R&S®VSE-K10x (LTE Downlink)
LTE Downlink Measurements
User Manual

ROHDE & SCHWARZ

Make ideas real

This manual applies to the following software, version 2.31 and later:

- R&S®VSE Enterprise Edition base software (1345.1105.06)
- R&S®VSE Basic Edition base software (1345.1011.06)

This manual describes functionality of the following R&S®VSE options:

- R&S®VSE-K100 (EUTRA/LTE FDD uplink and downlink measurement application) (1320.7545.02)
- R&S®VSE-K102 (EUTRA/LTE Advanced and MIMO measurement application) (1320.7551.02)
- R&S®VSE-K104 (EUTRA/LTE TDD uplink and downlink measurement application) (1320.7568.02)
- R&S®VSE-K175 (O-RAN Measurements) (1350.7020.02)
- R&S®VSE-KT100 (EUTRA/LTE FDD uplink and downlink measurement application) (1345.1786.02)
- R&S®VSE-KT102 (EUTRA/LTE Advanced and MIMO measurement application) (1345.7770.02)
- R&S®VSE-KT104 (EUTRA/LTE TDD uplink and downlink measurement application) (1345.1763.02)
- R&S®VSE-KT175 (O-RAN measurements) (1345.2076.02)
- R&S®VSE-KP100 (EUTRA/LTE FDD uplink and downlink measurement application) (1345.2524.02)
- R&S®VSE-KP102 (EUTRA/LTE Advanced and MIMO measurement application) (1345.2530.02)
- R&S®VSE-KP104 (EUTRA/LTE TDD uplink and downlink measurement application) (1345.2547.02)
- R&S®VSE-KP175 (O-RAN Measurements) (1345.2601.02)

Contents

1 Documentation Overview

This section provides an overview of the R&S VSE user documentation. Unless specified otherwise, you find the documents at:

www.rohde-schwarz.com/manual/VSE

Further documents are available at:

www.rohde-schwarz.com/product/VSE

1.1 User Manuals and Help

Separate user manuals are provided for the base software and additional software applications:

- Base software manual
  Contains the description of the graphical user interface, an introduction to remote control, the description of all remote control commands, programming examples, and information on maintenance, software interfaces and error messages.

- Software application manuals
  Contain the description of the specific functions of a software application, including the remote control commands. Basic information on operating the R&S VSE is not included.

The contents of the user manuals are available as help in the R&S VSE. The help offers quick, context-sensitive access to the complete information for the base software and the software applications.

All user manuals are also available for download or for immediate display on the Internet.

1.2 Data Sheets and Brochures

The data sheet contains the technical specifications of the R&S VSE. It also lists the firmware applications and their order numbers, and optional accessories.

The brochure provides an overview of the instrument and deals with the specific characteristics.

See www.rohde-schwarz.com/brochure-datasheet/VSE

1.3 Release Notes and Open Source Acknowledgment (OSA)

The release notes list new features, improvements and known issues of the current firmware version, and describe the firmware installation.

The software makes use of several valuable open source software packages. An open-source acknowledgment document provides verbatim license texts of the used open source software.

See www.rohde-schwarz.com/software/VSE

1.4 Application Notes, Application Cards, White Papers, etc.

These documents deal with special applications or background information on particular topics.

See www.rohde-schwarz.com/application/vse/

1.5 Videos

Find various videos on Rohde & Schwarz products and test and measurement topics on YouTube: https://www.youtube.com/@RohdeundSchwarz

2 Welcome to the LTE measurement application

The LTE measurement application is a firmware application that adds functionality to perform measurements on LTE signals according to the 3GPP standard to the R&S VSE.

This user manual contains a description of the functionality that the application provides, including remote control operation. Functions that are not discussed in this manual are the same as in the spectrum application and are described in the R&S VSE User Manual. The latest versions of the manuals are available for download at the product homepage.

https://www.rohde-schwarz.com/manual/vse.

2.1 LTE measurement application selection

The LTE measurement application adds a new application to the R&S VSE.

Starting the application

1.

   Select the "Add Channel" function in the "Sequence" tool window.

   A dialog box opens that contains all operating modes and applications currently available in your R&S VSE.

2. Select the "LTE" item.

   The R&S VSE opens a new measurement channel for the LTE application.

The application starts with the default settings. You can configure measurements with the items in the "Meas Setup" menu.

For more information see Chapter 5, "Configuration", on page 56.

2.2 Display information

The following figure shows a typical measurement diagram of the LTE application. All different information areas are labeled. They are explained in more detail in the following sections.

1 = Window title bar with information about the diagram and its traces
2 = Channel bar with measurement settings
3 = Diagram area
4 = Diagram footer with information about the contents of the diagram
5 = Color code for windows of the same channel (here: red)

Channel bar information

In the LTE measurement application, the R&S VSE shows the following settings:

Table 2-1: Information displayed in the channel bar in the LTE measurement application

Ref Level	Reference level
Att	Mechanical and electronic RF attenuation
Freq	Frequency
Mode	LTE standard
MIMO	Number of Tx and Rx antennas in the measurement setup
Capture Time	Signal length that has been captured
Frame Count	Number of frames that have been captured
Selected Subframe	Subframe considered in the signal analysis

In addition, the channel bar also displays information on instrument settings that affect the measurement results even though this is not immediately apparent from the display of the measured values (e.g. transducer or trigger settings). This information is displayed only when applicable for the current measurement. For a comprhensive description, refer to the user manual of the R&S VSE.

Window title bar information

The information in the window title bar depends on the result display.

The "Constellation Diagram", for example, shows the number of points that have been measured.

Status bar information

Global instrument settings, the instrument status and any irregularities are indicated in the status bar beneath the diagram. Furthermore, the progress of the current operation is displayed in the status bar.

Regarding the synchronization state, the application shows the following labels.

- Sync OK
  The synchronization was successful. The status bar is green.
- Sync Failed
  The synchronization was not successful. The status bar is red.
  There can be three different synchronization errors.
  - Sync Failed (Cyclic Prefix): The cyclic prefix correlation failed.
  - Sync Failed (P-SYNC): The P-SYNC correlation failed.
  - Sync Failed (S-SYNC): The S-SYNC correlation failed.

3 Measurements and result displays

The LTE measurement application measures and analyzes various aspects of an LTE signal.

It features several measurements and result displays. Measurements represent different ways of processing the captured data during the digital signal processing. Result displays are different representations of the measurement results. They may be diagrams that show the results as a graph or tables that show the results as numbers.

Remote command:

Measurement selection: `CONFigure[:LTE]:MEASurement` on page 183

Result display selection: `LAYout:ADD[:WINDow]?` on page 137

3.1 Selecting measurements

Access: "Overview" > "Select Measurement"

The "Select Measurement" dialog box contains several buttons. Each button represents a measurement. A measurement in turn is a set of result displays that thematically belong together and that have a particular display configuration. If these predefined display configurations do not suit your requirements, you can add or remove result displays as you like. For more information about selecting result displays, see Chapter 3.2, "Selecting result displays", on page 13.

Depending on the measurement, the R&S VSE changes the way it captures and processes the raw signal data.

EVM

EVM measurements record, process and demodulate the signal's I/Q data. The result displays available for EVM measurements show various aspects of the LTE signal quality.

For EVM measurements, you can combine the result displays in any way.

For more information on the result displays, see Chapter 3.4, "I/Q measurements", on page 14.

Remote command:
`CONFigure[:LTE]:MEASurement` on page 183

Time alignment error

Time alignment error (TAE) measurements record, process and demodulate the signal's I/Q data. The result displays available for TAE measurements indicate how well the antennas in a multi-antenna system are aligned.

For TAE measurements, you can combine the result displays in any way.

For more information on the result displays, see Chapter 3.5, "Time alignment error measurements", on page 36.

Remote command:
`CONFigure[:LTE]:MEASurement` on page 183

3.2 Selecting result displays

Access: 🖵 **or** "Window" > "New Window"

The R&S VSE opens a menu to select result displays. Depending on the number of LTE channels you are currently using, there is a submenu that contains all available result displays for each LTE channel.

In the default state of the application, it shows several conventional result displays.

- Capture Buffer
- EVM vs Carrier
- Power Spectrum
- Result Summary
- Constellation Diagram

From that predefined state, add and remove result displays to the channels as you like from the "Window" menu.

Remote command: `LAYout:ADD[:WINDow]?` on page 137

💡 **Measuring several data streams**

When you capture more than one data stream (for example component carriers), each result display is made up out of several tabs.

The first tab shows the results for all data streams. The other tabs show the results for each individual data stream. By default, the tabs are coupled to one another - if you select a certain data stream in one display, the application also selects this data stream in the other result displays (see Subwindow Coupling).

The number of tabs depends on the number of data streams.

3.3 Performing measurements

By default, the application measures the signal continuously. In "Continuous Sweep" mode, the R&S VSE captures and analyzes the data again and again.

- For I/Q measurements, the amount of captured data depends on the capture time.

- For frequency sweep measurement, the amount of captured data depends on the sweep time.

In "Single Sweep" mode, the R&S VSE stops measuring after it has captured the data once. The amount of data again depends on the capture time.

Refreshing captured data

You can also repeat a measurement based on the data that has already been captured with the "Refresh" function. Repeating a measurement with the same data can be useful, for example, if you want to apply different modulation settings to the same I/Q data.

For more information, see the documentation of the R&S VSE.

3.4 I/Q measurements

Access: [MEAS] > "EVM/Frequency Err/Power"

You can select the result displays from the evaluation bar and arrange them as you like with the SmartGrid functionality.

Remote command:

Measurement selection: `CONFigure[:LTE]:MEASurement` on page 183

Result display selection: `LAYout:ADD[:WINDow]?` on page 137

Capture Buffer

The "Capture Buffer" shows the complete range of captured data for the last data capture.

The x-axis represents time. The maximum value of the x-axis is equal to the Capture Time.

The y-axis represents the amplitude of the captured I/Q data in dBm (for RF input).

The capture buffer uses the auto peak detector to evaluate the measurement data. The auto peak detector determines the maximum and the minimum value of the measured levels for each measurement point and combines both values in one sample point.

Figure 3-1: Capture buffer without zoom

A colored bar at the bottom of the diagram represents the frame that is currently analyzed. Different colors indicate the OFDM symbol type.

- ▬▬▬▬
  Indicates the data stream.
- ▭▭▭▭
  Indicates the reference signal and data.
- ▬▬▬▬
  Indicates the P-Sync and data.
- ▬▬▬▬
  Indicates the S-Sync and data.

A green vertical line at the beginning of the green bar in the capture buffer represents the subframe start. The diagram also contains the "Start Offset" value. This value is the time difference between the subframe start and capture buffer start.

When you zoom into the diagram, you will see that the bar is interrupted at certain positions. Each small bar indicates the useful parts of the OFDM symbol.

Figure 3-2: Capture buffer after a zoom has been applied

Remote command:
Selection: `LAY:ADD ? '1',LEFT,CBUF`
Query (y-axis): TRACe:DATA?
Query (x-axis): `TRACe<n>[:DATA]:X?` on page 160
Subframe start offset: `FETCh[:CC<cc>]:SUMMary:TFRame?` on page 169

EVM vs Carrier

The "EVM vs Carrier" result display shows the error vector magnitude (EVM) of the subcarriers. With the help of a marker, you can use it as a debugging technique to identify any subcarriers whose EVM is too high.

The results are based on an average EVM that is calculated over the resource elements for each subcarrier. This average subcarrier EVM is determined for each analyzed subframe in the capture buffer.

If you analyze all subframes, the result display contains three traces.
- Average EVM
  This trace shows the subcarrier EVM, averaged over all subframes.
- Minimum EVM
  This trace shows the lowest (average) subcarrier EVM that has been found over the analyzed subframes.
- Maximum EVM
  This trace shows the highest (average) subcarrier EVM that has been found over the analyzed subframes.

If you select and analyze one subframe only, the result display contains one trace that shows the subcarrier EVM for that subframe only. Average, minimum and maximum values in that case are the same. For more information, see "Subframe Selection" on page 121.

The x-axis represents the center frequencies of the subcarriers. The y-axis shows the EVM in % or in dB, depending on the EVM Unit.

Remote command:
Selection `LAY:ADD ? '1',LEFT,EVCA`
Query (y-axis): TRACe:DATA?
Query (x-axis): `TRACe<n>[:DATA]:X?` on page 160

EVM vs Symbol

The "EVM vs Symbol" result display shows the error vector magnitude (EVM) of the OFDM symbols. You can use it as a debugging technique to identify any symbols whose EVM is too high.

The results are based on an average EVM that is calculated over all subcarriers that are part of a certain OFDM symbol. This average OFDM symbol EVM is determined for all OFDM symbols in each analyzed subframe.

The x-axis represents the OFDM symbols, with each symbol represented by a dot on the line. Any missing connections from one dot to another mean that the R&S VSE could not determine the EVM for that symbol.

The number of displayed symbols depends on the subframe selection and the length of the cyclic prefix.

For TDD signals, the result display does not show OFDM symbols that are not part of the measured link direction.

On the y-axis, the EVM is plotted either in % or in dB, depending on the EVM Unit.

Remote command:
Selection: `LAY:ADD ? '1',LEFT,EVSY`
Query (y-axis): TRACe:DATA?
Query (x-axis): `TRACe<n>[:DATA]:X?` on page 160

EVM vs RB

The "EVM vs RB" result display shows the Error Vector Magnitude (EVM) for all resource blocks that can be occupied by the PDSCH.

The results are based on an average EVM that is calculated over all resource elements in the resource block. This average resource block EVM is determined for each analyzed subframe. If you analyze all subframes, the result display contains three traces.

- Average EVM
  This trace shows the resource block EVM, averaged over all subframes.
- Minimum EVM
  This trace shows the lowest (average) resource block EVM that has been found over the analyzed subframes.
- Maximum EVM
  This trace shows the highest (average) resource block EVM that has been found over the analyzed subframes.

If you select and analyze one subframe only, the result display contains one trace that shows the resource block EVM for that subframe only. Average, minimum and maximum values in that case are the same. For more information, see "Subframe Selection" on page 121.

The x-axis represents the PDSCH resource blocks. On the y-axis, the EVM is plotted either in % or in dB, depending on the EVM Unit.

Remote command:
Selection: `LAY:ADD ? '1',LEFT,EVRP`
Query (y-axis): TRACe:DATA?
Query (x-axis): `TRACe<n>[:DATA]:X?` on page 160

EVM vs Subframe

The "EVM vs Subframe" result display shows the Error Vector Magnitude (EVM) for each subframe. You can use it as a debugging technique to identify a subframe whose EVM is too high.

The result is an average over all subcarriers and symbols of a specific subframe.

The x-axis represents the subframes, with the number of displayed subframes being 10.

On the y-axis, the EVM is plotted either in % or in dB, depending on the EVM Unit.

Remote command:
Selection: `LAY:ADD ? '1',LEFT,EVSU`
Query (y-axis): TRACe:DATA?
Query (x-axis): `TRACe<n>[:DATA]:X?` on page 160

Frequency Error vs Symbol

Th e "Frequency Error vs Symbol" result display shows the frequency error of each symbol. You can use it as a debugging technique to identify any frequency errors within symbols.

The result is an average over all subcarriers in the symbol.

The x-axis represents the OFDM symbols, with each symbol represented by a dot on the line. The number of displayed symbols depends on the subframe selection and the length of the cyclic prefix. Any missing connections from one dot to another mean that the R&S VSE could not determine the frequency error for that symbol.

On the y-axis, the frequency error is plotted in Hz.

Note that the variance of the measurement results in this result display can be much higher compared to the frequency error display in the numerical result summary, depending on the PDSCH and control channel configuration. The potential difference is caused by the number of available resource elements for the measurement on symbol level.

Remote command:
Selection: `LAY:ADD ? '1',LEFT,FEVS`
Query (y-axis): TRACe:DATA?
Query (x-axis): `TRACe<n>[:DATA]:X?` on page 160

Power Spectrum

The "Power Spectrum" shows the power density of the complete capture buffer in dBm/Hz.

The displayed bandwidth depends on the selected channel bandwidth.

The x-axis represents the frequency. On the y-axis, the power level is plotted.

Remote command:
Selection: `LAY:ADD ? '1',LEFT,PSPE`
Query (y-axis): TRACe:DATA?
Query (x-axis): `TRACe<n>[:DATA]:X?` on page 160

Power vs Resource Block PDSCH

The "Power vs Resource Block PDSCH" result display shows the power of the physical downlink shared channel per resource element averaged over one resource block.

By default, three traces are shown. One trace shows the average power. The second and the third traces show the minimum and maximum powers respectively. You can select to display the power for a specific subframe in the Subframe Selection dialog box. In that case, the application shows the powers of that subframe only.

The x-axis represents the resource blocks. The displayed number of resource blocks depends on the channel bandwidth or number of resource blocks you have set. On the y-axis, the power is plotted in dBm.

Remote command:
Selection: `LAY:ADD ? '1',LEFT,PCRP`
Query (y-axis): TRACe:DATA?
Query (x-axis): `TRACe<n>[:DATA]:X?` on page 160

Power vs Resource Block RS

The "Power vs Resource Block RS" result display shows the power of the reference signal per resource element averaged over one resource block.

By default, three traces are shown. One trace shows the average power. The second and the third traces show the minimum and maximum powers respectively. You can select to display the power for a specific subframe in the Subframe Selection dialog box. In that case, the application shows the power of that subframe only.

The x-axis represents the resource blocks. The displayed number of resource blocks depends on the channel bandwidth or number of resource blocks you have set. On the y-axis, the power is plotted in dBm.

Remote command:
Selection: `LAY:ADD ? '1',LEFT,PVRR`
Query (y-axis): TRACe:DATA?
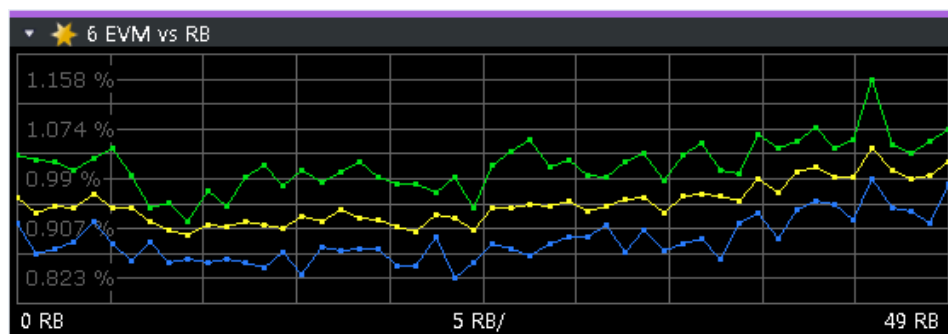Query (x-axis): `TRACe<n>[:DATA]:X?` on page 160

Channel Flatness

The "Channel Flatness" shows the relative power offset caused by the transmit channel.

The currently selected subframe depends on your selection.

The x-axis represents the frequency. On the y-axis, the channel flatness is plotted in dB.

Remote command:
Selection: `LAY:ADD ? '1',LEFT,FLAT`
Query (y-axis): TRACe:DATA?
Query (x-axis): `TRACe<n>[:DATA]:X?` on page 160

Group Delay

This "Group Delay" shows the group delay of each subcarrier.

The measurement is evaluated over the currently selected slot in the currently selected subframe.

The currently selected subframe depends on your selection.

The x-axis represents the frequency. On the y-axis, the group delay is plotted in ns.

Remote command:

Selection: `LAY:ADD ? '1',LEFT,GDEL`

Query (y-axis): `TRACe:DATA?`

Query (x-axis): `TRACe<n>[:DATA]:X?` on page 160

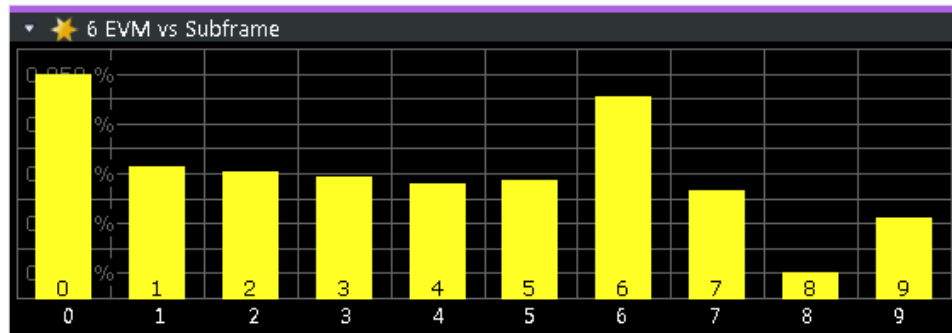**Channel Flatness Difference**

The "Channel Flatness Difference" shows the level difference in the spectrum flatness result between two adjacent physical subcarriers.

The currently selected subframe depends on your selection.

The x-axis represents the frequency. On the y-axis, the power is plotted in dB.

Remote command:

Selection: `LAY:ADD ? '1',LEFT,FDIF`

Query (y-axis): `TRACe:DATA?`

Query (x-axis): `TRACe<n>[:DATA]:X?` on page 160

Constellation Diagram
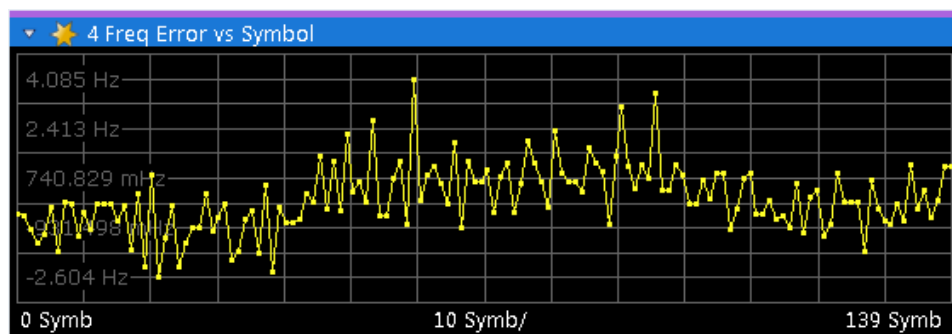
The "Constellation Diagram" shows the in-phase and quadrature phase results and is an indicator of the quality of the modulation of the signal.

In the default state, the result display evaluates the full range of the measured input data.

Each color represents a modulation type.

- ▬▬▬ : BPSK
- ▬▬▬ : RBPSK
- ▬▬▬ : MIXTURE
- ▬▬▬ : QPSK
- ▬▬▬ : 16QAM
- ▬▬▬ : 64QAM
- ▬▬▬ : 256QAM
- ▬▬▬ : 1024QAM
- ▬▬▬ : PSK (CAZAC)

You can filter the results by changing the evaluation range.

The constellation diagram also contains information about the current evaluation range, including the number of points that are displayed in the diagram.

Remote command:
Selection: `LAY:ADD ? '1',LEFT,CONS`
Query: TRACe:DATA?

CCDF

The "Complementary Cumulative Distribution Function (CCDF)" shows the probability of an amplitude exceeding the mean power. For the measurement, the complete capture buffer is used.

The x-axis represents the power relative to the measured mean power. On the y-axis, the probability is plotted in %.

In addition to the diagram, the results for the CCDF measurement are summarized in the CCDF table.

Mean	Mean power
Peak	Peak power
Crest	Crest factor (peak power – mean power)
10 %	10 % probability that the level exceeds mean power + [x] dB
1 %	1 % probability that the level exceeds mean power + [x] dB
0.1 %	0.1 % probability that the level exceeds mean power + [x] dB
0.01 %	0.01 % probability that the level exceeds mean power + [x] dB

Remote command:

Selection: `LAY:ADD ? '1',LEFT,CCDF`

Query (y-axis): TRACe:DATA?

Numerical results: `CALCulate<n>:STATistics:CCDF:X<t>?` on page 173

Numerical results: `CALCulate<n>:STATistics:RESult<res>?` on page 174

Allocation Summary

The "Allocation Summary" shows various parameters of the measured allocations in a table.

Each row in the allocation table corresponds to an allocation. A set of several allocations make up a subframe. A horizontal line indicates the beginning of a new subframe.

Special allocations summarize the characteristics of all allocations in a subframe ("ALL") and the complete frame (allocation "ALL" at the end of the table).

The columns of the table show the following properties for each allocation.

- The location of the allocation (subframe number).
- The ID of the allocation (channel type).
- Number of resource blocks used by the allocation.
- The relative power of the allocation in dB.
  The R&S VSE does not calculate the PHICH power if you turn on boosting estimation.
- The modulation of the allocation.
- The power of each resource element in the allocation in dBm.
- The EVM of the allocation.
  The unit depends on the EVM unit
- The EVM over all codewords in a layer. The layer EVM is calculated for all data allocations, and not for the DMRS or other physical signals.
  The unit depends on the EVM unit

For PDSCH allocations that use beamforming, the table contains two values. One for the PDSCH, and one for the UE-specific reference signal (UE RS).

Click **once** on the header row to open a dialog box that allows you to add and remove columns.

Remote command:
Selection: `LAY:ADD ? '1',LEFT,ASUM`
Query: TRACe:DATA?

Bitstream
The "Bitstream" shows the demodulated data stream for the data allocations.

At the end of the table is a summary of the bitstream for certain configurations.
- Total number of bits or symbols
- Total number of coded bits
- Total number of bit errors
- Bit error rate (BER) in percent
- Bits per second (= coded bits - bit errors)
  The totals are calculated over all PDSCH allocations that contribute to the bit-stream. If the crc fails for one of the allocations, the R&S VSE returns NAN for the total numbers.

The bitstream summary is displayed under the following conditions.
- Select an ORAN test case.
  The PDSCH reference data must be "ORAN PN23".

Depending on the bitstream format, the numbers represent either bits (bit order) or symbols (symbol order).

- For the bit format, each number represents one raw bit.
- For the symbol format, the bits that belong to one symbol are shown as hexadecimal numbers with two digits.
  (1024QAM: hexadecimal number with three digits)

Resource elements that do not contain data or are not part of the transmission are represented by a "-".

If a symbol could not be decoded because the number of layers exceeds the number of receive antennas, the application shows a "#" sign.

Sub-frame	Allocation ID	Code-word	Modulation	Symbol Index		Bit
0	PBCH	1/1	QPSK	0	00 00 02 00 00 00 00 00 00 00	
0	PBCH	1/1	QPSK	16	01 02 00 03 01 01 00 00 01 00	
0	PBCH	1/1	QPSK	32	00 00 02 01 00 00 00 00 01 00	
0	PBCH	1/1	QPSK	48	02 03 03 00 02 02 01 01 00 00	
0	PBCH	1/1	QPSK	64	00 00 00 00 00 00 03 00 00 02	
0	PBCH	1/1	QPSK	80	01 01 00 00 01 00 00 00 02 02	

The table contains the following information:

- **Subframe**
  Number of the subframe the bits belong to.
- **Allocation ID**

Channel the bits belong to.
- **Codeword**
  Code word of the allocation.
- **Modulation**
  Modulation type of the channels.
- **Symbol Index** or **Bit Index**
  Indicates the position of the table row's first bit or symbol within the complete stream.
- **Bit Stream**
  The actual bit stream.

Remote command:
Selection: `LAY:ADD ? '1',LEFT,BSTR`
Query: TRACe:DATA?

Channel Decoder Results

The "Channel Decoder" result display is a numerical result display that shows the characteristics of various channels for a specific subframe.

- Protocol information of the PBCH, PCFICH and PHICH.
- Information about the DCIs in the PDCCH.
- Decoded bitstream for each PDCCH.
- Decoded bitstream for each PDSCH.

The size of the table thus depends on the number of subframes in the signal.

Note that a complete set of results for the control channels is available only under certain circumstances.

- The corresponding control channel (PBCH, PCFICH or PHICH) has to be present and enabled.
- Each channel must have a certain configuration (see list below).

For each channel, the table shows a different set of values.
- PBCH
  For the PBCH, the Channel Decoder provides the following results.
  – The MIMO configuration of the DUT (1, 2 or 4 TX antennas)
  – The Transmission bandwidth
  – The Duration of the PHICH (normal or extended)
  – The PHICH resource which is the same as PHICH N_g (1/6, 1/2, 1 or 2)
  – System frame number

  If the CRC is not valid, a corresponding message is shown instead of the results.

Results for the PBCH can only be determined if the PHICH Duration or the PHICH N_g are automatically determined ("Auto") or if automatic decoding of all control channels is turned on.

- PCFICH
  For the PCFICH, the Channel Decoder provides the number of OFDM symbols that are used for PDCCH at the beginning of a subframe.
- PHICH
  The PHICH carries the hybrid-ARQ ACK/NACK. Multiple PHICHs mapped to the same set of resource elements are a PHICH group. The PHICHs within one group are separated by different orthogonal sequences.
  For the PHICH, the Channel Decoder provides the ACK/NACK pattern for the PHICH group and the relative power for each PHICH in the PHICH group. Each line in the result table represents one PHICH group. The columns on the left show the ACK/NACK pattern of the PHICH group. The columns on the right show the relative powers for each PHICH.
  If a PHICH is not transmitted, the table contains a "-" sign. Otherwise, the ACK/NACK pattern is either a "1" (acknowledgement) or a "0" (not acknowledged). The relative power is a numeric value in dB.
- PDCCH
  For each PDCCH that has been detected, the Channel Decoder shows several results. Each line in the table represents one PDCCH.
  - RNTI
  - DCI Format
    Shows the Downlink Control Information (DCI) format. The DCI contains information about the resource assignment for the UEs.
    The following DCI formats are supported: 0, 1, 1A, 1B, 1C, 2, 2A, 2C, 2D, 3, 3A.
    The DCI format is determined by the length of the DCI. Because they have the same length, the Channel Decoder is not able to distinguish formats 0, 3 and 3A. Note that a DCI that consist of only zero bits cannot be decoded.
  - PDCCH format used to transmit the DCI
  - CCE Offset
    The CCE Offset represents the position of the current DCI in the PDCCH bit stream.
  - Rel. Power
    Relative power of the corresponding PDCCH.

  Results for the PDCCH can only be determined if the PDSCH subframe configuration is detected by the "PDCCH Protocol" or if automatic decoding of all control channels is turned on.
- PDSCH
  For each decoded PDSCH allocation, there is a PDCCH DCI. The DCI contains parameters that are required for the decoding process. If the channel could be decoded successfully, the result display shows the bit stream for each codeword. If the Cyclic Redundancy Check (CRC) fails, the result display shows an error message instead.
  Results for the PDSCH can only be determined if the PDSCH subframe configuration is detected by the "PDCCH Protocol" or if automatic decoding of all control channels is turned on.

Remote command:

Selection: `LAY:ADD ? '1',LEFT,CDEC`

Query: TRACe:DATA?

EVM vs Symbol x Carrier

The "EVM vs Symbol x Carrier" result display shows the EVM for each carrier in each symbol.

The x-axis represents the symbols. The y-axis represents the subcarriers. Different colors in the diagram area represent the EVM. A color map in the diagram header indicates the corresponding power levels.

Remote command:

Selection: `LAY:ADD ? '1',LEFT,EVSC`

Query: TRACe:DATA?

Power vs Symbol x Carrier

The "Power vs Symbol x Carrier" result display shows the power for each carrier in each symbol.

The x-axis represents the symbols. The y-axis represents the subcarriers. Different colors in the diagram area represent the power. A color map in the diagram header indicates the corresponding power levels.

Remote command:

Selection: `LAY:ADD ? '1',LEFT,PVSC`

Query: TRACe:DATA?

Allocation ID vs Symbol x Carrier

The "Allocation ID vs Symbol x Carrier" result display is a graphical representation of the structure of the analyzed frame. It shows the allocation type of each subcarrier in each symbol of the received signal.

The x-axis represents the OFDM symbols. The y-axis represents the subcarriers.

Each type of allocation is represented by a different color. The legend above the diagram indicates the colors used for each allocation. You can also use a marker to get more information about the type of allocation.

Remote command:
Selection: `LAY:ADD ? '1',LEFT,AISC`
Query: TRACe:DATA?

UE RS Magnitude

The "UE RS Weights Magnitude" result display shows the magnitude of the measured weights of the UE-specific reference signal carriers. You can use it to calculate the magnitude difference between different antenna ports.

The x-axis represents the frequency, with the unit depending on your selection. The y-axis shows the amplitude of each reference signal in dB.

