurement are displayed in several different views.

For detailed description see chapter 4.2.9, "Measurement Results", on page 749.

The PRACH measurement provides an overview dialog and a detailed view for each diagram in the overview. The overview dialog shows modulation and I/Q constellation results as diagrams. A selection of statistical results is also shown.

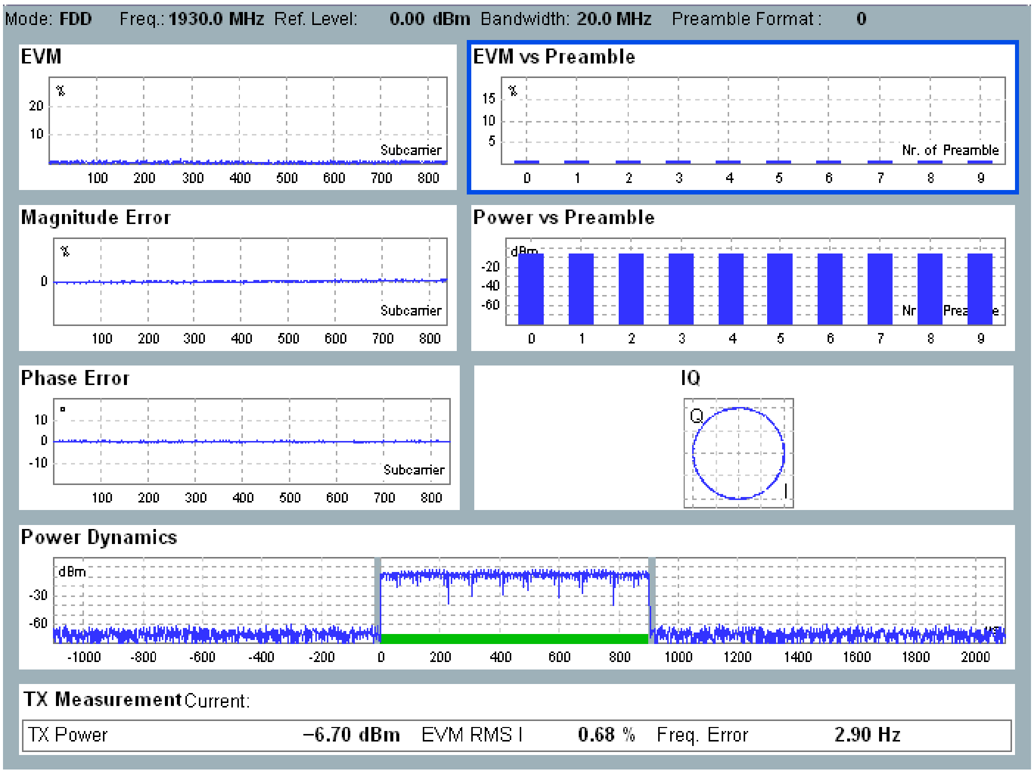


Fig. 4-21: LTE PRACH: Overview

Most of the detailed views show a diagram and a statistical overview of single-slot results.

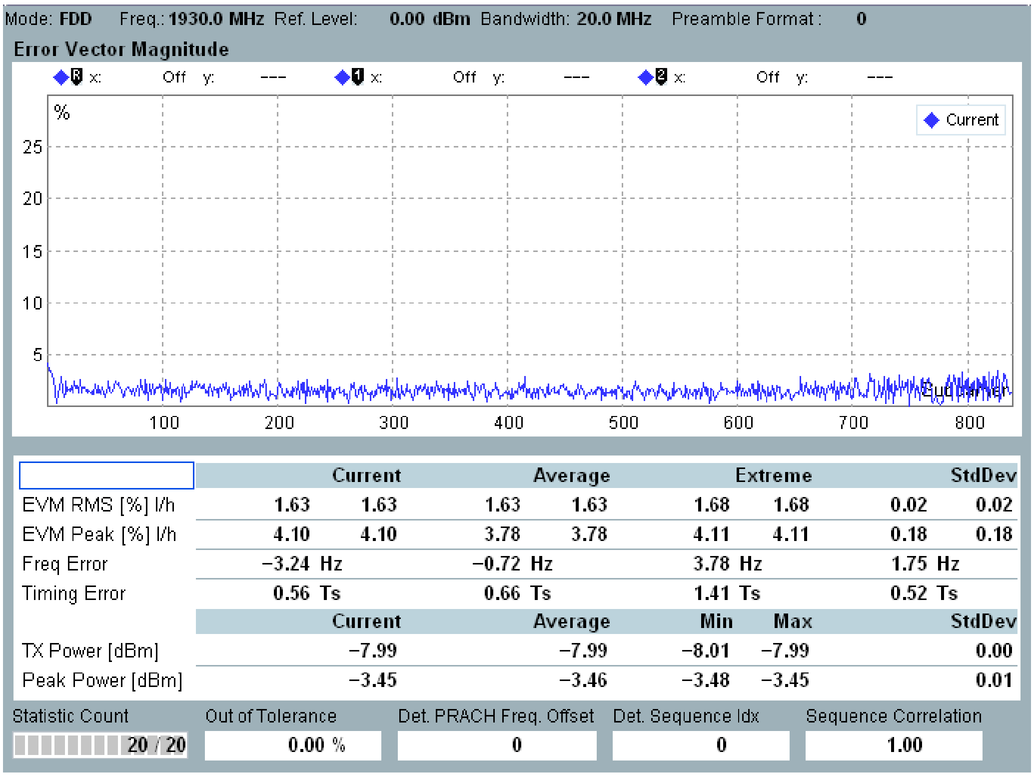


Fig. 4-22: LTE PRACH: EVM

Traces and Bar Graphs

The results can be retrieved via the following remote commands.

Remote command:

`FETCh:LTE:MEAS<i>:PRACh:TRACe:EVM:CURRent?` etc.

`FETCh:LTE:MEAS<i>:PRACh:TRACe:MERRor:CURRent?` etc.

`FETCh:LTE:MEAS<i>:PRACh:TRACe:PERRor:CURRent?` etc.

`FETCh:LTE:MEAS<i>:PRACh:TRACe:EVPReamble?` etc.

`FETCh:LTE:MEAS<i>:PRACh:TRACe:PVPReamble?` etc.

`FETCh:LTE:MEAS<i>:PRACh:TRACe:IQ?`

`FETCh:LTE:MEAS<i>:PRACh:TRACe:PDYNamics:CURRent?` etc.

Statistical Overviews and other Single Values

The results can be retrieved via the following remote commands.

Remote command:

FETCh:LTE:MEAS<i>:PRACh:MODulation:CURRent? etc.
FETCh:LTE:MEAS<i>:PRACh:MODulation:EXTReme? etc.
FETCh:LTE:MEAS<i>:PRACh:MODulation:PREamble<Number>? etc.
FETCh:LTE:MEAS<i>:PRACh:PDYNamics:AVERage? etc.
FETCh:LTE:MEAS<i>:PRACh:MODulation:DPFoffset?
FETCh:LTE:MEAS<i>:PRACh:MODulation:DSINdex?
FETCh:LTE:MEAS<i>:PRACh:MODulation:SCORrelation?
FETCh:LTE:MEAS<i>:PRACh:MODulation:DPFoffset:PREamble<Number>?
FETCh:LTE:MEAS<i>:PRACh:MODulation:DSINdex:PREamble<Number>?
FETCh:LTE:MEAS<i>:PRACh:MODulation:SCORrelation:
PREamble<Number>?

4.4 Programming

The following sections provide programming examples for the "LTE PRACH" measurement.

The examples have been tested with the aid of a simple software tool.

See also: "Remote Control" in the R&S CMW user manual

4.4.1 Key Features

The LTE PRACH measurement is programmed as follows:

- The measurement is controlled by SCPI commands with the following syntax: ...LTE:MEAS:PRACh...
- Use general commands of the type ...:LTE:MEAS... (no :PRACh mnemonic) to define the signal routing and perform RF and analyzer settings.
- After a *RST, the measurement is switched off. Use READ:LTE:MEAS:PRACh...? to initiate a single-shot measurement and retrieve the results. You can also start the measurement using INIT:LTE:MEAS:PRACh and retrieve the results using FETCh:LTE:MEAS:PRACh...?.

- For synchronization and proper decoding, some UE signal settings must be in accordance with the measured signal; see chapter 4.4.3, "Specifying Required PRACH Settings", on page 776.

4.4.2 Specifying General and Common Measurement Settings

```
// *****************************************************************************
// System-Reset
// *****************************************************************************
*RST; *OPC?
*CLS; *OPC?

// *****************************************************************************
// Define signal routing and perform RF and analyzer settings:
// Carrier center frequency 1850 MHz, frequency offset 1 kHz, peak power 7 dBm,
// 5 dB user margin and 1 dB mixer level offset.
// *****************************************************************************
ROUTe:LTE:MEAS:SCENario:SALone RF1C, RX1
CONFigure:LTE:MEAS:RFSettings:EATTenuation 2
CONFigure:LTE:MEAS:RFSettings:FREQuency 1850E+6
CONFigure:LTE:MEAS:RFSettings:FOFFset 1000
CONFigure:LTE:MEAS:RFSettings:ENPower 7
CONFigure:LTE:MEAS:RFSettings:UMARgin 5
CONFigure:LTE:MEAS:RFSettings:MLOFfset 1

// *****************************************************************************
// Set duplex mode TDD and query the resulting frame structure type (T2).
// Specify channel bandwidth 1.4 MHz.
// *****************************************************************************
CONFigure:LTE:MEAS:DMODe TDD
CONFigure:LTE:MEAS:FSTRucture?
CONFigure:LTE:MEAS:CBANdwidth B014
```

4.4.3 Specifying Required PRACH Settings

```
// *****************************************************************************
// Specify required UE signal settings: PRACH configuration index 1,
// logical root sequence index 50, zero correlation zone config 3.
// *****************************************************************************
CONFigure:LTE:MEAS:PRACh:PCINdex 1
CONFigure:LTE:MEAS:PRACh:MODulation:LRSindex 50
CONFigure:LTE:MEAS:PRACh:MODulation:ZCZConfig 3
```

4.4.4 Specifying Additional Measurement-Specific Settings

```
// *****************************************************************************
// Define stop condition (stop on limit failure), statistic counts (20 cycles),
```

```
// error handling and number of preambles. Enable high dynamic mode.
// ****************************************************************************
CONFigure:LTE:MEAS:PRACh:SCONdition SLFail
CONFigure:LTE:MEAS:PRACh:SCOunt:MODulation 20
CONFigure:LTE:MEAS:PRACh:SCOunt:PDYNamics 20
CONFigure:LTE:MEAS:PRACh:MOEXception ON
CONFigure:LTE:MEAS:PRACh:TOUT 3600
CONFigure:LTE:MEAS:PRACh:NOPReambles 10
CONFigure:LTE:MEAS:PRACh:POWer:HDMode ON

// ****************************************************************************
// Disable automatic detection of the PRACH frequency offset and
// specify it manually.
// ****************************************************************************
CONFigure:LTE:MEAS:PRACh:PFOFfset:AUTO OFF
CONFigure:LTE:MEAS:PRACh:PFOFfset 0

// ****************************************************************************
// Disable automatic detection of the preamble sequence index and
// specify it manually.
// ****************************************************************************
CONFigure:LTE:MEAS:PRACh:MODulation:SINDex:AUTO OFF
CONFigure:LTE:MEAS:PRACh:MODulation:SINDex 5

// ****************************************************************************
// Specify EVM window length for all preamble formats.
// Correct EVM window length for preamble format 2.
// Specify the EVM window position for traces.
// ****************************************************************************
CONFigure:LTE:MEAS:PRACh:MODulation:EWLength 1500,10000,3000,10000,200
CONFigure:LTE:MEAS:PRACh:MODulation:EWPosition HIGH
```

4.4.5 Configuring the Trigger System

```
// ****************************************************************************
// Set trigger source, slope, threshold, timeout and minimum trigger gap.
// ****************************************************************************
TRIGger:LTE:MEAS:PRACh:SOURce 'IF Power'
TRIGger:LTE:MEAS:PRACh:SLOPe FEDGe
TRIGger:LTE:MEAS:PRACh:THReshold -30
TRIGger:LTE:MEAS:PRACh:TOUT 1
TRIGger:LTE:MEAS:PRACh:MGAP 0.00006
```

4.4.6 Specifying Limits

```
// ****************************************************************************
// Define modulation limits.
// ****************************************************************************
```

```
CONFigure:LTE:MEAS:PRACh:LIMit:EVMagnitude 20, 40
CONFigure:LTE:MEAS:PRACh:LIMit:MERRor 20, OFF
CONFigure:LTE:MEAS:PRACh:LIMit:PERRor 20, OFF
CONFigure:LTE:MEAS:PRACh:LIMit:FERRor 150

// *****************************************************************************
// Define power dynamics limits.
// *****************************************************************************
CONFigure:LTE:MEAS:PRACh:LIMit:PDYNamics ON,6.8,-8.8,-48.8
```

4.4.7 Performing Single-Shot Measurements

```
// *****************************************************************************
// Enable all measurements.
// *****************************************************************************
CONFigure:LTE:MEAS:PRACh:RESult:ALL ON,ON,ON,ON,ON,ON,ON,ON

// *****************************************************************************
// Start single-shot measurement, return average EVM trace.
// Query the measurement state (should be "RDY").
// *****************************************************************************
READ:LTE:MEAS:PRACh:TRACe:EVM:AVERage?
FETCh:LTE:MEAS:PRACh:STATe?

// *****************************************************************************
// Retrieve detected PRACH frequency offset, sequence index and
// sequence correlation for "single preamble" measurements and for
// preamble number 4 of "multi preamble" measurements.
// *****************************************************************************
FETCh:LTE:MEAS:PRACh:MODulation:DPFoffset?
FETCh:LTE:MEAS:PRACh:MODulation:DSINdex?
FETCh:LTE:MEAS:PRACh:MODulation:SCORrelation?
FETCh:LTE:MEAS:PRACh:MODulation:DPFoffset:PREamble4?
FETCh:LTE:MEAS:PRACh:MODulation:DSINdex:PREamble4?
FETCh:LTE:MEAS:PRACh:MODulation:SCORrelation:PREamble4?

// *****************************************************************************
// Read other traces obtained in the last
// measurement without re-starting the measurement.
// *****************************************************************************
FETCh:LTE:MEAS:PRACh:TRACe:MERRor:AVERage?
FETCh:LTE:MEAS:PRACh:TRACe:MERRor:MAXimum?
FETCh:LTE:MEAS:PRACh:TRACe:PERRor:AVERage?
FETCh:LTE:MEAS:PRACh:TRACe:PERRor:MAXimum?
FETCh:LTE:MEAS:PRACh:TRACe:EVPReamble?
FETCh:LTE:MEAS:PRACh:TRACe:PVPReamble?
FETCh:LTE:MEAS:PRACh:TRACe:IQ?
FETCh:LTE:MEAS:PRACh:TRACe:PDYNamics:AVERage?
FETCh:LTE:MEAS:PRACh:TRACe:PDYNamics:MAXimum?
```

```
// *****************************************************************************
// Read single value results obtained in the last measurement
// without re-starting the measurement.
// *****************************************************************************
FETCh:LTE:MEAS:PRACh:MODulation:AVERage?
FETCh:LTE:MEAS:PRACh:MODulation:EXTReme?
FETCh:LTE:MEAS:PRACh:MODulation:PREamble4?
FETCh:LTE:MEAS:PRACh:PDYNamics:AVERage?
FETCh:LTE:MEAS:PRACh:PDYNamics:MINimum?
FETCh:LTE:MEAS:PRACh:PDYNamics:MAXimum?

// *****************************************************************************
// Read limit check results obtained in the last measurement
// without re-starting the measurement.
// *****************************************************************************
CALCulate:LTE:MEAS:PRACh:MODulation:AVERage?
CALCulate:LTE:MEAS:PRACh:MODulation:EXTReme?
CALCulate:LTE:MEAS:PRACh:PDYNamics:AVERage?
CALCulate:LTE:MEAS:PRACh:PDYNamics:MINimum?
CALCulate:LTE:MEAS:PRACh:PDYNamics:MAXimum?
```

4.4.8 Single-Shot and Continuous Measurements

```
// *****************************************************************************
// Start single-shot measurement, return magnitude error trace,
// return phase error trace (without repeating the measurement).
// Query the measurement state (should be "RDY").
// *****************************************************************************
INIT:LTE:MEAS:PRACh
FETCh:LTE:MEAS:PRACh:TRACe:MERRor:AVERage?
FETCh:LTE:MEAS:PRACh:TRACe:PERRor:AVERage?
FETCh:LTE:MEAS:PRACh:STATe?

// *****************************************************************************
// Start continuous measurement and wait for 5 ms.
// Return average EVM trace.
// Query measurement state and substates (should be "RUN,ADJ,ACT").
// *****************************************************************************
CONFigure:LTE:MEAS:PRACh:REPetition CONTinuous
INIT:LTE:MEAS:PRACh
Pause 5000
FETCh:LTE:MEAS:PRACh:TRACe:EVM:AVERage?
FETCh:LTE:MEAS:PRACh:STATe:ALL?
```

4.5 Command Reference

The following sections provide detailed reference information on the remote control commands of the "LTE PRACH" measurement.

4.5.1 Conventions and General Information

The following sections describe the most important conventions and general informations concerning the command reference.

4.5.1.1 MEAS<i>

MEAS<i> is used as abbreviation of "MEASurement<instance>". For better readability only the abbreviated form (which is also accepted by the instrument) is given in the command reference.

The <instance> is relevant for instruments supporting several instances of the same firmware application. It can be omitted if the instrument supports only one instance, or to address the first instance.

See also: "Firmware Applications" in the R&S CMW user manual, chapter "Remote Control"

4.5.1.2 FETCh, READ and CALCulate Commands

All commands are used to retrieve measurement results:

- `FETCh...` returns the results of the current measurement cycle (single-shot measurement) after they are valid. `FETCh...` must be used after the measurement has been started (`INITiate...`, measurement states RUN or RDY).
- `READ...` starts a new single-shot measurement and returns the results.
- `CALCulate...` returns one limit check result per `FETCh` result:
  – **OK**: The `FETCh` result is located within the limits or no limit has been defined/ enabled for this result.
  – **ULEU** (User limit exceeded upper): An upper limit is violated. The `FETCh` result is located above the limit.
  – **ULEL** (User limit exceeded lower): A lower limit is violated. The `FETCh` result is located below the limit.

See also: "Retrieving Measurement Results" in the R&S CMW user manual, chapter "Remote Control"

4.5.1.3 Current and Statistical Results

The R&S CMW repeats measurements according to the selected statistic count and repetition mode. Consecutive measurement values are stored and used to calculate statistical results, e.g. average, minimum, maximum and standard deviation.

See also: "Statistical Results" in the R&S CMW user manual, chapter "System Overview"

4.5.1.4 Keywords

Selected keywords used in the command description are described in the following.

- **Command usage**
  If the usage is not explicitly stated, the command allows you to set parameters and query parameters. Otherwise the command usage is stated as follows:
  – "Setting only": command can only be used to set parameters
  – "Query only": command can only be used to query parameters
  – "Event": command initiates an event
- **Parameter usage**
  The parameter usage is indicated by the keyword preceding the parameter(s):
  – "Parameters" are sent with a setting or query command and are returned as the result of a query
  – "Setting parameters" are only sent with a setting command
  – "Query parameters" are only sent with a query command (to refine the query)
  – "Return values" are only returned as the result of a query
- **Firmware/Software:**
  Indicates the lowest software version supporting the command. Command enhancements in later software versions are also indicated.

4.5.1.5 Reliability Indicator

The first value in the output arrays of `FETCh...?`, `READ...?` and `CALCulate...?` queries indicates the most severe error that has occurred during the measurement.

Example for an output array: 0, 10.22, 10.15, 10.01, 10.29, 100 (reliability = 0, followed by 5 numeric measurement values).

The reliability indicator has one of the following values:

- **0 (OK)**:
  Measurement values available, no error detected.
- **1 (Measurement Timeout)**:
  The measurement has been stopped after the (configurable) measurement timeout. Measurement results may be available, however, at least a part of the measurement provides only INValid results or has not completed the full statistic count.
- **2 (Capture Buffer Overflow)**:
  The measurement configuration results in a capture length, exceeding the available memory.

- **3 (Overdriven) / 4 (Underdriven)**:
The accuracy of measurement results may be impaired because the input signal level was too high / too low.
- **6 (Trigger Timeout)**:
The measurement could not be started or continued because no trigger event was detected.
- **7 (Acquisition Error)**:
The R&S CMW could not properly decode the RF input signal.
- **8 (Sync Error)**:
The R&S CMW could not synchronize to the RF input signal.
- **9 (Uncal)**:
Due to an inappropriate configuration of resolution bandwidth, video bandwidth or sweep time, the measurement results are not within the specified data sheet limits.
- **15 (Reference Frequency Error)**:
The instrument has been configured to use an external reference signal but the reference oscillator could not be phase locked to the external signal (e.g. signal level too low, frequency out of range or reference signal not available at all).
- **16 (RF Not Available)**:
The measurement could not be started because the configured RF input path was not active. This problem may occur e.g. when a measurement is started in combined signal path mode and the master application has not yet activated the input path. The LEDs above the RF connectors indicate whether the input and output paths are active.
- **17 (RF Level not Settled) / 18 (RF Frequency not Settled)**:
The measurement could not be started because the R&S CMW was not yet ready to deliver stable results after a change of the input signal power / the input signal frequency.
- **19 (Call not Established)**:
For measurements: The measurement could not be started because no signaling connection to the DUT was established.
For DAU IMS service: Establishing a voice over IMS call failed.
- **20 (Call Type not Usable)**:
For measurements: The measurement could not be started because the established signaling connection had wrong properties.
For DAU IMS service: The voice over IMS settings could not be applied.
- **21 (Call Lost)**:
For measurements: The measurement was interrupted because the signaling connection to the DUT was lost.
For DAU IMS service: The voice over IMS call was lost.
- **23 (Missing Option)**:
The ARB file cannot be played by the GPRF generator due to a missing option.
- **26 (Resource Conflict)**:
The application could not be started or has been stopped due to a conflicting hardware resource or software option that is allocated by another application.
Stop the application that has allocated the conflicting resources and try again.
- **27 (No Sensor Connected)**:

The GPRF External Power Sensor measurement could not be started due to missing power sensor.

- **30 (File not Found)**:
  The specified file could not be found.
- **40 (ARB File CRC Error)**:
  The ARB file CRC check failed. The ARB file is corrupt and not reliable.
- **42 (ARB Header Tag Invalid)**:
  The ARB file selected in the GPRF generator contains an invalid header tag.
- **43 (ARB Segment Overflow)**:
  The number of segments in the multi-segment ARB file is higher than the allowed maximum.
- **44 (ARB File not Found)**:
  The selected ARB file could not be found.
- **45 (ARB Memory Overflow)**:
  The ARB file length is greater than the available memory.
- **50 (Startup Error)**:
  The Data Application Unit (DAU), a DAU service or a DAU measurement could not be started. Please execute a DAU selftest.
- **51 (No Reply)**:
  The DAU has received no response, for example for a ping request.
- **52 (Connection Error)**:
  The DAU could not establish a connection to internal components. Please restart the instrument.
- **53 (Configuration Error)**:
  The current DAU configuration by the user is incomplete or wrong and could not be applied. Check especially the IP address configuration.
- **54 (Filesystem Error)**:
  The hard disk of the DAU is full or corrupt. Please execute a DAU selftest.
- **60 (Invalid RF-Connector Setting)**
  The individual segments of a list mode measurement with R&S CMWS use different connector benches. This is not allowed. All segments must use the same bench.
  Check the "Info" dialog for the relevant segment numbers.
- **101 (Firmware Error)**:
  Indicates a firmware or software error. If you encounter this error for the first time, restart the instrument.
  If the error occurs again, consider the following hints:
  – Firmware errors can often be repaired by restoring the factory default settings. To restore these settings, restart your instrument and press the "Factory Default" softkey during startup.
  – If a software package (update) has not been properly installed this is often indicated in the "Setup" dialog, section "SW/HW-Equipment > Installed Software".
  – A software update correcting the error may be available. Updates are e.g. provided in the "CMW Customer Web" on GLORIS (registration required): https://extranet.rohde-schwarz.com.

If you get firmware errors even with the properly installed latest software version, please send a problem report including log files to Rohde & Schwarz.

- **102 (Unidentified Error)**:
  Indicates an error not covered by other reliability values. For troubleshooting please follow the steps described for "101 (Firmware Error)".
- **103 (Parameter Error)**:
  Indicates that the measurement could not be performed due to internal conflicting parameter settings.
  A good approach to localize the conflicting settings is to start with a reset or preset or even restore the factory default settings. Then reconfigure the measurement step by step and check when the error occurs for the first time.
  If you need assistance to localize the conflicting parameter settings, please contact Rohde & Schwarz (see http://www.service.rohde-schwarz.com).

4.5.2 General Measurement Settings

The commands valid for all LTE measurements are described here: chapter 3.5.2, "General Measurement Settings", on page 584

4.5.3 PRACH Measurement Commands

The commands for the "LTE PRACH" measurement are divided into the groups listed below.

4.5.3.1 Measurement Control and States

The following commands control the measurement and return the current measurement state.

INITiate:LTE:MEAS<i>:PRACh
STOP:LTE:MEAS<i>:PRACh
ABORt:LTE:MEAS<i>:PRACh

Starts, stops, or aborts the measurement:

- `INITiate...` starts or restarts the measurement; the R&S CMW enters the "RUN" state.
- `STOP...` causes a running measurement to stop after the current evaluation period is terminated and valid results are available; the R&S CMW enters the "RDY" state.
- `ABORt...` causes a running measurement to stop immediately; the R&S CMW enters the "OFF" state.

Use `FETCh...STATe?` to query the current measurement state.

See also: "Measurement Control" in the R&S CMW user manual, chapter "Remote Control"

Example: See Single-Shot and Continuous Measurements

Usage: Event

Firmware/Software: V2.0.10

Manual operation: See "PRACH (Softkey)" on page 758

FETCh:LTE:MEAS<i>:PRACh:STATe?

Queries the main measurement state. Use `FETCh:...:STATe:ALL?` to query the measurement state including the substates. Use `INITiate...`, `STOP...`, `ABORt...` to change the measurement state.

See also: "Measurement Control" in the R&S CMW user manual, chapter "Remote Control"

Return values:

<MeasStatus> OFF | RUN | RDY

OFF: measurement switched off, no resources allocated, no results available (when entered after `ABORt...`)
RUN: measurement running (after `INITiate..., READ...`), synchronization pending or adjusted, resources active or queued
RDY: measurement has been terminated, valid results may be available

*RST: OFF

Example: See Performing Single-Shot Measurements

Usage: Query only

Firmware/Software: V2.0.10

Manual operation: See "PRACH (Softkey)" on page 758

FETCh:LTE:MEAS<i>:PRACh:STATe:ALL?

Queries the main measurement state and the measurement substates. Both measurement substates are relevant for running measurements only. Use `FETCh:...:STATe?` to query the main measurement state only. Use `INITiate..., STOP..., ABORt...` to change the measurement state.

See also: "Measurement Control" in the R&S CMW user manual, chapter "Remote Control"

Return values:

<MainState> OFF | RDY | RUN

OFF: measurement switched off, no resources allocated, no results available (when entered after `STOP...`)
RDY: measurement has been terminated, valid results may be available
RUN: measurement running (after `INITiate..., READ...`), synchronization pending or adjusted, resources active or queued

<SyncState> PEND | ADJ | INV

PEND: waiting for resource allocation, adjustment, hardware switching ("pending")
ADJ: all necessary adjustments finished, measurement running ("adjusted")
INV: not applicable because <MainState>: OFF or RDY ("invalid")

<ResourceState> QUE | ACT | INV

QUE: measurement without resources, no results available ("queued")
ACT: resources allocated, acquisition of results in progress but not complete ("active")
INV: not applicable because <MainState>: OFF or RDY ("invalid")

Example: See Single-Shot and Continuous Measurements

Usage: Query only

Firmware/Software: V2.0.10

Manual operation: See "PRACH (Softkey)" on page 758

4.5.3.2 Enabling Results and Views

The following commands select the evaluated results and the displayed views.

CONFigure:LTE:MEAS<i>:PRACh:RESult[:ALL] <EVM>, <MagnitudeError>, <PhaseError>, <IQ>, <PowerDynamics>, <TXMeasurement>[, <EVMvsPreamble>, <PowervsPreamble>]

Enables or disables the evaluation of results and shows or hides the views in the PRACH measurement. This command combines all other `CONFigure:LTE:MEAS<i>:PRACh:RESult...` commands.

Parameters:

<EVM> OFF | ON

Error Vector Magnitude
OFF: Do not evaluate results, hide the view
ON: Evaluate results and show the view

*RST: ON

<MagnitudeError> OFF | ON

Magnitude Error

*RST: OFF

<PhaseError> OFF | ON

Phase Error

*RST: OFF

<IQ> OFF | ON

I/Q Constellation Diagram

*RST: OFF

<PowerDynamics>	OFF | ON Power Dynamics *RST: ON
<TXMeasurement>	OFF | ON Statistical Overview *RST: ON
<EVMvsPreamble>	OFF | ON Error Vector Magnitude vs Preamble *RST: OFF
<PowervsPreamble>	OFF | ON Power vs Preamble *RST: OFF

Example: See Performing Single-Shot Measurements

Firmware/Software: V2.0.10
V2.1.20: added <EVMvsPreamble> and <PowervsPreamble>

Manual operation: See "PRACH > Assign Views" on page 772

CONFigure:LTE:MEAS<i>:PRACh:RESult:EVMagnitude <Enable>
CONFigure:LTE:MEAS<i>:PRACh:RESult:MERRor <Enable>
CONFigure:LTE:MEAS<i>:PRACh:RESult:PERRor <Enable>
CONFigure:LTE:MEAS<i>:PRACh:RESult:IQ <Enable>
CONFigure:LTE:MEAS<i>:PRACh:RESult:PDYNamics <Enable>
CONFigure:LTE:MEAS<i>:PRACh:RESult:TXM <Enable>
CONFigure:LTE:MEAS<i>:PRACh:RESult:EVPReamble <Enable>
CONFigure:LTE:MEAS<i>:PRACh:RESult:PVPReamble <Enable>

Enables or disables the evaluation of results and shows or hides the views in the PRACH measurement.

The mnemonic after "RESult" denotes the view type: Error Vector Magnitude, Magnitude Error, Phase Error, I/Q Constellation Diagram, Power Dynamics, TX Measurement Statistical Overview, Error Vector Magnitude vs Preamble, Power vs Preamble.

For reset values see `CONFigure:LTE:MEAS<i>:PRACh:RESult[:ALL]`.

Parameters:

<Enable>	OFF | ON **OFF:** Do not evaluate results, hide the view **ON:** Evaluate results and show the view *RST: Depends on measurement

Firmware/Software: V2.0.10
V2.1.20: `...:EVPReamble` and `...:PVPReamble` added

Manual operation: See "PRACH > Assign Views" on page 772

4.5.3.3 Measurement Parameters - General Part

The following commands define general measurement control parameters for the PRACH measurement.

CONFigure:LTE:MEAS<i>:PRACh:TOUT <Timeout>

Defines a timeout for the measurement. The timer is started when the measurement is initiated via a `READ` or `INIT` command. It is not started if the measurement is initiated manually (ON/OFF key or RESTART/STOP key).

When the measurement has completed the first measurement cycle (first single shot), the statistical depth is reached and the timer is reset.

If the first measurement cycle has not been completed when the timer expires, the measurement is stopped. The measurement state changes to `RDY` and the reliability indicator is set to 1, indicating that a measurement timeout occurred. Still running `READ`, `FETCh` or `CALCulate` commands are completed, returning the available results. At least for some results there are no values at all or the statistical depth has not been reached.

A timeout of 0 s corresponds to an infinite measurement timeout.

Parameters:

<Timeout> Default unit: s

Example: See Specifying Additional Measurement-Specific Settings

Firmware/Software: V2.0.10

CONFigure:LTE:MEAS<i>:PRACh:REPetition <Repetition>

Specifies the repetition mode of the measurement. The repetition mode specifies whether the measurement is stopped after a single-shot or repeated continuously. Use `CONFigure:...:MEAS<i>:....:SCOunt` to determine the number of measurement intervals per single shot.

See also: "Statistical Settings" in the R&S CMW user manual, chapter "Remote Control"

Parameters:

<Repetition> SINGleshot | CONTinuous

SINGleshot: Single-shot measurement
CONTinuous: Continuous measurement

*RST: SING

Example: See Single-Shot and Continuous Measurements

Firmware/Software: V2.0.10

Manual operation: See "Repetition" on page 763

CONFigure:LTE:MEAS<i>:PRACh:SCONdition <StopCondition>

Qualifies whether the measurement is stopped after a failed limit check or continued. `SLFail` means that the measurement is stopped and reaches the `RDY` state as soon as one of the results exceeds the limits.

Parameters:

<StopCondition> NONE | SLFail

NONE: Continue measurement irrespective of the limit check
SLFail: Stop measurement on limit failure

*RST: NONE

Example: See Specifying Additional Measurement-Specific Settings

Firmware/Software: V2.0.10

Manual operation: See "Stop Condition" on page 764

CONFigure:LTE:MEAS<i>:PRACh:MOEXception <MeasOnException>

Specifies whether measurement results that the R&S CMW identifies as faulty or inaccurate are rejected.

Parameters:

<MeasOnException> OFF | ON

OFF: Faulty results are rejected
ON: Results are never rejected

*RST: OFF

Example: See Specifying Additional Measurement-Specific Settings

Firmware/Software: V2.0.10

Manual operation: See "Measure on Exception" on page 764

CONFigure:LTE:MEAS<i>:PRACh:PCINdex <PRACHconfIndex>

The PRACH configuration index identifies the PRACH configuration used by the UE (preamble format, which resources in the time domain are allowed for transmission of preambles etc.).

This command is only relevant for the standalone scenario. For the combined signal path scenario, use:

- CONFigure:LTE:SIGN<i>:CELL:PRACh:PCINdex:FDD
- CONFigure:LTE:SIGN<i>:CELL:PRACh:PCINdex:TDD

Parameters:

<PRACHconfIndex> Range: 0 to 63 for FDD / 57 for TDD
*RST: 0

Example: See Specifying Required PRACH Settings

Firmware/Software: V2.0.10

Manual operation: See "PRACH Configuration Index" on page 764

CONFigure:LTE:MEAS<i>:PRACh:NOPReambles <NumberPreamble>

Specifies the number of preambles to be captured per measurement interval.

Parameters:

<NumberPreamble> Range: 1 to 16
*RST: 1

Example: See Specifying Additional Measurement-Specific Settings

Firmware/Software: V2.1.20

Manual operation: See "Number of Preambles" on page 765

CONFigure:LTE:MEAS<i>:PRACh:PFOFfset:AUTO <PRACHfreqAuto>

Enables or disables automatic detection of the PRACH frequency offset. To configure the offset manually for disabled automatic detection, see CONFigure:LTE:MEAS<i>:PRACh:PFOFfset on page 791.

Parameters:

<PRACHfreqAuto> OFF | ON
*RST: ON

Example: See Specifying Additional Measurement-Specific Settings

Firmware/Software: V2.0.10

Manual operation: See "PRACH Frequency Offset" on page 765

CONFigure:LTE:MEAS<i>:PRACh:PFOFfset <PRACHfreqOffset>

Specifies the PRACH frequency offset. This setting is only relevant if automatic detection is disabled, see CONFigure:LTE:MEAS<i>:PRACh:PFOFfset:AUTO.