Because the beamforming configuration can change between the subframes of one frame, the contents of this result display for Subframe Selection = 'All' might be invalid. Thus, it is recommended to select the precise subframe to be evaluated in order to get valid results.

You can select the antenna port you want to show the information for from the corresponding beamforming selection dropdown menu.

Remote command:

Selection: `LAY:ADD ? '1',LEFT,URWM`

Querying results: TRACe:DATA?

UE RS Phase

The "UE RS Weights Phase" result display shows the phase of the measured weights of the UE specific reference signal carriers. You can use it to calculate the phase difference between different antenna ports.

The x-axis represents the frequency, with the unit depending on your selection. The y-axis shows the phase of each reference signal in degree.

Because the beamforming configuration can change between the subframes of one frame, the contents of this result display for Subframe Selection = 'All' might be invalid. Thus, it is recommended to select the precise subframe to be evaluated in order to get valid results.

You can select the antenna port you want to show the information for from the corresponding beamforming selection dropdown menu.

Remote command:

Selection: `LAY:ADD ? '1',LEFT,URWP`

Query: TRACe:DATA?

Cell RS Magnitude

The "Cell RS Weights Magnitude" result display shows the magnitude of the measured weights of the reference signal (RS) carriers specific to the cell. This measurement enables magnitude measurements on antenna port 0 using, for example, the enhanced test models like E-TM 1.1.

You can use the result display to calculate the magnitude difference between different antenna ports.

The x-axis represents the frequency, with the unit depending on your selection. The y-axis shows the amplitude of each reference signal in dB.

Because the beamforming configuration can change between the subframes of one frame, the contents of this result display for Subframe Selection = 'All' might be invalid. Thus, it is recommended to select the precise subframe to be evaluated in order to get valid results.

You can select the antenna port you want to show the information for from the corresponding beamforming selection dropdown menu.

Remote command:
Selection: `LAY:ADD ? '1',LEFT,CRWM`
Query: TRACe:DATA?

Cell RS Phase

The "Cell RS Weights Phase" result display shows the phase of the measured weights of the reference signal (RS) carriers specific to the cell. This measurement enables phase measurements on antenna port 0 using, for example, the enhanced test models like E-TM 1.1.

You can use the result display to calculate the phase difference between different antenna ports.

The x-axis represents the frequency, with the unit depending on your selection. The y-axis shows the phase of each reference signal in degree.

Because the beamforming configuration can change between the subframes of one frame, the contents of this result display for Subframe Selection = 'All' might be invalid. Thus, it is recommended to select the precise subframe to be evaluated in order to get valid results.

You can select the antenna port you want to show the information for from the corresponding beamforming selection dropdown menu.

Remote command:
Selection: `LAY:ADD ? '1',LEFT,CRWP`
Query: TRACe:DATA?

CSI RS Magnitude

The "CSI RS Weights Magnitude" result display shows the magnitude of the measured weights of the CSI-specific reference signal carriers. You can use it to calculate the magnitude difference between different antenna ports.

The x-axis represents the frequency, with the unit depending on your selection. The y-axis shows the amplitude of each reference signal in dB.

Because the beamforming configuration can change between the subframes of one frame, the contents of this result display for Subframe Selection = 'All' might be invalid. Thus, it is recommended to select the precise subframe to be evaluated in order to get valid results.

You can select the antenna port you want to show the information for from the corresponding beamforming selection dropdown menu.

Remote command:
Selection: `LAY:ADD ? '1',LEFT,IRWM`
Query: TRACe:DATA?

CSI RS Phase

The "CSI RS Weights Phase" result display shows the phase of the measured weights of the CSI-specific reference signal carriers. You can use it to calculate the phase difference between different antenna ports.

The x-axis represents the frequency, with the unit depending on your selection. The y-axis shows the phase of each reference signal in degree.

Because the beamforming configuration can change between the subframes of one frame, the contents of this result display for Subframe Selection = 'All' might be invalid. Thus, it is recommended to select the precise subframe to be evaluated in order to get valid results.

You can select the antenna port you want to show the information for from the corresponding beamforming selection dropdown menu.

Remote command:

Selection: `LAY:ADD ? '1',LEFT,IRWP`

Query: TRACe:DATA?

Beamform Allocation Summary

The "Beamform Allocation Summary" shows the phase characteristics for each PDSCH and (if available) EPDCCH allocation used by the UE-specific reference signals in numerical form.

The rows in the table represent the allocations. A set of allocations form a subframe. The subframes are separated by a dashed line. The columns of the table contain the following information:

- **Subframe**
  Shows the subframe number.
- **Allocation ID**
  Shows the type / ID of the allocation.
- **Antenna Port**
  Shows the antenna port used by the allocation.
- **Phase**
  Shows the phase of the allocation.
- **Phase Diff(erence)**
  Shows the phase difference of the allocation relative to the first antenna.

Remote command:

Selection: `LAY:ADD ? '1',LEFT,URWA`

Query: TRACe:DATA?

Result Summary

The Result Summary shows all relevant measurement results in numerical form, combined in one table.

Remote command:

`LAY:ADD ? '1',LEFT,RSUM`

Contents of the result summary

6 Result Summary				
Frame Results 1/1	**Mean**	**Max**	**Limit**	**Min**
EVM PDSCH QPSK (%)	0.94	0.94	18.50	0.94
EVM PDSCH 16QAM (%)			13.50	
EVM PDSCH 64QAM (%)			9.00	
Results for Selection　　Subframes　All, Selection Ant 1, Frame Results　1/1				
EVM All (%)	0.95	0.96		0.93
EVM Phys Channel (%)	0.95	0.96		0.93
EVM Phys Signal (%)	0.95	0.98		0.92
Frequency Error (Hz)	-0.15	0.92		-1.52
Sampling Error (ppm)	0.00	0.09		-0.12
IQ Offset (dB)	-62.37	-61.52		-63.47
IQ Gain Imbalance (dB)	-0.01	-0.01		-0.01
IQ Quadrature Error (°)	0.02	0.04		0.01
RSTP (dBm)	-61.30	-61.30		-61.31
OSTP (dBm)	-33.52	-33.52		-33.52
RSSI (dBm)	-33.71	-33.70		-33.73
Power (dBm)	-33.58	-33.57		-33.60
Crest Factor (dB)	10.13			

The table is split in two parts. The first part shows results that refer to the complete frame. For each result, the minimum, mean and maximum values are displayed. It also indicates limit check results where available. The font of 'Pass' results is green and that of 'Fail' results is red.

In addition to the red font, the application also puts a red star (★ 25.60) in front of failed results.

EVM PDSCH QPSK	Shows the EVM for all QPSK-modulated resource elements of the PDSCH channel in the analyzed frame.
	`FETCh[:CC<cc>]:SUMMary:EVM:DSQP[:AVERage]?` on page 161
EVM PDSCH 16QAM	Shows the EVM for all 16QAM-modulated resource elements of the PDSCH channel in the analyzed frame.
	`FETCh[:CC<cc>]:SUMMary:EVM:DSST[:AVERage]?` on page 162
EVM PDSCH 64QAM	Shows the EVM for all 64QAM-modulated resource elements of the PDSCH channel in the analyzed frame.
	`FETCh[:CC<cc>]:SUMMary:EVM:DSSF[:AVERage]?` on page 162
EVM PDSCH 256QAM	Shows the EVM for all 256QAM-modulated resource elements of the PDSCH channel in the analyzed frame.
	`FETCh[:CC<cc>]:SUMMary:EVM:DSTS[:AVERage]?` on page 162
EVM PDSCH 1024QAM	Shows the EVM for all 1024QAM-modulated resource elements of the PDSCH channel in the analyzed frame.
	`FETCh[:CC<cc>]:SUMMary:EVM:DS1K[:AVERage]?` on page 163

By default, all EVM results are in %. To view the EVM results in dB, change the EVM Unit.

The second part of the table shows results that refer to a specific selection of the frame.

The statistic is always evaluated over the subframes.

The header row of the table contains information about the selection you have made (like the subframe).

EVM All	Shows the EVM for all resource elements in the analyzed frame. `FETCh[:CC<cc>]:SUMMary:EVM[:ALL][:AVERage]?` on page 164
EVM Phys Channel	Shows the EVM for all physical channel resource elements in the analyzed frame. A physical channel corresponds to a set of resource elements carrying information from higher layers. PDSCH, PBCH or PDCCH, for example, are physical channels. For more information, see 3GPP 36.211. `FETCh[:CC<cc>]:SUMMary:EVM:PCHannel[:AVERage]?` on page 165
EVM Phys Signal	Shows the EVM for all physical signal resource elements in the analyzed frame. The reference signal, for example, is a physical signal. For more information, see 3GPP 36.211. `FETCh[:CC<cc>]:SUMMary:EVM:PSIGnal[:AVERage]?` on page 165
Frequency Error	Shows the difference in the measured center frequency and the reference center frequency. `FETCh[:CC<cc>]:SUMMary:FERRor[:AVERage]?` on page 165
Sampling Error	Shows the difference in measured symbol clock and reference symbol clock relative to the system sampling rate. `FETCh[:CC<cc>]:SUMMary:SERRor[:AVERage]?` on page 169
I/Q Offset	Shows the power at spectral line 0 normalized to the total transmitted power. `FETCh[:CC<cc>]:SUMMary:IQOFfset[:AVERage]?` on page 166
I/Q Gain Imbalance	Shows the logarithm of the gain ratio of the Q-channel to the I-channel. `FETCh[:CC<cc>]:SUMMary:GIMBalance[:AVERage]?` on page 166
I/Q Quadrature Error	Shows the measure of the phase angle between Q-channel and I-channel deviating from the ideal 90 degrees. `FETCh[:CC<cc>]:SUMMary:QUADerror[:AVERage]?` on page 167
RSTP	Shows the reference signal transmit power as defined in 3GPP TS 36.141. It is required for the "DL RS Power" test. It is an average power and accumulates the powers of the reference symbols within a subframe divided by the number of reference symbols within a subframe. `FETCh[:CC<cc>]:SUMMary:RSTP[:AVERage]?` on page 168
OSTP	Shows the OFDM symbol transmit power as defined in 3GPP TS 36.141. It accumulates all subcarrier powers of the 4th OFDM symbol. The 4th (out of 14 OFDM symbols within a subframe (for frame type 1, normal CP length)) contains exclusively PDSCH. `FETCh[:CC<cc>]:SUMMary:OSTP[:AVERage]?` on page 167
RSSI	Shows the Received Signal Strength Indicator. The RSSI is the complete signal power of the channel that has been measured, regardless of the origin of the signal. `FETCh[:CC<cc>]:SUMMary:RSSI[:AVERage]?` on page 168

| **Power** | Shows the average time domain power of the analyzed signal. |
| | `FETCh[:CC<cc>]:SUMMary:POWer[:AVERage]?` on page 167 |

| **Crest Factor** | Shows the peak-to-average power ratio of captured signal. |
| | `FETCh[:CC<cc>]:SUMMary:CRESt[:AVERage]?` on page 164 |

Marker Table

Displays a table with the current marker values for the active markers.

This table is displayed automatically if configured accordingly.

Wnd	Shows the window the marker is in.
Type	Shows the marker type and number ("M" for a normal marker, "D" for a delta marker).
Trc	Shows the trace that the marker is positioned on.
Ref	Shows the reference marker that a delta marker refers to.
X- / Y-Value	Shows the marker coordinates (usually frequency and level).
Z-EVM **Z-Power** **Z-Alloc ID**	Shows the "EVM", power and allocation type at the marker position. Only in 3D result displays (for example "EVM vs Symbol x Carrier").

Remote command:

`LAY:ADD? '1',RIGH, MTAB`, see `LAYout:ADD[:WINDow]?` on page 137

Results:

`CALCulate<n>:MARKer<m>:X` on page 171

`CALCulate<n>:MARKer<m>:Y` on page 171

`CALCulate<n>:MARKer<m>:Z?` on page 172

`CALCulate<n>:MARKer<m>:Z:ALL?` on page 172

3.5 Time alignment error measurements

Access: [MEAS] > "Time Alignment Error"

The Time Alignment Error measurement captures and analyzes new I/Q data when you select it.

Note that the time alignment error measurement only work in a MIMO setup (2 or 4 antennas) or in a system with component carriers. Therefore, you have to mix the signal of the antennas into one cable that you can connect to the R&S VSE. For more

information on configuring and performing a time alignment error measurement see Chapter 4.6, "Performing time alignment measurements", on page 53.

In addition to the result displays mentioned in this section, the time alignment error measurement also supports the following result displays described elsewhere.

- "Capture Buffer" on page 15
- "Power Spectrum" on page 20
- "Marker Table" on page 36

You can select the result displays from the evaluation bar and arrange them as you like with the SmartGrid functionality.

Remote command:

Measurement selection: `CONFigure[:LTE]:MEASurement` on page 183

Result display selection: `LAYout:ADD[:WINDow]?` on page 137

Time Alignment Error
The time alignment is an indicator of how well the transmission antennas in a MIMO system and component carriers are synchronized. The time alignment error is either the time delay between a reference antenna (for example antenna 1) and another antenna or the time delay between a reference component carrier and other component carriers.

The application shows the results in a table.

Each row in the table represents one antenna. The reference antenna is not shown.

For each antenna, the maximum, minimum and average time delay that has been measured is shown. The minimum and maximum results are calculated only if the measurement covers more than one frame.

If you perform the measurement on a system with carrier aggregation, each row represents one antenna. The number of lines increases because of multiple carriers. The reference antenna of the main component carrier (CC1) is not shown.

In any case, results are only displayed if the transmission power of both antennas is within 15 dB of each other. Likewise, if only one antenna transmits a signal, results will not be displayed (for example if the cabling on one antenna is faulty).

For more information on configuring this measurement, see Chapter 5.2, "Configuring time alignment error measurements", on page 115.

The "Limit" value shown in the result display is the maximum time delay that may occur for each antenna (only displayed for systems without carrier aggregation).

You can select the reference antenna from the dropdown menu in the result display. You can also select the reference antenna in the MIMO Setup - if you change them in one place, they are also changed in the other.

In the default layout, the application also shows the "Capture Buffer" and "Power Spectrum" result displays for each component carrier.

Remote command:
Selection: `LAY:ADD ? '1',LEFT,TAL`
Query: `FETCh:TAERror[:CC<cc>]:ANTenna<ant>[:AVERage]?` on page 169
Reference antenna: `CONFigure[:LTE]:DL[:CC<cc>]:MIMO:ASELection` on page 192

3.6　3GPP test scenarios

3GPP defines several test scenarios for measuring base stations. These test scenarios are described in detail in 3GPP TS 36.141.

The following table provides an overview which measurements available in the LTE application are suited to use for the test scenarios in the 3GPP documents.

Table 3-1: Test scenarios for E-TMs as defined by 3GPP (3GPP TS 36.141)

Test Model	Test scenario	Test described in	Measurement
E-TM1.1	Base station output power	chapter 6.2	Power (➜ "Result Summary")
	Transmit on/off power	chapter 6.4	On/Off Power
	DL RS power	chapter 6.5.4	RSTP (➜ "Result Summary")
	Time alignment	chapter 6.5.3	Time alignment error
	Transmitter intermodulation	chapter 6.7	ACLR
	Occupied bandwidth	chapter 6.6.1	Occupied bandwidth[1]
	ACLR	chapter 6.6.2	ACLR
	Operating band unwanted emissions	chapter 6.6.3	Spectrum emission mask
	Transmitter spurious emissions	chapter 6.6.4	Spurious emissions[1]
E-TM1.2	ACLR	chapter 6.6.2	ACLR
	Operating band unwanted emissions	chapter 6.6.2	Spectrum emission mask
E-TM2	RE power control dynamic range	chapter 6.3.1	Power results
	Frequency error	chapter 6.5.1	Frequency Error (➜ "Result Summary")
	Total power dynamic range	chapter 6.3.2	OSTP (➜ "Result Summary")
	Error vector magnitude	chapter 6.5.2	EVM results
E-TM2a	Total power dynamic range	chapter 6.3.2	OSTP (➜ "Result Summary")
	Error vector magnitude	chapter 6.5.2	EVM results
	Frequency error	chapter 6.5.1	Frequency error (➜ "Result Summary")

Test Model	Test scenario	Test described in	Measurement
E-TM2b	Total power dynamic range	chapter 6.3.2	OSTP (➜ "Result Summary")
	Error vector magnitude	chapter 6.5.2	EVM results
	Frequency error	chapter 6.5.1	OSTP (➜ "Result Summary")
E-TM3.1	RE power control dynamic range	chapter 6.3.1	Power results
	Total power dynamic range	chapter 6.3.2	OSTP (➜ "Result Summary")
	Frequency error	chapter 6.5.1	Frequency error (➜ "Result Summary")
	Error vector magnitude	chapter 6.5.2	EVM results
E-TM3.1a	Total power dynamic range	chapter 6.3.2	OSTP (➜ "Result Summary")
	Error vector magnitude	chapter 6.5.2	EVM results
	Frequency error	chapter 6.5.1	Frequency error (➜ "Result Summary")
E-TM3.1b	Total power dynamic range	chapter 6.3.2	OSTP (➜ "Result Summary")
	Error vector magnitude	chapter 6.5.2	EVM results
	Frequency error	chapter 6.5.1	OSTP (➜ "Result Summary")
E-TM3.2	RE power control dynamic range	chapter 6.3.1	Power results
	Frequency error	chapter 6.5.1	Frequency error (➜ "Result Summary")
	Error vector magnitude	chapter 6.5.2	EVM results
E-TM3.3	RE power control dynamic range	chapter 6.3.1	Power results
	Frequency error	chapter 6.5.1	Frequency error (➜ "Result Summary")
	Error vector magnitude	chapter 6.5.2	EVM results

[1]these measurements are available in the spectrum application of the Rohde & Schwarz signal and spectrum analyzers (for example the R&S FSW)

4 Measurement basics

4.1 Symbols and variables

The following chapters use various symbols and variables in the equations that the measurements are based on. The table below explains these symbols for a better understanding of the measurement principles.

$a_{l,k} \hat{a}_{l,k}$	data symbol (actual, decided)
$b_{l,k}$	boosting factor
$\Delta f,\ \Delta \hat{f}_{coarse}$	carrier frequency offset between transmitter and receiver (actual, coarse estimate)
Δf_{res}	residual carrier frequency offset
ζ	relative sampling frequency offset
$H_{l,k},\ \hat{H}_{l,k}$	channel transfer function (actual, estimate)
i	time index
$\hat{i}_{coarse},\ \hat{i}_{fine}$	timing estimate (coarse, fine)
k	subcarrier index
l	OFDM symbol index
N_{FFT}	length of FFT
N_g	number of samples in cyclic prefix (guard interval)
N_s	number of Nyquist samples
N_{RE}	number of resource elements
n	subchannel index, subframe index
$n_{l,k}$	noise sample
Φ_l	common phase error
$r(i)$	received sample in the time domain
$r_{l,k},\ r'_{l,k},\ r''_{l,k}$	received sample (uncompensated, partially compensated, equalized) in the frequency domain
T	useful symbol time

T_g	guard time
T_s	symbol time

4.2 Overview

The digital signal processing (DSP) involves several stages until the software can present results like the EVM.

The contents of this chapter are structured like the DSP.

4.3 The LTE downlink analysis measurement application

The block diagram in Figure 4-1 shows the EUTRA/LTE downlink measurement application from the capture buffer containing the I/Q data to the actual analysis block. The outcome of the fully compensated reference path (orange) is the estimate $\hat{a}_{l,k}$ of the transmitted data symbols $a_{l,k}$. Depending on the user-defined compensation, the received samples $r''_{l,k}$ of the measurement path (blue) still contain the transmitted signal impairments of interest. The analysis block reveals these impairments by comparing the reference and the measurement path. Prior to the analysis, diverse synchronization and channel estimation tasks have to be accomplished.

4.3.1 Synchronization

The first of the synchronization tasks is to estimate the OFDM symbol timing, which coarsely estimates both timing and carrier frequency offset. The frame synchronization block determines the position of the P-/S-Sync symbols in time and frequency by using the coarse fractional frequency offset compensated capture buffer and the timing estimate $\hat{i}_{coarse}$ to position the window of the FFT. If no P-/S-Sync is available in the signal, the reference signal is used for synchronization. The fine timing block prior to the FFT allows a timing improvement and makes sure that the EVM window is centered on the measured cyclic prefix of the considered OFDM symbol. For the 3GPP EVM calculation according to 3GPP TS 36.211 (v8.9.0), the block "window" produces three signals taken at the timing offsets $\Delta\tilde{\tau}$, $\Delta\tilde{\tau}_l$ and $\Delta\tilde{\tau}_h$. For the reference path, only the signal taken at the timing offset $\Delta\tilde{\tau}$ is used.

Figure 4-1: Block diagram for the LTE DL measurement application

After the time to frequency transformation by an FFT of length N_{FFT}, the phase synchronization block is used to estimate the following:

- The relative sampling frequency offset ζ (SFO)
- The residual carrier frequency offset Δf_{res} (CFO)
- The common phase error Φ_l (CPE)

According to 3GPP TS 25.913 and 3GPP TR 25.892, the uncompensated samples can be expressed as

$$R_{l,k} = A_{l,k} \cdot H_{l,k} \cdot \underbrace{e^{j\Phi_l}}_{CPE} \cdot \underbrace{e^{j2\pi \cdot N_S/N_{FFT} \cdot \zeta \cdot k \cdot l}}_{SFO} \cdot \underbrace{e^{j2\pi \cdot N_S/N_{FFT} \cdot \Delta f_{res} \cdot T \cdot l}}_{res.CFO} + N_{l,k}$$

Equation 4-1:

where

- The data symbol is $a_{l,k}$, on subcarrier k at OFDM symbol l
- The channel transfer function is $H_{l,k}$
- The number of Nyquist samples is N_s within the symbol time T_s
- The useful symbol time $T = T_s - T_g$
- The independent and Gaussian distributed noise sample is $n_{l,k}$

Within one OFDM symbol, both the CPE and the residual CFO cause the same phase rotation for each subcarrier, while the rotation due to the SFO depends linearly on the subcarrier index. A linear phase increase in symbol direction can be observed for the residual CFO as well as for the SFO.

The results of the tracking estimation block are used to compensate the samples $r_{l,k}$

Whereas a full compensation is performed in the reference path, the signal impairments that are of interest to the user are left uncompensated in the measurement path.

After having decided the data symbols in the reference path, an additional phase tracking can be utilized to refine the CPE estimation.

4.3.2 Channel estimation and equalization

As shown in Figure 4-1, there is one coarse and one fine channel estimation block. The reference signal-based coarse estimation is tapped behind the CFO compensation block (SFO compensation can optionally be enabled) of the reference path. The coarse estimation block uses the reference signal symbols to determine estimates of the channel transfer function by interpolation in both time and frequency direction. A special channel estimation ($\hat{h}_{k}^{3GPP}$) as defined in 3GPP TS 36.211 is additionally generated. The coarse estimation results are used to equalize the samples of the reference path prior to symbol decision. Based on the decided data symbols, a fine channel estimation is optimally performed and then used to equalize the partially compensated samples of the measurement path.

4.3.3 Analysis

The analysis block of the EUTRA/LTE downlink measurement application allows to compute a variety of measurement variables.

EVM

The error vector magnitude (EVM) measurement results 'EVM PDSCH QPSK/16-QAM/64-QAM' are calculated according to the specification in 3GPP TS 36.211.

All other EVM measurement results are calculated according to

$$EVM_{l,k} = \frac{\left| r_{l,k}^{''} - \hat{a}_{l,k} \right|}{b_{l,k} \sqrt{E\left\{ \left| \frac{a_{l,k}}{b_{l,k}} \right|^2 \right\}}}$$

Equation 4-2:

on subcarrier k at OFDM symbol l, where $b_{l,k}$ is the boosting factor. Since the average power of all possible constellations is 1 when no boosting is applied, the equation can be rewritten as

$$EVM_{n,l} = \frac{\left| r_{l,k}^{''} - \hat{a}_{l,k} \right|}{b_{l,k}}$$

Equation 4-3:

The average EVM of all data subcarriers is then

$$EVM_{data} = \sqrt{\frac{1}{N_{REdata}} \sum_{l} \sum_{k_{data}} EVM_{l,k_{data}}^2}$$

Equation 4-4:

The number of resource elements taken into account is denoted by $N_{RE\,data}$.

I/Q imbalance

The I/Q imbalance can be written as

$$r(t) = I\,\Re\{s(t)\} + jQ\,\Im\{s(t)\}$$

Equation 4-5:

where s(t) is the transmit signal, r(t) is the received signal, and I and Q are the weighting factors. We define that I:=1 and Q:=1+ΔQ.

The I/Q imbalance estimation makes it possible to evaluate the

$$\text{modulator gain balance} = |1 + \Delta Q|$$

Equation 4-6:

and the

$$\text{quadrature mismatch} = \arg\{1 + \Delta Q\}$$

Equation 4-7:

based on the complex-valued estimate $\Delta\hat{Q}$.

Other measurement variables

Without going into detail, the EUTRA/LTE downlink measurement application additionally provides the following results.

- Total power
- Constellation diagram
- Group delay
- I/Q offset
- Crest factor
- Spectral flatness

4.4 MIMO measurement guide

Performing MIMO measurements requires additional equipment that allows you to capture multiple data streams.

- Several signal analyzers, the number depending on the number of data streams you have to capture.
  Alternatively, you can use an oscilloscope with multiple channels, the number of channels also depending on the number of data streams you have to capture.

True MIMO measurements are useful to verifiy MIMO precoding implementations for setups where it is not possible to decode the transmit data using only one antenna (e.g. applying spatial multiplexing MIMO precoding with more than 1 layer) and to measure the hardware performance of the MIMO transmitter hardware in a true MIMO measurement setup.

4.4.1 MIMO measurements with signal analyzers

MIMO measurements require multiple signal analyzers. The number depends on the number of data streams you have to capture.

For valid measurement results, the frequencies of the analyzers in the test setup have to be synchronized. It is also necessary to configure the trigger system properly to capture the data simultaneously.

Synchronizing the frequency

The frequency of the analyzers in the test setup have to be synchronized. Thus, one of the analyzers (primary) controls the other analyzers (secondary) in the test setup. The primary analyzer has to be equipped with the LTE MIMO application and provides the reference oscillator source for the secondary analyzers.

► Connect the REF OUT of the primary analyzer to the REF IN connector of the secondary analyzers. Make sure to configure the secondary analyzers to use an external reference (➜ General Setup menu).

If you are using a measurement setup with several R&S signal generators (for example R&S SMW), the situation is similar. One of the generators controls the other via the external reference.

► Connect the REF OUT of the primary generator to the REF IN of the secondary device. Make sure to configure the secondary devices to use an external reference (➜ Reference Oscillator settings).

Triggering MIMO measurements

For valid MIMO measurements, it is crucial to capture all data streams simultaneously. To do so, you need a trigger signal provided by the DUT or the signal generator. The trigger signal has to be connected to all analyzers. If you have several signal generators in the setup, the primary generator has to trigger the secondary devices as well.

The 4-2 shows a MIMO setup with two (or optional four) analyzers and one (or optional two) signal generators with two channels.

Figure 4-2: MIMO Hardware Setup

You can use several trigger configurations, with or without additional hardware.

Measurements with a delayed trigger signal

Simultaneous capture of the I/Q data requires the trigger inputs of all instruments in the setup to be armed.

Arming a trigger does not happen immediately when you start a measurement, but is delayed slightly for a number of reasons, for example:

- Connecting several instruments with a LAN or GPIB connection usually causes a certain network delay.
- Tasks like the auto leveling function require some time to finish.

Because of these factors, you have to make sure that the trigger event does not occur during this time frame. You can do so, for example, by configuring an appropriate delay time on the DUT.

The exact delay depends on the GPIB or network condition and the input settings.

A typical delay to arm the trigger is 2 seconds per instrument.

The minimum delay of the trigger signal must now be greater than the measured time multiplied with the number of measured antennas (the number of analyzers), because the spectrum analyzers are initialized sequentially.

The usage of an LTE frame trigger is not possible for this measurement setup.

Measurements with a frame trigger signal

You can use a frame trigger if all transmitted LTE frames use the same frame configuration and contain the same data. In this case, the analyzers in the test setup capture data from different LTE frames but with the same content.

This method to analyze data, however, raises one issue. The phase variations of the reference oscillators of the different signals that are transmitted are not the same, because the data is not captured simultaneously.

The result is a phase error which degrades the EVM (see the figures below).

An application for this measurement method is, for example, the test of the MIMO precoding implementation. Because of the bad EVM values, it is not recommended to use this test setup to measure hardware performance.

Figure 4-3: Constellation diagram

Figure 4-4: EVM vs OFDM symbol number

Measurements with the R&S FS-Z11 trigger unit

The trigger unit R&S FS-Z11 is a device that makes sure that the measurement starts on all analyzers (primary and decondary devices) at the same time.

Connecting the trigger unit

► Connect the NOISE SOURCE output of the primary analyzer to the NOISE SOURCE CONTROL input of the trigger unit.

► Connect the EXT TRIG inputs of all analyzers (primary **and** secondary) to the TRIG OUT 1 to 4 (or 1 and 2 in case of measurements on two antennas) of the trigger

unit. The order is irrelevant, that means it would be no problem if you connect the primary analyzer to the TRIG OUT 2 of the trigger unit.

With this setup, all analyzers (including the primary analyzer) are triggered by the trigger unit.

The trigger unit also has a TRIG INPUT connector that you can connect an external trigger to. If you are using an external trigger, the external trigger supplies the trigger event. If not, the analyzer noise source control supplies the trigger event. Note that if you do not use an external trigger, the TRIG INPUT must remain open.

To use the R&S FS-Z11 as the trigger source, you have to turn it on in the "Trigger" dialog box of the LTE measurement application. For more information see Chapter 5.1.24, "Trigger configuration", on page 107.

Figure 4-5: MIMO setup with trigger unit

4.4.2 MIMO measurements with oscilloscopes

This part presents an approach to measure a MIMO signal transmitted on two or four antennas using the R&S®RTO1044 digital oscilloscope, 4 GHz, 4 channels and the R&S®FS-K102/103PC LTE MIMO downlink/uplink PC software. This has multiple advantages:

- Only one measurement instrument is required. This not only reduces the number of test instruments but also simplifies the test setup and cabling (no reference oscillator and trigger cabling, no additional hardware for synchronization required like the R&S®FS-Z11).
- The measurement time is reduced.

For measuring LTE signals with the RTO it has to be equipped with the options R&S®RTO-B4 and R&S®RTO-K11.

The hardware setup is illustrated in Figure 4-6. All transmit antennas (TX) of the device under test (DUT) or an SMU are connected to the RF input of the RTO. Either two or optionally four antennas are attached. The LTE-Software runs on a PC and is connected to the RTO via a local area network (LAN).

Figure 4-6: Test setup for LTE MIMO measurements with an oscilloscope

To successfully connect the application to the oscilloscope, enter the correct network address in the "Analyzer Configuration" table and define the hardware properties (for example the number of input channels).

Figure 4-7: Configuration of the R&S RTO connection and input channels

For configuring the number of active R&S RTO inputs the DUT MIMO configuration (2 Tx antennas or 4 Tx antennas) and the "Tx Antenna Selection" must be set. The DUT MIMO configuration describes which antennas are available and the Tx antenna selection defines how many I/Q data streams are captured and which antennas are assigned to the streams. To measure more than one antenna at once, "Tx Antenna Selection" must be set to "All", "Auto (2 Antennas)" or "Auto (4 Antennas)".

- "All": all available Tx antennas are measured and the antennas are assigned to the streams in ascending order.
- "Auto": the antenna assignment is automatically detected.
  In case of "Auto (2 Antennas)" two streams are captured.
  In case of "Auto (4 Antennas)" four streams are captured.

The signal level of each R&S RTO input channel is measured and the reference level and attenuation settings are adjusted automatically. If a manual setting is preferred and for speed optimization, the automatic level adjustment can be disabled in the "General" tab of the "General Settings" dialog box.

4.5 Calibrating beamforming measurements

The quality of beamforming transmission depends on the phase characteristics of the transmission, because phase errors lead to an incorrect beamforming pattern. Thus, measuring the phase difference between the transmit antennas is the most important task regarding beamforming.