This command is only relevant for the standalone scenario. For the combined signal path scenario, use CONFigure:LTE:SIGN<i>:CELL:PRACh:PFOFfset.

Parameters:

<PRACHfreqOffset> Range: 0 to <total RB - 6> depending on channel bandwidth, see table below
*RST: 0

Example: See Specifying Additional Measurement-Specific Settings

Firmware/Software: V2.0.10

Manual operation: See "PRACH Frequency Offset" on page 765

Table 4-4: Maximum input value depending on channel bandwidth

Channel Bandwidth [MHz]	1.4	3	5	10	15	20
<total RB-6>	0	9	19	44	69	94

4.5.3.4 Modulation Measurement Settings

The following commands specify settings for the modulation measurements.

CONFigure:LTE:MEAS<i>:PRACh:SCOunt:MODulation <StatisticCount>

Specifies the statistic count of the measurement. The statistic count is equal to the number of measurement intervals per single shot. Use `CONFigure:...:MEAS<i>:...:REPetition SINGleshot | CONTinuous` to select either single-shot or continuous measurements.

See also: "Statistical Settings" in the R&S CMW user manual, chapter "Remote Control"

Parameters:

<StatisticCount> Number of measurement intervals
Range: 1 to 1000
*RST: 2

Example: See Specifying Additional Measurement-Specific Settings

Firmware/Software: V2.0.10

Manual operation: See "Statistic Count" on page 766

CONFigure:LTE:MEAS<i>:PRACh:MODulation:LRSindex <LogRootSeqIndex>

Specifies the logical root sequence index to be used for generation of the preamble sequence.

This command is only relevant for the standalone scenario. For the combined signal path scenario, use `CONFigure:LTE:SIGN<i>:CELL:PRACh:LRSindex`.

Parameters:

<LogRootSeqIndex>	Range:	preamble format 0,1,2,3: 0 to 837 / preamble format 4: 0 to 137
	*RST:	0

Example: See Specifying Required PRACH Settings

Firmware/Software: V2.0.10

Manual operation: See "Logical Root Sequence Index" on page 766

CONFigure:LTE:MEAS<i>:PRACh:MODulation:ZCZConfig <ZeroCorrZoneCon>

Specifies the zero correlation zone config, i.e. which N_{CS} value of an N_{CS} set is used for generation of the preamble sequence.

This command is only relevant for the standalone scenario. For the combined signal path scenario, use `CONFigure:LTE:SIGN<i>:CELL:PRACh:ZCZConfig`

.

Parameters:

<ZeroCorrZoneCon>	Range:	preamble format 0,1,2,3: 0 to 15 / preamble format 4: 0 to 6
	*RST:	0

Example: See Specifying Required PRACH Settings

Firmware/Software: V2.0.10

Manual operation: See "Zero Correlation Zone Config" on page 767

CONFigure:LTE:MEAS<i>:PRACh:MODulation:SINDex:AUTO <SeqIndexAuto>

Enables or disables automatic detection of the sequence index. To configure the index manually for disabled automatic detection, see `CONFigure:LTE:MEAS<i>:PRACh:MODulation:SINDex` on page 794.

Parameters:

<SeqIndexAuto>	OFF | ON	
	*RST:	ON

Example: See Specifying Additional Measurement-Specific Settings

Firmware/Software: V2.0.10

Manual operation: See "Sequence Index" on page 767

CONFigure:LTE:MEAS<i>:PRACh:MODulation:SINDex <SequenceIndex>

Specifies the sequence index, i.e. which of the 64 preamble sequences of the cell is used by the UE. This setting is only relevant if automatic detection is disabled, see `CONFigure:LTE:MEAS<i>:PRACh:MODulation:SINDex:AUTO`.

Parameters:

<SequenceIndex> Range: 0 to 63
*RST: 0

Example: See Specifying Additional Measurement-Specific Settings

Firmware/Software: V2.0.10

Manual operation: See "Sequence Index" on page 767

CONFigure:LTE:MEAS<i>:PRACh:MODulation:EWLength <LengthFormat0>, <LengthFormat1>, <LengthFormat2>, <LengthFormat3>, <LengthFormat4>

Specifies the EVM window length in samples for all preamble formats.

Parameters:

<LengthFormat0> Length for preamble format 0
Range: 1 to 3168
*RST: 3072

<LengthFormat1> Length for preamble format 1
Range: 1 to 21024
*RST: 20928

<LengthFormat2> Length for preamble format 2
Range: 1 to 6240
*RST: 6144

<LengthFormat3> Length for preamble format 3
Range: 1 to 21024
*RST: 20928

<LengthFormat4> Length for preamble format 4
Range: 1 to 448
*RST: 432

Example: See Specifying Additional Measurement-Specific Settings

Firmware/Software: V2.0.10
V2.0.20: *RST values modified

Manual operation: See "EVM Window Length" on page 767

CONFigure:LTE:MEAS<i>:PRACh:MODulation:EWPosition <EVMwindowPos>

Specifies the position of the EVM window used for calculation of the trace results.

Parameters:

<EVMwindowPos> LOW | HIGH

*RST: LOW

Example: See Specifying Additional Measurement-Specific Settings

Firmware/Software: V2.0.10

Manual operation: See "EVM Window Position" on page 767

4.5.3.5 Power Measurement Settings

The following commands specify settings for power dynamics measurements.

CONFigure:LTE:MEAS<i>:PRACh:SCOunt:PDYNamics <StatisticCount>

Specifies the statistic count of the measurement. The statistic count is equal to the number of measurement intervals per single shot. Use `CONFigure:...:MEAS<i>:...:REPetition SINGleshot | CONTinuous` to select either single-shot or continuous measurements.

See also: "Statistical Settings" in the R&S CMW user manual, chapter "Remote Control"

Parameters:

<StatisticCount> Number of measurement intervals

Range: 1 to 1000
*RST: 1

Example: See Specifying Additional Measurement-Specific Settings

Firmware/Software: V2.0.10

Manual operation: See "Dynamics > Statistic Count" on page 768

CONFigure:LTE:MEAS<i>:PRACh:POWer:HDMode <HighDynamicMode>

Enables or disables the high dynamic mode for power dynamics measurements.

Parameters:

<HighDynamicMode> OFF | ON

*RST: OFF

Example: See Specifying Additional Measurement-Specific Settings

Firmware/Software: V2.1.25

Manual operation: See "High Dynamic Mode" on page 768

4.5.3.6 Trigger Settings

The following commands define the trigger parameters.

TRIGger:LTE:MEAS<i>:PRACh:CATalog:SOURce?

Lists all trigger source values that can be set using `TRIGger:LTE:MEAS<i>:PRACh:SOURce`.

Return values:

<Sourcelist> Comma separated list of all supported values. Each value is represented as a string.

Usage: Query only

Firmware/Software: V2.0.10

Manual operation: See "Trigger Source" on page 769

TRIGger:LTE:MEAS<i>:PRACh:SOURce <Source>

Selects the source of the trigger events. Some values are always available in this firmware application. They are listed below. Depending on the installed options additional values may be available. A complete list of all supported values can be displayed using `TRIGger:...:CATalog:SOURce?`.

Parameters:

<Source> **'IF Power':** Power trigger (received RF power)
'Base1: External TRIG A': External trigger fed in at TRIG A connector
'Base1: External TRIG B': External trigger fed in at TRIG B connector
*RST: 'IF Power'

Example: See Configuring the Trigger System

Firmware/Software: V2.0.10

Manual operation: See "Trigger Source" on page 769

TRIGger:LTE:MEAS<i>:PRACh:SLOPe <Slope>

Qualifies whether the trigger event is generated at the rising or at the falling edge of the trigger pulse (valid for external and power trigger sources).

Parameters:

<Slope> REDGe | FEDGe

REDGe: Rising edge
FEDGe: Falling edge
*RST: REDG

Example: See Configuring the Trigger System

Firmware/Software: V2.0.10

Manual operation: See "Trigger Slope" on page 769

TRIGger:LTE:MEAS<i>:PRACh:THReshold <TrigThreshold>

Defines the trigger threshold for power trigger sources.

Parameters:

<TrigThreshold>	Range:	-50 dB to 0 dB
	*RST:	-20 dB
	Default unit:	dB

Example: See Configuring the Trigger System

Firmware/Software: V2.0.10

Manual operation: See "Trigger Threshold" on page 769

TRIGger:LTE:MEAS<i>:PRACh:TOUT <TriggerTimeOut>

Selects the maximum time that the R&S CMW will wait for a trigger event before it stops the measurement in remote control mode or indicates a trigger timeout in manual operation mode. This setting has no influence on "Free Run" measurements.

Parameters:

<TriggerTimeOut>	Range:	0.01 s to 167772.15 s
	*RST:	0.1 s
	Default unit:	s

Example: See Configuring the Trigger System

Firmware/Software: V2.0.10

Manual operation: See "Trigger Timeout" on page 769

TRIGger:LTE:MEAS<i>:PRACh:MGAP <MinTrigGap>

Sets a minimum time during which the IF signal must be below the trigger threshold before the trigger is armed so that an IF power trigger event can be generated.

Parameters:

<MinTrigGap>	Range:	0 s to 1E-3 s
	*RST:	50E-6 s
	Default unit:	s

Example: See Configuring the Trigger System

Firmware/Software: V2.0.10

Manual operation: See "Min Trigger Gap" on page 770

4.5.3.7 Limits (Modulation)

The following commands define limits for results which characterize the modulation accuracy of the PRACH signal.

CONFigure:LTE:MEAS<i>:PRACh:LIMit:EVMagnitude <RMS>, <Peak>

Defines upper limits for the RMS and peak values of the error vector magnitude (EVM).

Parameters:

<RMS>
Range: 0 % to 100 %
*RST: 17.5 %, ON
Default unit: %
Additional parameters: OFF | ON (disables the limit check | enables the limit check using the previous/default limit values)

<Peak>
Range: 0 % to 100 %
*RST: 35 %, OFF
Default unit: %
Additional parameters: OFF | ON (disables the limit check | enables the limit check using the previous/default limit values)

Example: See Specifying Limits

Firmware/Software: V2.0.10

Manual operation: See "Limits" on page 771

CONFigure:LTE:MEAS<i>:PRACh:LIMit:MERRor <RMS>, <Peak>

Defines upper limits for the RMS and peak values of the magnitude error.

Parameters:

<RMS>
Range: 0 % to 100 %
*RST: 17.5 %, OFF
Default unit: %
Additional parameters: OFF | ON (disables the limit check | enables the limit check using the previous/default limit values)

<Peak>
Range: 0 % to 100 %
*RST: 35 %, OFF
Default unit: %
Additional parameters: OFF | ON (disables the limit check | enables the limit check using the previous/default limit values)

Example: See Specifying Limits

Firmware/Software: V2.0.10

Manual operation: See "Limits" on page 771

CONFigure:LTE:MEAS<i>:PRACh:LIMit:PERRor <RMS>, <Peak>

Defines symmetric limits for the RMS and peak values of the phase error. The limit check fails if the absolute value of the measured phase error exceeds the specified values.

Parameters:

<RMS> Range: 0 deg to 180 deg
*RST: 17.5 deg, OFF
Default unit: deg
Additional parameters: OFF | ON (disables the limit check | enables the limit check using the previous/default limit values)

<Peak> Range: 0 deg to 180 deg
*RST: 35 deg, OFF
Default unit: deg
Additional parameters: OFF | ON (disables the limit check | enables the limit check using the previous/default limit values)

Example: See Specifying Limits

Firmware/Software: V2.0.10

Manual operation: See "Limits" on page 771

CONFigure:LTE:MEAS<i>:PRACh:LIMit:FERRor <FrequencyError>

Defines an upper limit for the carrier frequency error.

Parameters:

<FrequencyError> Range: 0 ppm to 1000 ppm
*RST: 0.1 ppm, ON
Additional parameters: OFF | ON (disables the limit check | enables the limit check using the previous/default limit values)

Example: See Specifying Limits

Firmware/Software: V2.0.10

Manual operation: See "Limits" on page 771

4.5.3.8 Limits (Power)

The following command defines limits for results which characterize the power dynamics of the PRACH signal.

CONFigure:LTE:MEAS<i>:PRACh:LIMit:PDYNamics <Enable>, <OnPowerUpper>, <OnPowerLower>, <OffPowerUpper>

Defines limits for the ON power and OFF power determined with the power dynamics measurement.

Parameters:

<Enable>	OFF | ON **OFF**: disables the limit check **ON**: enables the limit check *RST: ON
<OnPowerUpper>	Upper limit for the ON power Range: -256 dBm to 256 dBm *RST: 6.5 dBm Default unit: dBm
<OnPowerLower>	Lower limit for the ON power Range: -256 dBm to 256 dBm *RST: -8.5 dBm Default unit: dBm
<OffPowerUpper>	Upper limit for the OFF power Range: -256 dBm to 256 dBm *RST: -48.5 dBm Default unit: dBm

Example: See Specifying Limits

Firmware/Software: V2.0.10

Manual operation: See "Limits" on page 771

4.5.3.9 Detected Signal Configuration

The following commands return the detected PRACH frequency offset, sequence index and sequence correlation.

FETCh:LTE:MEAS<i>:PRACh:MODulation:DPFoffset?

Returns the automatically detected or manually configured PRACH frequency offset for "single preamble" measurements.

Return values:

<Reliability>	Reliability Indicator
<PRACHfreqOffset>	Range: 0 to 94

Example: See Performing Single-Shot Measurements

Usage: Query only

Firmware/Software: V2.0.10

Manual operation: See "Statistical Overviews and other Single Values" on page 775

FETCh:LTE:MEAS<i>:PRACh:MODulation:DSINdex?

Returns the automatically detected or manually configured sequence index for "single preamble" measurements.

Return values:

<Reliability> Reliability Indicator

<SequenceIndex> Range: 0 to 63

Example: See Performing Single-Shot Measurements

Usage: Query only

Firmware/Software: V2.0.10

Manual operation: See "Statistical Overviews and other Single Values" on page 775

FETCh:LTE:MEAS<i>:PRACh:MODulation:SCORrelation?

Returns the sequence correlation for "single preamble" measurements.

It indicates the correlation between the ideal preamble sequence determined from the parameter settings and the measured preamble sequence. A value of 1 corresponds to perfect correlation. A value much smaller than 1 indicates that the searched preamble sequence was not found.

Return values:

<Reliability> Reliability Indicator

<SeqCorrelation> Range: 0 to 1

Example: See Performing Single-Shot Measurements

Usage: Query only

Firmware/Software: V2.0.10

Manual operation: See "Statistical Overviews and other Single Values" on page 775

FETCh:LTE:MEAS<i>:PRACh:MODulation:DPFoffset:PREamble<Number>?

Returns the automatically detected or manually configured PRACH frequency offset for a selected preamble of "multi preamble" measurements.

Suffix:

<Number> 1..16
Number of the preamble for which the results shall be queried

Return values:

<Reliability> Reliability Indicator

<PRACHfreqOffset>	Range:	0 to 94

Example: See Performing Single-Shot Measurements

Usage: Query only

Firmware/Software: V2.1.20

Manual operation: See "Statistical Overviews and other Single Values" on page 775

FETCh:LTE:MEAS<i>:PRACh:MODulation:DSINdex:PREamble<Number>?

Returns the automatically detected or manually configured sequence index for a selected preamble of "multi preamble" measurements.

Suffix:
<Number> 1..16
Number of the preamble for which the results shall be queried

Return values:
<Reliability> Reliability Indicator

<SequenceIndex> Range: 0 to 63

Example: See Performing Single-Shot Measurements

Usage: Query only

Firmware/Software: V2.1.20

Manual operation: See "Statistical Overviews and other Single Values" on page 775

FETCh:LTE:MEAS<i>:PRACh:MODulation:SCORrelation:PREamble<Number>?

Returns the sequence correlation for a selected preamble of "multi preamble" measurements.

It indicates the correlation between the ideal preamble sequence determined from the parameter settings and the measured preamble sequence. A value of 1 corresponds to perfect correlation. A value much smaller than 1 indicates that the searched preamble sequence was not found.

Suffix:
<Number> 1..16
Number of the preamble for which the results shall be queried

Return values:
<Reliability> Reliability Indicator

<SeqCorrelation> Range: 0 to 1

Example: See Performing Single-Shot Measurements

Usage: Query only

Firmware/Software: V2.1.20

Manual operation: See "Statistical Overviews and other Single Values" on page 775

4.5.3.10 EVM vs. Subcarrier Results (Traces)

The following commands return the EVM vs. subcarrier traces of the PRACH measurement.

FETCh:LTE:MEAS<i>:PRACh:TRACe:EVM:CURRent?
FETCh:LTE:MEAS<i>:PRACh:TRACe:EVM:AVERage?
FETCh:LTE:MEAS<i>:PRACh:TRACe:EVM:MAXimum?
READ:LTE:MEAS<i>:PRACh:TRACe:EVM:CURRent?
READ:LTE:MEAS<i>:PRACh:TRACe:EVM:AVERage?
READ:LTE:MEAS<i>:PRACh:TRACe:EVM:MAXimum?

Return the values of the EVM vs. subcarrier traces. Each value is averaged over the samples in one preamble subcarrier. The results of the current, average and maximum traces can be retrieved.

See also chapter 4.2.9.2, "Detailed Views: EVM, Magnitude Error, Phase Error", on page 750.

Return values:

<Reliability> Reliability Indicator

<Results> The number of results depends on the preamble format.
Format 0 to 3: 839 EVM values, format 4: 139 EVM values

Range: 0 % to 100 %
Default unit: %

Example: See Performing Single-Shot Measurements

Usage: Query only

Firmware/Software: V2.0.10

For additional information concerning syntax elements and returned values refer to Conventions and General Information.

4.5.3.11 Magnitude Error Results (Traces)

The following commands return the magnitude error vs. subcarrier traces of the PRACH measurement.