The precision of beamforming phase measurements relies on the phase characteristics of the measurement equipment (cables, oscilloscope etc.). These phase characteristics should be considered in the test setup, otherwise measurement results could be affected by errors. Therefore, it is recommended to calibrate beamforming measurements before performing the actual measurement, and thus improve the precision of the measurement.

The application provides functionality that allows you to correct the measurement results by phase errors resulting from the measurement equipment.

Required equipment

Calibrating beamforming phase measurements requires the following equipment.

- An R&S RTO with four channels.
  Note: All data streams have to be measured on a single oscilloscope. Signal analyzers and oscilloscopes with less than four channels are not supported for the calibration.
  Calibration is only valid for a particular test setup. If you replace measurement equipment, calibration becomes invalid and you have to recalibrate the test setup.
- An Rohde & Schwarz signal generator (R&S SMBV or similar) equipped with the LTE option.
- An RF splitter (4-way or 2-way).
- Optional: an attenuator between cable and oscilloscope to improve the matching impedance. Improving the matching impedance improves the accuracy of the results even more.

Preparing the calibration measurement

The application creates the calibration data from an LTE signal that you can generate with an Rohde & Schwarz signal generator.

To get the signal, preset the signal generator and select the appropriate channel bandwidth for the beamforming phase measurement. All other settings should remain the same. However, make sure that the signal contains the antenna port 0 of the reference signal.

When done, configure the LTE measurement application with the settings required for the beamforming measurement. Note that after calibration is done, you must not change several parameters (see below).

Setting up the measurement equipment

Now that the generator and application are configured properly, feed the signal into the oscilloscope through an RF splitter.

If you are using a 4-way RF splitter with four data streams, calibration can be done in one go. If you are using a 2-way splitter with four data streams, you have to calibrate each input channel and cable separately (→ start the calibration, select the splitter type from the dialog box and follow the instructions).

Optionally, you can connect an attenuator to each oscilloscope channel and thus improve matching impedance.

Generating new calibration data

1. Start the calibration ("Input & Output" > "Beamforming Calibration" > "Generate").
   Note that this feature is only available when a connection to an R&S RTO has been established.
   The application performs a single measurement to calculate the correction values.

2. Select the splitter type you are using (2-way or 4-way).

3. Procedure for a 4-way splitter:

   a) Connect the input sources according to the diagram shown in the dialog box.
   b) Select "Run".
      The R&S VSE starts a single measurement to calculate the correction values.

4. Procedure for a 2-way splitter:
   For a 2-way splitter, calibration consists of several measurements, one for each antenna. After each measurement, you have to connect the signal to a different input channel.

   a) Connect the first two input sources according to the diagram shown in the dia-log box.

b) Select "Run".

The R&S VSE calibrates the first input channel. When done, it opens a new dialog box.

c) Connect the second input source according to the diagram shown in the dialog box.

d) Select "Run".

The R&S VSE calibrates the second input channel. When done, it opens a new dialog box.

e) Connect the last input sources according to the diagram shown in the dialog box.

The R&S VSE calibrates the third input channel.

After the calibration measurement is done, restore the actual test setup without splitters.

You can also save the calibration file. This can be useful if you want to use the same equipment again later on. The calibration file has the extension `.cal`. It contains the following parameters that will be restored if you use the calibration file again.

● Center frequency
● Reference level during calibration
● MIMO configuration (number of antennas and number of input channels)
● LTE bandwidth

If you do not save the calibration data, calibration becomes invalid when you change one of the parameters mentioned above or use different equipment (oscilloscope, cables etc.). The current calibration state is displayed in a status bar at the top of the user interface.

Remote command:

CALibration:PHASe:GENerate on page 192

Restoring previously recorded calibration data

If you have previously saved calibration data, you can restore it later on without having to recalibrate the measurement.

► Load the previously recorded file ("Input & Output" > "Beamforming Calibration" > "Load").

Note that this feature is only available when a connection to an R&S RTO has been established.

The application restores the frequency, reference level, MIMO configuration and LTE bandwidth that were active during calibration.

Note: Auto leveling is cancelled if you restore calibration data. Instead the reference level is set to the value stored in the calibration file.

Remote command:

CALibration:PHASe:LOAD on page 192

Performing beamforming phase measurement

After you are done calibrating the measurement, you can configure the actual phase measurement. Except for the parameters saved in the calibration file, you can change settings and configure the signal as required.

When all is set up, perform the actual measurement. The application corrects beamforming results based on the calibration data.

4.6 Performing time alignment measurements

The measurement application allows you to perform time alignment measurements between different antennas.

The measurement supports setups of up to four Tx antennas.

The result of the measurement is the time alignment error. The time alignment error is the time offset between a reference antenna (for example antenna 1) and another antenna.

The time alignment error results are summarized in the corresponding result display.

A schematic description of the results is provided in Figure 4-8.

Figure 4-8: Time Alignment Error (4 Tx antennas)

Test setup

Successful Time Alignment measurements require a correct test setup.

A typical hardware test setup is shown in Figure 4-9. Note that the dashed connections are only required for MIMO measurements on 4 Tx antennas.

Figure 4-9: Hardware setup

For best measurement result accuracy, it is recommended to use cables of the same length and identical combiners as adders.

In the application, make sure to correctly apply the following settings.

● Select a reference antenna in the MIMO Configuration dialog box (**not** "All")
● Set the Subframe Selection to "All"
● Turn on Compensate Crosstalk in the "Demodulation Settings"
● Note that the Time Alignment measurement only evaluates the reference signal and therefore ignores any PDSCH settings - for example, it does not have an influ-ence on this measurement if the PDSCH MIMO scheme is set to transmit diversity or spatial multiplexing.

4.7 O-RAN measurement guide

The O-RAN alliance specifies specific signal configurations (test cases) for standar-dized testing of O-RAN equipment. The R&S VSE provides these O-RAN test cases. When you apply one of them, the measurement configuration automatically adjusts to the values of the selected test case.

Basically, you can verify O-RAN based signals by certain bit sequences in the PDSCH and the positions of those sequences. The position of the bit sequence in the PDSCH is unique for each test case.

The type of bit sequence depends on the test case.

● Some test cases use a bit sequence of all 0's.
● Some test cases use an O-RAN specific PN23 bit sequence.

In addition, the data demodulation depends on the test case (before or after descram-bling).

As pointed out, these settings are automatically selected, depending on the selected test case.

For valid measurement results, it is essential that the measured signal complies with the selected test case and uses the correct bit sequences in the correct locations. If you get unexpected measurement results, check if the signal is configured correctly. You can do a quick check to validate the signal as follows.

- Check if the selected test case in the "Advanced Settings" is the same as the test case in the "Test Models" dialog.
- Use the Allocation ID vs Symbol x Carrier result display to verify if the correct PDSCH allocations are analyzed. If the signal contains the correct bit sequence, the EVM should be good.
- Use the Bitstream result display to verify if the bits match the O-RAN specifications. Each test case has a typical bit sequence. Make sure to select the bit sequence as the bitstream format.

5 Configuration

LTE measurements require a special application on the R&S VSE, which you can select by adding a new measurement channel or replacing an existing one.

For more information on controlling measurement applications, refer to the documentation of the R&S VSE base software.

When you start the LTE application, the R&S VSE starts to measure the input signal with the default configuration or the configuration of the last measurement (if you haven't performed a preset since then).

> **Automatic refresh of preview and visualization in dialog boxes after configuration changes**
>
> The R&S VSE supports you in finding the correct measurement settings quickly and easily - after each change in settings in dialog boxes, the preview and visualization areas are updated immediately and automatically to reflect the changes. Thus, you can see if the setting is appropriate or not before accepting the changes.

> **Unavailable menus**
>
> Note that the "Limits" and "Trace" menus have no contents and no function in the LTE application.

5.1 Configuring I/Q measurements

5.1.1 Configuration overview

Throughout the measurement channel configuration, an overview of the most important currently defined settings is provided in the "Overview". The "Overview" is displayed when you select the "Overview" menu item from the "Meas Setup" menu.

In addition to the main measurement settings, the "Overview" provides quick access to the main settings dialog boxes. The individual configuration steps are displayed in the order of the data flow. Thus, you can easily configure an entire measurement channel from input over processing to output and analysis by stepping through the dialog boxes as indicated in the "Overview".

In particular, the "Overview" provides quick access to the following configuration dialog boxes (listed in the recommended order of processing):

1. Signal Description
   See Chapter 5.1.2, "Signal characteristics", on page 59.

2. Input / Frontend
   See Chapter 5.1.20, "Selecting the input and output source", on page 97.

3. Trigger / Signal Capture
   See Chapter 5.1.24, "Trigger configuration", on page 107.

See Chapter 5.1.23, "Data capture", on page 105

4. Estimation / Tracking
   See Chapter 5.1.26, "Measurement error compensation", on page 111.

5. Demodulation
   See Chapter 5.1.27, "Demodulation", on page 112.

6. Evaluation Range
   See Chapter 6.2.2, "Evaluation range", on page 121.

7. Analysis
   See Chapter 6, "Analysis", on page 117.

8. Display Configuration
   See Chapter 3, "Measurements and result displays", on page 12.

In addition, the dialog box provides the "Select Measurement" button that serves as a shortcut to select the measurement type.

To configure settings

► Select any button in the "Overview" to open the corresponding dialog box.
  Select a setting in the channel bar (at the top of the measurement channel tab) to change a specific setting.

Preset Channel
Select "Preset Channel" in the lower left-hand corner of the "Overview" to restore all measurement settings *in the current channel* to their default values.

Remote command:
SYSTem:PRESet:CHANnel[:EXEC] on page 183

Select Measurement
Opens a dialog box to select the type of measurement.

For more information about selecting measurements, see Chapter 3.1, "Selecting measurements", on page 12.

Remote command:
CONFigure[:LTE]:MEASurement on page 183

Specific Settings for
The channel can contain several windows for different results. Thus, the settings indicated in the "Overview" and configured in the dialog boxes vary depending on the selected window.

Select an active window from the "Specific Settings for" selection list that is displayed in the "Overview" and in all window-specific configuration dialog boxes.

The "Overview" and dialog boxes are updated to indicate the settings for the selected window.

5.1.2　Signal characteristics

Access: "Overview" > "Signal Description" > "Signal Description"

The general signal characteristics contain settings to describe the general physical attributes of the signal.

Selecting the LTE mode
The "Mode" selects the LTE standard you are testing.

The choices you have depend on the set of options you have installed.
- Option xxx-K100 enables testing of 3GPP LTE FDD signals on both uplink and downlink
- Option xxx-K102 enables testing of 3GPP LTE MIMO signals on both uplink and downlink
- Option xxx-K104 enables testing of 3GPP LTE TDD signals on both uplink and downlink
- Option xxx-K106 enables testing of 3GPP LTE NB-IoT TDD signals on both uplink and downlink

FDD and TDD are **duplexing** methods.
- FDD mode uses different frequencies for the uplink and the downlink.
- TDD mode uses the same frequency for the uplink and the downlink.

Downlink (DL) and Uplink (UL) describe the **transmission path**.
- Downlink is the transmission path from the base station to the user equipment. The physical layer mode for the downlink is always OFDMA.

- Uplink is the transmission path from the user equipment to the base station.
  The physical layer mode for the uplink is always SC-FDMA.

Remote command:
Link direction: `CONFigure[:LTE]:LDIRection` on page 189
Duplexing mode: `CONFigure[:LTE]:DUPLexing` on page 185

Carrier Aggregation

Carrier aggregation has been introduced in the LTE standard to increase the bandwidth. In those systems, several carriers can be used to transmit a signal.

Each carrier usually has one of the channel bandwidths defined by 3GPP.

The R&S VSE features several measurements that support contiguous and non-contiguous intra-band carrier aggregation (the carriers are in the same frequency band).
- I/Q based measurements (EVM, frequency error, etc.) (downlink)
- I/Q based measurements (EVM, frequency error, etc.) (uplink)
- Time alignment error (downlink)
- Time alignment error (uplink)

The way to configure these measurements is similar (but not identical, the differences are indicated below).
- "Basic component carrier configuration" on page 60
- "Features of the I/Q measurements" on page 61
- "Features of the time alignment error measurement" on page 61
- "Remote commands to configure carrier aggregation" on page 61

Basic component carrier configuration ← Carrier Aggregation

The number of component carriers (CCs) you can select depends on the measurement.
- I/Q based measurements (EVM etc.): up to 2 CCs
- Time alignment error: up to 2 CCs

You can define the characteristics of the CCs in the table in the "Carrier Configuration" panel (in the "Signal Characteristics" dialog box). Depending on the "Number of Component Carriers", the application adjusts the size of the table. Each line corresponds to a component carrier.

- The "Center Frequency" defines the carrier frequency of the carriers.
- For each carrier, you can select the "Bandwidth" from the corresponding dropdown menu.
- For all component carriers, the R&S VSE also shows the "Frequency Offset" relative to the center frequency of the first carrier.
  If you define a different frequency offset, the application adjusts the center frequency accordingly.

Note that the actual measurement frequency differs from the carrier frequencies: the application calculates that frequency based on the carrier frequencies. It is somewhere in between the carrier frequencies.

The measurement frequency is displayed in the channel bar.

For each component carrier, you can select one of the **channel bandwidths** defined by 3GPP from the "Bandwidth" dropdown menus. The combination of bandwidths is arbitrary.

When the defined carrier configuration is not supported by the application, a corresponding error message is displayed. This can be the case, for example, if the carriers occupy a bandwidth that is too large.

Features of the I/Q measurements ← Carrier Aggregation
For measurements on component carriers, results are shown for each component carrier separately. The layout of the diagrams is adjusted like this:

- The first tab ("All") shows the results for all component carriers.
- The other tabs ("CC <x>") show the results for each component carrier individually.

The application also shows the "Occupied Bandwidth" of the aggregated carriers and the "Sample Rate" in a read-only field below the carrier configuration.

Occ BW	14.9 MHz
Sample Rate	30.72 MHz

Features of the time alignment error measurement ← Carrier Aggregation
When you perform a TAE measurement, you can capture the data of the component carriers either on one R&S VSE ("wideband capture") or on two R&S VSE. When you capture the data with only one R&S VSE, make sure that it has a bandwidth wide enough to capture all component carriers in a single measurement.

Note that the TAE measurements are possible on one R&S VSE only. Therefore the number of devices to measure is always "1".

You can configure additional signal characteristics of the first and second carrier in the "CC1" and "CC2" tabs.

In case you are testing a MIMO DUT, you can also select the number of antennas the DUT supports. When you select "1 Tx Antenna", the application measures the timing difference between two SISO carriers, when you select more than one antenna, it measures the timing difference between the antennas. In that case, you can select the reference antenna from the dropdown menu in the time alignment error result display.

Note that the application shows measurement results for the second component carrier even if only one antenna of the second component carrier is attached (i.e. no combiner is used).

Remote commands to configure carrier aggregation ← Carrier Aggregation

Remote command:

Number of carriers: `CONFigure[:LTE]:NOCC` on page 244

Carrier frequency: `[SENSe:]FREQuency:CENTer[:CC<cc>]` on page 223

Measurement frequency: `SENSe:FREQuency:CENTer?`

Offset: `[SENSe:]FREQuency:CENTer[:CC<cc>]:OFFSet` on page 223

Channel bandwidth: `CONFigure[:LTE]:DL[:CC<cc>]:BW` on page 185

Channel Bandwidth / Number of Resource Blocks

Specifies the channel bandwidth and number of resource blocks (RB).

The channel bandwidth and number of resource blocks (RB) are interdependent. Currently, the LTE standard recommends six bandwidths (see table below).

Tip: The "Auto LTE Config" feature (available in the "Auto Set" menu) automatically detects the channel bandwidth.

The application also calculates the FFT size, sampling rate, occupied bandwidth and occupied carriers from the channel bandwidth. Those are read only.

Channel Bandwidth [MHz]	1.4	3	5	10	15	20
Number of Resource Blocks	6	15	25	50	75	100
Sample Rate [MHz]	1.92	3.84	7.68	15.36	30.72	30.72
FFT Size	128	256	512	1024	2048	2048

For more information about configuring aggregated carriers, see "Carrier Aggregation" on page 60.

The application shows the currently selected LTE mode (including the bandwidth) in the channel bar.

Remote command:

`CONFigure[:LTE]:DL[:CC<cc>]:BW` on page 185

Cyclic Prefix

The cyclic prefix serves as a guard interval between OFDM symbols to avoid interferences. The standard specifies two cyclic prefix modes with a different length each.

The cyclic prefix mode defines the number of OFDM symbols in a slot.

- Normal
  A slot contains 7 OFDM symbols.
- Extended
  A slot contains 6 OFDM symbols.
  The extended cyclic prefix is able to cover larger cell sizes with higher delay spread of the radio channel.
- Auto
  The application automatically detects the cyclic prefix mode in use.

Remote command:

`CONFigure[:LTE]:DL[:CC<cc>]:CYCPrefix` on page 185

Configuring TDD Frames

TDD frames contain both uplink and downlink information separated in time with every subframe being responsible for either uplink or downlink transmission. The standard specifies several subframe configurations or resource allocations for TDD systems.

TDD UL/DL Allocations ← Configuring TDD Frames

Selects the configuration of the subframes in a radio frame in TDD systems.

The UL/DL configuration (or allocation) defines the way each subframe is used: for uplink, downlink or if it is a special subframe. The standard specifies seven different configurations.

Configuration	Subframe Number and Usage									
	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

U = uplink
D = downlink
S = special subframe

Remote command:
Subframe: `CONFigure[:LTE]:DL[:CC<cc>]:TDD:UDConf` on page 188

Conf. of Special Subframe ← Configuring TDD Frames

In combination with the cyclic prefix, the special subframes serve as guard periods for switches from uplink to downlink. They contain three parts or fields.

- DwPTS
  The DwPTS is the downlink part of the special subframe. It is used to transmit downlink data.
- GP
  The guard period makes sure that there are no overlaps of up- and downlink signals during a switch.
- UpPTS
  The UpPTS is the uplink part of the special subframe. It is used to transmit uplink data.

The length of the three fields is variable. This results in several possible configurations of the special subframe. The LTE standard defines 10 different configurations for the special subframe. However, configurations 8 and 9 only work for a normal cyclic prefix.

If you select configurations 8 or 9 using an extended cyclic prefix or automatic detection of the cyclic prefix, the application will show an error message.

Remote command:
Special subframe: `CONFigure[:LTE]:DL[:CC<cc>]:TDD:SPSC` on page 188

Configuring the Physical Layer Cell Identity

The "Cell ID", "Cell Identity Group" and physical layer "Identity" are interdependent parameters. In combination, they are responsible for synchronization between network and user equipment.

The physical layer cell ID identifies a particular radio cell in the LTE network. The cell identities are divided into 168 unique cell identity groups. Each group consists of 3 physical layer identities. According to:

$$N_{ID}^{cell} = 3 \cdot N_{ID}^{(1)} + N_{ID}^{(2)}$$

$N^{(1)}$ = cell identity group, {0...167}
$N^{(2)}$ = physical layer identity, {0...2}

there is a total of 504 different cell IDs.

If you change one of these three parameters, the application automatically updates the other two.

For automatic detection of the cell ID, turn on the "Auto" function.

Before it can establish a connection, the user equipment must synchronize to the radio cell it is in. For this purpose, two synchronization signals are transmitted on the downlink. These two signals are reference signals whose content is defined by the "Physical Layer Identity" and the "Cell Identity Group".

The first signal is one of 3 possible Zadoff-Chu sequences. The sequence that is used is defined by the physical layer identity. It is part of the P-Sync.

The second signal is one of 168 unique sequences. The sequence is defined by the cell identity group. This sequence is part of the S-Sync.

In addition to the synchronization information, the cell ID also determines:
- The cyclic shifts for PCFICH, PHICH and PDCCH mapping,
- The frequency shifts of the reference signal.

Remote command:
Cell ID: `CONFigure[:LTE]:DL[:CC<cc>]:PLC:CID` on page 187
Cell Identity Group (setting): `CONFigure[:LTE]:DL[:CC<cc>]:PLC:CIDGroup` on page 187
Cell Identity Group (query): `FETCh[:CC<cc>]:PLC:CIDGroup?` on page 189
Identity (setting): `CONFigure[:LTE]:DL[:CC<cc>]:PLC:PLID` on page 188
Identity (query): `FETCh[:CC<cc>]:PLC:PLID?` on page 190

Exclude Inband NB-IoT

The 3GPP standard specifies several operating modes, or deployments, for NB-IoT transmission. The deployment specifies where the NB-IoT signal is located in the frequency spectrum.

One of these deployments is the inband deployment. In that case, the The NB-IoT signal uses resource blocks within an LTE carrier.

You can exclude the resource blocks used by the NB-IoT signal from the measurement results when you turn on "Exclude Inband NBIoT". When you turn on this feature, you can also define the location of the NB-IoT signal within the LTE carrier as an resource block offset. The resource block offset is a value relative to resource block 0.

This feature is available for automatic PDSCH demodulation.

Remote command:

State: CONFigure[:LTE]:DL[:CC<cc>]:EINBiot[:STATe] on page 186

Offset: CONFigure[:LTE]:DL[:CC<cc>]:NRBoffset on page 186

5.1.3 Test scenarios

Access: "Overview" > "Signal Description" > "Test Models"

Test scenarios are descriptions of specific LTE signals for standardized testing of DUTs. These test scenarios are stored in .allocation files. You can select, manage and create test scenarios in the "Test Models" dialog box.

3GPP test models

Test models are certain signal descriptions defined by 3GPP for various test scenarios. 3GPP calls them E-TM. These E-TM are defined in 3GPP 36.141.

There are three main test model groups E-TM1, E-TM2 and E-TM3). Each of these main groups in turn contain signal descriptions for specific signal configurations (different transmission type, different bandwidth etc.).

Test models are defined by the following characteristics.
- Single antenna port, single code word, single layer and no precoding
- Duration of one frame
- Normal cyclic prefix
- Localized virtual resource blocks, no intra-subframe hopping for PDSCH
- UE-specific reference signal not used

The data content of the physical channels and signals is defined by 3GPP. Each E-TM is defined for all bandwidths defined in the standard (1.4 MHz / 3 MHz / 5 MHz / 10 MHz / 15 MHz / 20 MHz).

For an overview of the test scenarios, see Chapter 3.6, "3GPP test scenarios", on page 38.

Remote command:
MMEMory:LOAD[:CC<cc>]:TMOD:DL on page 190

ORAN test cases

O-RAN test cases are available for FDD signals.

In addition to the 3GPP test models, you can also use O-RAN test cases. O-RAN test cases are defined by the O-RAN alliance for standardized measurements.

The test cases comply with O-RAN specification O-RAN.WG4.CONF.0-v05.00.

The O-RAN test cases are based on the 3GPP test models (downlink) and fixed reference channels (uplink) and are customized for the O-RAN applications.

For more information about the test cases themselves, see the O-RAN specifications available on the O-RAN website.

For more information about using O-RAN test cases in measurements with the R&S VSE, see Chapter 4.7, "O-RAN measurement guide", on page 54.

Remote command:
MMEMory:LOAD[:CC<cc>]:TMOD:DL on page 190

User defined test scenarios

User defined test scenarios are custom signal descriptions for standardized measure-ments that you can save and restore as you like. To create a custom test scenario, describe a signal as required and then save it with the corresponding button. The R&S VSE stores custom scenarios in `.allocation` files.

If you do not need test scenarios any longer, you can also delete them.

Remote command:
Save: `MMEMory:STORe<n>[:CC<cc>]:DEModsetting` on page 191
Restore: `MMEMory:LOAD[:CC<cc>]:DEModsetting` on page 190

5.1.4 Configuring MIMO setups

Access: "Overview" > "Signal Description" > "MIMO / CA Setup"

MIMO measurements need a special setup that you can configure with the settings available in the MIMO configuration dialog box.

For more information on MIMO measurements, see Chapter 4.4, "MIMO measurement guide", on page 44.

The "Auto LTE Config" feature (available in the "Auto Set" menu) automatically detects the MIMO configuration.

Configuring component carriers

When you are doing measurements on aggregated carriers, you can configure each carrier separately.

When available, each carrier in the dialog boxes is represented by an additional tab labeled "CC<x>", with <x> indicating the number of the component carrier.

Note that the additional tabs are only added to the user interface after you have selected more than "1" component carrier.

Result displays

For measurements with several input sources, a result display is made up out of several subwindows instead of a single window. Each subwindow corresponds to the data captured by a single input source. The number of subwindows in a result display therefore corresponds to the number of input sources you have selected. For example, if you have selected 4 input channels, the application would show 4 constellation diagrams.

Because this screen layout can make it difficult to read individual results, you have several options to increase the comfort of evaluating the results.

- Display one result display in full screen mode only.
- Open each result display in a separate window.
- Filter the results for a specific antenna port only (see "Beamforming Selection" on page 123).
  Note that a single I/Q data stream can still contain information for several antenna ports.
  For more information about antenna port mapping, see "Number Of Input Sources" on page 67.

Functions in the "MIMO Setup" dialog box described elsewhere:

- "Number Of Component Carrier", see "Carrier Aggregation" on page 60.

Number Of Input Sources
The R&S VSE can analyze up to 8 I/Q data streams, each through one input source. You can capture the data from oscilloscope(s) or spectrum analyzer(s). The number of instruments you need depends on the number of data streams, for example capturing four data streams requires four analyzers or one oscilloscope with four channels.

You can configure the connected instruments in the "Instruments" dialog box and configure the data streams in the input source configuration table.

For more information about instrument configuration in the R&S VSE, see the R&S VSE user manual.

You can either select the number of data streams directly (1 to 8) or let the R&S VSE determine the number of data streams based on the antenna selection.

The "From Antenna Selection" menu item has the following effects.
- The number of input sources depends on the MIMO configuration in the system and the antenna selection.
- The contents of the "Tx Antenna Selection" dropdown menu change. In addition to selecting a specific antenna, you can let the application determine which antenna(s) to test and in which order (➜ "Auto <x>" menu items).
  In case of automatic detection, the application analyzes the reference signal(s) to select the antenna(s).

The mapping of antenna ports to data streams is as follows.

- AP0 to AP3 (cell-specific reference signals) are always mapped to the first four data streams.
  The number of cell-specific reference signals is variable and depends on the MIMO configuration.
- AP4 is not analyzed.
- AP5 is always mapped to the first data stream after the last cell-specific reference signal.
- AP6 (positioning reference signal) is always mapped to the data stream that comes after AP5.
- AP7 to AP14 (UE-specific reference signals) are always mapped to a single data stream, with AP7 being mapped to the first data stream.
  The number of UE-specific reference signals is variable and depends on the beam-forming configuration for the PDSCH.
- AP15 to AP22 (CSI reference signals) are always mapped to a single data stream, with AP15 being mapped to the first data stream.
  The number of CSI reference signals is variable and depends on how many antenna ports transmit the signal.

Example:

You are testing 2 cell-specific reference signals (selection of 2 Tx antennas) with the CSI reference signal and UE-specific reference signal being transmitted on 8 antenna ports. You therefore need 8 input sources.

The mapping of antenna ports to input sources must be as follows.

- AP0, AP7, AP15: input source 1
- AP1, AP8, AP16: input source 2
- AP5, AP9, AP17: input source 3
- AP6, AP10, AP18: input source 4
- AP11, AP19: input source 5
- AP12, AP20: input source 6
- AP13, AP21: input source 7
- AP14, AP22: input source 8

Remote command:
CONFigure[:LTE]:NSOurces on page 193

Input Source Type
The source of the data is either live data recorded with an instrument or previously recorded data stored in a file.

For more information about configuring instruments and using files as input, see the R&S VSE user manual.

Remote command:
INSTrument:BLOCk:CHANnel[:SETTings]:SOURce<si> on page 222

DUT MIMO Configuration
The "DUT MIMO Configuration" selects the number of antennas in the system you are analyzing.

The number of antennas corresponds to the number of cell-specific reference signals.

The R&S VSE supports measurements on one, two or four antennas.

Remote command:
CONFigure[:LTE]:DL[:CC<cc>]:MIMO:CONFig on page 193

Tx Antenna Selection

The "Tx Antenna Selection" selects the antenna(s) you want to analyze. The number of menu items depends on the number of antennas in the system.

Each antenna corresponds to a cell-specific reference signal.

For automatic detection, the R&S VSE analyzes the reference signal to select the antenna. It also determines the order in which the antennas are tested.

Antenna 1	Tests antenna 1 only (AP0).
Antenna 2	Tests antenna 2 only (AP1).
Antenna 3	Tests antenna 3 only (AP2).
Antenna 4	Tests antenna 4 only (AP3).
All	Tests all antennas in the test setup in consecutive order (1-2-3-4). A corresponding number of input sources is required.
Auto (1 antenna)	Measurement on one input source and automatic detection of the connected antenna.
Auto (2 antennas)	Measurement on two input sources and automatic detection of the connected antennas.
Auto (4 antennas)	Measurement on four input sources and automatic detection of the connected antennas.

The antenna you have selected is also the reference antenna for time alignment measurements.

Remote command:
CONFigure[:LTE]:DL[:CC<cc>]:MIMO:ASELection on page 192

Input Source Configuration Table

MIMO measurements require several input sources, depending on the number of data streams you are about to measure. The input source is either a spectrum analyzer or an oscilloscope.

For each data stream, you need either one spectrum analyzer or one oscilloscope channel.

You can configure the connected instruments in the "Instruments" dialog box.

The input source configuration table provides functionality to assign data streams to the connected instruments.

Each row in the table represents one instrument. The size of the table therefore depends on the number of input sources you have selected.

Table for input source = instrument
- "Source": Index number of the connected instrument.
- "State": Shows the connection state (connected or not connected).
- "Instrument": Shows the name of the connected instrument.

- "Input Source": Assigns the instrument to capture a specific data stream.

Table for input source = file
- "Source": Index number of the input source.
- "State": Shows if the selected file was found or not.
- "File": Shows the name of the selected file.
- "I/Q Channel": Assigns the file to a specific data stream.

Remote command:
not supported

5.1.5 PDSCH demodulation

Access: "Overview" > "Signal Description" > "PDSCH Settings"

The Physical Layer Shared Channel (PDSCH) carries user data, broadcast system information and paging messages. It is always present in a downlink transmission.

The application allows you to automatically demodulate the PDSCH and detect the subframe configuration of the signal you are testing.

For more information on manual PDSCH configuration, see Chapter 5.1.6, "PDSCH subframe configuration", on page 71.

| Signal Description | MIMO/CA Setup | PDSCH Settings | Advanced Settings | MBSFN Settings |

Demodulation: Auto | **Predefined**

Subframe Configuration Detection: Physical Detection | PDCCH | **Off**

Subframe Configuration

No of Subframes: 10   Selected Subframe: 0   Used Allocations: 4

ID / N_RNTI	Code Word	Modulation	Enhanced Settings	VRB GAP	Number of RBs	Offset RB	Rho A (Power)/dB	Conflict
0	1/1	256QAM	...	0	50	0	0 dB	
1	1/1	QPSK	...	0	25	50	0 dB	
2	1/1	QPSK	...	0	25	75	0 dB	
3	1/1	256QAM	...	0	50	100	0 dB	

PDSCH Subframe Configuration Detection
Selects the method of identifying the PDSCH resource allocation.

- Off
  Uses the user configuration to demodulate the PDSCH subframe. If the user configuration does not match the frame that was measured, a bad EVM will result.
- PDCCH protocol

Sets the PDSCH configuration according to the data in the protocol of the PDCCH DCIs.

When you use this method, the application measures the boosting for each PDCCH it has detected. The result is displayed in the Channel Decoder Results.

- Physical detection
  The physical detection is based on power and modulation detection.
  Physical detection makes measurements on TDD E-TMs without a 20 ms trigger signal possible.
  More information.

Remote command:
[SENSe:][LTE:]DL:FORMat:PSCD on page 194

Auto PDSCH Demodulation

Turns automatic demodulation of the PDSCH on and off.

When you turn on this feature, the application automatically detects the PDSCH resource allocation. This is possible by analyzing the protocol information in the PDCCH or by analyzing the physical signal. The application then writes the results into the PDSCH Configuration Table.

You can set the way the application identifies the PDSCH resource allocation with PDSCH Subframe Configuration Detection.

When you turn off automatic demodulation of the PDSCH, you have to configure the PDSCH manually. In that case, the application compares the demodulated LTE frame to the customized configuration. If the "PDSCH Subframe Configuration Detection" is not turned off, the application analyzes the frame only if both configurations are the same.

Remote command:
[SENSe:][LTE:]DL:DEMod:AUTO on page 194

5.1.6 PDSCH subframe configuration

Access: "Overview" > "Signal Description" > "PDSCH Settings"

The application allows you to configure individual subframes that are used to carry the information of the PDSCH. The PDSCH (Physical Downlink Shared Channel) primarily carries all general user data. It therefore takes up most of the space in a radio frame.

When you turn on "Auto Demodulation", the application automatically determines the subframe configuration for the PDSCH. In the default state, automatic configuration is on (➜ More information).

Configuring component carriers

When you are doing measurements on aggregated carriers, you can configure each carrier separately.

When available, each carrier in the dialog boxes is represented by an additional tab labeled "CC<x>", with <x> indicating the number of the component carrier.

Note that the additional tabs are only added to the user interface after you have selected more than "1" component carrier.

Every LTE frame (FDD and TDD) contains 10 subframes. (In TDD systems, some subframes are used by the uplink, however.) Each downlink subframe consists of one or more (resource) allocations. The application shows the contents for each subframe in the configuration table. In the configuration table, each row corresponds to one allocation.

ID / N_RNTI	Code Word	Modulation	Enhanced Settings	VRB GAP	Number of RBs	Offset RB	Rho A (Power)/dB	Conflict
0	1/1	256QAM	...	0	50	0	0 dB	
1	1/1	QPSK	...	0	25	50	0 dB	
2	1/1	QPSK	...	0	25	75	0 dB	
3	1/1	256QAM	...	0	50	100	0 dB	

If there are any errors or conflicts between allocations in one or more subframes, the application shows the corrupt subframe in the "Error in Subframes" field, which appears below the table and is highlighted red if an error occurs. In addition, it shows the conflicting rows of the configuration table. It does not show the kind of error.

ID / N_RNTI	Code Word	Modulation	Enhanced Settings	VRB GAP	Number of RBs	Offset RB	Rho A (Power)/dB	Conflict
0	1/1	256QAM	...	0	5	0	0 dB	Collision : 1
1	1/1	QPSK	...	0	5	1	0 dB	Collision : 0
2	1/1	QPSK	...	0	5	10	0 dB	
3	1/1	256QAM	...	0	5	15	0 dB	Exceeds BW

Error in Subframes: 0

Before you start to work on the contents of each subframe, you should define the number of subframes you want to customize with the "Configurable Subframes" parameter. The application supports the configuration of up to 40 subframes.

Then you can select a particular subframe that you want to customize in the "Selected Subframe" field. Enter the number of the subframe (starting with 0). The application updates the contents of the configuration table to the selected subframe.

Remote command:

Number of subframes: `CONFigure[:LTE]:DL[:CC<cc>]:CSUBframes` on page 194

Number of allocations: `CONFigure[:LTE]:DL[:CC<cc>]:SUBFrame<sf>: ALCount` on page 195

5.1.6.1 PDSCH allocations

In the default state, each subframe contains one allocation. Add allocations with the "Used Allocations" parameter. The application expands the configuration table accordingly with one row representing one allocation. You can define a different number of allocations for each subframe you want to configure and configure up to 110 allocations in every subframe.

The configuration table contains the settings to configure the allocations.

ID/N_RNTI

Selects the allocation's ID. The ID corresponds to the N_RNTI.

By default, the application assigns consecutive numbers starting with 0.

The ID, or N_RNTI, is the user equipment identifier for the corresponding allocation and is a number in the range from 0 to 65535. The order of the numbers is irrelevant. You can combine allocations by assigning the same number more than once. Combining allocations assigns those allocations to the same user.

Allocations with the same N_RNTI have the same modulation scheme and power settings.

Remote command:
CONFigure[:LTE]:DL[:CC<cc>]:SUBFrame<sf>:ALLoc<al>:UEID
on page 200

Code Word

Shows the code word of the allocation.

The code word is made up out of two numbers. The first number is the number of the code word in the allocation. The second number is the total number of code words that the allocation contains. Thus, a table entry of "1/2" would mean that the row corresponds to code word 1 out of 2 code words in the allocation.

Modulation

Selects the modulation scheme for the corresponding allocation.

The modulation scheme for the PDSCH is either QPSK, 16QAM, 64QAM, 256QAM or 1024QAM.

Remote command:
CONFigure[:LTE]:DL[:CC<cc>]:SUBFrame<sf>:ALLoc<al>[:CW<cw>]:
MODulation on page 200

Enhanced Settings

Opens a dialog box to configure MIMO functionality.

For more information see Chapter 5.1.6.2, "Enhanced settings", on page 75.

VRB Gap

Turns the use of virtual resource blocks (VRB) on and off.

The standard defines two types of VRBs. Localized VRBs and distributed VRBs. While localized VRBs have a direct mapping to the PRBs, distributed VRBs result in a better frequency diversity.

Three values of VRB gap are allowed.
- **0** = Localized VRBs are used.
- **1** = Distributed VRBs are used and the first gap is applied.
- **2** = Distributed VRBs are used and the second gap is applied (for channel bandwidths > 50 resource blocks).
  The second gap has a smaller size compared to the first gap.
  If on, the VRB Gap determines the distribution and mapping of the VRB pairs to the physical resource blocks (PRB) pairs.
  The distribution of the VRBs is performed in a way that consecutive VRBs are spread over the frequencies and are not mapped to PRBs whose frequencies are next to each other. Each VRB pair is split into two parts which results in a frequency gap between the two VRB parts. This method corresponds to frequency hopping on a slot basis.
  The information whether localized or distributed VRBs are applied is carried in the PDCCH. The DCI formats 1A, 1B and 1D provide a special 1-bit flag for this purpose ("Localized / Distributed VRB Assignment"). Another bit in the DCI formats controls whether the first or second bit is applied.

Remote command:
CONFigure[:LTE]:DL[:CC<cc>]:SUBFrame<sf>:ALLoc<al>:GAP on page 195

Number of RB
Defines the number of resource blocks the allocation covers. The number of resource blocks defines the size or bandwidth of the allocation.

If you allocate too many resource blocks compared to the bandwidth you have set, the application shows an error message in the "Conflicts" column and the "Error in Subframes" field.

Remote command:
CONFigure[:LTE]:DL[:CC<cc>]:SUBFrame<sf>:ALLoc<al>:RBCount
on page 199

Offset RB
Sets the resource block at which the allocation begins.

A wrong offset for any allocation would lead to an overlap of allocations. In that case, the application shows an error message.

Remote command:
CONFigure[:LTE]:DL[:CC<cc>]:SUBFrame<sf>:ALLoc<al>:RBOFfset
on page 199

Power
Sets the boosting of the allocation.

Boosting is the allocation's power relative to the reference signal power.

Remote command:
CONFigure[:LTE]:DL[:CC<cc>]:SUBFrame<sf>:ALLoc<al>:POWer
on page 195

Conflict

In case of a conflict, the application shows the type of conflict and the ID of the allocations that are affected. Possible conflicts are:

- bandwidth error (">BW")
  A bandwidth error occurs when the number of resource blocks in the subframe exceeds the bandwidth you have set.

Subframe Bandwidth = 3 MHz or 15 Resource Blocks

- RB overlap errors
  An RB overlap error occurs if one or more allocations overlap. In that case, check if the length and offset values of the allocations are correct.

Subframe Bandwidth = 3 MHz or 15 Resource Blocks

5.1.6.2 Enhanced settings

The "Enhanced Settings" contain mostly functionality to configure the precoding scheme of a physical channel. The application supports several precoding schemes that you can select from a dropdown menu.

In addition, you can configure PDSCH allocations that use carrier aggregation.

None

Turns off precoding.

Remote command:
CONFigure[:LTE]:DL[:CC<cc>]:SUBFrame<sf>:ALLoc<al>:PRECoding[:
SCHeme] on page 198

Transmit Diversity

Turns on precoding for transmit diversity according to 3GPP TS 36.211.

Remote command:
CONFigure[:LTE]:DL[:CC<cc>]:SUBFrame<sf>:ALLoc<al>:PRECoding[:
SCHeme] on page 198

Spatial Multiplexing

Turns on precoding for spatial multiplexing according to 3GPP TS 36.211.

If you are using spatial multiplexing, you can also define the number of layers for any allocation and the codebook index.

The number of layers of an allocation in combination with the number of code words determines the layer mapping. The available number of layers depends on the number of transmission antennas. Thus, the maximum number of layers you can select is eight.

The codebook index determines the precoding matrix. The available number of indices depends on the number of transmission antennas in use. The range is from 0 to 15. The application automatically selects the codebook index if you turn on the "Cyclic Delay Diversity" (CDD).

Remote command:

CONFigure[:LTE]:DL[:CC<cc>]:SUBFrame<sf>:ALLoc<al>:PRECoding[: SCHeme] on page 198

CONFigure[:LTE]:DL[:CC<cc>]:SUBFrame<sf>:ALLoc<al>:PRECoding: CLMapping on page 197

CONFigure[:LTE]:DL[:CC<cc>]:SUBFrame<sf>:ALLoc<al>:PRECoding: CBINdex on page 196

CONFigure[:LTE]:DL[:CC<cc>]:SUBFrame<sf>:ALLoc<al>:PRECoding:CDD on page 197

Beamforming (UE Spec RS)

Turns on the precoding for beamforming.

If you are using beamforming, you can also define the number of layers and code-words (see Spatial Multiplexing), the scrambling identity and the single layer antenna port.

The mapping of antenna port to the physical antenna is fixed:
- Port 5 and 7: Antenna 1
- Port 8: Antenna 2
- Port 9: Antenna 3
- Port 10: Antenna 4

The scrambling identity (n_{SCID}) is available for antenna ports 7 and 8. It is used to initialize the sequence that generates UE specific reference signals according to 36.211 (section 6.10.3.1).

The single layer antenna port selects the preconfigured antenna port in single layer beamforming scenarios. Available if the codeword to layer mapping is "1/1".

Remote command:

CONFigure[:LTE]:DL[:CC<cc>]:SUBFrame<sf>:ALLoc<al>:PRECoding[: SCHeme] on page 198

CONFigure[:LTE]:DL[:CC<cc>]:SUBFrame<sf>:ALLoc<al>:PRECoding: CLMapping on page 197

CONFigure[:LTE]:DL[:CC<cc>]:SUBFrame<sf>:ALLoc<al>:PRECoding: SCID on page 197

CONFigure[:LTE]:DL[:CC<cc>]:SUBFrame<sf>:ALLoc<al>:PRECoding:AP on page 196

Carrier Aggregation

Defines the PDSCH start offset for the selected PDSCH allocation in a system that uses carrier aggregation.

For cross-scheduled UEs, the PDSCH start offset for the secondary carrier is usually not defined for each subframe individually but is constant over several subframes. In case the control channel region of the secondary component carrier is longer than the PDSCH start offset you have defined for the primary carrier, PDSCH resource elements might be overwritten by the resource elements of the control channel. Note that the bit stream result displays labels these resource elements with a "#" sign.

Remote command:
CONFigure[:LTE]:DL[:CC<cc>]:SUBFrame<sf>:ALLoc<al>:PSOFfset
on page 198

5.1.7 Global signal characteristics

Access: "Overview" > "Signal Description" > "Advanced Settings" > "Global Settings"

The global settings contain settings that apply to the complete signal.

The global signal settings are part of the "Advanced Settings" tab of the "Signal Description" dialog box.

Configuring component carriers

When you are doing measurements on aggregated carriers, you can configure each carrier separately.

When available, each carrier in the dialog boxes is represented by an additional tab labeled "CC<x>", with <x> indicating the number of the component carrier.

Note that the additional tabs are only added to the user interface after you have selected more than "1" component carrier.

ORAN Test Case..78

ORAN Test Case
Selects the O-RAN test case that the DSP uses for signal analysis.

Select "None" when you do not measure O-RAN signals.

See Chapter 4.7, "O-RAN measurement guide", on page 54 for more information about O-RAN measurements.

Available for FDD signals.

Remote command:
CONFigure[:LTE]:ORAN:TCASe on page 201

5.1.8 Synchronization signal configuration

Access: "Overview" > "Signal Description" > "Advanced Settings" > "Synchronization Signal"

The synchronization signal settings contain settings to describe the physical attributes and structure of the synchronization signal.

Configuring component carriers

When you are doing measurements on aggregated carriers, you can configure each carrier separately.

When available, each carrier in the dialog boxes is represented by an additional tab labeled "CC<x>", with <x> indicating the number of the component carrier.

Note that the additional tabs are only added to the user interface after you have selected more than "1" component carrier.

P-/S-SYNC Tx Antenna
Selects the antenna that transmits the synchronization signal (P-SYNC or S-SYNC).

When selecting the antenna, you implicitly select the synchronization method. If the selected antenna transmits no synchronization signal, the application uses the reference signal to synchronize. Note that automatic cell ID detection is not available if synchronization is based on the reference signal.

Remote command:
CONFigure[:LTE]:DL[:CC<cc>]:SYNC:ANTenna on page 201

P-Sync Relative Power

Defines the power of the primary synchronization signal (P-Sync) relative to the reference signal.

Remote command:
CONFigure[:LTE]:DL[:CC<cc>]:SYNC:PPOWer on page 203

S-Sync Relative Power

Defines the power of the secondary synchronization signal (S-Sync) relative to the reference signal.

Remote command:
CONFigure[:LTE]:DL[:CC<cc>]:SYNC:SPOWer on page 204

Custom Sync Weight

Turns custom weighting of the (primary and secondary) synchronization signals on and off (for example for beamforming scenarios).

If you turn on custom weights, you can define the weights applied to the first and second half frames. The signal weights are a complex number and are therefore defined by the real and imaginary parts of the signal.

Remote command:
State: CONFigure[:LTE]:DL[:CC<cc>]:SYNC:CSWeight[:STATe] on page 203
1st 1/2 frame real: CONFigure[:LTE]:DL[:CC<cc>]:SYNC:CSWeight:FHFRame:REAL on page 202
1st 1/2 frame imaginary: CONFigure[:LTE]:DL[:CC<cc>]:SYNC:CSWeight:FHFRame:IMAGinary on page 201
2nd 1/2 frame real: CONFigure[:LTE]:DL[:CC<cc>]:SYNC:CSWeight:SHFRame:REAL on page 203
2nd 1/2 frame imaginary: CONFigure[:LTE]:DL[:CC<cc>]:SYNC:CSWeight:SHFRame:IMAGinary on page 202

5.1.9 Reference signal configuration

Access: "Overview" > "Signal Description" > "Advanced Settings" > "Reference Signal"

The reference signal settings contain settings to describe the physical attributes and structure of the reference signal.

Configuring component carriers

When you are doing measurements on aggregated carriers, you can configure each carrier separately.

When available, each carrier in the dialog boxes is represented by an additional tab labeled "CC<x>", with <x> indicating the number of the component carrier.

Note that the additional tabs are only added to the user interface after you have selected more than "1" component carrier.

Rel Power (Reference Signal)..81

Rel Power (Reference Signal)
Defines the relative power of the reference signal compared to all the other physical signals and physical channels.

Note that this setting gives you an offset to all other relative power settings.

Remote command:
CONFigure[:LTE]:DL[:CC<cc>]:REFSig:POWer on page 204

5.1.10 Positioning reference signal configuration

Access: "Overview" > "Signal Description" > "Advanced Settings" > "Reference Signal"

The positioning reference signal settings contain settings to describe the physical attributes and structure of the positioning reference signal.

Configuring component carriers

When you are doing measurements on aggregated carriers, you can configure each carrier separately.

When available, each carrier in the dialog boxes is represented by an additional tab labeled "CC<x>", with <x> indicating the number of the component carrier.

Note that the additional tabs are only added to the user interface after you have selected more than "1" component carrier.

Present

Turns the positioning reference signal on and off.

Remote command:
CONFigure[:LTE]:DL[:CC<cc>]:PRSS:STATe on page 206

Bandwidth

Defines the bandwidth and thus the number of resource blocks the positioning reference signal occupies.

Note that the PRS bandwidth has to be smaller than the channel bandwidth.

Remote command:
CONFigure[:LTE]:DL[:CC<cc>]:PRSS:BW on page 204

Configuration Index

Defines the PRS Configuration Index I_{PRS} as defined in 3GPP TS 36.211, table 6.10.4.3-1.

Remote command:
CONFigure[:LTE]:DL[:CC<cc>]:PRSS:CI on page 205

Num. Subframes (N_PRS)
Defines the number of consecutive DL subframes in that PRS are transmitted.

Remote command:
CONFigure[:LTE]:DL[:CC<cc>]:PRSS:NPRS on page 205

Relative Power (Positioning Reference Signal)
Defines the power of a PRS resource element in relation to the power of a common reference signal resource element.

Remote command:
CONFigure[:LTE]:DL[:CC<cc>]:PRSS:POWer on page 205

Frame Number Offset
Defines the system frame number of the current frame that you want to analyze.

Because the positioning reference signal and the CSI reference signal usually have a periodicity of several frames, for some reference signal configurations it is necessary to change the expected system frame number of the frame to be analyzed.

Note that if you define the frame number offset for either reference signal, it is automatically defined for both reference signals.

Remote command:
CONFigure[:LTE]:DL[:CC<cc>]:SFNO on page 206

5.1.11 Channel state information reference signal configuration

Access: "Overview" > "Signal Description" > "Advanced Settings" > "Reference Signal"

The channel state information reference signal (CSI-RS) settings contain settings to describe the physical attributes and structure of the Channel State Information Reference Signal (CSI-RS).

CSI-RS are used to estimate the channel properties of the signal propagation channel from the base station to the user equipment. This information is quantized and fed back to the base station. The base station makes use of this information for example to adjust the beamforming parameters.

The mapping of up to four antenna ports to the physical antenna is as follows:
- Port 15: antenna 1
- Port 16: antenna 2
- Port 17: antenna 3
- Port 18: antenna 4

Resource elements used by CSI-RS are shown in yellow color in the Allocation ID versus Symbol X Carrier measurement.

Configuring component carriers

When you are doing measurements on aggregated carriers, you can configure each carrier separately.

When available, each carrier in the dialog boxes is represented by an additional tab labeled "CC<x>", with <x> indicating the number of the component carrier.

Note that the additional tabs are only added to the user interface after you have selected more than "1" component carrier.

Present
Turns the CSI reference signal on and off.

Remote command:
CONFigure[:LTE]:DL[:CC<cc>]:CSIRs:STATe on page 208

Antenna Ports
Defines the number of antenna ports that transmit the CSI reference signal.

The CSI reference signals are transmitted on one, two, four or eight antenna ports using

- p = 15
- p = 15 to 16
- p = 15 to 18
- p = 15 to 22

Remote command:
CONFigure[:LTE]:DL[:CC<cc>]:CSIRs:NAP on page 207

Configuration Index
Defines the CSI reference signal configuration as defined in 3GPP TS 36.211, table 6.10.5.2-1/2

Remote command:
CONFigure[:LTE]:DL[:CC<cc>]:CSIRs:CI on page 206

Overwrite PDSCH
Turns overwriting of PDSCH resource elements for UEs that do not consider the CSI reference signal on and off.

If on, the application assumes that the UE is not configured to consider CSI reference signals. Thus, resource elements of the CSI reference signal overwrite the PDSCH resource elements. Note that the bit stream result displays labels these resource elements with a "#" sign.

Remote command:
CONFigure[:LTE]:DL[:CC<cc>]:CSIRs:OPDSch on page 207

Relative Power (CSI Reference Signal)
Defines the power of a CSI reference signal resource element in relation to the power of a common reference signal resource element.

Remote command:
CONFigure[:LTE]:DL[:CC<cc>]:CSIRs:POWer on page 207

Subframe Configuration
Defines the CSI reference signal subframe configuration index (I_CSI-RS) as defined in 3GPP TS 36.211, table 6.10.5.3-1.

Remote command:
CONFigure[:LTE]:DL[:CC<cc>]:CSIRs:SCI on page 208

Frame Number Offset
Defines the system frame number of the current frame that you want to analyze.

Because the positioning reference signal and the CSI reference signal usually have a periodicity of several frames, for some reference signal configurations it is necessary to change the expected system frame number of the frame to be analyzed.

Note that if you define the frame number offset for either reference signal, it is automatically defined for both reference signals.

Remote command:
CONFigure[:LTE]:DL[:CC<cc>]:SFNO on page 206

5.1.12 PDSCH resource block symbol offset

Access: "Overview" > "Signal Description" > "Advanced Settings" > "Control Channel"

Configuring component carriers

When you are doing measurements on aggregated carriers, you can configure each carrier separately.

When available, each carrier in the dialog boxes is represented by an additional tab labeled "CC<x>", with <x> indicating the number of the component carrier.

Note that the additional tabs are only added to the user interface after you have selected more than "1" component carrier.

PRB Symbol Offset
PRB Symbol Offset specifies the symbol offset of the PDSCH allocations relative to the subframe start. This setting applies to all subframes in a frame.

With this setting, the number of OFDM symbols used for control channels is defined, too. For example, if this parameter is set to "2" and the PDCCH is enabled, the number of OFDM symbols actually used by the PDCCH is "2".

Special control channels like the PCFICH or PHICH require a minimum number of control channel OFDM symbols at the beginning of each subframe. If PRB Symbol Offset is lower than the required value, the control channel data overwrites some resource elements of the PDSCH.

If Auto is selected, the Control Region for PDCCH (PRB Symbol Offset) value is detected from the PCFICH. For correct demodulation of a PCFICH signal conforming to 3GPP, the Scrambling of Coded Bits has to be enabled.

Remote command:
CONFigure[:LTE]:DL[:CC<cc>]:PSOFfset on page 214

5.1.13 PBCH configuration

Access: "Overview" > "Signal Description" > "Advanced Settings" > "Control Channel"

The physical broadcast channel (PBCH) carries system information for the user equipment. You can include or exclude the PBCH in the test setup and define the relative power of this channel.

Configuring component carriers

When you are doing measurements on aggregated carriers, you can configure each carrier separately.

When available, each carrier in the dialog boxes is represented by an additional tab labeled "CC<x>", with <x> indicating the number of the component carrier.

Note that the additional tabs are only added to the user interface after you have selected more than "1" component carrier.

PBCH Present
Includes or excludes the PBCH from the test setup.

Remote command:
CONFigure[:LTE]:DL[:CC<cc>]:PBCH:STAT on page 210

PBCH Relative Power
Defines the power of the PBCH relative to the reference signal.

Remote command:
CONFigure[:LTE]:DL[:CC<cc>]:PBCH:POWer on page 210

5.1.14 PCFICH configuration

Access: "Overview" > "Signal Description" > "Advanced Settings" > "Control Channel"

The physical control format indicator channel (PCFICH) carries information about the format of the PDCCH. You can include or exclude the PCFICH in the test setup and define the relative power of this channel.

Configuring component carriers

When you are doing measurements on aggregated carriers, you can configure each carrier separately.

When available, each carrier in the dialog boxes is represented by an additional tab labeled "CC<x>", with <x> indicating the number of the component carrier.

Note that the additional tabs are only added to the user interface after you have selected more than "1" component carrier.

PCFICH Present
Includes or excludes the PCFICH from the test setup.

Remote command:
CONFigure[:LTE]:DL[:CC<cc>]:PCFich:STAT on page 211

PCFICH Relative Power
Defines the power of the PCFICH relative to the reference signal.

Remote command:
CONFigure[:LTE]:DL[:CC<cc>]:PCFich:POWer on page 211

5.1.15 PHICH configuration

Access: "Overview" > "Signal Description" > "Advanced Settings" > "Control Channel"

The physical hybrid ARQ indicator channel (PHICH) contains the hybrid ARQ indicator. The hybrid ARQ indicator contains the acknowledgement / negative acknowledgments for uplink blocks.

You can set several specific parameters for the PHICH.

Turning off the PHICH

If you set the value of the PHICH N$_g$ to "Custom" and at the same time define "0" PHICH groups, the PHICH is excluded from the signal.

Configuring component carriers

When you are doing measurements on aggregated carriers, you can configure each carrier separately.

When available, each carrier in the dialog boxes is represented by an additional tab labeled "CC<x>", with <x> indicating the number of the component carrier.

Note that the additional tabs are only added to the user interface after you have selected more than "1" component carrier.

PHICH Duration

Selects the duration of the PHICH. Normal and extended durations are supported.

With a normal duration, all resource element groups of the PHICH are allocated on the first OFDM symbol.

With an extended duration, the resource element groups of the PHICH are distributed over three OFDM symbols for a normal subframe or over two symbols within a special subframe.

If you select Auto, the duration of PHICH is automatically determined and based on the PBCH decoding results.

Note that you have to turn on the PBCH for an automatic determination of the PHICH duration.

Remote command:
CONFigure[:LTE]:DL[:CC<cc>]:PHICh:DURation on page 212

PHICH TDD m_i=1 (E-TM)

Turns the special setting of the PHICH for the enhanced test models on and off.

The special setting is defined in 36.141 V9.0.0, 6.1.2.6: "For frame structure type 2 the factor m_i shall not be set as per TS36.211, Table 6.9-1, but instead shall be set to m_i=1 for all transmitted subframes".

The parameter is available if you have selected TDD.

Remote command:
CONFigure[:LTE]:DL[:CC<cc>]:PHICh:MITM on page 213

PHICH N_g

Defines the variable N_g.

N_g in combination with the number of resource blocks defines the number of PHICH groups in a downlink subframe. The standard specifies several values for N_g that you can select from the dropdown menu.

If you need a customized configuration, you can set the number of PHICH groups in a subframe by selecting the "Custom" menu item and define the number of PHICH groups directly with PHICH Number of Groups.

Remote command:
CONFigure[:LTE]:DL[:CC<cc>]:PHICh:NGParameter on page 213

PHICH Number of Groups

Defines the number of PHICH groups in a subframe.

To select the number of groups, you have to set the PHICH N_g to "Custom".

Remote command:
CONFigure[:LTE]:DL[:CC<cc>]:PHICh:NOGRoups on page 213

PHICH Rel Power

Defines the power of all PHICHs in a PHICH group relative to the reference signal.

The application measures a separate relative power for each PHICH if Boosting Estimation is on. In that case, the "Rel. Power / dB" result in the Allocation Summary stays empty, because it refers to the common relative power for all PHICHs. The relative powers for each PHICH in the group are displayed in the Channel Decoder Results.

Note that the PHICH power results are quantized to 1 dB steps based on the PHICH relative power, because only a few PHICH symbols are available for boosting estimation.

Example:

The "PHICH Rel Power" is -3.01 dB.

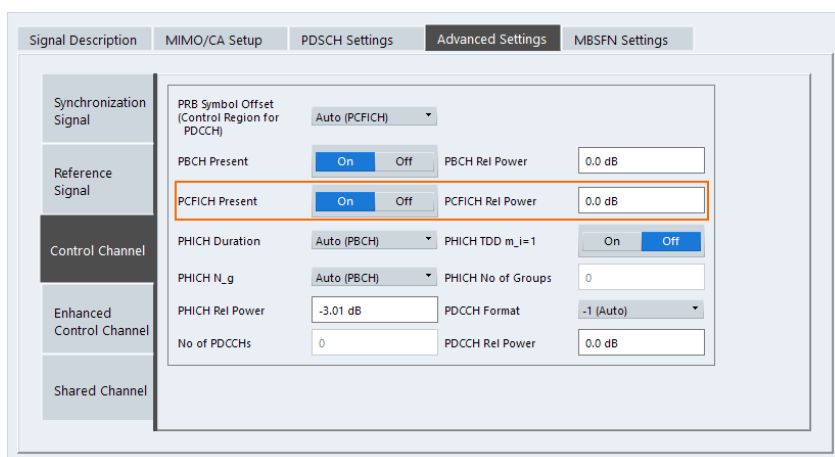In that case, possible PHICH boostings are -4.01 dB, -3.01 dB, -2.01 dB, etc.

Remote command:
CONFigure[:LTE]:DL[:CC<cc>]:PHICh:POWer on page 214

5.1.16 PDCCH configuration

Access: "Overview" > "Signal Description" > "Advanced Settings" > "Control Channel"
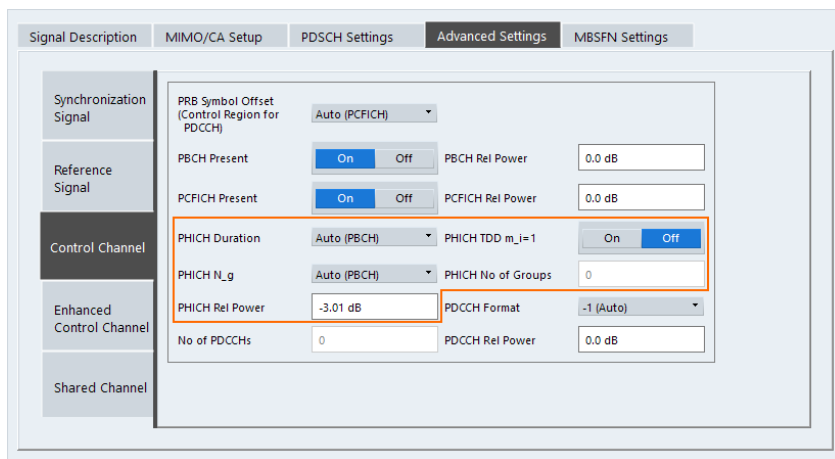
The physical downlink control channel (PDCCH) carries the downlink control information (for example the information about the PDSCH resource allocation).

You can define several specific parameters for the PDCCH.

Configuring component carriers

When you are doing measurements on aggregated carriers, you can configure each carrier separately.

When available, each carrier in the dialog boxes is represented by an additional tab labeled "CC<x>", with <x> indicating the number of the component carrier.

Note that the additional tabs are only added to the user interface after you have selected more than "1" component carrier.

PDCCH Format
Defines the format of the PDCCH (physical downlink control channel).

Note that PDCCH format "-1" is not defined in the standard. This format corresponds to the transmission of one PDCCH on all available resource element groups. As a special case for this PDCCH format, the center of the constellation diagram is treated as a valid constellation point.

Remote command:
CONFigure[:LTE]:DL[:CC<cc>]:PDCCh:FORMat on page 211

Number of PDCCHs
Sets the number of physical downlink control channels.

This parameter is available if the PDCCH format is -1.

Remote command:
CONFigure[:LTE]:DL[:CC<cc>]:PDCCh:NOPD on page 212

PDCCH Rel Power
Defines the power of the PDCCH relative to the reference signal.

Remote command:
CONFigure[:LTE]:DL[:CC<cc>]:PDCCh:POWer on page 212

5.1.17 EPDCCH configuration

Access: "Overview" > "Signal Description" > "Advanced Settings" > "Enhanced Control Channel"

The enhanced physical downlink control channel (EPDCCH) carries the downlink control information. Compared to the PDCCH, the EPDCCH uses resource blocks normally reserved for the PDSCH.

> **Shared resource blocks of PDSCH and EPDCCH**
> PDSCH allocations overwrite the EPDCCH if they occupy the same resource blocks.

The EPDCCH is always transmitted in an EPDCCH-PRB set. For each cell and user, you can define one or two EPDCCH-PRB sets. An EPDCCH-PRB set is made up out of two or more resource blocks that are combined logically.

Note that you have to measure one EPDCCH-PRB set at a time. If you have to measure a signal with more than one EPDCCH-PRB set, you have to configure each set separately and refresh the I/Q data for each set.

You can define several parameters for the EPDCCH.

Configuring component carriers

When you are doing measurements on aggregated carriers, you can configure each carrier separately.

When available, each carrier in the dialog boxes is represented by an additional tab labeled "CC<x>", with <x> indicating the number of the component carrier.

Note that the additional tabs are only added to the user interface after you have selected more than "1" component carrier.

EPDCCH PRB Pairs

Selects the number of resource blocks used in an EPDCCH-PRB set.

If you select the "Disabled" item, the EPDCCH is turned off.

For more information, see 3GPP TS 36.213 (`numberPRBPairs-r11`).

Remote command:
CONFigure[:LTE]:DL[:CC<cc>]:EPDCch:NPRB on page 209

EPDCCH Set ID

Defines the EPDCCH set ID.