FETCh:LTE:MEAS<i>:PRACh:TRACe:MERRor:CURRent?
FETCh:LTE:MEAS<i>:PRACh:TRACe:MERRor:AVERage?
FETCh:LTE:MEAS<i>:PRACh:TRACe:MERRor:MAXimum?
READ:LTE:MEAS<i>:PRACh:TRACe:MERRor:CURRent?
READ:LTE:MEAS<i>:PRACh:TRACe:MERRor:AVERage?
READ:LTE:MEAS<i>:PRACh:TRACe:MERRor:MAXimum?

Return the values of the magnitude error traces. Each value is averaged over the samples in one preamble subcarrier. The results of the current, average and maximum traces can be retrieved.

See also chapter 4.2.9.2, "Detailed Views: EVM, Magnitude Error, Phase Error", on page 750.

Return values:

<Reliability> Reliability Indicator

<Results> The number of results depends on the preamble format.
Format 0 to 3: 839 EVM values, format 4: 139 EVM values

Range: 0 % to 100 %
Default unit: %

Example: See Performing Single-Shot Measurements

Usage: Query only

Firmware/Software: V2.0.10

For additional information concerning syntax elements and returned values refer to Conventions and General Information.

4.5.3.12 Phase Error Results (Traces)

The following commands return the phase error vs. subcarrier traces of the PRACH measurement.

FETCh:LTE:MEAS<i>:PRACh:TRACe:PERRor:CURRent?
FETCh:LTE:MEAS<i>:PRACh:TRACe:PERRor:AVERage?
FETCh:LTE:MEAS<i>:PRACh:TRACe:PERRor:MAXimum?
READ:LTE:MEAS<i>:PRACh:TRACe:PERRor:CURRent?
READ:LTE:MEAS<i>:PRACh:TRACe:PERRor:AVERage?
READ:LTE:MEAS<i>:PRACh:TRACe:PERRor:MAXimum?

Return the values of the phase error traces. Each value is averaged over the samples in one preamble subcarrier. The results of the current, average and maximum traces can be retrieved.

See also chapter 4.2.9.2, "Detailed Views: EVM, Magnitude Error, Phase Error", on page 750.

Return values:

<Reliability> Reliability Indicator

<Results> The number of results depends on the preamble format.
Format 0 to 3: 839 EVM values, format 4: 139 EVM values

Range: 0 deg to 180 deg
Default unit: deg

Example: See Performing Single-Shot Measurements

Usage: Query only

Firmware/Software: V2.0.10

For additional information concerning syntax elements and returned values refer to Conventions and General Information.

4.5.3.13 EVM vs. Preamble Results (Traces)

The following commands return the EVM vs. preamble trace of the PRACH measurement.

FETCh:LTE:MEAS<i>:PRACh:TRACe:EVPReamble?
READ:LTE:MEAS<i>:PRACh:TRACe:EVPReamble?

Return the values of the EVM vs. preamble traces.

See also chapter 4.2.9.3, "Detailed Views: EVM vs Preamble, Power vs Preamble", on page 751.

Return values:

<Reliability> Reliability Indicator

<Results> 16 EVM values, for preamble 1 to 16 (NCAP for not measured preambles)
Range: 0 % to 100 %
Default unit: %

Example: See Performing Single-Shot Measurements

Usage: Query only

Firmware/Software: V2.1.20

For additional information concerning syntax elements and returned values refer to Conventions and General Information.

4.5.3.14 Power vs. Preamble Results (Traces)

The following commands return the power vs. preamble trace of the PRACH measurement.

FETCh:LTE:MEAS<i>:PRACh:TRACe:PVPReamble?
READ:LTE:MEAS<i>:PRACh:TRACe:PVPReamble?

Return the values of the power vs. preamble traces.

See also chapter 4.2.9.3, "Detailed Views: EVM vs Preamble, Power vs Preamble", on page 751.

Return values:

<Reliability> Reliability Indicator

<Results> 16 power values, for preamble 1 to 16 (NCAP for not measured preambles)
Range: -100 dBm to 55 dBm
Default unit: dBm

Example: See Performing Single-Shot Measurements

Usage: Query only

Firmware/Software: V2.1.20

For additional information concerning syntax elements and returned values refer to Conventions and General Information.

4.5.3.15 I/Q Constellation Results (Traces)

The following command returns the results in the I/Q constellation diagram.

FETCh:LTE:MEAS<i>:PRACh:TRACe:IQ?

Returns the results in the I/Q constellation diagram.

See also chapter 4.2.9.4, "Detailed Views: I/Q Constellation Diagram", on page 753.

Return values:

<Reliability>	Reliability Indicator
<I_Phase_1> <Q_Phase_1> ... <I_Phase_139/839> <Q_Phase_139/839>	Normalized I and Q amplitudes, one value pair per modulation symbol. For preamble format 4 there are 139 symbols. For preamble format 0 to 3 there are 839 symbols. Range: -2 to 2
Example:	See Performing Single-Shot Measurements
Usage:	Query only
Firmware/Software:	V2.0.10
Manual operation:	See "Traces and Bar Graphs" on page 774

For additional information concerning syntax elements and returned values refer to Conventions and General Information.

4.5.3.16 Power Dynamics Results (Traces)

The following commands return the results in the power dynamics diagram.

FETCh:LTE:MEAS<i>:PRACh:TRACe:PDYNamics:CURRent?
FETCh:LTE:MEAS<i>:PRACh:TRACe:PDYNamics:AVERage?
FETCh:LTE:MEAS<i>:PRACh:TRACe:PDYNamics:MAXimum?
READ:LTE:MEAS<i>:PRACh:TRACe:PDYNamics:CURRent?
READ:LTE:MEAS<i>:PRACh:TRACe:PDYNamics:AVERage?
READ:LTE:MEAS<i>:PRACh:TRACe:PDYNamics:MAXimum?

Return the values of the power dynamics traces. Each value is sampled with 48 T_s, corresponding to 1.5625 µs. The results of the current, average and maximum traces can be retrieved.

See also chapter 4.2.9.5, "Detailed Views: Power Dynamics", on page 753.

Return values:

<Reliability>	Reliability Indicator

<Power> 2048 power values, from -1100 µs to +2098.4375 µs relative to the start of the preamble. The values have a spacing of 1.5625 µs. The 705th value is located at the start of the preamble (0 µs).

Range: -100 dBm to 55 dBm
Default unit: dBm

Example: See Performing Single-Shot Measurements

Usage: Query only

Firmware/Software: V2.0.10

For additional information concerning syntax elements and returned values refer to Conventions and General Information.

4.5.3.17 "TX Measurement" Results (Single Values)

The following commands return the statistical modulation results as presented in the "TX Measurement" view.

FETCh:LTE:MEAS<i>:PRACh:MODulation:CURRent?
FETCh:LTE:MEAS<i>:PRACh:MODulation:AVERage?
FETCh:LTE:MEAS<i>:PRACh:MODulation:SDEViation?
READ:LTE:MEAS<i>:PRACh:MODulation:CURRent?
READ:LTE:MEAS<i>:PRACh:MODulation:AVERage?
READ:LTE:MEAS<i>:PRACh:MODulation:SDEViation?
CALCulate:LTE:MEAS<i>:PRACh:MODulation:CURRent?
CALCulate:LTE:MEAS<i>:PRACh:MODulation:AVERage?

Return the current, average and standard deviation single value results.

The values described below are returned by `FETCh` and `READ` commands. `CALCulate` commands return limit check results instead, one value for each result listed below.

The ranges indicated below apply to all results except standard deviation results. The minimum for standard deviation results equals 0. The maximum equals the width of the indicated range divided by two. Exceptions are explicitly stated.

The number to the left of each result parameter is provided for easy identification of the parameter position within the result array.

Return values:

<1_Reliability> Reliability Indicator

<2_OutOfTol> Out of tolerance result, i.e. percentage of measurement intervals of the statistic count (`CONFigure:LTE:MEAS<i>:PRACh:SCOunt:MODulation`) exceeding the specified modulation limits.

Range: 0 % to 100 %
Default unit: %

<3_EVM_RMSlow>
<4_EVM_RMShigh>
<5_EVMpeakLow>
<6_EVMpeakHigh> Error vector magnitude RMS and peak values for low and high EVM window position

Range: 0 % to 100 %
Default unit: %

<7_MErr_RMSlow>
<8_MErr_RMShigh> Magnitude error RMS value for low and high EVM window position

Range: 0 % to 100 %
Default unit: %

<9_MErrPeakLow>
<10_MErrPeakHigh> Magnitude error peak value for low and high EVM window position

Range: -100 % to 100 % (AVERage: 0 % to 100 %, SDEViation: 0 % to 50 %)
Default unit: %

<11_PErr_RMSlow>
<12_PErr_RMSh> Phase error RMS value for low and high EVM window position

Range: 0 deg to 180 deg
Default unit: deg

<13_PErrPeakLow>
<14_PErrPeakHigh> Phase error peak value for low and high EVM window position

Range: -180 deg to 180 deg (AVERage: 0 deg to 180 deg, SDEViation: 0 deg to 90 deg)
Default unit: deg

<15_FreqError> Carrier frequency error

Range: -80000 Hz to 80000 Hz
Default unit: Hz

<16_TimingError> Transmit time error

Range: -32000 Ts to 32000 Ts
Default unit: Ts (basic LTE time unit)

<17_TXpower> User equipment power

Range: -100 dBm to 55 dBm
Default unit: dBm

<18_PeakPower> User equipment peak power

Range: -100 dBm to 55 dBm
Default unit: dBm

Example: See Performing Single-Shot Measurements

Usage: Query only

Firmware/Software: V2.0.10

For additional information concerning syntax elements and returned values refer to Conventions and General Information.

FETCh:LTE:MEAS<i>:PRACh:MODulation:EXTReme?
READ:LTE:MEAS<i>:PRACh:MODulation:EXTReme?
CALCulate:LTE:MEAS<i>:PRACh:MODulation:EXTReme?

Returns the extreme single value results.

The values described below are returned by `FETCh` and `READ` commands. `CALCulate` commands return limit check results instead, one value for each result listed below.

The number to the left of each result parameter is provided for easy identification of the parameter position within the result array.

Return values:

<1_Reliability> Reliability Indicator

<2_OutOfTol> Out of tolerance result, i.e. percentage of measurement intervals of the statistic count (`CONFigure:LTE:MEAS<i>:PRACh:SCOunt:MODulation`) exceeding the specified modulation limits.
Range: 0 % to 100 %
Default unit: %

<3_EVM_RMSlow>
<4_EVM_RMShigh>
<5_EVMpeakLow>
<6_EVMpeakHigh> Error vector magnitude RMS and peak values for low and high EVM window position
Range: 0 % to 100 %
Default unit: %

<7_MErr_RMSlow>
<8_MErr_RMShigh> Magnitude error RMS value for low and high EVM window position
Range: 0 % to 100 %
Default unit: %

<9_MErrPeakLow>
<10_MErrPeakHigh> Magnitude error peak value for low and high EVM window position
Range: -100 % to 100 %
Default unit: %

<11_PErr_RMSlow>
<12_PErr_RMSh> Phase error RMS value for low and high EVM window position
Range: 0 deg to 180 deg
Default unit: deg

<13_PErrPeakLow>
<14_PErrPeakHigh> Phase error peak value for low and high EVM window position
Range: -180 deg to 180 deg
Default unit: deg

<15_FreqError>	Carrier frequency error Range: -80000 Hz to 80000 Hz Default unit: Hz
<16_TimingError>	Transmit time error Range: -32000 Ts to 32000 Ts Default unit: Ts (basic LTE time unit)
<17_TXpowerMin> <18_TXpowerMax>	Minimum and maximum user equipment power Range: -100 dBm to 55 dBm Default unit: dBm
<19_PeakPowMin> <20_PeakPowMax>	Minimum and maximum user equipment peak power Range: -100 dBm to 55 dBm Default unit: dBm

Example: See Performing Single-Shot Measurements

Usage: Query only

Firmware/Software: V2.0.10

For additional information concerning syntax elements and returned values refer to Conventions and General Information.

4.5.3.18 EVM / Power vs. Preamble Results (Single Values)

The following commands return the single value modulation results as presented in the "EMV vs Preamble" and "Power vs Preamble" views.

For additional commands see chapter 4.5.3.9, "Detected Signal Configuration", on page 800.

FETCh:LTE:MEAS<i>:PRACh:MODulation:PREamble<Number>?
READ:LTE:MEAS<i>:PRACh:MODulation:PREamble<Number>?

Return the single value results of the "EVM vs Preamble" and "Power vs Preamble" views, for a selected preamble.

See also chapter 4.2.9.3, "Detailed Views: EVM vs Preamble, Power vs Preamble", on page 751.

The number to the left of each result parameter is provided for easy identification of the parameter position within the result array.

Suffix:

<Number>	1..16 Number of the preamble for which the results shall be queried

Return values:

<1_Reliability>	Reliability Indicator
<2_PreambleRel>	Reliability indicator for the preamble. The meaning of the returned values is the same as for the common reliability indicator, see previous parameter.

<3_EVM_RMSlow> <4_EVM_RMShigh> <5_EVMpeakLow> <6_EVMpeakHigh>	Error vector magnitude RMS and peak values for low and high EVM window position Range: 0 % to 100 % Default unit: %
<7_MErr_RMSlow> <8_MErr_RMShigh>	Magnitude error RMS value for low and high EVM window position Range: 0 % to 100 % Default unit: %
<9_MErrPeakLow> <10_MErrPeakHigh>	Magnitude error peak value for low and high EVM window position Range: -100 % to 100 % Default unit: %
<11_PErr_RMSlow> <12_PErr_RMSh>	Phase error RMS value for low and high EVM window position Range: 0 deg to 180 deg Default unit: deg
<13_PErrPeakLow> <14_PErrPeakHigh>	Phase error peak value for low and high EVM window position Range: -180 deg to 180 deg Default unit: deg
<15_FreqError>	Carrier frequency error Range: -80000 Hz to 80000 Hz Default unit: Hz
<16_TimingError>	Transmit time error Range: -32000 Ts to 32000 Ts Default unit: Ts (basic LTE time unit)
<17_TXpower>	User equipment power Range: -100 dBm to 55 dBm Default unit: dBm
<18_PeakPower>	User equipment peak power Range: -100 dBm to 55 dBm Default unit: dBm

Example: See Performing Single-Shot Measurements

Usage: Query only

Firmware/Software: V2.1.20

For additional information concerning syntax elements and returned values refer to Conventions and General Information.

4.5.3.19 Power Dynamics Results (Single Values)

The following commands return the statistical results of the power dynamics measurement.

FETCh:LTE:MEAS<i>:PRACh:PDYNamics:CURRent?
FETCh:LTE:MEAS<i>:PRACh:PDYNamics:AVERage?
FETCh:LTE:MEAS<i>:PRACh:PDYNamics:MINimum?
FETCh:LTE:MEAS<i>:PRACh:PDYNamics:MAXimum?
FETCh:LTE:MEAS<i>:PRACh:PDYNamics:SDEViation?
READ:LTE:MEAS<i>:PRACh:PDYNamics:CURRent?
READ:LTE:MEAS<i>:PRACh:PDYNamics:AVERage?
READ:LTE:MEAS<i>:PRACh:PDYNamics:MINimum?
READ:LTE:MEAS<i>:PRACh:PDYNamics:MAXimum?
READ:LTE:MEAS<i>:PRACh:PDYNamics:SDEViation?
CALCulate:LTE:MEAS<i>:PRACh:PDYNamics:CURRent?
CALCulate:LTE:MEAS<i>:PRACh:PDYNamics:AVERage?
CALCulate:LTE:MEAS<i>:PRACh:PDYNamics:MINimum?
CALCulate:LTE:MEAS<i>:PRACh:PDYNamics:MAXimum?

Return the current, average, minimum, maximum and standard deviation single value results of the power dynamics measurement.

The values described below are returned by `FETCh` and `READ` commands. `CALCulate` commands return limit check results instead, one value for each result listed below.

The ranges indicated below apply to all results except standard deviation results. The minimum for standard deviation results equals 0. The maximum equals the width of the indicated range divided by two. Exceptions are explicitly stated.

Return values:

<Reliability> Reliability Indicator

<OutOfTolerance> Out of tolerance result, i.e. percentage of measurement intervals of the statistic count (`CONFigure:LTE:MEAS<i>:PRACh:SCOunt:PDYNamics`) exceeding the specified power dynamics limits.

Range: 0 % to 100 %
Default unit: %

<OffPowerBefore> OFF power mean value for subframe before preamble without transient period

Range: -100 dBm to 55 dBm
Default unit: dBm

<OnPowerRMS> ON power mean value over preamble

Range: -100 dBm to 55 dBm
Default unit: dBm

<OnPowerPeak> ON power peak value within preamble

Range: -100 dBm to 55 dBm
Default unit: dBm

<OffPowerAfter> OFF power mean value for subframe after preamble without transient period

Range: -100 dBm to 55 dBm
Default unit: dBm

Example: See Performing Single-Shot Measurements

Usage: Query only

Firmware/Software: V2.0.10

For additional information concerning syntax elements and returned values refer to Conventions and General Information.

4.5.4 Combined Signal Path Commands

For some settings, the command to be used depends on the active scenario. While the Combined Signal Path (CSP) scenario is active, these settings are configured via commands of the signaling application. While the Standalone (SA) scenario is active, they are configured via measurement commands.

The following table provides the mapping for PRACH measurement commands. For general measurement settings, see table 3-2.