The set ID controls the generation of reference symbols for the EPDCCH. For more information see TS36.211, 6.10.3A.1.

Remote command:
CONFigure[:LTE]:DL[:CC<cc>]:EPDCch:SID on page 210

EPDCCH Rel Power

Defines the power of the EPDCCH relative to the reference signal.

Remote command:
CONFigure[:LTE]:DL[:CC<cc>]:EPDCch:POWer on page 209

EPDCCH RB Assignment

Defines the location of the resource blocks that the EPDCCH is transmitted in.

For more information, see 3GPP TS 36.213 (`resourceBlockAssignment-r11`).

Remote command:
CONFigure[:LTE]:DL[:CC<cc>]:EPDCch:RBASsign on page 210

EPDCCH Localized

Turns localized transmission of the EPDCCH on and off.

Localized transmission is useful for known channel conditions. In that case, the scheduling and MIMO precoding can be optimized.

If the channel conditions are unknown, distributed transmission is used. Distributed transmission utilizes the frequency diversity in that the information is distributed over the selected frequency range.

Remote command:
CONFigure[:LTE]:DL[:CC<cc>]:EPDCch:LOCalized on page 209

5.1.18 Shared channel configuration

Access: "Overview" > "Signal Description" > "Advanced Settings" > "Shared Channel"

PDSCH Power Ratio
Selects the PDSCH P_B parameter that defines the cell-specific ratio of rho_B to rho_A according to 3GPP TS 36.213, table 5.2-1.

The table below shows the resulting values as a function of the number of antennas.

PDSCH P_B	1 Tx antenna	2 and 4 Tx antennas
0	0.000 dB	0.969 dB
1	-0.969 dB	0.000 dB
2	-2.218 dB	-1.249 dB
3	-3.979 dB	-3.010 dB

If you select "p_B/p_A=1", the ratio is always 1, regardless of the number of antennas.

Remote command:
CONFigure[:LTE]:DL[:CC<cc>]:PDSCh:PB on page 215

5.1.19 MBSFN characteristics

Access: "Overview" > "Signal Description" > "MBSFN Settings"

The MBSFN settings contain settings to configure Multimedia Broadcast Single Frequency Networks (MBSFNs).

5.1.19.1 MBSFN configuration

The general MBSFN settings contain settings that apply to all subframes that contain MBSFN information.

Configuring component carriers

When you are doing measurements on aggregated carriers, you can configure each carrier separately.

When available, each carrier in the dialog boxes is represented by an additional tab labeled "CC<x>", with <x> indicating the number of the component carrier.

Note that the additional tabs are only added to the user interface after you have selected more than "1" component carrier.

Present
Includes or excludes an MBSFN from the test setup.

Remote command:
CONFigure[:LTE]:DL[:CC<cc>]:MBSFn:STATe on page 216

MBSFN Relative Power
Defines the power of the MBSFN transmission relative to the reference signal.

Remote command:
CONFigure[:LTE]:DL[:CC<cc>]:MBSFn:POWer on page 216

Area ID
Defines the ID for an MBFSN area.

Radio cells that transmit the same content to multiple users will form a so called MBSFN area. Multiple cells can belong to such an area, and every cell can be part of up to eight MBSFN areas. There could be up to 256 different MBSFN areas defined, each one with an own identity.

The area ID (N_{ID}^{MBFSN}) is defined in 3GPP 36.211.

Remote command:
CONFigure[:LTE]:DL[:CC<cc>]:MBSFn:AI:ID on page 215

Non-MBSFN Region Length
Selects the length of the MBSFN control data region at the start of the MBSFN subframe.

If you select a region length of '1', the first symbol in an MBFSN subframe carries data of the control channel. All other symbols of an MBSFN region may be used by the PMCH.

If you select a region length of '2', the first two symbols in an MBFSN subframe carry data of the control channel.

Remote command:
CONFigure[:LTE]:DL[:CC<cc>]:MBSFn:AI:NMRL on page 215

5.1.19.2 MBSFN subframes

If you are testing systems that support MBSFN, 3GPP allows you to reserve one or more subframes for multimedia broadcasting.

MBSFN Subframe	Active	PMCH Present	Modulation
1	On Off	On Off	QPSK ▾
2	On Off	On Off	256QAM ▾
3	On Off	On Off	QPSK ▾
6	On Off	On Off	QPSK ▾
7	On Off	On Off	QPSK ▾
8	On Off	On Off	QPSK ▾

MBSFN Subframe
Shows the subframe number that may contain MBSFN data.

Note that 3GPP only allows to turn selected subframes into MBSFN subframes. Depending on the configuration (for example the TDD configuration), different subframe numbers are available for MBSFN transmissions.

Active
Turns a subframe into an MBSFN subframe.

If active, the corresponding subframe contains MBSFN data.

Remote command:
CONFigure[:LTE]:DL[:CC<cc>]:MBSFn:SUBFrame<sf>:STATe on page 217

PMCH Present
Turns the Physical Multicast Channel (PMCH) on and off.

If you turn on the PMCH, the resource elements of the MBSFN subframe are used by the PMCH.

If you turn off the PMCH, the resource elements of the MBSFN subframe may be used by the PDSCH.

Remote command:
CONFigure[:LTE]:DL[:CC<cc>]:MBSFn:SUBFrame<sf>:PMCH:STATe
on page 217

Modulation
Selects the modulation scheme for the MBSFN subframe.

Remote command:
CONFigure[:LTE]:DL[:CC<cc>]:MBSFn:SUBFrame<sf>:PMCH:MODulation
on page 216

5.1.20 Selecting the input and output source

The application supports several input sources and outputs.

The supported input sources depend on the connected instrument. Refer to the documentation of the instrument in use for a comprehensive description of input sources.

5.1.20.1 RF input

Functions to configure the RF input described elsewhere:

- "Input Coupling" on page 105
- "Impedance" on page 105

Note that the actual functions to configure the RF input depend on the configuration of the connected instrument.

ⓘ Multiple input sources

For MIMO measurements with multiple input sources, you can select the device that you want to configure input and amplitude characteristics for from the "Input Source" dropdown menu.

High Pass Filter 1 to 3 GHz
Activates an additional internal highpass filter for RF input signals from 1 GHz to
3 GHz. This filter is used to remove the harmonics of the analyzer to measure the harmonics for a DUT, for example.

For some connected instruments, this function requires an additional hardware option on the instrument.

Note: For RF input signals outside the specified range, the high-pass filter has no effect. For signals with a frequency of approximately 4 GHz upwards, the harmonics are suppressed sufficiently by the YIG-preselector, if available.)

Remote command:
INPut<ip>:FILTer:HPASs[:STATe] on page 219

YIG-Preselector
Enables or disables the YIG-preselector.

This setting requires an additional option on the connected instrument.

An internal YIG-preselector at the input of the connected instrument ensures that image frequencies are rejected. However, image rejection is only possible for a restricted bandwidth. To use the maximum bandwidth for signal analysis you can disable the YIG-preselector at the input of the connected instrument, which can lead to image-frequency display.

Note: Note that the YIG-preselector is active only higher frequencies, depending on the connected instrument. Therefore, switching the YIG-preselector on or off has no effect if the frequency is below that value.

To use the optional 90 GHz frequency extension (R&S FSW-B90G), the YIG-preselector must be disabled.

To use the optional 54 GHz frequency extension (R&S FSV3-B54G), the YIG-preselector must be disabled.

Remote command:
INPut<ip>:FILTer:YIG[:STATe] on page 219

Capture Mode
Determines how data from an oscilloscope is input to the R&S VSE software.

This function is only available for a connected R&S oscilloscope with a firmware version 3.0.1.1 or higher (for other versions and instruments the input is always I/Q data).

"I/Q"   The measured waveform is converted to I/Q data directly on the R&S oscilloscope (requires option K11), and input to the R&S VSE software as I/Q data.
For data imports with small bandwidths, importing data in this format is quicker. However, the maximum record length is restricted by the R&S oscilloscope. (Memory options on the R&S oscilloscope are not available for I/Q data.)

"Waveform"   The data is input in its original waveform format and converted to I/Q data in the R&S VSE software. No additional options are required on the R&S oscilloscope.
For data imports with large bandwidths, this format is more convenient as it allows for longer record lengths if appropriate memory options are available on the R&S oscilloscope.

"Auto"   Uses "I/Q" mode when possible, and "Waveform" only when required by the application (e.g. Pulse measurement, oscilloscope baseband input).

Remote command:
INPut<ip>:RF:CAPMode on page 220

Oscilloscope Sample Rate
Determines the sample rate used by the connected oscilloscope.

This setting is only available if an R&S oscilloscope is used to obtain the input data, either directly or via the R&S FSW.

"10 GHz"   Default for waveform Capture Mode (not available for I/Q Capture Mode); provides maximum record length

"20 GHz"   Achieves a higher decimation gain, but reduces the record length by
                  half.
                  Only available for R&S oscilloscope models that support a sample
                  rate of 20 GHz (see data sheet).
                  For R&S oscilloscopes with an analysis bandwidth of 4 GHz or larger,
                  a sample rate of 20 GHZ is always used in waveform Capture Mode

"40 GHz"   Provides a maximum sample rate.
                  Only available for I/Q Capture Mode, and only for R&S RTP13/RTP16
                  models that support a sample rate of 40 GHz (see data sheet)

Remote command:
Input source R&S FSW via oscilloscope:
SYSTem:COMMunicate:RDEVice:OSCilloscope:SRATe on page 222
Input source oscilloscope waveform mode:
INPut<ip>:RF:CAPMode:WAVeform:SRATe on page 221
Input source oscilloscope I/Q mode:
INPut<ip>:RF:CAPMode:IQ:SRATe on page 220

5.1.20.2   I/Q file input

Or: "Input & Output" > "Input Source" > "I/Q File"

Loading a file via drag&drop

You can load a file simply by selecting it in a file explorer and dragging it to the
R&S VSE software. Drop it into the "Measurement Group Setup" window or the chan-
nel bar for any channel. The channel is automatically configured for file input, if neces-
sary. If the file contains all essential information, the file input is immediately displayed
in the channel. Otherwise, the "Recall I/Q Recording" dialog box is opened for the
selected file so you can enter the missing information.

If the file contains data from multiple channels (e.g. from LTE measurements), it can be
loaded to individual input sources, if the application supports them.

For details see the R&S VSE Base Software User Manual.

The "Input Source" settings defined in the "Input" dialog box are identical to those con-
figured for a specific channel in the "Measurement Group Setup" window.

(See "Controlling Instruments and Capturing Data" in the R&S VSE User Manual).

> If the Frequency Response Correction option (R&S VSE-K544) is installed, the LTE measurement application also supports frequency response correction using Touchstone (`.snp`) files or `.fres` files.
>
> For details on user-defined frequency response correction, see the R&S VSE Base Software User Manual.

> Encrypted `.wv` files can also be imported. Note, however, that traces resulting from encrypted file input cannot be exported or stored in a saveset.

Input Type (Instrument / File)
Selects an instrument or a file as the type of input provided to the channel.

Note: External mixers are only available for input from a connected instrument.

Note: If the R&S VSE software is installed directly on an instrument, or integrated in Cadence®AWR®VSS, some restrictions apply on the available input type.

Remote command:
INSTrument:BLOCk:CHANnel[:SETTings]:SOURce<si> on page 222
INPut:SELect on page 220

Input File
Specifies the I/Q data file to be used for input.

Select "Select File" to open the "Load I/Q File" dialog box.

(See "Data Management - Loading the I/Q Data File" in the R&S VSE base software user manual).

Zero Padding

Enables or disables zero padding for input from an I/Q data file that requires resampling. For resampling, a number of samples are required due to filter settling. These samples can either be taken from the provided I/Q data, or the software can add the required number of samples (zeros) at the beginning and end of the file.

If enabled, the required number of samples are inserted as zeros at the beginning and end of the file. The entire input data is analyzed. However, the additional zeros can effect the determined spectrum of the I/Q data. If zero padding is enabled, a status message is displayed.

If disabled (default), no zeros are added. The required samples for filter settling are taken from the provided I/Q data in the file. The start time in the R&S VSE Player is adapted to the actual start (after filter settling).

Note: You can activate zero padding directly when you load the file, or afterwards in the "Input Source" settings.

Remote command:
INPut<ip>:FILE:ZPADing on page 218

5.1.21 Frequency configuration

Access: "Overview" > "Input / Frontend" > "Frequency"

Frequency settings define the frequency characteristics of the signal at the RF input. They are part of the "Frequency" tab of the "Signal Characteristics" dialog box.

The remote commands required to configure the frequency are described in Chapter 7.8.2.3, "Frequency configuration", on page 223.

Signal Frequency

For measurements with an RF input source, you have to match the **center frequency** of the analyzer to the frequency of the signal.

Center Frequency ← Signal Frequency

Defines the center frequency of the signal and thus the frequency the R&S VSE tunes to.

The frequency range depends on the hardware configuration of the analyzer you are using.

Remote command:

Center frequency: `[SENSe:]FREQuency:CENTer[:CC<cc>]` on page 223

Frequency offset: `[SENSe:]FREQuency:CENTer[:CC<cc>]:OFFSet` on page 223

Frequency Stepsize ← Signal Frequency

In addition to the frequency itself, you can also define a frequency stepsize. The frequency stepsize defines the extent of a frequency change if you change it, for example with the rotary knob.

You can define the stepsize in two ways.

- = Center
  One frequency step corresponds to the current center frequency.
- Manual
  Define any stepsize you need.

Remote command:

Frequency stepsize: `[SENSe:]FREQuency:CENTer:STEP` on page 224

5.1.22 Amplitude configuration

Access: "Overview" > "Input / Frontend" > "Amplitude"

Amplitude settings define the expected level characteristics of the signal at the RF input.

Level characteristics are available when you capture data with an instrument. In addition, the functions that are available depend on the configuration of the connected instrument.

The remote commands required to configure the amplitude are described in Chapter 7.8.2.4, "Amplitude configuration", on page 224.

Reference Level

The reference level is the power level the analyzer expects at the RF input. Keep in mind that the power level at the RF input is the peak envelope power for signals with a high crest factor like LTE.

To get the best dynamic range, you have to set the reference level as low as possible. At the same time, make sure that the maximum signal level does not exceed the reference level. If it does, it will overload the A/D converter, regardless of the signal power. Measurement results can deteriorate (e.g. EVM), especially for measurements with more than one active channel near the one you are trying to measure (± 6 MHz).

Note that the signal level at the A/D converter can be stronger than the level the application displays, depending on the current resolution bandwidth. This is because the resolution bandwidths are implemented digitally after the A/D converter.

The reference level is a value in dBm.

Remote command:
Reference level: `DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:RLEVel<ant>` on page 225

Auto Level ← Reference Level

Automatically determines the ideal reference level. The automatic leveling process measures the signal and defines the ideal reference signal for the measured signal.

Automatic level detection also optimizes RF attenuation.

Auto leveling slightly increases the measurement time, because of the extra leveling measurement prior to each sweep. By default, the R&S VSE automatically defines the time for auto leveling, but you can also define it manually ([Auto Set] > "Auto Level Config" > "Meas Time").

"Auto Level All Devices" determines the optimal reference level on all connected instruments at the same time. This feature is available for MIMO measurements with more than one connected input source.

Remote command:
Automatic: `[SENSe:]ADJust:LEVel<ant>` on page 243
Automatic (all): `[SENSe:]ADJust:LEVel<ant>:ALL` on page 243
Auto level mode: `[SENSe<ip>:]ADJust:CONFigure:LEVel:DURation:MODE` on page 242
Auto level time: `[SENSe<ip>:]ADJust:CONFigure:LEVel:DURation` on page 241

Reference Level Offset ← Reference Level

The reference level offset is an arithmetic level offset. A level offset is useful if the signal is attenuated or amplified before it is fed into the analyzer. All displayed power level results are shifted by this value. Note however, that the reference value ignores the level offset. Thus, it is still mandatory to define the actual power level that the analyzer has to handle as the reference level.

Remote command:
DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:
RLEVel<ant>:OFFSet on page 225

Attenuating the Signal

Attenuation of the signal becomes necessary if you have to reduce the power of the signal that you have applied. Power reduction is necessary, for example, to prevent an overload of the input mixer.

For a comprehensive information about signal attenuation, refer to the user manual of the R&S VSE.

The LTE measurement application provides several attenuation modes.

RF Attenuation ← Attenuating the Signal

Controls the RF (or mechanical) attenuator at the RF input.

If you select automatic signal attenuation, the attenuation level is coupled to the reference level.

If you select manual signal attenuation, you can define an arbitrary attenuation (within the supported value range).

Positive values correspond to signal attenuation and negative values correspond to signal gain.

Remote command:
State: INPut<ip>:ATTenuation<ant>:AUTO on page 226
Level: INPut<ip>:ATTenuation<ant> on page 226

Electronic Attenuation ← Attenuating the Signal

Controls the optional electronic attenuator.

If you select automatic signal attenuation, the attenuation level is coupled to the reference level.

If you select manual signal attenuation, you can define an arbitrary attenuation (within the supported value range).

Positive values correspond to signal attenuation and negative values correspond to signal gain.

Note that the frequency range must not exceed the specification of the electronic attenuator for it to work.

Remote command:
Electronic attenuation: INPut<ip>:EATT<ant>:STATe on page 229
Electronic attenuation: INPut<ip>:EATT<ant>:AUTO on page 228
Electronic attenuation: INPut<ip>:EATT<ant> on page 228

Preamplifier

If the (optional) internal preamplifier hardware is installed on the connected instrument, a preamplifier can be activated for the RF input signal.

You can use a preamplifier to analyze signals from DUTs with low output power.

Note: If an optional external preamplifier is activated, the internal preamplifier is automatically disabled, and vice versa.

For an active external frontend, a preamplifier is not available.

"Off"   Deactivates the preamplifier.

"15 dB"   The RF input signal is amplified by about 15 dB.

"30 dB"   The RF input signal is amplified by about 30 dB.

Depending on the connected instrument, different settings are available. See the instrument's documentation for details.

Remote command:
INPut<ip>:GAIN<ant>:STATe on page 227
INPut<ip>:GAIN<ant>[:VALue] on page 227

Input Coupling
The RF input of the R&S VSE can be coupled by alternating current (AC) or direct current (DC).

The RF input of the connected instrument can be coupled by alternating current (AC) or direct current (DC).

For an active external frontend, input coupling is always DC.

Not available for input from the optional "Analog Baseband" interface.

AC coupling blocks any DC voltage from the input signal. AC coupling is activated by default to prevent damage to the instrument. Very low frequencies in the input signal can be distorted.

However, some specifications require DC coupling. In this case, you must protect the instrument from damaging DC input voltages manually. For details, refer to the data sheet.

Remote command:
INPut<ip>:COUPling<ant> on page 226

Impedance
For some measurements, the reference impedance for the measured levels of the connected instrument can be set to 50 Ω or 75 Ω.

For an active external frontend, impedance is always 50 Ω.

Select 75 Ω if the 50 Ω input impedance is transformed to a higher impedance using a 75 Ω adapter of the RAZ type. (That corresponds to 25Ω in series to the input impedance of the instrument.) The correction value in this case is 1.76 dB = 10 log (75Ω/50Ω).

This value also affects the unit conversion.

Not available for input from the optional "Analog Baseband" interface. For analog baseband input, an impedance of 50 Ω is always used.

Remote command:
INPut<ip>:IMPedance<ant> on page 228

5.1.23 Data capture

Access: "Overview" > "Trig / Sig Capture" > "Signal Capture"

The data capture settings contain settings that control the data capture.

The data capture settings are part of the "Signal Capture" tab of the "Trigger/Signal Capture" dialog box.

Capture Time

The "Capture Time" corresponds to the time of one measurement. Therefore, it defines the amount of data the application captures during a single measurement (or sweep).

By default, the application captures 20.1 ms of data to make sure that at least one complete LTE frame is captured in the measurement.

Remote command:
[SENSe:]SWEep:TIME on page 231

Swap I/Q

Swaps the real (I branch) and the imaginary (Q branch) parts of the signal.

Remote command:
[SENSe:]SWAPiq on page 231

Overall Frame Count

The "Overall Frame Count" turns the manual selection of the number of frames to capture (and analyze) on and off.

When you turn on the overall frame count, you can define the number of frames to capture and analyze. The measurement runs until all frames have been analyzed, even if it takes more than one capture.

The results are an average of the captured frames.

When you turn off the overall frame count, the application analyzes all LTE frames found in one capture buffer.

The overall frame count is always off when you measure component carrier signals.

Remote command:
[SENSe:][LTE:]FRAMe:COUNt:STATe on page 230

Auto According to Standard

Turns automatic selection of the number of frames to capture and analyze on and off.

When you turn on this feature, the R&S VSE captures and evaluates a number of frames the 3GPP standard specifies for EVM tests.

If you want to analyze an arbitrary number of frames, turn off the feature.

This parameter is not available when the overall frame count is inactive.

Remote command:
[SENSe:][LTE:]FRAMe:COUNt:AUTO on page 230

Number of Frames to Analyze

Defines the number of frames you want to capture and analyze.

If the number of frames you have set last longer than a single measurement, the application continues the measurement until all frames have been captured.

The parameter is read only in the following cases:
- If you turn off the overall frame count.
- If you capture the data according to the standard.

Remote command:
[SENSe:][LTE:]FRAMe:COUNt on page 229

Maximum Number of Subframes per Frame to Analyze

Selects the maximum number of subframes that the application analyzes and therefore improves measurement speed.

Reducing the number of analyzed subframes may become necessary if you define a capture time of less than 20.1 ms. For successful synchronization, all subframes that you want to analyze must be in the capture buffer. You can make sure that this is the case by using, for example, an external frame trigger signal.

For maximum measurement speed, the application turns off Auto According to Standard and sets the Number of Frames to Analyze to 1. These settings prevent the application from capturing more than once for a single run measurement.

Remote command:
[SENSe:][LTE:]FRAMe:SCOunt on page 230

5.1.24 Trigger configuration

Access: "Overview" > "Trig / Sig Capture" > "Trigger"

A trigger allows you to capture those parts of the signal that you are really interested in.

While the application runs freely and analyzes all signal data in its default state, no matter if the signal contains information or not, a trigger initiates a measurement only under certain circumstances (the trigger event).

Except for the available trigger sources, the functionality is the same as that of the R&S VSE base system. For MIMO measurements, the application provides additional features to trigger more than one instrument.

For a comprehensive description of the available trigger settings not described here, refer to the documentation of the connected instrument.

Trigger Source

The application supports several trigger modes or sources.

- **Free Run**
  Starts the measurement immediately and measures continuously.
  When you analyze a signal from an I/Q file, then the trigger source is always to "Free Run".

- **External <x>**
  The trigger event is the level of an external trigger signal. The measurement starts when this signal meets or exceeds a specified trigger level at the trigger input. Some measurement devices have several trigger ports. When you use one of these, several external trigger sources are available.

- **I/Q Power**
  The trigger event is the magnitude of the sampled I/Q data. The measurement starts when the magnitude of the I/Q data meets or exceeds the trigger level.

- **IF Power**
  The trigger event is the level of the intermediate frequency (IF). The measurement starts when the level of the IF meets or exceeds the trigger level.

- **RF Power**
  The trigger event is the level measured at the RF input. The measurement starts when the level of the signal meets or exceeds the trigger level.

For all trigger sources, except "Free Run", you can define several trigger characteristics.

- The trigger "Level" defines the signal level that initiates the measurement.
- The trigger "Offset" is the time that must pass between the trigger event and the start of the measurement. This can be a negative value (a pretrigger).

- The trigger "Drop-out Time" defines the time the input signal must stay below the trigger level before triggering again.
- The trigger "Slope" defines whether triggering occurs when the signal rises to the trigger level or falls down to it.
- The trigger "Holdoff" defines a time period that must at least pass between one trigger event and the next.
- The trigger "Hysteresis" is available for the IF power trigger. It defines a distance to the trigger level that the input signal must stay below to fulfill the trigger condition.

For a detailed description of the trigger parameters, see the user manual of the I/Q analyzer.

Remote command:
Source: `TRIGger[:SEQuence]:SOURce<ant>` on page 237
Level (external): `TRIGger[:SEQuence]:LEVel<ant>[:EXTernal<tp>]` on page 233
Level (I/Q power): `TRIGger[:SEQuence]:LEVel<ant>:IQPower` on page 234
Level (IF power): `TRIGger[:SEQuence]:LEVel<ant>:IFPower` on page 233
Level (RF power): `TRIGger[:SEQuence]:LEVel<ant>:RFPower` on page 234
Offset: `TRIGger[:SEQuence]:HOLDoff<ant>[:TIME]` on page 232
Hysteresis: `TRIGger[:SEQuence]:IFPower:HYSTeresis` on page 233
Drop-out time: `TRIGger[:SEQuence]:DTIMe` on page 232
Slope: `TRIGger[:SEQuence]:SLOPe` on page 236
Holdoff: `TRIGger[:SEQuence]:IFPower:HOLDoff` on page 232

Triggering multiple data streams (MIMO measurements)
For valid MIMO measurements, it is mandatory to capture all signals simultaneously. It is therefore important to apply a trigger in these measurements and configure a trigger for each instrument you use in the setup. The LTE provides some advanced functionality not available for single stream data capture.

The "Trigger Sources" are limited to "Free Run" mode and external trigger. Free run mode analyzes all incoming data, regardless if it contains information or not. An external trigger initiates a measurement when an external trigger signal meets or exceeds a certain level.

When more than one instrument is connected in the setup, you have to configure each instrument individually in the "Source <x>" tabs. In the default state, all instruments use the same settings as the first instrument ("Same as Primary Setting" is on).

The settings for each instrument are the same as in the base unit.

You can also use a trigger unit (R&S FS-Z11)

The trigger unit R&S FS-Z11 is a device that controls the analyzers in the MIMO test setup. It makes sure that all data streams are captured simultaneously. When you turn on the trigger unit, the application takes the trigger unit into account during measurements.

The diagram next to the trigger settings visualizes the connections and cabling necessary to use the trigger unit. It is displayed in color when you turn on the trigger unit. For more information, see "Measurements with the R&S FS-Z11 trigger unit" on page 47.

For more information about triggering single stream measurements, see "Trigger Source" on page 108 or the R&S VSE user manual.

Remote command:

Trigger source: `TRIGger[:SEQuence]:SOURce<ant>` on page 237

Trigger slope: `TRIGger[:SEQuence]:SLOPe` on page 236

Trigger port: `TRIGger[:SEQuence]:PORT<ant>` on page 235

Trigger level: `TRIGger[:SEQuence]:LEVel<ant>[:EXTernal<tp>]` on page 233

Trigger offset: `TRIGger[:SEQuence]:HOLDoff<ant>[:TIME]` on page 232

Trigger configuration for secondary analyzer: `TRIGger[:SEQuence]:SMSetting<ant>` on page 236

5.1.25 Parameter estimation and tracking

Access: "Overview" > "Estimation / Tracking"

Parameter estimation and tracking provides functionality to estimate various settings based on the measured signal and functionality to compensate for errors in the signal.

Boosting Estimation

Turns boosting estimation on and off.

Boosting estimation, when you turn it on, automatically sets the relative power settings of all physical channels, the P-Sync and S-Sync by analyzing the signal.

Remote command:

`[SENSe:][LTE:]DL:DEMod:BESTimation` on page 240

Channel Estimation

Selects the method of channel estimation.

- **EVM 3GPP Definition**
  Channel estimation according to 3GPP TS 36.141. This method is based on averaging in frequency direction and linear interpolation. Examines the reference signal only.
- **Optimal, Pilot only**
  Optimal channel estimation method. Examines the reference signal only.
- **Optimal, Pilot and Payload**
  Optimal channel estimation method. Examines both the reference signal and the payload resource elements.
- **Off**
  Turns off channel estimation.

Remote command:

[SENSe:][LTE:]DL:DEMod:CESTimation on page 240

Phase

Turns phase tracking on and off.

When you turn on phase tracking, the application compensates the measurement results for the phase error on a symbol level.

"Off"   Phase tracking is not applied.

"Pilot Only"   Only the reference signal is used for the estimation of the phase error.

"Pilot and Pay-   Both reference signal and payload resource elements are used for
load"   the estimation of the phase error.

Remote command:

[SENSe:][LTE:]DL:TRACking:PHASe on page 241

Time Tracking

Turns time tracking on and off.

Clock deviations (slower or faster sampling time) lead to a drift of the ideal sampling instant over time, causing a rotating constellation diagram.

When you turn on time tracking, the application compensates the measurement results for timing errors on a symbol level.

Remote command:

[SENSe:][LTE:]DL:TRACking:TIME on page 241

5.1.26 Measurement error compensation

Access: "Overview" > "Estimation / Tracking"

The tracking settings contain settings that compensate for various common measurement errors that may occur.

Phase

Turns phase tracking on and off.

When you turn on phase tracking, the application compensates the measurement results for the phase error on a symbol level.

"Off"   Phase tracking is not applied.

"Pilot Only"   Only the reference signal is used for the estimation of the phase error.

"Pilot and Pay-   Both reference signal and payload resource elements are used for
load"   the estimation of the phase error.

Remote command:

[SENSe:][LTE:]DL:TRACking:PHASe on page 241

Time Tracking

Turns time tracking on and off.

Clock deviations (slower or faster sampling time) lead to a drift of the ideal sampling instant over time, causing a rotating constellation diagram.

When you turn on time tracking, the application compensates the measurement results for timing errors on a symbol level.

Remote command:
[SENSe:][LTE:]DL:TRACking:TIME on page 241

5.1.27   Demodulation

Access: "Overview" > "Demodulation"

Demodulation settings contain settings that describe signal processing and the way the signal is measured.

Multicarrier Filter

Turns the suppression of interference of neighboring carriers for tests on multiradio base stations on and off (e.g. LTE, WCDMA, GSM etc.).

The R&S VSE automatically selects the multicarrier filter when you analyze more than 1 component carrier.

Remote command:
[SENSe:][LTE:]DL:DEMod:MCFilter on page 238

Compensate Crosstalk

Turns compensation of crosstalk produced by one of the components in the test setup on and off.

Turn on this feature, if you expect crosstalk from the DUT or another component in the test setup. This can become necessary, for example, for over-the-air measurements.

If you connect the DUT to the analyzer by cable, turn off crosstalk compensation. In that case, the only crosstalk results from the DUT itself and contributes as distortion to the measurement results.

Crosstalk compensation must be activated for Time Alignment Error measurements. For more information, see Chapter 4.6, "Performing time alignment measurements", on page 53.

Remote command:
CONFigure[:LTE]:DL[:CC<cc>]:MIMO:CROSstalk on page 238

Scrambling of Coded Bits
Turns the scrambling of coded bits for all physical channels like PDSCH on and off.

The scrambling of coded bits affects the bitstream results.

Figure 5-1: Source for bitstream results if scrambling for coded bits is on and off

Remote command:
[SENSe:][LTE:]DL:DEMod:CBSCrambling on page 238

Decode All Channels
Turns the decoding of all physical channels on and off.

When you turn on this feature, the application shows the decoding results in the "Channel Decoder Results" result display.

In addition, the application only measures the EPDCCH resource blocks that are actually used.

When you turn off the feature,
- the PBCH is decoded only if the PHICH Duration or the PHICH N_g are automatically determined
- the PDCCH is decoded only if the PDSCH Subframe Configuration Detection is set to PDCCH protocol.

If decoding of all control channels is off, measurement speed will increase.

Remote command:
[SENSe:][LTE:]DL:DEMod:DACHannels on page 239

EVM Calculation Method
Selects the way the EVM is calculated.

"EVM 3GPP
Definition"

Calculates the EVM according to 3GPP TS 36.141. Evaluates the EVM at two trial timing positions and then uses the higher EVM of the two.

"At Optimal
Timing Posi-
tion"

Calculates the EVM using the optimal timing position.

Remote command:
[SENSe:][LTE:]DL:DEMod:EVMCalc on page 239

PDSCH Reference Data

Selects the type of reference data to calculate the EVM for the PDSCH.

By default, the R&S VSE automatically detects the PDSCH reference values and maps the measured values to the nearest reference point.

"Auto Detect"   Automatically detects the PDSCH reference values.

"All 0"   Assumes the PDSCH to be all 0's, according to test model definitions.

"ORAN PN23"   Assumes the PDSCH to be based on the pseudo random sequence 23, as defined by the ORAN alliance. Note that this type of reference data is automatically selected when you select an ORAN test case. The R&S VSE assumes that the measured signal actually contains the corresponding ORAN PN23 sequence.
For this option, each PDSCH has an individual sequence.

"ORAN PN23
All Slots"

Assumes the PDSCH to be based on the pseudo random sequence 23, as defined by the ORAN alliance. Note that this type of reference data is automatically selected when you select an ORAN test case. The R&S VSE assumes that the measured signal actually contains the corresponding ORAN PN23 sequence.
For this option, all PDSCH / PDCCH have the same sequence.

Remote command:
[SENSe:][LTE:]DL:DEMod:PRData on page 239

Suppress Interferer for Synchronization

Turns the suppression of 5G resources with a 30 kHz subcarrier spacing in signals that use dynamic spectrum sharing on and off.

Measuring LTE signals that contain 5G resources with 30 kHz subcarrier spacing can cause synchronization to fail. Turn on this setting to synchronize such signals success-fully.

Remote command:
[SENSe:][LTE:]DL:DEMod:SISYnc on page 239

5.1.28 Automatic configuration

Access: in the toolbar: "Auto Level" / "Auto Config" / "Auto Scale" / "Auto S-All" / "Auto All"

The R&S VSE features several automatic configuration routines. When you use one of those, the R&S VSE configures different parameters based on the signal that you are measuring.

Auto leveling

You can use the auto leveling routine for a quick determination of preliminary amplitude settings for the current LTE input signal.

For MIMO measurements with multiple devices (more than one input source), you can do an auto level routine on all devices at the same time with the "Auto Level All Devices" feature available in the "Amplitude" dialog box ("Input & Output" > "Amplitude").

Remote command:

[SENSe:]ADJust:LEVel<ant> on page 243

[SENSe:]ADJust:LEVel<ant>:ALL on page 243

Auto LTE

Determines various signal characteristics, and configures the application accordingly.

- Channel bandwidth
- MIMO configuration

Remote command:

[SENSe:]ADJust:CONFigure:LTE on page 242

Auto Scaling

Scales the y-axis for best viewing results. Also see "Automatic scaling of the y-axis" on page 119.

Remote command:

DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:AUTO on page 250

5.2 Configuring time alignment error measurements

Several settings supported by Time Alignment Error measurements are the same as those for I/Q measurements. For a comprehensive description, refer to the following chapters.

- Chapter 5.1.2, "Signal characteristics", on page 59
- Chapter 5.1.8, "Synchronization signal configuration", on page 79
  (note that the Time Alignment Error measurement does not support all synchronization signal settings)
- Chapter 5.1.20, "Selecting the input and output source", on page 97
- Chapter 5.1.21, "Frequency configuration", on page 101
- Chapter 5.1.22, "Amplitude configuration", on page 102
- Chapter 5.1.23, "Data capture", on page 105
- Chapter 5.1.24, "Trigger configuration", on page 107
- Chapter 5.1.27, "Demodulation", on page 112

For more information about configuring component carriers in the Time Alignment Error measurement see Carrier Aggregation.

6 Analysis

The R&S VSE provides various tools to analyze the measurement results.

6.1 General analysis tools

The general analysis tools are tools available for all measurements.

6.1.1 Data export

Access: [TRACE] > "Trace Export Config"

You can export the measurement results to an ASCII file, for example to backup the results or analyze the results with external applications (for example in a Microsoft Excel spreadsheet).

You can also export the I/Q data itself, for example if you want to keep it for later reevaluation.

The data export is available for:
- I/Q measurements
- Time alignment error measurements
- Transmit power on / off measurements

Exporting trace data

1. Select [TRACE] > "Trace Export Config".

2. Select the data you would like to export.

3. Select the results you would like to export from the "Specifics For" dropdown menu.

4. Export the data with the "Export Trace to ASCII File" feature.

5. Select the location where you would like to save the data (as a `.dat` file).

   Note that the measurement data stored in the file depend on the selected result display ("Specifics For" selection).

Exporting I/Q data

1. Select the disk icon in the toolbar.

2. Select "Export" > "I/Q Export".

3. Define a file name and location for the I/Q data.
   The file type is `iq.tar`.

4. Later on, you can import the I/Q data using the I/Q file input source.

Data import and export

The basic principle for both trace export and I/Q data export and import is the same as in the spectrum application. For a comprehensive description, refer to the R&S VSE user manual.

Remote command:
Trace export: `TRACe<n>[:DATA]?` on page 160
I/Q export: `MMEMory:STORe<n>:IQ:STATe` on page 183
I/Q import: `INPut:FILE<fi>:PATH` on page 218

6.1.2 Microservice export

Access: "Edit" > "Microservice Export"

In addition to exporting the signal configuration locally, you can export the signal configuration in a file format compatible to the cloud-based microservice (`.m5g` file extension).

For a comprehensive description of the microservice, refer to the microservice user manual.

Remote command:

`MMEMory:STORe<n>:MSERvice` on page 246

6.1.3 Diagram scale

Access: "Overview" > "Analysis" > "Scale"

You can change the scale of the y-axis in various diagrams. The y-axis scale determines the vertical resolution of the measurement results.

The scale of the x-axis in the diagrams is fix. If you want to get a better resolution of the x-axis, you have to zoom into the diagram.

The remote commands required to configure the y-axis scale are described in Chapter 7.9.4, "Y-axis scale", on page 250.

Manual scaling of the y-axis
The "Y Minimum" and "Y Maximum" properties define a custom scale of the y-axis.

The "Y Minimum" corresponds to the value at the origin. The "Y Maximum" corresponds to the last value on the y-axis. The scale you select applies to the currently active window.

You can restore the original scale anytime with "Restore Scale".

Remote command:
DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:MAXimum
on page 251
DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:MINimum
on page 251

Automatic scaling of the y-axis
Usually, the best way to view the results is if they fit ideally in the diagram area and display the complete trace. The "Auto Scale Once" automatically determines the scale of the y-axis that fits this criteria in the currently active window.

Tip: You can also scale the windows in the "Auto Set" menu. In addition to scaling the selected window ("Auto Scale Window"), you can change the scale of all windows at the same time ("Auto Scale All").

You can restore the original scale anytime with "Restore Scale".

Remote command:
DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:AUTO
on page 250

6.1.4 Zoom

The zoom feature allows you to zoom into any graphical result display. This can be a useful tool if you want to analyze certain parts of a diagram in more detail.

The zoom functionality is the same as in the spectrum application.

The following zoom functions are supported.

- 🔍: Magnifies the selected diagram area.
- 🔍: Magnifies the selected diagram area, but keeps the original diagram in a separate window.
- 🔍: Restores the original diagram.

Note that the zoom is a graphical feature that magnifies the data in the capture buffer. Zooming into the diagram does not reevaluate the I/Q data.

For a comprehensive description of the zoom, refer to the R&S VSE user manual.

6.1.5 Markers

Access: "Overview" > "Analysis" > "Marker"

Markers are a tool that help you to identify measurement results at specific trace points. When you turn on a marker, it gives you the coordinates of its position, for example the frequency and its level value or the symbol and its EVM value.

In general, the marker functionality of setting and positioning markers is similar to the spectrum application.

For I/Q measurement, the R&S VSE supports up to four markers, for frequency sweep measurements there are more. Markers give either absolute values (normal markers) or values relative to the first marker (deltamarkers). If a result display has more than one trace, for example the "EVM vs Symbol" result display, you can position the marker on either trace. By default, all markers are positioned on trace 1.

Note that if you analyze more than one bandwidth part, each bandwidth part is represented by a different trace.

The R&S VSE also supports several automatic positioning mechanisms that allow you to move the marker to the maximum trace value (peak), the minimum trace value or move it from peak to subsequent peak.

The marker table summarizes the marker characteristics.

For a comprehensive description, refer to the R&S VSE user manual.

Markers in result displays with a third quantity

In result displays that show a third quantity, for example the "EVM vs Symbol x Carrier" result, the R&S VSE provides an extended marker functionality.

You can position the marker on a specific resource element, whose position is defined by the following coordinates:

- The "Symbol" input field selects the symbol.
- The "Carrier" input field selects the carrier.

Alternatively, you can define the marker position in the "Marker Configuration" dialog box, which is expanded accordingly.

The marker information shows the EVM, the power and the allocation ID of the resource element you have selected as the marker position.

6.2 Analysis tools for I/Q measurements

6.2.1 Layout of numerical results

You can customize the displayed information of some numerical result displays or tables, for example the allocation summary.

► Select some point in the header row of the table.

The application opens a dialog box to add or remove columns.

Add and remove columns as required.

6.2.2 Evaluation range

Access (general): "Overview" > "Evaluation Range" > "Global / Constellation"

Access (beamforming): "Overview" > "Evaluation Range" > "Beamforming"

The evaluation range defines the signal parts that are considered during signal analysis.

Configuring component carriers

When you are doing measurements on aggregated carriers, you can configure each carrier separately.

When available, each carrier in the dialog boxes is represented by an additional tab labeled "CC<x>", with <x> indicating the number of the component carrier.

Note that the additional tabs are only added to the user interface after you have selected more than "1" component carrier.

Subframe Selection

The "Subframe" selection filters the results by a specific subframe number.

If you apply the filter, only the results for the subframe you have selected are displayed. Otherwise, the R&S VSE shows the results for all subframes that have been analyzed.

The R&S VSE shows three traces if you display the results for all subframes.
- One trace ("Min") shows the minimum values measured over all analyzed subframes.

- One trace ("Max") shows the maximum values measured over all analyzed subframes.
- One trace ("Avg") shows the average values measured over all subframes.

If you filter by a single subframe, the R&S VSE shows one trace that represents the values measured for that subframe only.

You can apply the filter to the following result displays.

- Result Summary
- EVM vs Carrier / EVM vs Symbol / EVM vs Symbol X Carrier
- Channel Flatness / Channel Flatness Difference
- Group Delay
- Power vs Symbol X Carrier
- Constellation Diagram
- Allocation Summary
- Bit Stream
- Time Alignment Error

Remote command:

[SENSe:][LTE:][CC<cc>:]SUBFrame:SELect on page 250

Evaluation range for the constellation diagram

The "Evaluation Range" for the constellation diagram selects the information displayed in the constellation diagram.

By default, the constellation diagram contains the constellation points of the complete data that has been analyzed. However, you can filter the results by several aspects.

- Modulation
  Filters the results by the selected type of modulation.
- Allocation
  Filters the results by a certain type of allocation.
- Symbol (OFDM)
  Filters the results by a certain OFDM symbol.
  Filtering by OFDM symbols is available for constellations created before MIMO decoding.
- Carrier
  Filters the results by a certain subcarrier.
  Filtering by carrier is available for constellations created before MIMO decoding.
- Symbol (code word)
  Filters the results by a certain codeword symbol.

Filtering by codeword symbols is available for constellations created after MIMO decoding.

- Codeword
  Filters the results by a certain codeword.
  Filtering by codeword is available for constellations created after MIMO decoding.
- Location
  Selects the point in the signal processing at which the constellation diagram is created, before or after the MIMO encoding.
  For spatial multiplexing, symbols of different encoding schemes are merged in the MIMO encoder. Thus you get a mix of different modulation alphabets. When you filter these symbols to show a modulation "MIXTURE", you get the mixed symbols only if you have selected the "Before MIMO/CDMA Decoder" option.
  Note that the PHICH is CDMA encoded. Thus, the constellation points for the PHICH are either created before or after CDMA encoding.
  If you have selected "After MIMO/CDMA Decoder", filtering by "Symbol" and "Carrier" is not available. Instead, you can filter by "Symbol" and "Codeword".

Remote command:
Modulation: `[SENSe:][LTE:][CC<cc>:]MODulation:SELect` on page 249
Allocation: `[SENSe:][LTE:][CC<cc>:]ALLocation:SELect` on page 248
Symbol: `[SENSe:][LTE:][CC<cc>:]SYMBol:SELect` on page 250
Carrier: `[SENSe:][LTE:][CC<cc>:]CARRier:SELect` on page 248
Location: `[SENSe:][LTE:][CC<cc>:]LOCation:SELect` on page 249

Beamforming Selection
Filters the displayed results to include only certain antenna port(s).

The availability of antenna ports depends on the number of transmission antennas and the number of beamforming layers you are testing.

In addition, you can select the antenna port for each type of reference signal separately (UE reference signal, cell reference signal and CSI reference signal).

Remote command:
Cell RS: `CONFigure[:LTE]:DL[:CC<cc>]:BF:AP:CELL` on page 246
UE RS: `CONFigure[:LTE]:DL[:CC<cc>]:BF:AP[:UERS]` on page 247
CSI RS: `CONFigure[:LTE]:DL[:CC<cc>]:BF:AP:CSI` on page 247

6.2.3 Result settings

Access: "Overview" > "Analysis" > "Result Settings"

Result settings define the way certain measurement results are displayed.

EVM Unit	%
Bitstream Format	Symbols
Carrier Axes	Hertz
Marker Coupling	On / Off

EVM Unit

The "EVM Unit" selects the unit for the EVM measurement results in diagrams and numerical result displays.

Possible units are dB and %.

Remote command:
UNIT:EVM on page 253

Bit Stream Format

Selects the way the bit stream is displayed.

The bit stream is either a stream of raw bits or of symbols. In case of the symbol format, the bits that belong to a symbol are shown as hexadecimal numbers with two digits.

Example:

Figure 6-1: Bit stream display in downlink application if the bit stream format is set to "symbols"

Figure 6-2: Bit stream display in downlink application if the bit stream format is set to "bits"

Remote command:
UNIT:BSTR on page 253

Carrier Axes

The "Carrier Axes" selects the unit of the x-axis in result displays that show results over the subcarriers.

- "Hertz"
  X-axis shows the results in terms of the subcarrier frequency.
- "Subcarrier Number"
  X-axis shows the results in terms of the subcarrier number.

Remote command:
UNIT:CAXes on page 253

Marker Coupling

Couples or decouples markers that are active in multiple result displays.

When you turn on this feature, the application moves the marker to its new position in all active result displays.

When you turn it off, you can move the markers in different result displays independent from each other.

Remote command:
CALCulate<n>:MARKer<m>:COUPling on page 252

Subwindow Coupling

Couples or decouples result display tabs (subwindows).

If the coupling is on and you select another tab in a result display, the application automatically selects the same tab for all result displays.

Subwindow coupling is available for measurements with multiple data streams (for example carrier aggregation).

Remote command:
DISPlay[:WINDow<n>][:SUBWindow<w>]:COUPling on page 252

7 Remote control

The following remote control commands are required to configure and perform noise figure measurements in a remote environment. The R&S VSE must already be set up for remote operation in a network as described in the base unit manual.

Universal functionality

Note that basic tasks that are also performed in the base unit in the same way are not described here. For a description of such tasks, see the R&S VSE User Manual.

In particular, this includes:

- Managing Settings and Results, i.e. storing and loading settings and result data.
- Basic instrument configuration, e.g. checking the system configuration, customizing the screen layout, or configuring networks and remote operation.
- Using the common status registers (specific status registers for Pulse measurements are not used).

7.1 Common suffixes

In the LTE measurement application, the following common suffixes are used in remote commands:

Table 7-1: Common suffixes used in remote commands in the LTE measurement application

Suffix	Value range	Description
<m>	1..4	Marker
<n>	1..16	Window (**in the currently selected channel**)
<t>	1..6	Trace
	1 to 8	Limit line
<al>	0..110	Selects a subframe allocation.
<in>		Selects an instrument for MIMO measurements.
<ant>	1..4	Selects an antenna for MIMO measurements.

Suffix	Value range	Description
<cc>	1..5	Selects a component carrier. The actual number of supported component carriers depends on the selected measurement
<cluster>	1..2	Selects a cluster (uplink only).
<cw>	1..n	Selects a codeword.
<k>	---	Selects a limit line. Irrelevant for the LTE application.
<sf>	DL: 0..49 UL: 0..9	Selects a subframe.

7.2 Introduction

Commands are program messages that a controller (e.g. a PC) sends to the instrument or software. They operate its functions ('setting commands' or 'events') and request information ('query commands'). Some commands can only be used in one way, others work in two ways (setting and query). If not indicated otherwise, the commands can be used for settings and queries.

The syntax of a SCPI command consists of a header and, usually, one or more parameters. To use a command as a query, you have to append a question mark after the last header element, even if the command contains a parameter.

A header contains one or more keywords, separated by a colon. Header and parameters are separated by a "white space" (ASCII code 0 to 9, 11 to 32 decimal, e.g. blank). If there is more than one parameter for a command, they are separated by a comma from one another.

Only the most important characteristics that you need to know when working with SCPI commands are described here. For a more complete description, refer to the user manual of the R&S VSE.

ⓘ **Remote command examples**

Note that some remote command examples mentioned in this general introduction are possibly not supported by this particular application.

7.2.1 Conventions used in descriptions

The following conventions are used in the remote command descriptions:

- **Command usage**
  If not specified otherwise, commands can be used both for setting and for querying parameters.
  If a command can be used for setting or querying only, or if it initiates an event, the usage is stated explicitly.
- **Parameter usage**

If not specified otherwise, a parameter can be used to set a value and it is the result of a query.
Parameters required only for setting are indicated as **Setting parameters**.
Parameters required only to refine a query are indicated as **Query parameters**.
Parameters that are only returned as the result of a query are indicated as **Return values**.

- **Conformity**
  Commands that are taken from the SCPI standard are indicated as **SCPI confirmed**. All commands used by the R&S VSE follow the SCPI syntax rules.

- **Asynchronous commands**
  A command which does not automatically finish executing before the next command starts executing (overlapping command) is indicated as an **Asynchronous command**.

- **Reset values (*RST)**
  Default parameter values that are used directly after resetting the instrument (`*RST` command) are indicated as ***RST** values, if available.

- **Default unit**
  The default unit is used for numeric values if no other unit is provided with the parameter.

- **Manual operation**
  If the result of a remote command can also be achieved in manual operation, a link to the description is inserted.

7.2.2 Long and short form

The keywords have a long and a short form. You can use either the long or the short form, but no other abbreviations of the keywords.

The short form is emphasized in uppercase letters. Note however, that this emphasis only serves the purpose to distinguish the short from the long form in the manual. For the instrument, the case does not matter.

Example:
`SENSe:FREQuency:CENTer` is the same as `SENS:FREQ:CENT`.

7.2.3 Numeric suffixes

Some keywords have a numeric suffix if the command can be applied to multiple instances of an object. In that case, the suffix selects a particular instance (e.g. a measurement window).

Numeric suffixes are indicated by angular brackets (<n>) next to the keyword.

If you do not quote a suffix for keywords that support one, a 1 is assumed.

Example:

`DISPlay[:WINDow<1...4>]:ZOOM:STATe` enables the zoom in a particular measurement window, selected by the suffix at `WINDow`.

`DISPlay:WINDow4:ZOOM:STATe ON` refers to window 4.

7.2.4 Optional keywords

Some keywords are optional and are only part of the syntax because of SCPI compliance. You can include them in the header or not.

ⓘ If an optional keyword has a numeric suffix and you need to use the suffix, you have to include the optional keyword. Otherwise, the suffix of the missing keyword is assumed to be the value 1.

Optional keywords are emphasized with square brackets.

Example:

Without a numeric suffix in the optional keyword:

`[SENSe:]FREQuency:CENTer` is the same as `FREQuency:CENTer`

With a numeric suffix in the optional keyword:

`DISPlay[:WINDow<1...4>]:ZOOM:STATe`

`DISPlay:ZOOM:STATe ON` enables the zoom in window 1 (no suffix).

`DISPlay:WINDow4:ZOOM:STATe ON` enables the zoom in window 4.

7.2.5 Alternative keywords

A vertical stroke indicates alternatives for a specific keyword. You can use both keywords to the same effect.

Example:

`[SENSe:]BANDwidth|BWIDth[:RESolution]`

In the short form without optional keywords, `BAND 1MHZ` would have the same effect as `BWID 1MHZ`.

7.2.6 SCPI parameters

Many commands feature one or more parameters.

If a command supports more than one parameter, they are separated by a comma.

Example:

`LAYout:ADD:WINDow Spectrum,LEFT,MTABle`

Parameters can have different forms of values.

7.2.6.1 Numeric values

Numeric values can be entered in any form, i.e. with sign, decimal point or exponent. For physical quantities, you can also add the unit. If the unit is missing, the command uses the basic unit.

Example:

With unit: `SENSe:FREQuency:CENTer 1GHZ`

Without unit: `SENSe:FREQuency:CENTer 1E9` would also set a frequency of 1 GHz.

Values exceeding the resolution of the instrument are rounded up or down.

If the number you have entered is not supported (e.g. for discrete steps), the command returns an error.

Instead of a number, you can also set numeric values with a text parameter in special cases.

- MIN/MAX
  Defines the minimum or maximum numeric value that is supported.
- DEF
  Defines the default value.
- UP/DOWN
  Increases or decreases the numeric value by one step. The step size depends on the setting. Sometimes, you can customize the step size with a corresponding command.

Querying numeric values

When you query numeric values, the system returns a number. For physical quantities, it applies the basic unit (e.g. Hz for frequencies). The number of digits after the decimal point depends on the type of numeric value.

Example:

Setting: `SENSe:FREQuency:CENTer 1GHZ`

Query: `SENSe:FREQuency:CENTer?` would return `1E9`

Sometimes, numeric values are returned as text.

- INF/NINF
  Infinity or negative infinity. Represents the numeric values 9.9E37 or -9.9E37.
- NAN

Not a number. Represents the numeric value 9.91E37. NAN is returned if errors occur.

7.2.6.2 Boolean

Boolean parameters represent two states. The "on" state (logically true) is represented by "ON" or the numeric value 1. The "off" state (logically untrue) is represented by "OFF" or the numeric value 0.

Querying Boolean parameters

When you query Boolean parameters, the system returns either the value 1 ("ON") or the value 0 ("OFF").

Example:

Setting: `DISPlay:WINDow:ZOOM:STATe ON`

Query: `DISPlay:WINDow:ZOOM:STATe?` would return 1

7.2.6.3 Character data

Character data follows the syntactic rules of keywords. You can enter text using a short or a long form. For more information, see Chapter 7.2.2, "Long and short form", on page 128.

Querying text parameters

When you query text parameters, the system returns its short form.

Example:

Setting: `SENSe:BANDwidth:RESolution:TYPE NORMal`

Query: `SENSe:BANDwidth:RESolution:TYPE?` would return `NORM`

7.2.6.4 Character strings

Strings are alphanumeric characters. They have to be in straight quotation marks. You can use a single quotation mark (') or a double quotation mark (").

Example:

`INSTRument:DELete 'Spectrum'`

7.2.6.5 Block data

Block data is a format which is suitable for the transmission of large amounts of data.

The ASCII character # introduces the data block. The next number indicates how many of the following digits describe the length of the data block. The data bytes follow. During the transmission of these data bytes, all end or other control signs are ignored until

all bytes are transmitted. #0 specifies a data block of indefinite length. The use of the indefinite format requires an `NL^END` message to terminate the data block. This format is useful when the length of the transmission is not known or if speed or other considerations prevent segmentation of the data into blocks of definite length.

7.3　LTE application selection

INSTrument[:SELect] <ChannelType>

Selects a new measurement channel with the defined channel type.

Parameters:

<ChannelType>　　　　**LTE**

　　　　　　　　　　　　LTE measurement channel

Example:　　　　　　//Select LTE application

　　　　　　　　　　　　`INST LTE`

7.4　Screen layout

7.4.1　General layout

The following commands are required to configure general window layout, independent of the application.

Note that the suffix <n> always refers to the window *in the currently selected measurement channel*.

DISPlay[:WINDow<n>][:SUBWindow<w>]:SELect

Sets the focus on the selected result display window.

This window is then the active window.

For measurements with multiple results in subwindows, the command also selects the subwindow. Use this command to select the (sub)window before querying trace data.

Suffix:

<n>　　　　　　　　　　Window

<w>	subwindow
	Not supported by all applications
Example:	//Put the focus on window 1
	`DISP:WIND1:SEL`
Example:	//Put the focus on subwindow 2 in window 1
	`DISP:WIND1:SUBW2:SEL`

DISPlay[:WINDow<n>]:TAB<tab>:SELect

Selects a tab in diagrams with multiple subwindows (or views).

Note that selecting a tab does not actually select a subwindow. To select a subwindow, for example to query the results of a subwindow, use `DISPlay[:WINDow<n>][:SUBWindow<w>]:SELect`.

Suffix:

<n>	Window
<tab>	1..n
	Tab
Example:	//Select a tab
	`DISP:WIND2:TAB2:SEL`

7.4.2 Layout over all channels

The following commands are required to change the evaluation type and rearrange the screen layout across measurement channels as you do in manual operation.

(i) For compatibility with other Rohde & Schwarz Signal and Spectrum Analyzers, the layout commands described in Chapter 7.4.3, "Layout of a single channel", on page 137 are also supported. Note, however, that the commands described there only allow you to configure the layout within the *active* measurement channel.

LAYout:GLOBal:ADD[:WINDow]?
   <ExChanName>,<ExWinName>,<Direction>,<NewChanName>,<NewWinType>

Adds a window to the display next to an existing window. The new window may belong to a different channel than the existing window.

To replace an existing window, use the `LAYout:GLOBal:REPLace[:WINDow]` command.

Parameters:

<ExChanName>	string
	Name of an existing channel
<ExWinName>	string
	Name of the existing window within the <ExChanName> channel the new window is inserted next to.
	By default, the name of a window is the same as its index. To determine the name and index of all active windows use the LAYout:GLOBal:IDENtify[:WINDow]? query.
<Direction>	LEFT | RIGHt | ABOVe | BELow | TAB
	Direction the new window is added relative to the existing window.
	TAB
	The new window is added as a new tab in the specified existing window.
<NewChanName>	string
	Name of the channel for which a new window is to be added.
<NewWinType>	string
	Type of result display (evaluation method) you want to add.
	See the table below for available parameter values.

Return values:

<NewWindowName>	When adding a new window, the command returns its name (by default the same as its number) as a result.

Example:

	LAYout:GLOBal:ADD:WINDow? 'IQ Analyzer','1',RIGH,'IQ Analyzer2','FREQ'
	Adds a new window named 'Spectrum' with a Spectrum display to the right of window 1 in the channel 'IQ Analyzer'.

Usage:　　　　Query only

Table 7-2: <WindowType> parameter values for LTE downlink measurement application

Parameter value	Window type
I/Q measurements	
AISC	Allocation ID vs. Symbol X Carrier
ASUM	Allocation Summary
BSTR	Bitstream
CBUF	Capture Buffer
CCDF	CCDF
CDEC	Channel Decoder Results
FLAT	Channel Flatness
CONS	Constellation Diagram

Parameter value	Window type
CRWM	Cell RS Magnitude
CRWP	Cell RS Phase
EVCA	EVM vs. Carrier
EVRP	EVM vs. RB
EVSC	EVM vs. Symbol X Carrier
EVSU	EVM vs. Subframe
EVSY	EVM vs. Symbol
FEVS	Frequency Error vs. Symbol
IRWM	CSI RS Magnitude
IRWP	CSI RS Phase
GDEL	Group Delay
MTAB	Marker Table
PSPE	Power Spectrum
PVRP	Power vs. RB PDSCH
PVRR	Power vs. RB RS
PVSC	Power vs. Symbol X Carrier
RSUM	Result Summary
URWA	Beamforming Allocation Summary
URWM	UE RS Magnitude
URWP	UE RS Phase
Time alignment error	
CBUF	Capture Buffer
MTAB	Marker Table
PSPE	Power Spectrum
TAL	Time Alignment Error

LAYout:GLOBal:CATalog[:WINDow]?

Queries the name and index of all active windows from top left to bottom right for each active channel. The result is a comma-separated list of values for each window, with the syntax:

<ChannelName_1>: <WindowName_1>,<WindowIndex_1>..<WindowName_n>,<WindowIndex_n>

..

<ChannelName_m>: <WindowName_1>,<WindowIndex_1>..<WindowName_n>,<WindowIndex_n>

Return values:

<ChannelName>   String containing the name of the channel. The channel name is displayed as the tab label for the measurement channel.

<WindowName>   string
Name of the window.
In the default state, the name of the window is its index.

<WindowIndex>   **numeric value**
Index of the window.

Example: `LAY:GLOB:CAT?`
Result:
`IQ Analyzer: '1',1,'2',2`
`Analog Demod: '1',1,'4',4`
For the I/Q Analyzer channel, two windows are displayed, named '2' (at the top or left), and '1' (at the bottom or right). For the Analog Demodulation channel, two windows are displayed, named '1' (at the top or left), and '4' (at the bottom or right).

Usage: Query only

LAYout:GLOBal:IDENtify[:WINDow]? <ChannelName>,<WindowName>

Queries the **index** of a particular display window in the specified channel.

Note: to query the **name** of a particular window, use the `LAYout:WINDow<n>:IDENtify?` query.

Parameters:

<ChannelName>   String containing the name of the channel. The channel name is displayed as the tab label for the measurement channel.

Query parameters:

<WindowName>   String containing the name of a window.

Return values:

<WindowIndex>   Index number of the window.

Example: `LAYout:GLOBal:ADD:WINDow? IQ,'1',RIGH,`
`'Spectrum',FREQ`
Adds a new window named 'Spectrum' with a Spectrum display to the right of window 1.

Example: `LAYout:GLOBal:IDENtify? 'IQ Analyzer',`
`'Spectrum'`
Result:
`2`
Window index is: 2.

Usage: Query only

LAYout:GLOBal:REMove[:WINDow] <ChannelName>, <WindowName>

Setting parameters:
<ChannelName>

<WindowName>

Usage: Setting only

LAYout:GLOBal:REPLace[:WINDow] <ExChannelName>, <WindowName>, <NewChannelName>, <WindowType>

Setting parameters:
<ExChannelName>

<WindowName>

<NewChannelName>

<WindowType>

Usage: Setting only

7.4.3 Layout of a single channel

The following commands are required to change the evaluation type and rearrange the screen layout for a measurement channel as you do using the SmartGrid in manual operation. Since the available evaluation types depend on the selected application, some parameters for the following commands also depend on the selected measurement channel.

Note that the suffix <n> always refers to the window *in the currently selected measurement channel*.

LAYout:ADD[:WINDow]? <WindowName>, <Direction>, <WindowType>

Adds a window to the display in the active channel.

Is always used as a query so that you immediately obtain the name of the new window as a result.

To replace an existing window, use the `LAYout:REPLace[:WINDow]` command.

Note: Use this command to select a result display instead of `CALCulate:FEED` (still supported for compatibility reasons, but deprecated).

Query parameters:

<WindowName>	String containing the name of the existing window the new window is inserted next to. By default, the name of a window is the same as its index. To determine the name and index of all active windows, use the `LAYout:CATalog[:WINDow]?` query.
<Direction>	LEFT | RIGHt | ABOVe | BELow Direction the new window is added relative to the existing window.
<WindowType>	text value Type of result display (evaluation method) you want to add. See the table below for available parameter values. Note that the window type must be valid for the active channel. To create a window for a different channel, use the `LAYout:GLOBal:REPLace[:WINDow]` command.

Return values:

<NewWindowName>	When adding a new window, the command returns its name (by default the same as its number) as a result.

Example:	`LAY:ADD? '1',LEFT,MTAB`
	 Result:
	 `'2'`
	 Adds a new window named '2' with a marker table to the left of window 1.