Table 4-5: Mapping for PRACH measurement commands

Setting	Commands for SA scenario	Commands for CSP scenario
PRACH configuration index	CONFigure:LTE:MEAS<i>:PRACh:PCINdex	CONFigure:LTE:SIGN<i>:CELL:PRACh:PCINdex:FDD CONFigure:LTE:SIGN<i>:CELL:PRACh:PCINdex:TDD
PRACH frequency offset	CONFigure:LTE:MEAS<i>:PRACh:PFOFfset	CONFigure:LTE:SIGN<i>:CELL:PRACh:PFOFfset
Logical root sequence index	CONFigure:LTE:MEAS<i>:PRACh:MODulation:LRSindex	CONFigure:LTE:SIGN<i>:CELL:PRACh:LRSindex
Zero correlation zone config	CONFigure:LTE:MEAS<i>:PRACh:MODulation:ZCZConfig	CONFigure:LTE:SIGN<i>:CELL:PRACh:ZCZConfig
High dynamic mode	CONFigure:LTE:MEAS<i>:PRACh:POWer:HDMode	Fixed value OFF

4.6 List of Commands

5 LTE SRS Measurement

The "LTE SRS" measurement provides quick and flexible tests on LTE FDD and TDD sounding reference signals. The tests cover the following UE transmitter properties:

- Transmit OFF power, transmit ON power and power ramping between them (Power Dynamics)

The SRS measurement requires option R&S CMW-KM500 for FDD signals and R&S CMW-KM550 for TDD signals.

5.1 What's New in this Revision

This revision describes version 3.2.82 and later of the "LTE SRS Measurement" firmware application. Compared to version 3.2.10, it provides the following new features:

- Shortcut softkey to the GPRF generator, see Shortcut Configuration

Software Version

To check your R&S CMW software version, open the "Setup" dialog and click "HW/SW Equipment". The initial software version for each remote control command is quoted in the reference description.

5.2 General Description

The LTE SRS measurement captures an uplink LTE Sounding Reference Signal (SRS) and provides power dynamics measurement results. The signal to be measured must not contain any additional components, e.g. a PUSCH or PUCCH.

Both FDD signals (option R&S CMW-KM500) and TDD signals (option R&S CMW-KM550) can be measured.

The following sections describe how to perform and configure the measurement.

5.2.1 Test Setup

The external RF signal source (mobile station, signal generator etc.) is connected to one of the RF input connectors (RF COM) at the front panel of the R&S CMW. No additional cabling and no external trigger is needed.

The input level ranges of all RF COM connectors are identical.

See also: "RF Connectors" in the R&S CMW user manual, chapter "Getting Started"

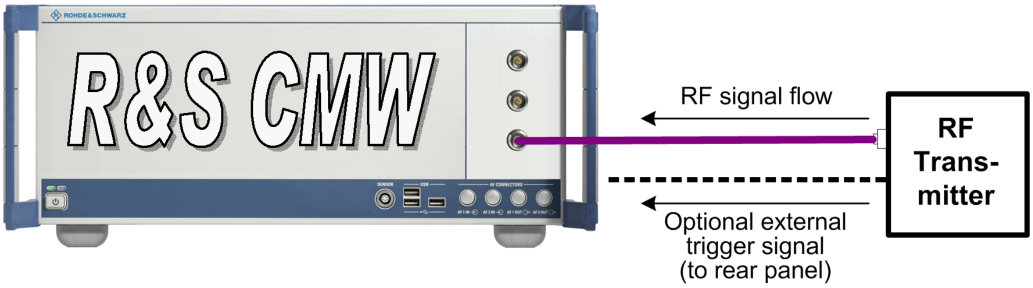


Fig. 5-1: Connecting an RF transmitter to the instrument

5.2.2 How to Measure an Uplink SRS Signal

The measurement expects a pure LTE SRS UL signal. Any other signals, e.g. an LTE SRS UL signal with additional PUSCH will not yield correct measurement results.

After connecting your LTE UE to the R&S CMW, you have to adjust at least the following analyzer settings to the properties of the analyzed SRS signal:

- Duplex mode
- Analyzer "Frequency"
- "Expected Nominal Power", (optional) "User Margin" and "External Attenuation (Input)".
  Recommended values: "Expected Nominal Power" = peak power of the UE signal during the measurement; "User Margin" = 0 dB. The smallest possible value of the "Expected Nominal Power" plus the "User Margin" ensures maximum dynamic range.

The "Channel Bandwidth" must also be in accordance with the measured signal. For configuration refer to the "Measurement Control" section of the configuration dialog.

The default trigger settings are usually appropriate and don't need to be modified, see chapter 5.2.4, "Trigger Modes", on page 818.

5.2.3 Parallel Signaling and Measurement

The SRS measurement can be used in parallel to the LTE signaling application (option R&S CMW-KS500/-KS550), i.e. a connection to the UE can be set up by the signaling application and the sounding reference signal sent by the UE can be measured using the SRS measurement.

To use both applications in parallel, the combined signal path scenario must be activated (see "Scenario = Combined Signal Path" on page 823). Most signal routing and analyzer settings and some measurement control settings are then configured by the signaling application. The SRS measurement displays the corresponding signaling settings instead of its own settings. These signaling settings can be configured both in the measurement GUI and in the GUI of the signaling application.

To configure these settings via remote commands, the commands of the signaling application must be used. For a command mapping table, see chapter 5.5.4, "Combined Signal Path Commands", on page 851.

The most important signaling parameters not relevant for standalone measurements can nevertheless be configured both in the measurement GUI and in the GUI of the signaling application. In the measurement GUI they can be accessed via hotkeys.

5.2.4 Trigger Modes

The LTE SRS measurement requires a trigger event for each SRS symbol to be measured. It can be performed in the following trigger modes:

- IF Power (default mode): With an internal IF power trigger, the measurement is triggered by the power ramp of the received SRS symbol. The default value of the minimum trigger gap is usually big enough to ensure that the measurement is not re-triggered within an SRS symbol and small enough to ensure that the trigger system is re-armed for the next measurement interval.
- External Trigger A/B: External trigger signal fed in via TRIG A or TRIG B on the rear panel of the instrument.
- Additional trigger modes: Other firmware applications, e.g. the LTE signaling application (option R&S CMW-KS500/-KS550) or the GPRF generator may provide additional trigger modes. Refer to the documentation of the corresponding firmware application for a description of these trigger modes.

For configuration see chapter 5.3.2.3, "Trigger Settings", on page 829.

5.2.5 Limit Settings and Conformance Requirements

Conformance requirements for LTE transmitter tests are specified in 3GPP TS 36.521, section 6, "Transmitter Characteristics".

The following section gives an overview of the SRS measurement limit settings and the related test requirements.

5.2.5.1 Power Dynamics Limits

Transmission at excessive uplink power increases interference to other channels while a too low uplink power increases transmission errors. For SRS transmission 3GPP defines a time mask to verify the UL power while an SRS symbol is transmitted (ON power), the UL power in the adjacent SC-FDMA symbols (OFF power) and the power ramping in between.

The ON power is specified as the mean UE output power over the SRS symbol(s), excluding transient periods of 20 µs. For the OFF power the mean power has to be measured both in the preceding symbols and in the subsequent subframe, excluding transient periods of 20 µs.

The following figures provide a summary of the time periods relevant for ON and OFF power limits for FDD and TDD. The transient periods between the two TDD SRS symbols are only defined for signal configurations with frequency hopping or power change between the two symbols. The measurement assumes that this condition is fulfilled and excludes these transient periods for result calculation.

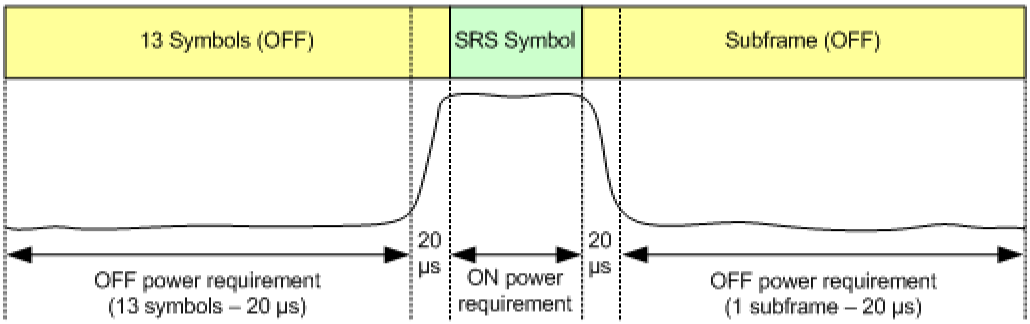


Fig. 5-2: Measurement periods ON/OFF power, FDD SRS signal

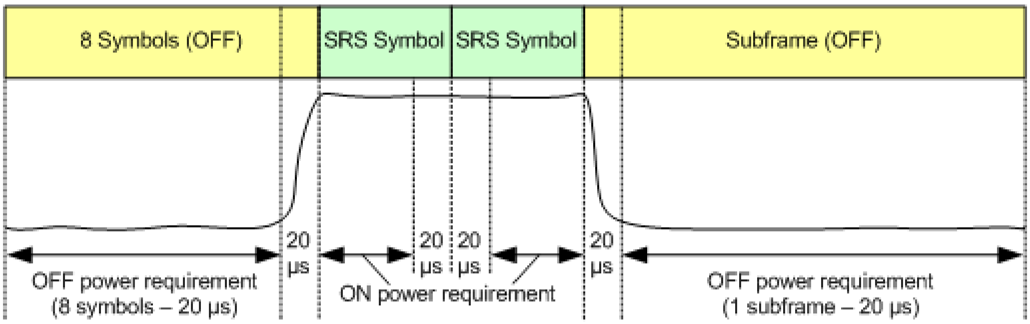


Fig. 5-3: Measurement periods ON/OFF power, TDD SRS signal

According to 3GPP the OFF power shall not exceed -48.5 dBm. The ON power shall be between -10.1 dBm and 4.9 dBm. The limits for ON and OFF power can be set in the configuration dialog.

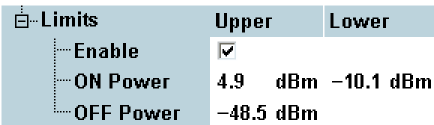


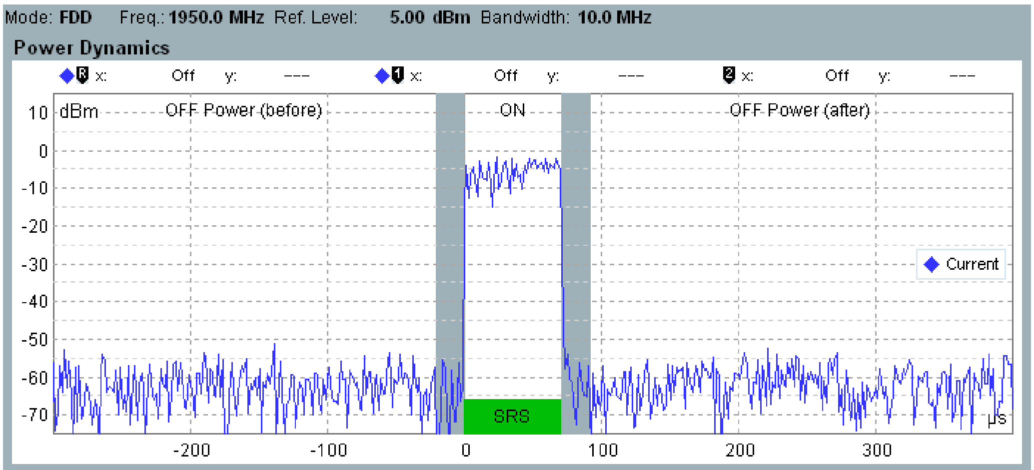
Fig. 5-4: Power dynamics limit settings

Characteristics	Refer to 3GPP TS 36.521 V9.3.0, section...	Specified Limit
ON power	6.3.4.2 PRACH and SRS Time Mask	≥ -10.1 dBm, ≤ 4.9 dBm
OFF power	6.3.4.2 PRACH and SRS Time Mask	≤ -48.5 dBm

5.2.6 Measurement Results

The results of the LTE SRS measurement are displayed in the view "Power Dynamics".

It shows a diagram and a statistical overview of related power results.



	OFF Power (before)	ON Power		OFF Power (after)
		RMS	Peak	
Current	−61.51 dBm	−4.95 dBm	−1.57 dBm	−61.41 dBm
Average	−61.51 dBm	−4.95 dBm	−1.57 dBm	−61.41 dBm
Min	−61.55 dBm	−4.95 dBm	−1.59 dBm	−61.58 dBm
Max	−61.40 dBm	−4.94 dBm	−1.56 dBm	−61.37 dBm
StdDev	0.00 dBm	0.00 dBm	0.00 dBm	0.00 dBm

Statistic Count 1 / 1 Out of Tolerance 0.00 %

Fig. 5-5: LTE SRS: Power Dynamics, FDD

The diagram shows the UE output power vs. time, sampled with 48 T_s (1.5625 µs). The trace covers the range from -1100 µs to +1298.4375 µs relative to the start of the SRS symbol.

Transient periods are indicated by gray vertical bars in the diagram. They are excluded from the measurement and have a width of 20 µs each. For TDD signals there are two exclusion periods between the two SRS symbols.

The table below the diagram shows ON power and OFF power values:

- **ON Power**:
  The ON power is the mean UE output power over the SRS symbol, i.e. over the measurement period marked by a green horizontal bar in the diagram. In addition to the mean value the table lists also the peak power within the measurement period.
  For TDD signals two SRS symbols are measured and separate RMS and peak ON power results are provided for each SRS symbol.
- **OFF Power**:
  The OFF power represents a mean power. It is determined before and after the SRS symbol(s) within the following measurement periods:
  – OFF Power (before): 13 SC-FDMA symbols for FDD, 8 SC-FDMA symbols for TDD
  – OFF Power (after): one subframe (FDD and TDD)

Statistical Results

The statistical values in the table are calculated as follows:

- **Current:** Value of the result obtained in the last measurement interval.
- **Average:** Average of all "Current" values referenced to the last statistics cycle.
- **Min, Max:** Largest or smallest "Current" value that the R&S CMW obtained since the start of the measurement.
- **StdDev:** Standard deviation of all "Current" values since the start of the measurement.

All statistical results (statistical tables and "Average" or "Max" traces) are calculated according to the general rules for statistical results.

See also: "Statistical Results" in the R&S CMW user manual, chapter "System Overview"

Statistic Count

Progress bar for the measurement. During the first single shot after the start of the measurement, the bar shows the number of completed measurement intervals relative to the "Statistic Count". A filled progress bar indicates that the first shot is complete and the statistical depth has been reached.

See also: "Statistical Settings" in the R&S CMW user manual, chapter "System Overview"

Out of Tolerance

Percentage of measurement intervals (SRS symbols) that were failed because they exceeded the limits in the diagram.

5.2.6.1 Modifying Views

Use the "Display" parameters to change the appearance and contents of the view. The following "Display" hotkeys are available at the bottom of the GUI:

Hotkey	Description
"Select Trace ..."	Select the trace types to be displayed in the view.
"X Scale... / Y Scale..."	Modify the ranges of the X-axis and the Y-axis.

5.2.6.2 Using Markers

Use the "Marker" parameters to activate markers and to modify their position. The following "Marker" hotkeys are available at the bottom of the GUI:

Hotkey	Description
"Ref. Marker ..."	Enable or disable the reference marker and select the marker position. If several traces can be displayed, a trace can also be selected.
"Marker 1 /2 ..."	Enable or disable marker 1 or 2 and define the marker position (absolute or relative to the reference marker). Depending on the trace mode, a trace can also be selected.
"Select Trace Mode"	Define whether marker 1 and 2 are set to the same trace as the reference marker (collective) or to selectable individual traces.

See also: "Markers" in the R&S CMW user manual, chapter "System Overview"

5.3 GUI Reference

The following sections provide detailed reference information on the Graphical User Interface (GUI) and the parameters of the "LTE SRS" measurement.

5.3.1 Measurement Control

The measurement is turned on or off using the ON | OFF or RESTART | STOP keys.

See also: "Measurement Control" in the R&S CMW user manual, chapter "System Overview"

SRS (Softkey)
The softkey shows the current measurement state. Additional measurement substates can be retrieved via remote control.

Remote command:
`INITiate:LTE:MEAS<i>:SRS`
`STOP:LTE:MEAS<i>:SRS`
`ABORt:LTE:MEAS<i>:SRS`
`FETCh:LTE:MEAS<i>:SRS:STATe?`
`FETCh:LTE:MEAS<i>:SRS:STATe:ALL?`

5.3.2 Parameters and Settings

The most important settings of the "LTE SRS" measurement are displayed in the measurement dialog.

All settings are defined via softkeys and hotkeys or using the "LTE SRS Configuration" dialog. The configuration dialog is described in the following sections. To open the dialog, select the "SRS" tab and press the "Config" hotkey.

5.3.2.1 Signal Routing and Analyzer Settings

The following parameters configure the RF input path. All parameters are common measurement settings, i.e. they have the same value in all measurements (e.g. SRS measurement and multi evaluation measurement).

See also: "Connection Control (Measurements)" in the R&S CMW user manual, chapter "System Overview"

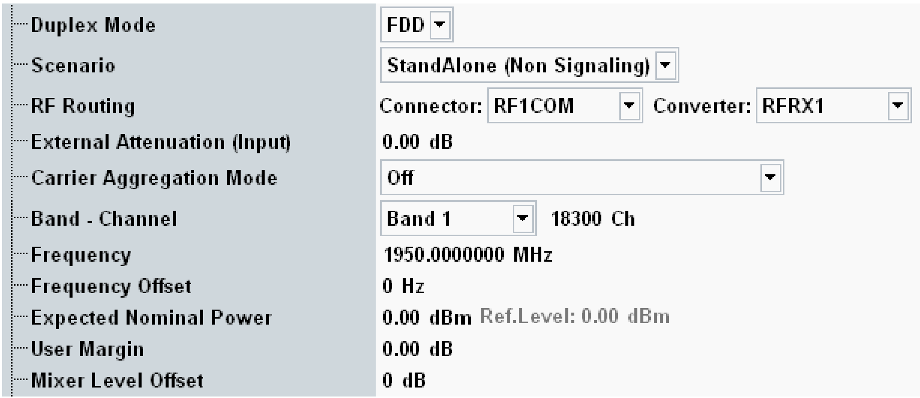


Fig. 5-6: Signal routing and analyzer settings

Duplex Mode

Selects the duplex mode of the LTE signal: FDD or TDD.