Usage:	Query only

Manual operation: See "Capture Buffer" on page 15
See "EVM vs Carrier" on page 16
See "EVM vs Symbol" on page 17
See "EVM vs RB" on page 18
See "EVM vs Subframe" on page 18
See "Frequency Error vs Symbol" on page 19
See "Power Spectrum" on page 20
See "Power vs Resource Block PDSCH" on page 20
See "Power vs Resource Block RS" on page 21
See "Channel Flatness" on page 21
See "Group Delay" on page 22
See "Channel Flatness Difference" on page 22
See "Constellation Diagram" on page 22
See "CCDF" on page 23
See "Allocation Summary" on page 24
See "Bitstream" on page 25
See "Channel Decoder Results" on page 26
See "EVM vs Symbol x Carrier" on page 28
See "Power vs Symbol x Carrier" on page 28
See "Allocation ID vs Symbol x Carrier" on page 29
See "UE RS Magnitude" on page 29
See "UE RS Phase" on page 30
See "Cell RS Magnitude" on page 30
See "Cell RS Phase" on page 31
See "CSI RS Magnitude" on page 31
See "CSI RS Phase" on page 32
See "Beamform Allocation Summary" on page 33
See "Marker Table" on page 36
See "Time Alignment Error" on page 37

Table 7-3: <WindowType> parameter values for LTE downlink measurement application

Parameter value	Window type
I/Q measurements	
AISC	"Allocation ID vs. Symbol X Carrier"
ASUM	"Allocation Summary"
BSTR	"Bitstream"
CBUF	"Capture Buffer"
CCDF	"CCDF"
CDEC	"Channel Decoder Results"
FLAT	"Channel Flatness"
CONS	"Constellation" Diagram
CRWM	"Cell RS Magnitude"
CRWP	"Cell RS Phase"
EVCA	"EVM vs. Carrier"

Parameter value	Window type
EVRP	"EVM vs. RB"
EVSC	"EVM vs. Symbol X Carrier"
EVSU	"EVM vs. Subframe"
EVSY	"EVM vs. Symbol"
FEVS	"Frequency Error vs. Symbol"
IRWM	"CSI RS Magnitude"
IRWP	"CSI RS Phase"
GDEL	"Group Delay"
MTAB	"Marker Table"
PSPE	"Power Spectrum"
PVRP	"Power vs. RB PDSCH"
PVRR	"Power vs. RB RS"
PVSC	"Power vs. Symbol X Carrier"
RSUM	"Result Summary"
URWA	"Beamforming Allocation Summary"
URWM	"UE RS Magnitude"
URWP	"UE RS Phase"
Time alignment error	
CBUF	"Capture Buffer"
MTAB	"Marker Table"
PSPE	"Power Spectrum"
TAL	"Time Alignment Error"

LAYout:CATalog[:WINDow]?

Queries the name and index of all active windows in the active channel from top left to bottom right. The result is a comma-separated list of values for each window, with the syntax:

<WindowName_1>,<WindowIndex_1>..<WindowName_n>,<WindowIndex_n>

To query the name and index of all windows in all channels, use the `LAYout:GLOBal: CATalog[:WINDow]?` command.

Return values:

<WindowName>   string

Name of the window.
In the default state, the name of the window is its index.

<WindowIndex>	**numeric value**
	Index of the window.

Example:	`LAY:CAT?`
	Result:
	`'2',2,'1',1`
	Two windows are displayed, named '2' (at the top or left), and '1' (at the bottom or right).

Usage:	Query only

LAYout:IDENtify[:WINDow]? <WindowName>

Queries the **index** of a particular display window in the active channel.

Note: to query the **name** of a particular window, use the `LAYout:WINDow<n>:IDENtify?` query.

To query the index of a window in a different channel, use the `LAYout:GLOBal:IDENtify[:WINDow]?` command.

Query parameters:
<WindowName>	String containing the name of a window.

Return values:
<WindowIndex>	Index number of the window.

Example:	`LAY:IDEN:WIND? '2'`
	Queries the index of the result display named '2'.
	Response:
	`2`

Usage:	Query only

LAYout:REMove[:WINDow] <WindowName>

Removes a window from the display in the active channel.

Setting parameters:
<WindowName>	String containing the name of the window. In the default state, the name of the window is its index.

Example:	`LAY:REM '2'`
	Removes the result display in the window named '2'.

Usage:	Setting only

LAYout:REPLace[:WINDow] <WindowName>,<WindowType>

Replaces the window type (for example from "Diagram" to "Result Summary") of an already existing window in the active channel while keeping its position, index and window name.

To add a new window, use the `LAYout:ADD[:WINDow]?` command.

Setting parameters:

<WindowName>   String containing the name of the existing window.
By default, the name of a window is the same as its index. To determine the name and index of all active windows in the active channel, use the LAYout:CATalog[:WINDow]? query.

<WindowType>   Type of result display you want to use in the existing window.
See LAYout:ADD[:WINDow]? on page 137 for a list of available window types.
Note that the window type must be valid for the active channel. To create a window for a different channel, use the LAYout:GLOBal:REPLace[:WINDow] command.

Example: LAY:REPL:WIND '1',MTAB
Replaces the result display in window 1 with a marker table.

Usage: Setting only

LAYout:WINDow<n>:ADD? <Direction>,<WindowType>

Adds a measurement window to the display. Note that with this command, the suffix <n> determines the existing window next to which the new window is added. Unlike LAYout:ADD[:WINDow]?, for which the existing window is defined by a parameter.

To replace an existing window, use the LAYout:WINDow<n>:REPLace command.

Is always used as a query so that you immediately obtain the name of the new window as a result.

Suffix:

<n>   Window

Query parameters:

<Direction>   LEFT | RIGHt | ABOVe | BELow

<WindowType>   Type of measurement window you want to add.
See LAYout:ADD[:WINDow]? on page 137 for a list of available window types.
Note that the window type must be valid for the active channel. To create a window for a different channel, use the LAYout:GLOBal:ADD[:WINDow]? command.

Return values:

<NewWindowName>   When adding a new window, the command returns its name (by default the same as its number) as a result.

Example: LAY:WIND1:ADD? LEFT,MTAB
Result:
'2'
Adds a new window named '2' with a marker table to the left of window 1.

Usage: Query only

LAYout:WINDow<n>:IDENtify?

Queries the **name** of a particular display window (indicated by the <n> suffix) in the active channel.

Note: to query the **index** of a particular window, use the `LAYout:IDENtify[:WINDow]?` command.

Suffix:

<n>　　　　　　　　　　Window

Return values:

<WindowName>　　　　String containing the name of a window.
　　　　　　　　　　　In the default state, the name of the window is its index.

Example:　　　　　`LAY:WIND2:IDEN?`
　　　　　　　　　　　Queries the name of the result display in window 2.
　　　　　　　　　　　Response:
　　　　　　　　　　　`'2'`

Usage:　　　　　　Query only

LAYout:WINDow<n>:REMove

Removes the window specified by the suffix <n> from the display in the active channel.

The result of this command is identical to the `LAYout:REMove[:WINDow]` command.

To remove a window in a different channel, use the `LAYout:GLOBal:REMove[:WINDow]` command.

Suffix:

<n>　　　　　　　　　　Window

Example:　　　　　`LAY:WIND2:REM`
　　　　　　　　　　　Removes the result display in window 2.

Usage:　　　　　　Event

LAYout:WINDow<n>:REPLace <WindowType>

Changes the window type of an existing window (specified by the suffix <n>) in the active channel.

The effect of this command is identical to the `LAYout:REPLace[:WINDow]` command.

To add a new window, use the `LAYout:WINDow<n>:ADD?` command.

Suffix:

<n>　　　　　　　　　　Window

Setting parameters:

<WindowType>   Type of measurement window you want to replace another one with.
See `LAYout:ADD[:WINDow]?` on page 137 for a list of available window types.
Note that the window type must be valid for the active channel. To create a window for a different channel, use the `LAYout:GLOBal:REPLace[:WINDow]` command.

Example: `LAY:WIND2:REPL MTAB`
Replaces the result display in window 2 with a marker table.

Usage: Setting only

LAYout:WINDow<n>:TYPE <WindowType>

Queries or defines the window type of the window specified by the index <n>. The window type determines which results are displayed. For a list of possible window types, see `LAYout:ADD[:WINDow]?` on page 137.

Note that this command is not available in all applications and measurements.

Suffix:

<n>   1..n
Window

Parameters:
<WindowType>

Example: `LAY:WIND2:TYPE?`

7.5 Trace data readout

7.5.1 Using the TRACe[:DATA] command

This chapter contains information on the `TRACe:DATA` command and a detailed description of the characteristics of that command.

The `TRACe:DATA` command queries the trace data or results of the currently active measurement or result display. The type, number and structure of the return values are specific for each result display. In case of results that have any kind of unit, the command returns the results in the unit you have currently set for that result display.

Note also that return values for results that are available for both downlink and uplink may be different.

For several result displays, the command also supports various SCPI parameters in combination with the query. If available, each SCPI parameter returns a different

aspect of the results. If SCPI parameters are supported, you have to quote one in the query.

Example:

`TRAC2:DATA? TRACE1`

The format of the return values is either in ASCII or binary characters and depends on the format you have set with `FORMat[:DATA]`.

Following this detailed description, you will find a short summary of the most important functions of the command (`TRACe<n>[:DATA]?`).

Selecting a measurement window

Before querying results, you have to select the measurement window with the suffix <n> at `TRACe`. The range of <n> depends on the number of active measurement windows.

On an R&S FSQ or R&S FSV, the suffix <n> was not supported. On these instruments, you had to select the measurement window with `DISPlay:WINDow<n>:SELect` first.

For measurements on aggregated carriers or multiple antennas, where each measurement window has subwindows, you have to select the subwindow first with `DISPlay[:WINDow<n>][:SUBWindow<w>]:SELect`.

7.5.1.1 Allocation ID vs symbol x carrier

For the allocation ID vs symbol x carrier, the command returns one value for each resource element.

`<ID[Symbol(0),Carrier(1)]>, ..., <ID[Symbol(0),Carrier(n)]>,`

`<ID[Symbol(1),Carrier(1)]>, ..., <ID[Symbol(1),Carrier(n)]>,`

`...`

`<ID[Symbol(n),Carrier(1)]>, ..., <ID[Symbol(n),Carrier(n)]>,`

The `<allocation ID>` is encoded.

For the code assignment, see Chapter 7.5.1.28, "Return value codes", on page 157.

The following parameters are supported.

● `TRAC:DATA TRACE1`

7.5.1.2 Allocation summary

For the allocation summary, the command returns several values for each line of the table.

● `<subframe>`
● `<allocation ID>`
● `<number of RB>`
● `<relative power>`
● `<modulation>`
● `<absolute power>`
● `<EVM>`
● `<LayerEVM>`

The data format of the return values is always ASCII.

The return values have the following characteristics.

● The `<allocation ID` is encoded.
  For the code assignment, see Chapter 7.5.1.28, "Return value codes", on page 157.
● The unit for `<relative power>` is always dB.
● The `<modulation>` is encoded.
  For the code assignment, see Chapter 7.5.1.28, "Return value codes", on page 157.
● The unit for `<absolute power>` is always dBm.
● The unit for `<EVM>` depends on `UNIT:EVM`.

- The unit for `<LayerEVM>` depends on `UNIT:EVM`.

Example:

`TRAC:DATA? TRACE1` would return:

```
0, -5, 0, 0.0000000000000, 2, -45.5463829153428, 7.33728660354122E-05, 8.2587600145187E-05
0, -3, 0, 0.0073997452251, 6, -42.5581007463452, 2.54197349219455E-05, 2.9270188222955E-05
0, -4, 0, 0.0052647197362, 1, -42.5464220485716, 2.51485275782241E-05, 2.5002471912438E-05
...
```

Additional information "ALL"

The allocation summary contains additional lines "ALL" that summarize the number of RB analyzed in each subframe and the average EVM measured in that subframe. This information is added to the return values after all allocations of the subframe have been returned. The "ALL" information has the allocation ID code "-2".

In addition, there is a line at the end of the allocation summary that shows the average EVM over all analyzed subframes. This information is also added as the last return values. The "ALL" information has the subframe ID and allocation ID code "-2".

A query result would thus look like this, for example:

```
//For subframe 0:
0, -40, 10, 2, 2, -84.7431947342849, 2.68723483754626E-06,
0, -41, 0, 0, 6, -84.7431432845264, 2.37549449584568E-06,
(...)
//ALL for subframe 0:
0,-2,20,,,,2.45581475911678E-06
//For subframe 1:
1, -40, 10, 2, 2, -84.7431947342849, 2.68723483754626E-06,
1, -41, 0, 0, 6, -84.7431432845264, 2.37549449584568E-06,
(...)
//ALL for subframe 1:
1,-2,20,,,,2.45581475911678E-06
(...)
//ALL for all subframes
-2,-2,,,,,2.13196434228374E-06
```

7.5.1.3   Beamform allocation summary

For the beamform allocation summary result display, the command returns four values for each allocation that has been found.

`<Subframe>, <AllocationID>, <Phase>, <PhaseDifference>, ...`

The unit for `<Phase>` and `<PhaseDifference>` is always degrees. The `<Subframe>` has no unit.

The `<allocation ID>` is encoded. For the code assignment see Chapter 7.5.1.28, "Return value codes", on page 157.

7.5.1.4 Bit stream

For the bitstream result display, the number of return values depends on the parameter.

- `TRACE:DATA TRACE1`
  Returns several values and the bitstream for each line of the table.
  `<subframe>, <allocation ID>, <codeword>, <modulation>, <# of symbols/bits>, <hexadecimal/binary numbers>,...`

- `TRACE:DATA TRACE2`
  Returns all informative values of an allocation, including the totals over all PDSCH allocations that contribute to the bitstream, but not the bitstream itself.
  `<subframe>, <allocation ID>, <codeword>, <modulation>, <# of symbols/bits>, <hexadecimal/binary numbers>,...,<total # bits>, <total # bit errors>, <total # decoded bits>, <total bit error rate>`

- `TRACE:DATA TRACE3`
  Returns all informative values of an allocation, including the totals over all PDSCH allocations that contribute to the bitstream, but not the bitstream itself. The difference to `TRACE2` is that this query also includes the Bit/s result.
  `<subframe>, <allocation ID>, <codeword>, <modulation>, <# of symbols/bits>, <hexadecimal/binary numbers>,...,<total # bits>, <total # bit errors>, <total # decoded bits>, <total bit error rate>, <bits/second>`

All values have no unit. The format of the bit stream depends on Bit Stream Format.

The `<allocation ID>`, `<codeword>` and `<modulation>` are encoded. For the code assignment see Chapter 7.5.1.28, "Return value codes", on page 157.

For symbols or bits that are not transmitted, the command returns
- "FFF" if the bit stream format is "Symbols"
- "9" if the bit stream format is "Bits".

For symbols or bits that could not be decoded because the number of layer exceeds the number of receive antennas, the command returns
- "FFE" if the bit stream format is "Symbols"
- "8" if the bit stream format is "Bits".

Note that the data format of the return values is always ASCII.

Example:

`TRAC:DATA? TRACE1` would return:

`0, -12, 0, 2, 0, 01, 01, 00, 02, 03, 00, 01, 02, 01, 02, 01, ...`

`<continues like this until the next data block starts or the end of data is reached>`

`0, -12, 0, 2, 32, 03, 02, 03, 03, 03, 03, 01, 03, 00, 03, ...`

7.5.1.5 Capture buffer

For the capture buffer result display, the command returns one value for each I/Q sample in the capture buffer.

`<absolute power>, ...`

The unit is always dBm.

The following parameters are supported.

- `TRAC:DATA TRACE1`

Note that the command returns positive peak values only.

7.5.1.6 CCDF

For the CCDF result display, the type of return values depends on the parameter.

- `TRAC:DATA TRACE1`
  Returns the probability values (y-axis).
  `<# of values>, <probability>, ...`
  The unit is always %.
  The first value that is returned is the number of the following values.
- `TRAC:DATA TRACE2`
  Returns the corresponding power levels (x-axis).
  `<# of values>, <relative power>, ...`
  The unit is always dB.
  The first value that is returned is the number of the following values.

7.5.1.7 Cell RS weights phase

For the cell RS weights magnitude result display, the command returns one value for each subcarrier that has been analyzed.

`<Phase>, ...`

The unit degree.

The following parameters are supported.

- `TRAC:DATA TRACE1`

Returns the phase of the measured weights of the reference signal (RS) carriers over one subframe.

7.5.1.8 Cell RS weights magnitude

For the cell RS weights magnitude result display, the command returns one value for each subcarrier that has been analyzed.

`<Magnitude>, ...`

The unit is dB.

The following parameters are supported.

- `TRAC:DATA TRACE1`
  Returns the magnitude of the measured weights of the reference signal (RS) carriers over one subframe.

7.5.1.9 Channel decoder results

For the channel decoder results, the number and type of return values depend on the parameter.

- `TRAC:DATA PBCH`
  Returns the results for the PBCH if PBCH decoding (or CRC check) was successful. The results are made up out of six values.
  `<subframe>, <# of antennas>, <system bandwidth>, <frame>, <PHICH duration>, <PHICH resource>`
  The unit for `<system bandwidth>` is Hz. All other values have no unit.
  The `<PHICH duration>` and `<PHICH resource>` are encoded. For the code assignment see Chapter 7.5.1.28, "Return value codes", on page 157.
  If PBCH decoding was not successful, the command returns NAN.

- `TRAC:DATA PCFICH`
  Returns the results for the PCFICH. The results are made up out of two parameters.
  `<subframe>, <number of symbols for PDCCH>`
  The values have no unit.

- `TRAC:DATA PHICH`
  Returns the results for the PHICH. The results are made up out of three values for each line of the table.
  `<subframe>, <ACK/NACK>, <relative power>`
  The unit for `<relative power>` is dB. All other values have no unit.
  The `<ACK/NACK>` is encoded. For the code assignment see Chapter 7.5.1.28, "Return value codes", on page 157.

- `TRAC:DATA PDCCH`
  Returns the results for the PDCCH. The results are made up out of seven values for each line of the table.
  `<subframe>, <RNTI>, <DCI format>, <PDCCH format>, <CCE offset>, <# of transmitted bits>, [stream of binary numbers]`
  The values have no unit.

The `[stream of binary numbers]` is a list of binary numbers separated by comma.

The `<DCI format>` and `<PDCCH format>` are encoded. For the code assignment see Chapter 7.5.1.28, "Return value codes", on page 157.

- `TRAC:DATA PDSCH`
  Returns the results for the PDSCH. The results are made up out of five values for each line of the table.
  `<subframe>, <allocationID>, <codeword>, <# of transmitted bits>, [stream of binary numbers]`
  The values have no unit.
  The `[stream of binary numbers]` is a list of binary numbers separated by comma.
  If the PDSCH could not be decoded, the NAN is returned instead of the `<# of transmitted bits>`. The `[stream of binary numbers]` is not shown.
  The `<allocationID>` and `<codeword>` are encoded. For the code assignment see Chapter 7.5.1.28, "Return value codes", on page 157.

7.5.1.10 Channel and spectrum flatness

For the channel flatness result display, the command returns one value for each trace point.

`<relative power>, ...`

The unit is always dB.

The following parameters are supported.

- `TRAC:DATA TRACE1`
  Returns the average power over all subframes.

- `TRAC:DATA TRACE2`
  Returns the minimum power found over all subframes. If you are analyzing a particular subframe, it returns nothing.

- `TRAC:DATA TRACE3`
  Returns the maximum power found over all subframes. If you are analyzing a particular subframe, it returns nothing.

7.5.1.11 Channel and spectrum flatness difference

For the channel flatness difference result display, the command returns one value for each trace point.

`<relative power>, ...`

The unit is always dB. The number of values depends on the selected LTE bandwidth.

The following parameters are supported.

- `TRAC:DATA TRACE1`
  Returns the average power over all subframes.

- `TRAC:DATA TRACE2`

Returns the minimum power found over all subframes. If you are analyzing a particular subframe, it returns nothing.

- `TRAC:DATA TRACE3`
  Returns the maximum power found over all subframes. If you are analyzing a particular subframe, it returns nothing.

7.5.1.12 Group delay

For the group delay result display, the command returns one value for each trace point.

`<group delay>, ...`

The unit is always ns. The number of values depends on the selected LTE bandwidth.

The following parameters are supported.

- `TRAC:DATA TRACE1`
  Returns the group delay.

7.5.1.13 Constellation diagram

For the constellation diagram, the command returns two values for each constellation point.

`<I[SF0][Sym0][Carrier1]>, <Q[SF0][Sym0][Carrier1]>, ..., <I[SF0][Sym0][Carrier(n)]>, <Q[SF0][Sym0][Carrier(n)]>,`

`<I[SF0][Sym1][Carrier1]>, <Q[SF0][Sym1][Carrier1]>, ..., <I[SF0][Sym1][Carrier(n)]>, <Q[SF0][Sym1][Carrier(n)]>,`

`<I[SF0][Sym(n)][Carrier1]>, <Q[SF0][Sym(n)][Carrier1]>, ..., <I[SF0][Sym(n)][Carrier(n)]>, <Q[SF0][Sym(n)][Carrier(n)]>,`

`<I[SF1][Sym0][Carrier1]>, <Q[SF1][Sym0][Carrier1]>, ..., <I[SF1][Sym0][Carrier(n)]>, <Q[SF1][Sym0][Carrier(n)]>,`

`<I[SF1][Sym1][Carrier1]>, <Q[SF1][Sym1][Carrier1]>, ..., <I[SF1][Sym1][Carrier(n)]>, <Q[SF1][Sym1][Carrier(n)]>,`

`<I[SF(n)][Sym(n)][Carrier1]>, <Q[SF(n)][Sym(n)][Carrier1]>, ..., <I[SF(n)][Sym(n)][Carrier(n)]>, <Q[SF(n)][Sym(n)][Carrier(n)]>`

With SF = subframe and Sym = symbol of that subframe.

The I and Q values have no unit.

The number of return values depends on the constellation selection. By default, it returns all resource elements including the DC carrier.

The following parameters are supported.

- `TRAC:DATA TRACE1`
  Returns all constellation points included in the selection.

7.5.1.14 CSI RS weights magnitude

For the CSI RS weights magnitude result display, the command returns one value for each subcarrier that has been analyzed.

```
<Magnitude>, ...
```

The unit dB.

The following parameters are supported.

- `TRAC:DATA TRACE1`
  Returns the magnitude of the measured weights of the reference signal (RS) carriers over one subframe.

7.5.1.15　CSI RS weights phase

For the CSI RS weights phase result display, the command returns one value for each subcarrier that has been analyzed.

```
<Phase>, ...
```

The unit degrees.

The following parameters are supported.

- `TRAC:DATA TRACE1`
  Returns the phase of the measured weights of the reference signal (RS) carriers over one subframe.

7.5.1.16　EVM vs carrier

For the EVM vs carrier result display, the command returns one value for each subcarrier that has been analyzed.

```
<EVM>, ...
```

The unit depends on `UNIT:EVM`.

The following parameters are supported.

- `TRAC:DATA TRACE1`
  Returns the average EVM over all subframes
- `TRAC:DATA TRACE2`
  Returns the minimum EVM found over all subframes. If you are analyzing a particular subframe, it returns nothing.
- `TRAC:DATA TRACE3`
  Returns the maximum EVM found over all subframes. If you are analyzing a particular subframe, it returns nothing.

7.5.1.17　EVM vs RB

For the EVM vs RB result display, the command returns one value for each resource block that has been analyzed.

```
<EVM>, ...
```

The unit depends on `UNIT:EVM`.

The following parameters are supported.

- `TRAC:DATA TRACE1`
  Returns the average EVM for each resource block over all subframes.
- `TRAC:DATA TRACE2`
  Returns the minimum EVM found over all subframes. If you are analyzing a single subframe, it returns nothing.
- `TRAC:DATA TRACE3`
  Returns the maximum EVM found over all subframes. If you are analyzing a single subframe, it returns nothing.

7.5.1.18 EVM vs subframe

For the EVM vs subframe result display, the command returns one value for each subframe that has been analyzed.

`<EVM>, ...`

The unit depends on `UNIT:EVM`.

The following parameters are supported.

- `TRAC:DATA TRACE1`

7.5.1.19 EVM vs symbol

For the EVM vs symbol result display, the command returns one value for each OFDM symbol that has been analyzed.

`<EVM>, ...`

For measurements on a single subframe, the command returns the symbols of that subframe only.

The unit depends on `UNIT:EVM`.

The following parameters are supported.

- `TRAC:DATA TRACE1`

7.5.1.20 EVM vs symbol x carrier

For the EVM vs symbol x carrier, the command returns one value for each resource element.

`<EVM[Symbol(0),Carrier(1)]>, ..., <EVM[Symbol(0),Carrier(n)]>,`

`<EVM[Symbol(1),Carrier(1)]>, ..., <EVM[Symbol(1),Carrier(n)]>,`

`...`

`<EVM[Symbol(n),Carrier(1)]>, ..., <EVM[Symbol(n),Carrier(n)]>,`

The unit depends on `UNIT:EVM`.

Resource elements that are unused return `NAN`.

The following parameters are supported.

● `TRAC:DATA TRACE1`

7.5.1.21 Frequency error vs symbol

For the frequency error vs symbol result display, the command returns one value for each OFDM symbol that has been analyzed.

`<frequency error>,...`

The unit is always Hz.

The following parameters are supported.

● `TRAC:DATA TRACE1`

7.5.1.22 Power spectrum

For the power spectrum result display, the command returns one value for each trace point.

`<power>,...`

The unit is always dBm/Hz.

The following parameters are supported.

● `TRAC:DATA TRACE1`

7.5.1.23 Power vs RB RS

For the power vs RB RS result display, the command returns one value for each resource block of the reference signal that has been analyzed.

`<absolute power>,...`

The unit is always dBm.

The following parameters are supported.

● `TRAC:DATA TRACE1`
  Returns the average power over all subframes

● `TRAC:DATA TRACE2`
  Returns the minimum power found over all subframes. If you are analyzing a particular subframe, it returns nothing.

● `TRAC:DATA TRACE3`
  Returns the maximum power found over all subframes. If you are analyzing a particular subframe, it returns nothing.

7.5.1.24 Power vs RB PDSCH

For the power vs RB PDSCH result display, the command returns one value for each resource block of the PDSCH that has been analyzed.

`<absolute power>,...`

The unit is always dBm.

The following parameters are supported.

- `TRAC:DATA TRACE1`
  Returns the average power over all subframes

- `TRAC:DATA TRACE2`
  Returns the minimum power found over all subframes. If you are analyzing a particular subframe, it returns nothing.

- `TRAC:DATA TRACE3`
  Returns the maximum power found over all subframes. If you are analyzing a particular subframe, it returns nothing.

7.5.1.25   Power vs symbol x carrier

For the power vs symbol x carrier, the command returns one value for each resource element.

`<P[Symbol(0),Carrier(1)]>, ..., <P[Symbol(0),Carrier(n)]>,`

`<P[Symbol(1),Carrier(1)]>, ..., <P[Symbol(1),Carrier(n)]>,`

`...`

`<P[Symbol(n),Carrier(1)]>, ..., <P[Symbol(n),Carrier(n)]>,`

with P = Power of a resource element.

The unit is always dBm.

Resource elements that are unused return `NAN`.

The following parameters are supported.

- `TRAC:DATA TRACE1`

7.5.1.26   UE RS weights magnitude

For the UE RS weights magnitude result display, the command returns one value for each subcarrier that has been analyzed.

`<Magnitude>, ...`

The unit dB.

The following parameters are supported.

- `TRAC:DATA TRACE1`
  Returns the magnitude of the measured weights of the reference signal (RS) carriers over one subframe.

7.5.1.27   UE RS weights phase

For the UE RS phase result display, the command returns one value for each subcarrier that has been analyzed.

`<Phase>, ...`

The unit degrees.

The following parameters are supported.

- `TRAC:DATA TRACE1`
  Returns the phase of the measured weights of the reference signal (RS) carriers over one subframe.

7.5.1.28   Return value codes

<number of symbols or bits>

In hexadecimal mode, this represents the number of symbols to be transmitted. In binary mode, it represents the number of bits to be transmitted.

<ACK/NACK>

The range is {-1...1}.

- **1** = ACK
- **0** = NACK
- **-1** = DTX

<allocation ID>

Represents the allocation ID. The range is as follows.

- **0 - 65535** = PDSCH
- **-1** = Invalid / not used
- **-2** = All
- **-3** = P-Sync
- **-4** = S-Sync
- **-5** = Reference Signal (Antenna 1)
- **-6** = Reference Signal (Antenna 2)
- **-7** = Reference Signal (Antenna 3)
- **-8** = Reference Signal (Antenna 4)
- **-9** = PCFICH
- **-10** = PHICH
- **-11** = PDCCH
- **-12** = PBCH
- **-13** = PMCH
- **-14** = Positioning Reference Signal
- **-15** = CSI Reference Signal (Port 15 and 16)
- **-16** = CSI Reference Signal (Port 17 and 18)
- **-17** = CSI Reference Signal (Port 19 and 20)
- **-18** = CSI Reference Signal (Port 21 and 22)

- **-19** = EPDCCH
- **-20** = EPDCCH DMRS1
- **-21** = EPDCCH DMRS2
- **-22** = PMCH Reference Signal
- **-1xxxxx** = UE Reference Signal (Port 5)
- **-2xxxxx** = UE Reference Signal 1 (Port 7, 8, 11, 12)
- **-3xxxxx** = UE Reference Signal 2 (Port 9, 10, 13, 14, signals with more than 2 layers)
  Note. **xxxxx** is a placeholder for the ID of the PDSCH.
  If the PDSCH has, for example, the ID 22, the return value would be -100022, -200022 or -300022 (depending on the configuration)

<channel type>

- **0** = TX channel
- **1** = adjacent channel
- **2** = alternate channel

<codeword>

Represents the codeword of an allocation. The range is {0...6}.

- **0** = 1/1
- **1** = 1/2
- **2** = 2/2
- **3** = 1/4
- **4** = 2/4
- **5** = 3/4
- **6** = 4/4

<DCI format>

Represents the DCI format. The value is a number in the range {0...103}.

- **0** = DCI format 0
- **10** = DCI format 1
- **11** = DCI format 1A
- **12** = DCI format 1B
- **13** = DCI format 1C
- **14** = DCI format 1D
- **20** = DCI format 2
- **21** = DCI format 2A
- **22** = DCI format 2B
- **23** = DCI format 2C
- **24** = DCI format 2D
- **30** = DCI format 3

- **31** = DCI format A
- **103** = DCI format 0/3/3A

<modulation>

Represents the modulation scheme.

- **0** = unrecognized
- **1** = RBPSK
- **2** = QPSK
- **3** = 16QAM
- **4** = 64QAM
- **5** = 8PSK
- **6** = CAZAC
- **7** = mixed modulation
- **8** = BPSK
- **14** = 256QAM
- **15** = 1024QAM

<PHICH duration>

Represents the PHICH duration. The range is {1...2}.

- **1** = normal
- **2** = extended

<PHICH resource>

Represents the parameter N_g. The range is {1...4}.

- **1** = N_g 1/6
- **2** = N_g 1/2
- **3** = N_g 1
- **4** = N_g 2

FORMat[:DATA] <Format>

Selects the data format for the data transmission between the R&S VSE and the remote client.

Parameters:

<Format>	ASCii | REAL	
	*RST:	ASCii

Example:	//Select data format
	`FORM REAL`

TRACe<n>[:DATA]? <Result>

This command queries the trace data for each measurement point (y-axis values).

In combination with `TRACe<n>[:DATA]:X?`, you can thus query the coordinates of each measurement point.

Suffix:

<n>   Window

Query parameters:

<TraceNumber>   **TRACE1 | TRACE2 | TRACE3**
                       Queries the trace data of the corresponding trace.

LIST   Queries the results for the SEM measurement.

PBCH   Queries the results for the PBCH in the channel decoder.

PCFICH   Queries the results for the PCFICH in the channel decoder.

PHICH   Queries the results for the PHICH in the channel decoder.

PDCCH   Queries the results for the PDCCH in the channel decoder.

Return values:

<TraceData>   For more information about the type of return values in the different result displays, see Chapter 7.5.1, "Using the TRACe[:DATA] command", on page 144.

Example: //Query results of the second measurement window. The type of data that is returned by the parameter (`TRACE1`) depends on the result display shown in measurement window 2.
                       `TRAC2? TRACE1`

Usage: Query only

Manual operation: See "Data import and export" on page 118

TRACe<n>[:DATA]:X? <Result>

Queries the horizontal trace data for each measurement point (x-axis values).

In combination with `TRACe<n>[:DATA]?`, you can thus query the coordinates of each measurement point.

Suffix:

<n>   Window

Query parameters:

<TraceNumber>   TRACe1 | TRACe2 | TRACe3 | TRACe4 | TRACe5 | TRACe6

Return values:

<TraceData>   The type of value depends on the information displayed on the x-axis of the result display whose contents you query.