In the Standalone (SA) scenario, this parameter is controlled by the measurement. In the Combined Signal Path (CSP) scenario, it is controlled by the signaling application.

Remote command:
`CONFigure:LTE:MEAS<i>:DMODe` (SA)
`CONFigure:LTE:SIGN<i>:DMODe` (CSP)

Scenario = StandAlone

The SRS measurement is used standalone.

Remote command:
`ROUTe:LTE:MEAS<i>:SCENario:SALone`
`ROUTe:LTE:MEAS<i>:SCENario?`
`ROUTe:LTE:MEAS<i>?`

Scenario = Combined Signal Path

Allows to use an LTE signaling application (option R&S CMW-KS500/-KS550) in parallel to the LTE SRS measurement. The signaling application is selected by the additional parameter "Controlled by".

Most parameters described in this section and some parameters described in section Measurement Control Settings display values determined by the signaling application. The corresponding measurement settings are remembered in the background and displayed again when switching back to the standalone scenario.

Connection status information of the signaling application is displayed at the bottom of the measurement views. Softkeys and hotkeys provide access to the settings of the signaling application and allow to switch the downlink signal on or off, see chapter 5.3.2.6, "Additional Softkeys and Hotkeys", on page 831.

For additional information see chapter 5.2.3, "Parallel Signaling and Measurement", on page 817.

Remote command:
`ROUTe:LTE:MEAS<i>:SCENario:CSPath`
`ROUTe:LTE:MEAS<i>:SCENario?`
`ROUTe:LTE:MEAS<i>?`

Scenario = Measure@ProtocolTest
Allows to use an LTE protocol test application in parallel to the LTE measurement. The protocol test application is selected by the additional parameter "Controlled by".

The signal routing and analyzer settings described in this section are ignored by the measurement application. The corresponding settings have to be configured within the protocol test application.

Protocol test applications are available for R&S CMW500, but not for R&S CMW270 and R&S CMW280.

Remote command:
`ROUTe:LTE:MEAS<i>:SCENario:MAPRotocol`
`ROUTe:LTE:MEAS<i>:SCENario?`

RF Routing
Selects the input path for the measured RF signal, i.e. the input connector and the RX module to be used.

Depending on your hardware configuration there may be dependencies between both parameters. Select the RF connector first. The "Converter" parameter offers only values compatible with the selected RF connector.

In the Standalone (SA) scenario, these parameters are controlled by the measurement. In the Combined Signal Path (CSP) scenario, they are controlled by the signaling application.

For connector and converter settings in the combined signal path scenario, use one of the `ROUTe:LTE:SIGN<i>:SCENario:...` signaling commands.

Remote command:
`ROUTe:LTE:MEAS<i>:SCENario:SALone` (SA)
`ROUTe:LTE:SIGN<i>:SCENario:...` (CSP)

External Attenuation (Input)
Defines the value of an external attenuation (or gain, if the value is negative) in the input path. The power readings of the R&S CMW are corrected by the external attenuation value.

The external attenuation value is also used in the calculation of the maximum input power that the R&S CMW can measure.

If a correction table for frequency-dependent attenuation is active for the chosen connector, then the table name and a button are displayed. Press the button to display the table entries.

In the Standalone (SA) scenario, this parameter is controlled by the measurement. In the Combined Signal Path (CSP) scenario, it is controlled by the signaling application.

Remote command:
`CONFigure:LTE:MEAS<i>:RFSettings:EATTenuation` (SA)
`CONFigure:LTE:SIGN<i>:RFSettings[:PCC]:EATTenuation:INPut` (CSP)

Carrier Aggregation Mode
This setting has no effect for SRS measurements. Only the PCC is evaluated, even if carrier aggregation is active.

The parameter is only visible, if option R&S CMW-KM502/552 is available.

Band / Channel / Frequency
Center frequency of the RF analyzer. Set this frequency to the frequency of the measured RF signal to obtain a meaningful measurement result. The relation between operating band, frequency and channel number is defined by 3GPP (see chapter 3.2.4.2, "Frequency Bands", on page 506).

You can specify the RF frequency in two ways:
- Enter the frequency directly. The band and channel settings can be ignored or used for validation of the entered frequency. For validation select the designated band. The channel number resulting from the selected band and frequency is displayed. For an invalid combination no channel number is displayed.
- Select a band and enter a channel number valid for this band. The R&S CMW calculates the resulting frequency.

In the Standalone (SA) scenario, these parameters are controlled by the measurement. In the Combined Signal Path (CSP) scenario, they are controlled by the signaling application.

Remote command:
`CONFigure:LTE:MEAS<i>:BAND` (SA)
`CONFigure:LTE:MEAS<i>:RFSettings[:PCC]:FREQuency` (SA)
`CONFigure:LTE:SIGN<i>[:PCC]:BAND` (CSP)
`CONFigure:LTE:SIGN<i>:RFSettings[:PCC]:CHANnel:UL` (CSP)

Frequency Offset
Positive or negative frequency offset to be added to the specified center frequency of the RF analyzer.

In the Standalone (SA) scenario, this parameter is controlled by the measurement. In the Combined Signal Path (CSP) scenario, it is controlled by the signaling application.

Remote command:
`CONFigure:LTE:MEAS<i>:RFSettings:FOFFset` (SA)
`CONFigure:LTE:SIGN<i>:RFSettings[:PCC]:FOFFset:UL` (CSP)

Expected Nominal Power
Defines the nominal power of the RF signal to be measured. An appropriate value for LTE signals is the peak output power at the DUT during the measurement. The "Ref. Level" is calculated as follows:

Reference power = Expected Nominal Power + User Margin

Note: The actual input power at the connectors (i.e. the "Reference Level" minus the "External Attenuation (Input)" value, if all power settings are configured correctly) must be within the level range of the selected RF input connector; refer to the data sheet.

In the Standalone (SA) scenario, this parameter is controlled by the measurement. In the Combined Signal Path (CSP) scenario, it is controlled by the signaling application.

Remote command:
`CONFigure:LTE:MEAS<i>:RFSettings:ENPower` (SA)
`CONFigure:LTE:SIGN<i>:RFSettings:ENPMode` (CSP)
`CONFigure:LTE:SIGN<i>:RFSettings:ENPower` (CSP)

User Margin
Margin that the R&S CMW adds to the "Expected Nominal Power" in order to determine its reference power ("Ref. Level"). The "User Margin" is typically used to account for the known variations of the RF input signal power, e.g. the variations due to a specific channel configuration.

The variations (crest factor) depend on the LTE signal parameters, in particular the modulation scheme. If the "Expected Nominal Power" is set to the peak power during the measurement, a 0 dB user margin is sufficient.

In the Standalone (SA) scenario, this parameter is controlled by the measurement. In the Combined Signal Path (CSP) scenario, it is controlled by the signaling application.

Remote command:
`CONFigure:LTE:MEAS<i>:RFSettings:UMARgin` (SA)
`CONFigure:LTE:SIGN<i>:RFSettings:UMARgin` (CSP)

Mixer Level Offset
Varies the input level of the mixer in the analyzer path. A negative offset reduces the mixer input level, a positive offset increases it. Optimize the mixer input level according to the properties of the measured signal.

Mixer Level Offset	Advantages	Possible Shortcomings
< 0 dB	Suppression of distortion (e.g. of the intermodulation products generated in the mixer)	Lower dynamic range (due to smaller signal-to-noise ratio)
> 0 dB	High signal-to-noise ratio, higher dynamic range	Risk of intermodulation, smaller overdrive reserve

In the Standalone (SA) scenario, this parameter is controlled by the measurement. In the Combined Signal Path (CSP) scenario, it is controlled by the signaling application.

Remote command:
`CONFigure:LTE:MEAS<i>:RFSettings:MLOFfset` (SA)
`CONFigure:LTE:SIGN<i>:RFSettings:MLOFfset` (CSP)

5.3.2.2 Measurement Control Settings

The "Measurement Control" parameters configure the scope of the LTE SRS measurement.

While the combined signal path scenario is active, some of the measurement control parameters display values determined by the controlling signaling application. This is indicated in the parameter description. See also "Scenario = Combined Signal Path" on page 823.

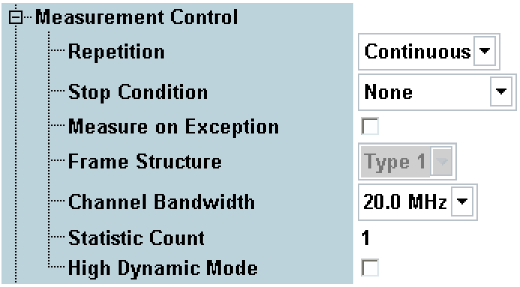


Fig. 5-7: LTE SRS: Measurement Control settings

Repetition
Defines how often the measurement is repeated if it is not stopped explicitly or by a failed limit check.

- **Continuous:** The measurement is continued until it is explicitly terminated; the results are periodically updated.
- **Single-Shot:** The measurement is stopped after one statistics cycle.

Single-shot is preferable if only a single measurement result is required under fixed conditions, which is typical for remote-controlled measurements. Continuous mode is suitable for monitoring the evolution of the measurement results in time and observe how they depend on the measurement configuration, which is typically done in manual control. The reset/preset values therefore differ from each other.

Remote command:
CONFigure:LTE:MEAS<i>:SRS:REPetition

Stop Condition
Specifies the conditions for an early termination of the measurement:

- **None:** The measurement is performed according to its "Repetition" mode and "Statistic Count", irrespective of the limit check results.
- **On Limit Failure:** The measurement is stopped as soon as one of the limits is exceeded, irrespective of the repetition mode set. If no limit failure occurs, it is performed according to its "Repetition" mode and "Statistic Count". Use this setting for measurements that are essentially intended for checking limits, e.g. production tests.

Remote command:
CONFigure:LTE:MEAS<i>:SRS:SCONdition

Measure on Exception

Specifies whether measurement results that the R&S CMW identifies as faulty or inaccurate are rejected. A faulty result occurs e.g. when an overload is detected. In remote control, the cause of the error is indicated by the "reliability indicator".

- **Off:** Faulty results are rejected. The measurement is continued; the statistical counters are not re-set. Use this mode to ensure that a single faulty result does not affect the entire measurement.
- **On:** Results are never rejected. Use this mode e.g. for development purposes, if you want to analyze the reason for occasional wrong transmissions.

Remote command:

`CONFigure:LTE:MEAS<i>:SRS:MOEXception`

Frame Structure

Displays the frame structure of the uplink signal as defined in 3GPP TS 36.211. The value is set implicitly via the Duplex Mode (Type 1 = FDD, Type 2 = TDD).

Remote command:

`CONFigure:LTE:MEAS<i>:FSTRucture?`

Channel Bandwidth

Channel bandwidth between 1.4 MHz and 20 MHz. Set the bandwidth in accordance with the measured LTE signal.

The parameter is a common measurement setting, i.e. it has the same value in all measurements (e.g. SRS measurement and multi evaluation measurement).

In the Standalone (SA) scenario, this parameter is controlled by the measurement. In the Combined Signal Path (CSP) scenario, it is controlled by the signaling application.

Remote command:

`CONFigure:LTE:MEAS<i>[:PCC]:CBANdwidth` (SA)

`CONFigure:LTE:SIGN<i>:CELL:BANDwidth[:PCC]:DL` (CSP)

Statistic Count

Defines the number of measurement intervals per measurement cycle (statistics cycle, single-shot measurement). This value is also relevant for continuous measurements, because the averaging procedures depend on the statistic count.

For SRS measurements the measurement interval is completed when the R&S CMW has measured a full trace, including one or two SRS symbols and the preceding and following OFF time.

Remote command:

`CONFigure:LTE:MEAS<i>:SRS:SCOunt:PDYNamics`

High Dynamic Mode

Enables or disables the high dynamic mode.

The high dynamic mode is suitable for power dynamics measurements involving high ON powers. In that case the dynamic range of the R&S CMW may not be sufficient to measure both the high ON powers and the low OFF powers accurately.

In high dynamic mode the dynamic range is increased by measuring the results in two shots. One shot uses the configured settings to measure the ON power. The other shot uses a lower "Expected Nominal Power" value to measure the OFF power results.

Disable the high dynamic mode to optimize the measurement speed, e.g. when you measure low ON powers using a low "Expected Nominal Power" setting, so that the normal dynamic range is sufficient.

While the combined signal path scenario is active, this parameter is not configurable.

Remote command:
CONFigure:LTE:MEAS<i>:SRS:HDMode

5.3.2.3 Trigger Settings

The "Trigger" parameters configure the trigger system for the LTE SRS measurement.

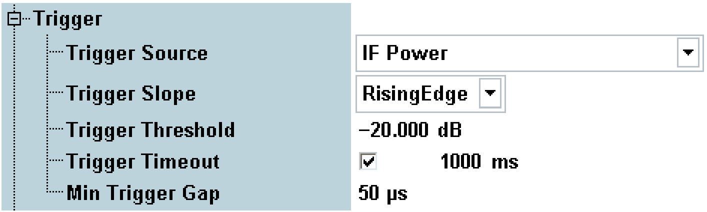


Fig. 5-8: Trigger settings

Trigger Source
Selects the source of the trigger event. Some of the trigger sources require additional options.

- **IF Power:**
  The measurement is triggered by the power of the received signal, converted into an IF signal. The trigger event coincides with the rising or falling edge of the detected LTE burst (i.e. for an SRS signal, the start or end of an SRS symbol). Parameter Min Trigger Gap is also relevant.
- **…External…:**
  External trigger signal fed in via TRIG A or TRIG B on the rear panel of the instrument.

Remote command:
TRIGger:LTE:MEAS<i>:SRS:SOURce
TRIGger:LTE:MEAS<i>:SRS:CATalog:SOURce?

Trigger Slope
Qualifies whether the trigger event is generated at the rising or at the falling edge of the trigger pulse. This setting has no influence on the evaluation of trigger pulses provided by other firmware applications.

Remote command:
TRIGger:LTE:MEAS<i>:SRS:SLOPe

Trigger Threshold

Defines the input signal power where the trigger condition is satisfied and a trigger event is generated. The trigger threshold is valid for power trigger sources. It is a dB value, relative to the reference level minus the external attenuation (<Ref. Level> – <External Attenuation (Input)> – <Frequency Dependent External Attenuation>). If the reference level is set to the actual maximum output power of the DUT, and the external attenuation settings are in accordance with the test setup, then the trigger threshold is referenced to the actual maximum RF input power at the R&S CMW.

A low threshold may be required to ensure that the R&S CMW can always detect the input signal. A higher threshold can prevent unintended trigger events.

Remote command:

`TRIGger:LTE:MEAS<i>:SRS:THReshold`

Trigger Timeout

Sets a time after which an initiated measurement must have received a trigger event. If no trigger event is received, a trigger timeout is indicated in manual operation mode. In remote control mode the measurement is automatically stopped.

This setting has no influence on "Free Run" measurements.

Remote command:

`TRIGger:LTE:MEAS<i>:SRS:TOUT`

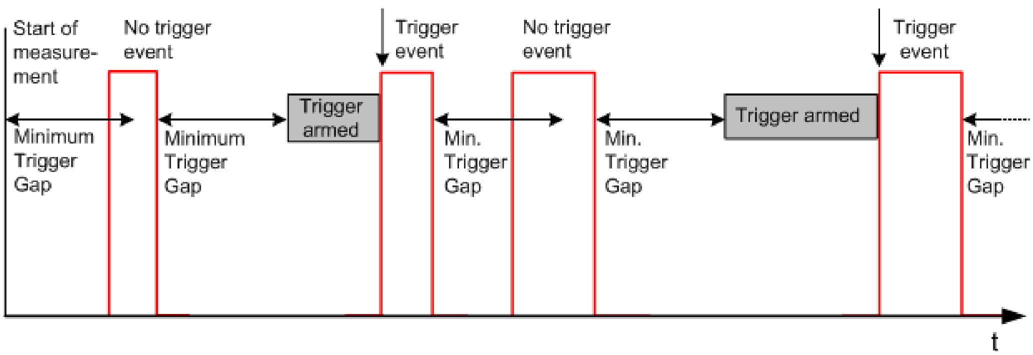
Min Trigger Gap

Defines a minimum duration of the power-down periods (gaps) between two triggered power pulses. This setting is valid for an "(IF) Power" trigger source.

The trigger system is controlled by means of a timer which is reset to zero in the following instances:

- At the IF power-down ramp of each triggered or untriggered pulse, even though the previous counter may not have elapsed yet. A power-down ramp is detected when the signal power falls below the trigger threshold.
- At the beginning of each measurement: The minimum gap defines the minimum time between the start of the measurement and the first trigger event.

The trigger system is re-armed as soon as the timer has reached the specified minimum gap.



This parameter can be used to prevent unwanted trigger events due to fast power variations.

Remote command:
TRIGger:LTE:MEAS<i>:SRS:MGAP

5.3.2.4 Limit Settings

The "Limits" in the "LTE SRS Configuration" dialog define upper limits for the power results.

For details see chapter 5.2.5, "Limit Settings and Conformance Requirements", on page 818.

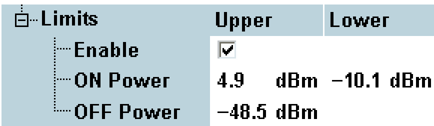


Fig. 5-9: Limit settings

Limits
The limits can be configured via the following remote commands.

Remote command:
CONFigure:LTE:MEAS<i>:SRS:LIMit:PDYNamics

5.3.2.5 Shortcut Configuration

This section configures a shortcut softkey that provides a fast way to access the GPRF generator from the measurement.

The setting is a common measurement setting. It has the same value in all measurements (e.g. PRACH measurement and multi evaluation measurement).

Fig. 5-10: Shortcut configuration

Generator Shortcut
Selects a GPRF generator instance. Softkeys for the selected instance are added to the softkey panel.

5.3.2.6 Additional Softkeys and Hotkeys

The "LTE SRS" measurement provides some softkey/hotkey combinations which have no equivalent in the configuration dialog. Most of these hotkeys provide display configurations (like diagram scaling). They are self-explanatory and do not have any remote-control commands assigned.

The remaining softkeys > hotkeys are described below.

The softkeys "Signaling Parameter" and "LTE Signaling" are displayed only if the combined signal path scenario is active and are provided by the "LTE Signaling" application selected as master application. See also "Scenario = Combined Signal Path" on page 823.

The softkeys "ARB / List Mode" and "GPRF Generator" are displayed only if the standalone scenario is active and the generator shortcut is enabled, see chapter 3.3.8, "Shortcut Configuration", on page 562.

While one of the signaling or generator softkeys is selected, the "Config" hotkey opens the configuration dialog of the generator or signaling application, not the configuration dialog of the measurement.

Signaling Parameter > ...
Provides access to the most essential settings of the "LTE Signaling" application.

Remote command:
Use the commands of the signaling application.

LTE Signaling
Select this softkey and press ON | OFF to turn the downlink signal transmission on or off.

Press the softkey two times (select it and press it again) to switch to the signaling application.

Remote command:
Use the commands of the signaling application.

ARB / List Mode > ...
Provides access to the most important ARB and list mode settings of the GPRF generator.

Remote command:
Use the commands of the GPRF generator.

GPRF Generator
Select this softkey and press ON | OFF to turn the GPRF generator on or off.

Press the softkey two times (select it and press it again) to switch to the generator application.

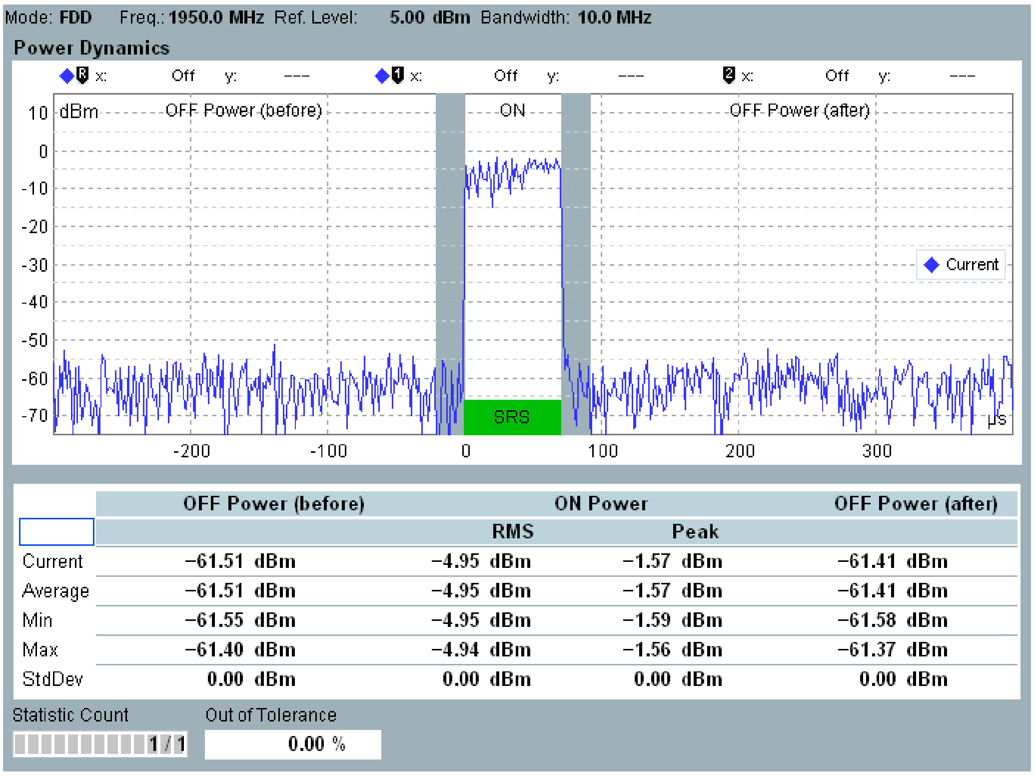
The hotkeys assigned to this softkey provide access to the most important GPRF generator settings.

Remote command:
Use the commands of the GPRF generator.

5.3.3 Measurement Results

All results of the LTE SRS measurement are displayed in a single view.

For a detailed description see chapter 5.2.6, "Measurement Results", on page 819.



	OFF Power (before)	ON Power RMS	ON Power Peak	OFF Power (after)
Current	−61.51 dBm	−4.95 dBm	−1.57 dBm	−61.41 dBm
Average	−61.51 dBm	−4.95 dBm	−1.57 dBm	−61.41 dBm
Min	−61.55 dBm	−4.95 dBm	−1.59 dBm	−61.58 dBm
Max	−61.40 dBm	−4.94 dBm	−1.56 dBm	−61.37 dBm
StdDev	0.00 dBm	0.00 dBm	0.00 dBm	0.00 dBm

Fig. 5-11: LTE SRS: Power Dynamics results

Traces

The results can be retrieved via the following remote commands.

Remote command:

`FETCh:LTE:MEAS<i>:SRS:TRACe:PDYNamics:CURRent?` etc.
`FETCh:LTE:MEAS<i>:SRS:TRACe:PDYNamics:AVERage?` etc.
`FETCh:LTE:MEAS<i>:SRS:TRACe:PDYNamics:MAXimum?` etc.

Single Values

The results can be retrieved via the following remote commands.

Remote command:

`FETCh:LTE:MEAS<i>:SRS:PDYNamics:CURRent?` etc.
`FETCh:LTE:MEAS<i>:SRS:PDYNamics:AVERage?` etc.
`FETCh:LTE:MEAS<i>:SRS:PDYNamics:MINimum?` etc.
`FETCh:LTE:MEAS<i>:SRS:PDYNamics:MAXimum?` etc.
`FETCh:LTE:MEAS<i>:SRS:PDYNamics:SDEViation?` etc.

5.4 Programming

The following sections provide programming examples for the "LTE SRS" measurement.

The examples have been tested with the aid of a simple software tool.

See also: "Remote Control" in the R&S CMW user manual

5.4.1 Key Features

The LTE SRS measurement is programmed as follows:

- The measurement is controlled by SCPI commands with the following syntax: `...LTE:MEAS:SRS...`
- Use general commands of the type `...:LTE:MEAS...` (no `:SRS` mnemonic) to define the signal routing and perform RF and analyzer settings.
- After a `*RST`, the measurement is switched off. Use `READ:LTE:MEAS:SRS...?` to initiate a single-shot measurement and retrieve the results. You can also start the measurement using `INIT:LTE:MEAS:SRS` and retrieve the results using `FETCh:LTE:MEAS:SRS...?`.

5.4.2 Specifying General and Common Measurement Settings

```
// *****************************************************************************
// System-Reset
// *****************************************************************************
*RST; *OPC?
*CLS; *OPC?

// *****************************************************************************
// Define signal routing and perform RF and analyzer settings:
// Carrier center frequency 1850 MHz, frequency offset 1 kHz, peak power 7 dBm,
// 5 dB user margin and 1 dB mixer level offset.
// *****************************************************************************
ROUTe:LTE:MEAS:SCENario:SALone RF1C, RX1
CONFigure:LTE:MEAS:RFSettings:EATTenuation 2
CONFigure:LTE:MEAS:RFSettings:FREQuency 1850E+6
CONFigure:LTE:MEAS:RFSettings:FOFFset 1000
CONFigure:LTE:MEAS:RFSettings:ENPower 7
CONFigure:LTE:MEAS:RFSettings:UMARgin 5
CONFigure:LTE:MEAS:RFSettings:MLOFfset 1

// *****************************************************************************
// Set duplex mode TDD and query the resulting frame structure type (T2).
// Specify channel bandwidth 1.4 MHz.
// *****************************************************************************
```

```
CONFigure:LTE:MEAS:DMODe TDD
CONFigure:LTE:MEAS:FSTRucture?
CONFigure:LTE:MEAS:CBANdwidth B014
```

5.4.3 Specifying Additional Measurement-Specific Settings

```
// *****************************************************************************
// Define stop condition (stop on limit failure), statistic count (20 cycles)
// and error handling. Enable the high dynamic mode.
// *****************************************************************************
CONFigure:LTE:MEAS:SRS:SCONdition SLFail
CONFigure:LTE:MEAS:SRS:SCOunt:PDYNamics 20
CONFigure:LTE:MEAS:SRS:MOEXception ON
CONFigure:LTE:MEAS:SRS:TOUT 3600
CONFigure:LTE:MEAS:SRS:HDMode ON
```

5.4.4 Configuring the Trigger System

```
// *****************************************************************************
// Set trigger source, slope, threshold, timeout and minimum trigger gap.
// *****************************************************************************
TRIGger:LTE:MEAS:SRS:SOURce 'IF Power'
TRIGger:LTE:MEAS:SRS:SLOPe FEDGe
TRIGger:LTE:MEAS:SRS:THReshold -30
TRIGger:LTE:MEAS:SRS:TOUT 1
TRIGger:LTE:MEAS:SRS:MGAP 0.00006
```

5.4.5 Specifying Limits

```
// *****************************************************************************
// Define power dynamics limits.
// *****************************************************************************
CONFigure:LTE:MEAS:SRS:LIMit:PDYNamics ON,5.1,-10.3,-48.8
```

5.4.6 Performing Single-Shot Measurements

```
// *****************************************************************************
// Start single-shot measurement, return average power dynamics trace.
// Query the measurement state (should be "RDY").
// *****************************************************************************
READ:LTE:MEAS:SRS:TRACe:PDYNamics:AVERage?
FETCh:LTE:MEAS:SRS:STATe?

// *****************************************************************************
// Read other traces obtained in the last
// measurement without re-starting the measurement.
```

```
// *****************************************************************************
FETCh:LTE:MEAS:SRS:TRACe:PDYNamics:CURRent?
FETCh:LTE:MEAS:SRS:TRACe:PDYNamics:MAXimum?

// *****************************************************************************
// Read statistical results obtained in the last measurement
// without re-starting the measurement.
// *****************************************************************************
FETCh:LTE:MEAS:SRS:PDYNamics:CURRent?
FETCh:LTE:MEAS:SRS:PDYNamics:AVERage?
FETCh:LTE:MEAS:SRS:PDYNamics:MINimum?
FETCh:LTE:MEAS:SRS:PDYNamics:MAXimum?
FETCh:LTE:MEAS:SRS:PDYNamics:SDEViation?

// *****************************************************************************
// Read limit check results obtained in the last measurement
// without re-starting the measurement.
// *****************************************************************************
CALCulate:LTE:MEAS:SRS:PDYNamics:CURRent?
CALCulate:LTE:MEAS:SRS:PDYNamics:AVERage?
CALCulate:LTE:MEAS:SRS:PDYNamics:MINimum?
CALCulate:LTE:MEAS:SRS:PDYNamics:MAXimum?
CALCulate:LTE:MEAS:SRS:PDYNamics:SDEViation?
```

5.4.7 Single-Shot and Continuous Measurements

```
// *****************************************************************************
// Start single-shot measurement, return current power dynamics trace,
// return average trace (without repeating the measurement).
// Query the measurement state (should be "RDY").
// *****************************************************************************
INIT:LTE:MEAS:SRS
FETCh:LTE:MEAS:SRS:TRACe:PDYNamics:CURRent?
FETCh:LTE:MEAS:SRS:TRACe:PDYNamics:AVERage?
FETCh:LTE:MEAS:SRS:STATe?

// *****************************************************************************
// Start continuous measurement and wait for 5 ms.
// Return average trace.
// Query measurement state and substates (should be "RUN,ADJ,ACT").
// *****************************************************************************
CONFigure:LTE:MEAS:SRS:REPetition CONTinuous
INIT:LTE:MEAS:SRS
Pause 5000
FETCh:LTE:MEAS:SRS:TRACe:PDYNamics:AVERage?
FETCh:LTE:MEAS:SRS:STATe:ALL?
```

5.5 Command Reference

The following sections provide detailed reference information on the remote control commands of the "LTE SRS" measurement.

5.5.1 Conventions and General Information

The following sections describe the most important conventions and general informations concerning the command reference.

5.5.1.1 MEAS<i>

MEAS<i> is used as abbreviation of "MEASurement<instance>". For better readability only the abbreviated form (which is also accepted by the instrument) is given in the command reference.

The <instance> is relevant for instruments supporting several instances of the same firmware application. It can be omitted if the instrument supports only one instance, or to address the first instance.

See also: "Firmware Applications" in the R&S CMW user manual, chapter "Remote Control"

5.5.1.2 FETCh, READ and CALCulate Commands

All commands are used to retrieve measurement results:

- `FETCh...` returns the results of the current measurement cycle (single-shot measurement) after they are valid. `FETCh...` must be used after the measurement has been started (`INITiate...`, measurement states RUN or RDY).
- `READ...` starts a new single-shot measurement and returns the results.
- `CALCulate...` returns one limit check result per `FETCh` result:
  – **OK**: The `FETCh` result is located within the limits or no limit has been defined/ enabled for this result.
  – **ULEU** (User limit exceeded upper): An upper limit is violated. The `FETCh` result is located above the limit.
  – **ULEL** (User limit exceeded lower): A lower limit is violated. The `FETCh` result is located below the limit.

See also: "Retrieving Measurement Results" in the R&S CMW user manual, chapter "Remote Control"

5.5.1.3 Current and Statistical Results

The R&S CMW repeats measurements according to the selected statistic count and repetition mode. Consecutive measurement values are stored and used to calculate statistical results, e.g. average, minimum, maximum and standard deviation.

See also: "Statistical Results" in the R&S CMW user manual, chapter "System Overview"

5.5.1.4 Keywords

Selected keywords used in the command description are described in the following.

- **Command usage**
  If the usage is not explicitly stated, the command allows you to set parameters and query parameters. Otherwise the command usage is stated as follows:
  – "Setting only": command can only be used to set parameters
  – "Query only": command can only be used to query parameters
  – "Event": command initiates an event
- **Parameter usage**
  The parameter usage is indicated by the keyword preceding the parameter(s):
  – "Parameters" are sent with a setting or query command and are returned as the result of a query
  – "Setting parameters" are only sent with a setting command
  – "Query parameters" are only sent with a query command (to refine the query)
  – "Return values" are only returned as the result of a query
- **Firmware/Software:**
  Indicates the lowest software version supporting the command. Command enhancements in later software versions are also indicated.

5.5.1.5 Reliability Indicator

The first value in the output arrays of `FETCh...?`, `READ...?` and `CALCulate...?` queries indicates the most severe error that has occurred during the measurement.

Example for an output array: 0, 10.22, 10.15, 10.01, 10.29, 100 (reliability = 0, followed by 5 numeric measurement values).

The reliability indicator has one of the following values:

- **0 (OK)**:
  Measurement values available, no error detected.
- **1 (Measurement Timeout)**:
  The measurement has been stopped after the (configurable) measurement timeout. Measurement results may be available, however, at least a part of the measurement provides only INValid results or has not completed the full statistic count.
- **2 (Capture Buffer Overflow)**:
  The measurement configuration results in a capture length, exceeding the available memory.

- **3 (Overdriven) / 4 (Underdriven)**:
  The accuracy of measurement results may be impaired because the input signal level was too high / too low.
- **6 (Trigger Timeout)**:
  The measurement could not be started or continued because no trigger event was detected.
- **7 (Acquisition Error)**:
  The R&S CMW could not properly decode the RF input signal.
- **8 (Sync Error)**:
  The R&S CMW could not synchronize to the RF input signal.
- **9 (Uncal)**:
  Due to an inappropriate configuration of resolution bandwidth, video bandwidth or sweep time, the measurement results are not within the specified data sheet limits.
- **15 (Reference Frequency Error)**:
  The instrument has been configured to use an external reference signal but the reference oscillator could not be phase locked to the external signal (e.g. signal level too low, frequency out of range or reference signal not available at all).
- **16 (RF Not Available)**:
  The measurement could not be started because the configured RF input path was not active. This problem may occur e.g. when a measurement is started in combined signal path mode and the master application has not yet activated the input path. The LEDs above the RF connectors indicate whether the input and output paths are active.
- **17 (RF Level not Settled) / 18 (RF Frequency not Settled)**:
  The measurement could not be started because the R&S CMW was not yet ready to deliver stable results after a change of the input signal power / the input signal frequency.
- **19 (Call not Established)**:
  For measurements: The measurement could not be started because no signaling connection to the DUT was established.
  For DAU IMS service: Establishing a voice over IMS call failed.
- **20 (Call Type not Usable)**:
  For measurements: The measurement could not be started because the established signaling connection had wrong properties.
  For DAU IMS service: The voice over IMS settings could not be applied.
- **21 (Call Lost)**:
  For measurements: The measurement was interrupted because the signaling connection to the DUT was lost.
  For DAU IMS service: The voice over IMS call was lost.
- **23 (Missing Option)**:
  The ARB file cannot be played by the GPRF generator due to a missing option.
- **26 (Resource Conflict)**:
  The application could not be started or has been stopped due to a conflicting hardware resource or software option that is allocated by another application.
  Stop the application that has allocated the conflicting resources and try again.
- **27 (No Sensor Connected)**:

The GPRF External Power Sensor measurement could not be started due to missing power sensor.

- **30 (File not Found)**:
  The specified file could not be found.
- **40 (ARB File CRC Error)**:
  The ARB file CRC check failed. The ARB file is corrupt and not reliable.
- **42 (ARB Header Tag Invalid)**:
  The ARB file selected in the GPRF generator contains an invalid header tag.
- **43 (ARB Segment Overflow)**:
  The number of segments in the multi-segment ARB file is higher than the allowed maximum.
- **44 (ARB File not Found)**:
  The selected ARB file could not be found.
- **45 (ARB Memory Overflow)**:
  The ARB file length is greater than the available memory.
- **50 (Startup Error)**:
  The Data Application Unit (DAU), a DAU service or a DAU measurement could not be started. Please execute a DAU selftest.
- **51 (No Reply)**:
  The DAU has received no response, for example for a ping request.
- **52 (Connection Error)**:
  The DAU could not establish a connection to internal components. Please restart the instrument.
- **53 (Configuration Error)**:
  The current DAU configuration by the user is incomplete or wrong and could not be applied. Check especially the IP address configuration.
- **54 (Filesystem Error)**:
  The hard disk of the DAU is full or corrupt. Please execute a DAU selftest.
- **60 (Invalid RF-Connector Setting)**
  The individual segments of a list mode measurement with R&S CMWS use different connector benches. This is not allowed. All segments must use the same bench.
  Check the "Info" dialog for the relevant segment numbers.
- **101 (Firmware Error)**:
  Indicates a firmware or software error. If you encounter this error for the first time, restart the instrument.
  If the error occurs again, consider the following hints:
  – Firmware errors can often be repaired by restoring the factory default settings. To restore these settings, restart your instrument and press the "Factory Default" softkey during startup.
  – If a software package (update) has not been properly installed this is often indicated in the "Setup" dialog, section "SW/HW-Equipment > Installed Software".
  – A software update correcting the error may be available. Updates are e.g. provided in the "CMW Customer Web" on GLORIS (registration required): https://extranet.rohde-schwarz.com.

If you get firmware errors even with the properly installed latest software version, please send a problem report including log files to Rohde & Schwarz.

- **102 (Unidentified Error)**:
  Indicates an error not covered by other reliability values. For troubleshooting please follow the steps described for "101 (Firmware Error)".
- **103 (Parameter Error)**:
  Indicates that the measurement could not be performed due to internal conflicting parameter settings.
  A good approach to localize the conflicting settings is to start with a reset or preset or even restore the factory default settings. Then reconfigure the measurement step by step and check when the error occurs for the first time.
  If you need assistance to localize the conflicting parameter settings, please contact Rohde & Schwarz (see http://www.service.rohde-schwarz.com).

5.5.2 General Measurement Settings

The commands valid for all LTE measurements are described here: chapter 3.5.2, "General Measurement Settings", on page 584

5.5.3 SRS Measurement Commands

The commands for the "LTE SRS" measurement are divided into the groups listed below.

5.5.3.1 Measurement Control and States

The following commands control the measurement and return the current measurement state.

INITiate:LTE:MEAS<i>:SRS
STOP:LTE:MEAS<i>:SRS
ABORt:LTE:MEAS<i>:SRS

Starts, stops, or aborts the measurement:

- `INITiate...` starts or restarts the measurement; the R&S CMW enters the "RUN" state.
- `STOP...` causes a running measurement to stop after the current evaluation period is terminated and valid results are available; the R&S CMW enters the "RDY" state.
- `ABORt...` causes a running measurement to stop immediately; the R&S CMW enters the "OFF" state.

Use `FETCh...STATe?` to query the current measurement state.

See also: "Measurement Control" in the R&S CMW user manual, chapter "Remote Control"

Example: See Single-Shot and Continuous Measurements

Usage: Event

Firmware/Software: V2.0.20

Manual operation: See "SRS (Softkey)" on page 822

FETCh:LTE:MEAS<i>:SRS:STATe?

Queries the main measurement state. Use `FETCh:...:STATe:ALL?` to query the measurement state including the substates. Use `INITiate...`, `STOP...`, `ABORt...` to change the measurement state.

See also: "Measurement Control" in the R&S CMW user manual, chapter "Remote Control"

Return values:

<MeasStatus> OFF | RUN | RDY

OFF: measurement switched off, no resources allocated, no results available (when entered after `ABORt...`)
RUN: measurement running (after `INITiate...`, `READ...`), synchronization pending or adjusted, resources active or queued
RDY: measurement has been terminated, valid results may be available

*RST: OFF

Example: See Performing Single-Shot Measurements

Usage: Query only

Firmware/Software: V2.0.20

Manual operation: See "SRS (Softkey)" on page 822

FETCh:LTE:MEAS<i>:SRS:STATe:ALL?

Queries the main measurement state and the measurement substates. Both measurement substates are relevant for running measurements only. Use `FETCh:...:STATe?` to query the main measurement state only. Use `INITiate...`, `STOP...`, `ABORt...` to change the measurement state.

See also: "Measurement Control" in the R&S CMW user manual, chapter "Remote Control"

Return values:

<MainState> OFF | RDY | RUN

OFF: measurement switched off, no resources allocated, no results available (when entered after `STOP...`)
RDY: measurement has been terminated, valid results may be available
RUN: measurement running (after `INITiate...`, `READ...`), synchronization pending or adjusted, resources active or queued

<SyncState> PEND | ADJ | INV

PEND: waiting for resource allocation, adjustment, hardware switching ("pending")
ADJ: all necessary adjustments finished, measurement running ("adjusted")
INV: not applicable because <MainState>: OFF or RDY ("invalid")

<ResourceState> QUE | ACT | INV

QUE: measurement without resources, no results available ("queued")
ACT: resources allocated, acquisition of results in progress but not complete ("active")
INV: not applicable because <MainState>: OFF or RDY ("invalid")

Example: See Single-Shot and Continuous Measurements

Usage: Query only

Firmware/Software: V2.0.20

Manual operation: See "SRS (Softkey)" on page 822

5.5.3.2 Measurement Parameters

The following commands define measurement control parameters for the SRS measurement.

CONFigure:LTE:MEAS<i>:SRS:TOUT <Timeout>

Defines a timeout for the measurement. The timer is started when the measurement is initiated via a `READ` or `INIT` command. It is not started if the measurement is initiated manually (ON/OFF key or RESTART/STOP key).

When the measurement has completed the first measurement cycle (first single shot), the statistical depth is reached and the timer is reset.

If the first measurement cycle has not been completed when the timer expires, the measurement is stopped. The measurement state changes to `RDY` and the reliability indicator is set to 1, indicating that a measurement timeout occurred. Still running `READ`, `FETCh` or `CALCulate` commands are completed, returning the available results. At least for some results there are no values at all or the statistical depth has not been reached.

A timeout of 0 s corresponds to an infinite measurement timeout.

Parameters:
<Timeout> Default unit: s

Example: See Specifying Additional Measurement-Specific Settings

Firmware/Software: V2.0.20

CONFigure:LTE:MEAS<i>:SRS:REPetition <Repetition>

Specifies the repetition mode of the measurement. The repetition mode specifies whether the measurement is stopped after a single-shot or repeated continuously. Use `CONFigure:..:MEAS<i>:...:SCOunt` to determine the number of measurement intervals per single shot.

See also: "Statistical Settings" in the R&S CMW user manual, chapter "Remote Control"

Parameters:
<Repetition> SINGleshot | CONTinuous

SINGleshot: Single-shot measurement
CONTinuous: Continuous measurement

*RST: SING

Example: See Single-Shot and Continuous Measurements

Firmware/Software: V2.0.20

Manual operation: See "Repetition" on page 827

CONFigure:LTE:MEAS<i>:SRS:SCONdition <StopCondition>

Qualifies whether the measurement is stopped after a failed limit check or continued. `SLFail` means that the measurement is stopped and reaches the `RDY` state as soon as one of the results exceeds the limits.

Parameters:
<StopCondition> NONE | SLFail

NONE: Continue measurement irrespective of the limit check
SLFail: Stop measurement on limit failure

*RST: NONE

Example: See Specifying Additional Measurement-Specific Settings

Firmware/Software: V2.0.20

Manual operation: See "Stop Condition" on page 827

CONFigure:LTE:MEAS<i>:SRS:MOEXception <MeasOnException>

Specifies whether measurement results that the R&S CMW identifies as faulty or inaccurate are rejected.

Parameters:
<MeasOnException> OFF | ON

OFF: Faulty results are rejected
ON: Results are never rejected

*RST: OFF

Example: See Specifying Additional Measurement-Specific Settings

Firmware/Software: V2.0.20

Manual operation: See "Measure on Exception" on page 828

CONFigure:LTE:MEAS<i>:SRS:SCOunt:PDYNamics <StatisticCount>

Specifies the statistic count of the measurement. The statistic count is equal to the number of measurement intervals per single shot. Use `CONFigure:...:MEAS<i>:...:REPetition SINGleshot | CONTinuous` to select either single-shot or continuous measurements.

See also: "Statistical Settings" in the R&S CMW user manual, chapter "Remote Control"

Parameters:
<StatisticCount> Number of measurement intervals

Range: 1 to 1000
*RST: 1

Example: See Specifying Additional Measurement-Specific Settings

Firmware/Software: V2.0.20

Manual operation: See "Statistic Count" on page 828

CONFigure:LTE:MEAS<i>:SRS:HDMode <HighDynamicMode>

Enables or disables the high dynamic mode for power dynamics measurements.

Parameters:
<HighDynamicMode> OFF | ON
*RST: OFF

Example: See Specifying Additional Measurement-Specific Settings

Firmware/Software: V2.1.25

Manual operation: See "High Dynamic Mode" on page 828

5.5.3.3 Trigger Settings

The following commands define the trigger parameters.

TRIGger:LTE:MEAS<i>:SRS:CATalog:SOURce?

Lists all trigger source values that can be set using `TRIGger:LTE:MEAS<i>:SRS:SOURce`.

Return values:
<Sourcelist> Comma separated list of all supported values. Each value is represented as a string.

Usage: Query only

Firmware/Software: V2.0.20

Manual operation: See "Trigger Source" on page 829

TRIGger:LTE:MEAS<i>:SRS:SOURce <Source>

Selects the source of the trigger events. Some values are always available in this firmware application. They are listed below. Depending on the installed options additional values may be available. A complete list of all supported values can be displayed using `TRIGger:...:CATalog:SOURce?`.

Parameters:

<Source> **'IF Power':** Power trigger (received RF power)
'Base1: External TRIG A': External trigger fed in at TRIG A connector
'Base1: External TRIG B': External trigger fed in at TRIG B connector
*RST: 'IF Power'

Example: See Configuring the Trigger System

Firmware/Software: V2.0.20

Manual operation: See "Trigger Source" on page 829

TRIGger:LTE:MEAS<i>:SRS:SLOPe <Slope>

Qualifies whether the trigger event is generated at the rising or at the falling edge of the trigger pulse (valid for external and power trigger sources).

Parameters:

<Slope> REDGe | FEDGe
REDGe: Rising edge
FEDGe: Falling edge
*RST: REDG

Example: See Configuring the Trigger System

Firmware/Software: V2.0.20

Manual operation: See "Trigger Slope" on page 829

TRIGger:LTE:MEAS<i>:SRS:THReshold <TrigThreshold>

Defines the trigger threshold for power trigger sources.

Parameters:

<TrigThreshold> Range: -50 dB to 0 dB
*RST: -20 dB
Default unit: dB

Example: See Configuring the Trigger System

Firmware/Software: V2.0.20

Manual operation: See "Trigger Threshold" on page 830

TRIGger:LTE:MEAS<i>:SRS:TOUT <TriggerTimeOut>

Selects the maximum time that the R&S CMW will wait for a trigger event before it stops the measurement in remote control mode or indicates a trigger timeout in manual operation mode. This setting has no influence on "Free Run" measurements.

Parameters:

<TriggerTimeOut> Range: 0.01 s to 167772.15 s
*RST: 0.1 s
Default unit: s

Example: See Configuring the Trigger System

Firmware/Software: V2.0.20

Manual operation: See "Trigger Timeout" on page 830

TRIGger:LTE:MEAS<i>:SRS:MGAP <MinTrigGap>

Sets a minimum time during which the IF signal must be below the trigger threshold before the trigger is armed so that an IF power trigger event can be generated.

Parameters:

<MinTrigGap> Range: 0 s to 1E-3 s
*RST: 50E-6 s
Default unit: s

Example: See Configuring the Trigger System

Firmware/Software: V2.0.20

Manual operation: See "Min Trigger Gap" on page 830

5.5.3.4 Limits

The following command defines limits for results which characterize the power dynamics of the SRS signal.

CONFigure:LTE:MEAS<i>:SRS:LIMit:PDYNamics <Enable>, <OnPowerUpper>, <OnPowerLower>, <OffPowerUpper>

Defines limits for the ON power and OFF power determined with the power dynamics measurement.

Parameters:

<Enable> OFF | ON

OFF: disables the limit check
ON: enables the limit check

*RST: ON

<OnPowerUpper> Upper limit for the ON power

Range: -256 dBm to 256 dBm
*RST: 4.9 dBm
Default unit: dBm

<OnPowerLower> Lower limit for the ON power

Range: -256 dBm to 256 dBm
*RST: -10.1 dBm
Default unit: dBm

<OffPowerUpper> Upper limit for the OFF power

Range: -256 dBm to 256 dBm
*RST: -48.5 dBm
Default unit: dBm

Example: See Specifying Limits

Firmware/Software: V2.0.20

Manual operation: See "Limits" on page 831

5.5.3.5 Power Dynamics Results (Traces)

The following commands return the results in the power dynamics diagram.

FETCh:LTE:MEAS<i>:SRS:TRACe:PDYNamics:CURRent?
FETCh:LTE:MEAS<i>:SRS:TRACe:PDYNamics:AVERage?
FETCh:LTE:MEAS<i>:SRS:TRACe:PDYNamics:MAXimum?
READ:LTE:MEAS<i>:SRS:TRACe:PDYNamics:CURRent?
READ:LTE:MEAS<i>:SRS:TRACe:PDYNamics:AVERage?
READ:LTE:MEAS<i>:SRS:TRACe:PDYNamics:MAXimum?

Return the values of the power dynamics traces. Each value is sampled with 48 T_s, corresponding to 1.5625 µs. The results of the current, average and maximum traces can be retrieved.

Please note that the GUI shows only the beginning of the trace returned via remote command. The last 800 µs can not be displayed at the GUI.

See also chapter 5.2.6, "Measurement Results", on page 819.

Return values:

<Reliability> Reliability Indicator

<Power> 2048 power values, from -1100 µs to +2098.4375 µs relative to the start of the SRS symbol. The values have a spacing of 1.5625 µs. The 705th value is located at the start of the SRS symbol (0 µs).

Range: -100 dBm to 55 dBm
Default unit: dBm

Example: See Performing Single-Shot Measurements

Usage: Query only

Firmware/Software: V2.0.20

For additional information concerning syntax elements and returned values refer to Conventions and General Information.

5.5.3.6 Power Dynamics Results (Single Values)

The following commands return the statistical results of the power dynamics measurement.

FETCh:LTE:MEAS<i>:SRS:PDYNamics:CURRent?
FETCh:LTE:MEAS<i>:SRS:PDYNamics:AVERage?
FETCh:LTE:MEAS<i>:SRS:PDYNamics:MINimum?
FETCh:LTE:MEAS<i>:SRS:PDYNamics:MAXimum?
FETCh:LTE:MEAS<i>:SRS:PDYNamics:SDEViation?
READ:LTE:MEAS<i>:SRS:PDYNamics:CURRent?
READ:LTE:MEAS<i>:SRS:PDYNamics:AVERage?
READ:LTE:MEAS<i>:SRS:PDYNamics:MINimum?
READ:LTE:MEAS<i>:SRS:PDYNamics:MAXimum?
READ:LTE:MEAS<i>:SRS:PDYNamics:SDEViation?
CALCulate:LTE:MEAS<i>:SRS:PDYNamics:CURRent?
CALCulate:LTE:MEAS<i>:SRS:PDYNamics:AVERage?
CALCulate:LTE:MEAS<i>:SRS:PDYNamics:MINimum?
CALCulate:LTE:MEAS<i>:SRS:PDYNamics:MAXimum?

Return the current, average, minimum, maximum and standard deviation single value results of the power dynamics measurement.

The values described below are returned by `FETCh` and `READ` commands. `CALCulate` commands return limit check results instead, one value for each result listed below.

The ranges indicated below apply to all results except standard deviation results. The minimum for standard deviation results equals 0. The maximum equals the width of the indicated range divided by two. Exceptions are explicitly stated.

Return values:

<Reliability> Reliability Indicator

<OutOfTolerance> Out of tolerance result, i.e. percentage of measurement intervals of the statistic count (`CONFigure:LTE:MEAS<i>:SRS:SCOunt:PDYNamics`) exceeding the specified power dynamics limits.

Range: 0 % to 100 %
Default unit: %

<OffPowerBefore> OFF power mean value for time period before SRS symbol

Range: -100 dBm to 55 dBm
Default unit: dBm

<OnPowerRMS1> ON power mean value over the first SRS symbol

Range: -100 dBm to 55 dBm
Default unit: dBm

<OnPowerPeak1> ON power peak value for the first SRS symbol

Range: -100 dBm to 55 dBm
Default unit: dBm

<OnPowerRMS2> ON power mean value over the second SRS symbol (NCAP returned for FDD)

Range: -100 dBm to 55 dBm
Default unit: dBm

<OnPowerPeak2> ON power peak value for the second SRS symbol (NCAP returned for FDD)

Range: -100 dBm to 55 dBm
Default unit: dBm

<OffPowerAfter> OFF power mean value for subframe after SRS symbol

Range: -100 dBm to 55 dBm
Default unit: dBm

Example: See Performing Single-Shot Measurements

Usage: Query only

Firmware/Software: V2.0.20

For additional information concerning syntax elements and returned values refer to Conventions and General Information.

5.5.4 Combined Signal Path Commands

For some settings, the command to be used depends on the active scenario. While the Combined Signal Path (CSP) scenario is active, these settings are configured via commands of the signaling application. While the Standalone (SA) scenario is active, they are configured via measurement commands.

The following table provides the mapping for SRS measurement commands. For general measurement settings, see table 3-2.

Table 5-1: Mapping for SRS measurement commands

Setting	Commands for SA scenario	Commands for CSP scenario
High dynamic mode	`CONFigure:LTE:MEAS<i>:SRS:HDMode`	Fixed value `OFF`

5.6 List of Commands

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