Example: //Query trace data of trace 1 in window 2
                       `TRAC2? TRACE1`
                       `TRAC2:X? TRACE1`

Usage:	Query only
Manual operation:	See "Capture Buffer" on page 15
	See "EVM vs Carrier" on page 16
	See "EVM vs Symbol" on page 17
	See "EVM vs RB" on page 18
	See "EVM vs Subframe" on page 18
	See "Frequency Error vs Symbol" on page 19
	See "Power Spectrum" on page 20
	See "Power vs Resource Block PDSCH" on page 20
	See "Power vs Resource Block RS" on page 21
	See "Channel Flatness" on page 21
	See "Group Delay" on page 22
	See "Channel Flatness Difference" on page 22

7.6 Numeric result readout

7.6.1 Frame results

FETCh[:CC<cc>]:SUMMary:EVM:DSQP:MAXimum?
FETCh[:CC<cc>]:SUMMary:EVM:DSQP:MINimum?
FETCh[:CC<cc>]:SUMMary:EVM:DSQP[:AVERage]?

Queries the EVM of all PDSCH resource elements with a QPSK modulation.

Suffix:

<cc>   Component Carrier

Return values:

<EVM>   <numeric value>

                             EVM in % or dB, depending on the unit you have set.

Example: //Query EVM
                             FETC:SUMM:EVM:DSQP?

Usage: Query only

FETCh[:CC<cc>]:SUMMary:EVM:DSST:MAXimum?
FETCh[:CC<cc>]:SUMMary:EVM:DSST:MINimum?
FETCh[:CC<cc>]:SUMMary:EVM:DSST[:AVERage]?

Queries the EVM of all PDSCH resource elements with a 16QAM modulation.

Suffix:

<cc>   Component Carrier

Return values:

<EVM>   <numeric value>

                             EVM in % or dB, depending on the unit you have set.

Example: //Query EVM
                             FETC:SUMM:EVM:DSST?

Usage: Query only

FETCh[:CC<cc>]:SUMMary:EVM:DSSF:MAXimum?
FETCh[:CC<cc>]:SUMMary:EVM:DSSF:MINimum?
FETCh[:CC<cc>]:SUMMary:EVM:DSSF[:AVERage]?

Queries the EVM of all PDSCH resource elements with a 64QAM modulation.

Suffix:

<cc>   Component Carrier

Return values:

<EVM>   <numeric value>

                             EVM in % or dB, depending on the unit you have set.

Example: //Query EVM
                             FETC:SUMM:EVM:DSSF?

Usage: Query only

FETCh[:CC<cc>]:SUMMary:EVM:DSTS:MAXimum?
FETCh[:CC<cc>]:SUMMary:EVM:DSTS:MINimum?
FETCh[:CC<cc>]:SUMMary:EVM:DSTS[:AVERage]?

Queries the EVM of all PDSCH resource elements with a 256QAM modulation.

Suffix:

<cc>	Component Carrier

Return values:

<EVM>	<numeric value>
	EVM in % or dB, depending on the unit you have set.

Example:

//Query EVM
`FETC:SUMM:EVM:DSTS?`

Usage:

Query only

FETCh[:CC<cc>]:SUMMary:EVM:DS1K:MAXimum?
FETCh[:CC<cc>]:SUMMary:EVM:DS1K:MINimum?
FETCh[:CC<cc>]:SUMMary:EVM:DS1K[:AVERage]?

Queries the EVM of all resource elements of the PDSCH with a 1024QAM modulation.

Suffix:

<cc>	Component Carrier

Return values:

<EVM>	<numeric value>
	EVM in % or dB, depending on the unit you have set.

Example:

//Query EVM
`FETC:SUMM:EVM:DS1K?`

Usage:

Query only

7.6.2 Result for selection

FETCh[:CC<cc>]:SUMMary:CRESt[:AVERage]?

Queries the average crest factor as shown in the result summary.

Suffix:

<cc>	Component Carrier

Return values:

<CrestFactor>	<numeric value>
	Crest Factor in dB.

Example:

	//Query crest factor
	`FETC:SUMM:CRES?`

Usage: Query only

FETCh[:CC<cc>]:SUMMary:EVM[:ALL]:MAXimum?
FETCh[:CC<cc>]:SUMMary:EVM[:ALL]:MINimum?
FETCh[:CC<cc>]:SUMMary:EVM[:ALL][:AVERage]?

Queries the EVM of all resource elements.

Suffix:

<cc>	Component Carrier

Return values:

<EVM>	<numeric value>
	Minimum, maximum or average EVM, depending on the last command syntax element. The unit is % or dB, depending on your selection.

Example:

	//Query EVM
	`FETC:SUMM:EVM?`

Usage: Query only

FETCh[:CC<cc>]:SUMMary:EVM:PCHannel:MAXimum?
FETCh[:CC<cc>]:SUMMary:EVM:PCHannel:MINimum?
FETCh[:CC<cc>]:SUMMary:EVM:PCHannel[:AVERage]?

Queries the EVM of all physical channel resource elements.

Suffix:
<cc>   Component Carrier

Return values:
<EVM>   <numeric value>

EVM in % or dB, depending on the unit you have set.

Example: //Query EVM
                        FETC:SUMM:EVM:PCH?

Usage: Query only

FETCh[:CC<cc>]:SUMMary:EVM:PSIGnal:MAXimum?
FETCh[:CC<cc>]:SUMMary:EVM:PSIGnal:MINimum?
FETCh[:CC<cc>]:SUMMary:EVM:PSIGnal[:AVERage]?

Queries the EVM of all physical signal resource elements.

Suffix:
<cc>   Component Carrier

Return values:
<EVM>   <numeric value>

Minimum, maximum or average EVM, depending on the last
command syntax element.
The unit is % or dB, depending on your selection.

Example: //Query EVM
                        FETC:SUMM:EVM:PSIG?

Usage: Query only

FETCh[:CC<cc>]:SUMMary:FERRor:MAXimum?
FETCh[:CC<cc>]:SUMMary:FERRor:MINimum?
FETCh[:CC<cc>]:SUMMary:FERRor[:AVERage]?

Queries the frequency error.

Suffix:
<cc>   Component Carrier

Return values:

<FrequencyError>	<numeric value>
	Minimum, maximum or average frequency error, depending on the last command syntax element.
	Default unit: Hz
Example:	//Query average frequency error
	`FETC:SUMM:FERR?`
Usage:	Query only

FETCh[:CC<cc>]:SUMMary:GIMBalance:MAXimum?
FETCh[:CC<cc>]:SUMMary:GIMBalance:MINimum?
FETCh[:CC<cc>]:SUMMary:GIMBalance[:AVERage]?

Queries the I/Q gain imbalance.

Suffix:

<cc>	Component Carrier

Return values:

<GainImbalance>	<numeric value>
	Minimum, maximum or average I/Q imbalance, depending on the last command syntax element.
	Default unit: dB
Example:	//Query average gain imbalance
	`FETC:SUMM:GIMB?`
Usage:	Query only

FETCh[:CC<cc>]:SUMMary:IQOFfset:MAXimum?
FETCh[:CC<cc>]:SUMMary:IQOFfset:MINimum?
FETCh[:CC<cc>]:SUMMary:IQOFfset[:AVERage]?

Queries the I/Q offset.

Suffix:

<cc>	Component Carrier

Return values:

<IQOffset>	<numeric value>
	Minimum, maximum or average I/Q offset, depending on the last command syntax element.
	Default unit: dB
Example:	//Query average IQ offset
	`FETC:SUMM:IQOF?`
Usage:	Query only

FETCh[:CC\<cc>]:SUMMary:OSTP:MAXimum?
FETCh[:CC\<cc>]:SUMMary:OSTP:MINimum?
FETCh[:CC\<cc>]:SUMMary:OSTP[:AVERage]?

Queries the OSTP.

Suffix:

\<cc>	Component Carrier

Return values:

\<OSTP>	\<numeric value>
	Minimum, maximum or average OSTP, depending on the last command syntax element.
	Default unit: dBm

Example:	//Query average OSTP
	FETC:SUMM:OSTP?

Usage:	Query only

FETCh[:CC\<cc>]:SUMMary:POWer:MAXimum?
FETCh[:CC\<cc>]:SUMMary:POWer:MINimum?
FETCh[:CC\<cc>]:SUMMary:POWer[:AVERage]?

Queries the total power.

Suffix:

\<cc>	Component Carrier

Return values:

\<Power>	\<numeric value>
	Minimum, maximum or average power, depending on the last command syntax element.
	Default unit: dBm

Example:	//Query average total power
	FETC:SUMM:POW?

Usage:	Query only

FETCh[:CC\<cc>]:SUMMary:QUADerror:MAXimum?
FETCh[:CC\<cc>]:SUMMary:QUADerror:MINimum?
FETCh[:CC\<cc>]:SUMMary:QUADerror[:AVERage]?

Queries the quadrature error.

Suffix:

\<cc>	Component Carrier

Return values:

<QuadratureError>	<numeric value>
	Minimum, maximum or average quadrature error, depending on the last command syntax element.
	Default unit: deg
Example:	//Query average quadrature error
	`FETC:SUMM:QUAD?`
Usage:	Query only

FETCh[:CC<cc>]:SUMMary:RSSI:MAXimum?
FETCh[:CC<cc>]:SUMMary:RSSI:MINimum?
FETCh[:CC<cc>]:SUMMary:RSSI[:AVERage]?

Queries the RSSI.

Suffix:

<cc>	Component Carrier

Return values:

<RSSI>	<numeric value>
	Minimum, maximum or average sampling error, depending on the last command syntax element.
	Default unit: dBm
Example:	//Query average RSSI
	`FETC:SUMM:RSSI?`
Usage:	Query only

FETCh[:CC<cc>]:SUMMary:RSTP:MAXimum?
FETCh[:CC<cc>]:SUMMary:RSTP:MINimum?
FETCh[:CC<cc>]:SUMMary:RSTP[:AVERage]?

Queries the RSTP.

Suffix:

<cc>	Component Carrier

Return values:

<RSTP>	<numeric value>
	Default unit: dBm
Example:	//Query RSTP
	`FETC:SUMM:RSTP?`
Usage:	Query only

FETCh[:CC<cc>]:SUMMary:SERRor:MAXimum?
FETCh[:CC<cc>]:SUMMary:SERRor:MINimum?
FETCh[:CC<cc>]:SUMMary:SERRor[:AVERage]?

Queries the sampling error.

Suffix:

<cc>	Component Carrier

Return values:

<SamplingError>	<numeric value>
	Minimum, maximum or average sampling error, depending on the last command syntax element.
	Default unit: ppm

Example: //Query average sampling error
`FETC:SUMM:SERR?`

Usage: Query only

FETCh[:CC<cc>]:SUMMary:TFRame?

Queries the (sub)frame start offset as shown in the capture buffer.

Suffix:

<cc>	Component Carrier

Return values:

<Offset>	Time difference between the (sub)frame start and capture buffer start.
	Default unit: s

Example: //Query subframe start offset
`FETC:SUMM:TFR?`

Usage: Query only

Manual operation: See "Capture Buffer" on page 15

7.6.3   Time alignment error

FETCh:TAERror[:CC<cc>]:ANTenna<ant>:MAXimum?
FETCh:TAERror[:CC<cc>]:ANTenna<ant>:MINimum?
FETCh:TAERror[:CC<cc>]:ANTenna<ant>[:AVERage]?

Queries the time alignment error.

Suffix:

<cc>	Component Carrier

<ant>	Antenna

Return values:

<TAE>	Minimum, maximum or average time alignment error, depending on the last command syntax element.
	Default unit: s

Example:	//Query average TAE between reference antenna and antenna 2
	FETC:TAER:ANT2?

Usage:	Query only

Manual operation:	See "Time Alignment Error" on page 37

7.6.4 Marker table

CALCulate<n>:DELTamarker<m>:X <Position>

Moves a delta marker to a particular coordinate on the x-axis.

If necessary, the command activates the delta marker and positions a reference marker to the peak power.

Suffix:

<n>	Window

<m>	Marker

Parameters:

<Position>	Numeric value that defines the marker position on the x-axis.
	Range:	The value range and unit depend on the measurement and scale of the x-axis.

Example:	CALC:DELT:X?
	Outputs the absolute x-value of delta marker 1.

CALCulate<n>:DELTamarker<m>:Y?

Queries the position of a deltamarker on the y-axis.

If necessary, the command activates the deltamarker first.

To get a valid result, you have to perform a complete measurement with synchronization to the end of the measurement before reading out the result. This is only possible for single measurement mode.

Note that result displays with a third aspect (for example "EVM vs Symbol x Carrier") do not support deltamarkers.

Suffix:

<n>	Window
<m>	Marker

Return values:

<Result>	<numeric value>
	Result at the deltamarker position. The return value is a value relative to the position of marker 1. The type of value and its unit depend on the selected result display.

Example: //Query coordinates of deltamarker 2 in window 4
`CALC4:DELT2:X?`
`CALC4:DELT2:Y?`

Usage: Query only

CALCulate<n>:MARKer<m>:X <Position>

Moves a marker to a specific coordinate on the x-axis.

If necessary, the command activates the marker.

If the marker has been used as a delta marker, the command turns it into a normal marker.

Suffix:

<n>	Window
<m>	Marker
	Note that 3D diagrams only support one marker.

Parameters:

<Position>	Numeric value that defines the marker position on the x-axis. The unit depends on the result display.
	Range: The range depends on the current x-axis range. Default unit: Hz

Example: `CALC:MARK2:X 1.7MHz`
Positions marker 2 to frequency 1.7 MHz.

Manual operation: See "Marker Table" on page 36

CALCulate<n>:MARKer<m>:Y <Result>

Queries the position of a marker on the y-axis.

In result displays with a third aspect (for example "EVM vs Symbol x Carrier"), you can also use the command to define the position of the marker on the y-axis.

If necessary, the command activates the marker first.

To get a valid result, you have to perform a complete measurement with synchronization to the end of the measurement before reading out the result. This is only possible for single measurement mode.

Suffix:

<n>	Window
<m>	Marker Note that 3D diagrams only support one marker.

Parameters:

<Result>	<numeric value> Result at the marker position. The type of value and its unit depend on the selected result display.

Example: //Query coordinates of marker 2 in window 4
`CALC4:MARK2:X?`
`CALC4:MARK2:Y?`

Example: //Define position of marker in 3D diagram
`CALC:MARK:X 16`
`CALC:MARK:Y 6`

Manual operation: See "Marker Table" on page 36

CALCulate<n>:MARKer<m>:Z?

Queries the marker position on the z-axis of three-dimensional result displays.

Returns the type of value displayed in the selected result display (EVM, Power or Allocation ID).

Suffix:

<n>	Window
<m>	Marker

Return values:

<Position>	<numeric value> Default unit: Depends on result display

Example: //Query marker position
`CALC:MARK:Z?`

Usage: Query only

Manual operation: See "Marker Table" on page 36

CALCulate<n>:MARKer<m>:Z:ALL?

Queries the marker position on the z-axis of three-dimensional result displays.

Instead of returning a certain type of value (EVM, Power **or** Allocation ID), which is possible with `CALCulate<n>:MARKer<m>:Z?`, this command returns all types of values (EVM, Power **and** Allocation ID), regardless of the result display type.

Suffix:

<n>	Window
<m>	irrelevant

Return values:

<Position> <numeric value>

EVM
EVM at the marker position.

Power
Power at the marker position.

Allocation ID
Allocation ID at the marker position.

Modulation
Modulation type at the marker position.

Example: //Query EVM, Power and Allocation ID at the marker position.
`CALC:MARK:Z:ALL?`

Usage: Query only

Manual operation: See "Marker Table" on page 36

7.6.5 CCDF table

CALCulate<n>:STATistics:CCDF:X<t>? <Probability>

Queries the results of the CCDF.

Suffix:

<n>	Window
<t>	Trace

Query parameters:

<Probability> **P0_01**
Level value for 0.01 % probability

P0_1
Level value for 0.1 % probability

P1
P1: Level value for 1 % probability

P10
Level value for 10 % probability

Return values:
<CCDF Result>

Example:	`CALC:STAT:CCDF:X1? P10`
	Returns the level values that are over 10 % above the mean value.
Usage:	Query only
Manual operation:	See "CCDF" on page 23

CALCulate<n>:STATistics:RESult<res>? <ResultType>

Queries the results of a measurement for a specific trace.

Suffix:

<n>	Window
<res>	Trace

Query parameters:

<ResultType>

MEAN
Average (=RMS) power in dBm measured during the measurement time.

PEAK
Peak power in dBm measured during the measurement time.

CFACtor
Determined crest factor (= ratio of peak power to average power) in dB.

ALL
Results of all three measurements mentioned before, separated by commas: <mean power>,<peak power>,<crest factor>

Example:	`CALC:STAT:RES2? ALL`
	Reads out the three measurement results of trace 2. Example of answer string: 5.56,19.25,13.69 i.e. mean power: 5.56 dBm, peak power 19.25 dBm, crest factor 13.69 dB
Usage:	Query only
Manual operation:	See "CCDF" on page 23

7.7 Limit check result readout

7.7.1 Limits for numerical result display

CALCulate<n>:LIMit<li>[:CC<cc>]:SUMMary:EVM[:ALL]:MAXimum:RESult?
CALCulate<n>:LIMit<li>[:CC<cc>]:SUMMary:EVM[:ALL][:AVERage]:RESult?

Queries the results of the EVM limit check of all resource elements.

Suffix:

<n>	irrelevant
	irrelevant
<cc>	Component Carrier

Return values:

<LimitCheck>	The type of limit (average or maximum) that is queried depends on the last syntax element.
	FAILED Limit check has failed.
	PASSED Limit check has passed.
	NOTEVALUATED Limits have not been evaluated.

Example:	//Query EVM limit check results `CALC:LIM:SUMM:EVM:RES?`
Usage:	Query only

CALCulate<n>:LIMit<li>[:CC<cc>]:SUMMary:EVM:DSQP:MAXimum:RESult?
CALCulate<n>:LIMit<li>[:CC<cc>]:SUMMary:EVM:DSQP[:AVERage]:RESult?

Queries the results of the EVM limit check of all PDSCH resource elements with a QPSK modulation.

Suffix:

<n>	irrelevant
	irrelevant
<cc>	Component Carrier

Return values:

<LimitCheck>   The type of limit (average or maximum) that is queried depends on the last syntax element.

FAILED
Limit check has failed.

PASSED
Limit check has passed.

NOTEVALUATED
Limits have not been evaluated.

Example: //Query EVM limit check results
CALC:LIM:SUMM:EVM:DSQP:RES?

Usage: Query only

CALCulate<n>:LIMit<li>[:CC<cc>]:SUMMary:EVM:DSSF:MAXimum:RESult?
CALCulate<n>:LIMit<li>[:CC<cc>]:SUMMary:EVM:DSSF[:AVERage]:RESult?

Queries the results of the EVM limit check of all PDSCH resource elements with a 64QAM modulation.

Suffix:

<n>	irrelevant
	irrelevant
<cc>	Component Carrier

Return values:

<LimitCheck>   The type of limit (average or maximum) that is queried depends on the last syntax element.

FAILED
Limit check has failed.

PASSED
Limit check has passed.

NOTEVALUATED
Limits have not been evaluated.

Example: //Query EVM limit check results
CALC:LIM:SUMM:EVM:DSSF:RES?

Usage: Query only

CALCulate<n>:LIMit<li>[:CC<cc>]:SUMMary:EVM:DSST:MAXimum:RESult?
CALCulate<n>:LIMit<li>[:CC<cc>]:SUMMary:EVM:DSST[:AVERage]:RESult?

Queries the results of the EVM limit check of all PDSCH resource elements with a 16QAM modulation.

Suffix:

<n>	irrelevant
	irrelevant
<cc>	Component Carrier

Return values:

<LimitCheck>   The type of limit (average or maximum) that is queried depends on the last syntax element.

FAILED
Limit check has failed.

PASSED
Limit check has passed.

NOTEVALUATED
Limits have not been evaluated.

Example: //Query EVM limit check results
`CALC:LIM:SUMM:EVM:DSST:RES?`

Usage: Query only

CALCulate<n>:LIMit<li>[:CC<cc>]:SUMMary:EVM:DSTS:MAXimum:RESult?
CALCulate<n>:LIMit<li>[:CC<cc>]:SUMMary:EVM:DSTS[:AVERage]:RESult?

Queries the results of the EVM limit check of all PDSCH resource elements with a 256QAM modulation.

Suffix:

<n>	irrelevant
	irrelevant
<cc>	Component Carrier

Return values:

<LimitCheck>   The type of limit (average or maximum) that is queried depends on the last syntax element.

FAILED
Limit check has failed.

PASSED
Limit check has passed.

NOTEVALUATED
Limits have not been evaluated.

Example: //Query EVM limit check results

`CALC:LIM:SUMM:EVM:DSTS:RES?`

Usage: Query only

CALCulate<n>:LIMit<li>[:CC<cc>]:SUMMary:EVM:DS1K:MAXimum:RESult?
CALCulate<n>:LIMit<li>[:CC<cc>]:SUMMary:EVM:DS1K[:AVERage]:RESult?

Queries the results of the EVM limit check of all PDSCH resource elements with a 1024QAM modulation.

Suffix:

<n>   irrelevant

   irrelevant

<cc>   Component Carrier

Return values:

<LimitCheck>   The type of limit (average or maximum) that is queried depends on the last syntax element.

FAILED
Limit check has failed.

PASSED
Limit check has passed.

NOTEVALUATED
Limits have not been evaluated.

Example: //Query EVM limit check results

`CALC:LIM:SUMM:EVM:DS1K:RES?`

Usage: Query only

CALCulate<n>:LIMit<li>[:CC<cc>]:SUMMary:EVM:PCHannel:MAXimum:RESult?
CALCulate<n>:LIMit<li>[:CC<cc>]:SUMMary:EVM:PCHannel[:AVERage]:RESult?

Queries the results of the EVM limit check of all physical channel resource elements.

Suffix:

<n>   irrelevant

   irrelevant

<cc>   Component Carrier

Return values:

<LimitCheck>   The type of limit (average or maximum) that is queried depends on the last syntax element.

FAILED
Limit check has failed.

PASSED
Limit check has passed.

NOTEVALUATED
Limits have not been evaluated.

Example:	//Query physical channel limit check result
	`CALC:LIM:SUMM:EVM:PCH:RES?`
Usage:	Query only

CALCulate<n>:LIMit<li>[:CC<cc>]:SUMMary:EVM:PSIGnal:MAXimum:RESult?
CALCulate<n>:LIMit<li>[:CC<cc>]:SUMMary:EVM:PSIGnal[:AVERage]:RESult?

Queries the results of the EVM limit check of all physical signal resource elements.

Suffix:

<n>	irrelevant
	irrelevant
<cc>	Component Carrier

Return values:

<LimitCheck>	The type of limit (average or maximum) that is queried depends on the last syntax element.
	FAILED
	Limit check has failed.
	PASSED
	Limit check has passed.
	NOTEVALUATED
	Limits have not been evaluated.

Example:	//Query physical signal limit check result
	`CALC:LIM:SUMM:EVM:PSIG:RES?`
Usage:	Query only

CALCulate<n>:LIMit<li>[:CC<cc>]:SUMMary:FERRor:MAXimum:RESult?
CALCulate<n>:LIMit<li>[:CC<cc>]:SUMMary:FERRor[:AVERage]:RESult?

Queries the result of the frequency error limit check.

Suffix:

<n>	irrelevant
	irrelevant
<cc>	Component Carrier

Return values:

<LimitCheck>	The type of limit (average or maximum) that is queried depends on the last syntax element.
	FAILED
	Limit check has failed.
	PASSED
	Limit check has passed.

NOTEVALUATED
Limits have not been evaluated.

Example:	//Query frequency error limit check result `CALC:LIM:SUMM:SERR:RES?`
Usage:	Query only

CALCulate<n>:LIMit<li>[:CC<cc>]:SUMMary:GIMBalance:MAXimum:RESult?
CALCulate<n>:LIMit<li>[:CC<cc>]:SUMMary:GIMBalance[:AVERage]:RESult?

Queries the result of the gain imbalance limit check.

Suffix:

<n>	irrelevant
	irrelevant
<cc>	Component Carrier

Return values:

<LimitCheck>	The type of limit (average or maximum) that is queried depends on the last syntax element. **FAILED** Limit check has failed. **PASSED** Limit check has passed. **NOTEVALUATED** Limits have not been evaluated.
Example:	//Query gain imbalance limit check result `CALC:LIM:SUMM:GIMB:RES?`
Usage:	Query only

CALCulate<n>:LIMit<li>[:CC<cc>]:SUMMary:IQOFfset:MAXimum:RESult?
CALCulate<n>:LIMit<li>[:CC<cc>]:SUMMary:IQOFfset[:AVERage]:RESult?

Queries the result of the I/Q offset limit check.

Suffix:

<n>	irrelevant
	irrelevant
<cc>	Component Carrier

Return values:

<LimitCheck>	The type of limit (average or maximum) that is queried depends on the last syntax element. **FAILED** Limit check has failed. **PASSED** Limit check has passed.

NOTEVALUATED
Limits have not been evaluated.

Example:	//Query I/Q offset limit check result `CALC:LIM:SUMM:IQOF:MAX:RES?`
Usage:	Query only

CALCulate<n>:LIMit<li>[:CC<cc>]:SUMMary:QUADerror:MAXimum:RESult?
CALCulate<n>:LIMit<li>[:CC<cc>]:SUMMary:QUADerror[:AVERage]:RESult?

Queries the result of the quadrature error limit check.

Suffix:

<n>	irrelevant
	irrelevant
<cc>	Component Carrier

Return values:

<LimitCheck>	The type of limit (average or maximum) that is queried depends on the last syntax element. **FAILED** Limit check has failed. **PASSED** Limit check has passed. **NOTEVALUATED** Limits have not been evaluated.

Example:	//Query quadrature error limit check results `CALC:LIM:SUMM:QUAD:RES?`
Usage:	Query only

CALCulate<n>:LIMit<li>[:CC<cc>]:SUMMary:SERRor:MAXimum:RESult?
CALCulate<n>:LIMit<li>[:CC<cc>]:SUMMary:SERRor[:AVERage]:RESult?

Queries the results of the sampling error limit check.

Suffix:

<n>	irrelevant
	irrelevant
<cc>	Component Carrier

Return values:

<LimitCheck>	The type of limit (average or maximum) that is queried depends on the last syntax element. **FAILED** Limit check has failed. **PASSED** Limit check has passed.

NOTEVALUATED
Limits have not been evaluated.

Example: //Query sample error limit check result
                      `CALC:LIM:SUMM:SERR:RES?`

Usage: Query only

7.8 Remote commands to configure the application

7.8.1 General configuration

The following remote control command control general configuration of the application.

The remote control commands to select the result displays for I/Q measurements are described in Chapter 7.4, "Screen layout", on page 132.

To load several file based I/Q data streams and treat them as separate input sources, for example to test a MIMO setup, use the following commands. The suffix `<fi>` assigns the file to an input source.

- General: `INSTrument:BLOCk:FILE<fi>`

- Replace a file: `INSTrument:BLOCk:FILE<fi>:REPLace`

- csv file: `INSTrument:BLOCk:FILE<fi>:CSV`

- iq.tar file: `INSTrument:BLOCk:FILE<fi>:IQTar`

- iqw file: `INSTrument:BLOCk:FILE<fi>:IQW`

- iqx file: `INSTrument:BLOCk:FILE<fi>:IQX`

- matlab file: `INSTrument:BLOCk:FILE<fi>:MAT`

- wv file: `INSTrument:BLOCk:FILE<fi>:WV`

For a comprehensive description of these commands, refer to the user manual of the R&S VSE software.

CONFigure[:LTE]:MEASurement <Measurement>

Selects the measurement.

Parameters:

<Measurement>   **EVM**
                        Selects I/Q measurements.

                        TAERor
                        Selects the Time Alignment Error measurement.

                        *RST: EVM

Example: //Select measurement
                        CONF:MEAS EVM

Manual operation: See "EVM" on page 12
                        See "Time alignment error" on page 13
                        See "Select Measurement" on page 58

MMEMory:STORe<n>:IQ:STATe <Value>,<FileName>

Saves I/Q data to a file.

Suffix:

<n>   irrelevant

Parameters:

<Value>   1

<FileName>   String containing the path and name of the target file.

Example: MMEM:STOR:IQ:STAT 'C:
                        \R_S\Instr\user\data.iq.tar'
                        Saves I/Q data to the specified file.

Manual operation: See "Data import and export" on page 118

SYSTem:PRESet:CHANnel[:EXEC]

Restores the default software settings in the current channel.

Use INST:SEL to select the channel.

Example: INST:SEL 'Spectrum2'
                        Selects the channel for "Spectrum2".
                        SYST:PRES:CHAN:EXEC
                        Restores the factory default settings to the "Spectrum2" channel.

Usage: Event

Manual operation: See "Preset Channel" on page 58

7.8.2   Configuring I/Q measurements

7.8.2.1   Signal description

Signal characteristics

CONFigure[:LTE]:DUPLexing <Duplexing>

Selects the duplexing mode.

Parameters:

<Duplexing>　　　　　　**TDD**
Time division duplex
FDD
Frequency division duplex
*RST:　　　　FDD

Example:　　　　　//Select time division duplex
CONF:DUPL TDD

Manual operation:　See "Selecting the LTE mode" on page 59

CONFigure[:LTE]:DL[:CC<cc>]:BW <Bandwidth>

Selects the channel bandwidth.

Suffix:

<cc>　　　　　　　　Component Carrier

Parameters:

<Bandwidth>　　　　BW1_40 | BW3_00 | BW5_00 | BW10_00 | BW15_00 |
BW20_00 | NB_1rb | NB_6rb
*RST:　　　　BW10_00

Example:　　　　　//Single carrier measurement:
//Define channel bandwidth
CONF:DL:BW BW1_40

Example:　　　　　//Aggregated carrier measurement:
//Selects two carriers, one with a bandwidth of 5 MHz, the other
with 10 MHz.
CONF:NOCC 2
CONF:DL:CC1:BW BW10_00
CONF:DL:CC2:BW BW5_00

Manual operation:　See "Remote commands to configure carrier aggregation"
on page 61
See "Channel Bandwidth / Number of Resource Blocks"
on page 62

CONFigure[:LTE]:DL[:CC<cc>]:CYCPrefix <PrefixLength>

Selects the cyclic prefix.

Suffix:

\<cc\>	Component Carrier

Parameters:

\<PrefixLength\> **NORM**
Normal cyclic prefix length
EXT
Extended cyclic prefix length
AUTO
Automatic cyclic prefix length detection
*RST: AUTO

Example: //Single carrier measurements:
//Select an extended cyclic prefix
CONF:DL:CYCP EXT

Example: //Aggregated carrier measurements:
//Select an extended cyclic prefix for the first carrier
CONF:DL:CC1:CYCP EXT

Manual operation: See "Cyclic Prefix" on page 62

CONFigure[:LTE]:DL[:CC\<cc\>]:EINBiot[:STATe] \<State\>

Turns the exclusion of resource blocks used by an NB-IoT inband deployment from the LTE measurement results on and off.

Suffix:

\<cc\>	Component Carrier

Parameters:

\<State\> ON | OFF | 1 | 0
*RST: OFF

Example: //Exclude resource blocks used for NB-IoT
CONF:DL:EINB ON

Manual operation: See "Exclude Inband NB-IoT" on page 64

CONFigure[:LTE]:DL[:CC\<cc\>]:NRBoffset \<Offset\>

Defines an the location of the NB-IoT signal within the LTE carrier as a resource block offset.

Prerequisites for this command

● Turn on exclusion of inband NB-IoT (CONFigure[:LTE]:DL[:CC\<cc\>]:
EINBiot[:STATe]).

Suffix:

\<cc\>	Component Carrier

Parameters:

<Offset>	<numeric value> (integer only)
	*RST: 0

Example:	//Define offset for NB-IoT carrier
	`CONF:DL:EINB ON`
	`CONF:DL:NRB 12`

Manual operation:	See "Exclude Inband NB-IoT" on page 64

CONFigure[:LTE]:DL[:CC<cc>]:PLC:CID <CellID>

Defines the cell ID.

Suffix:

<cc>	Component Carrier

Parameters:

<CellID>	**AUTO**
	Automatically defines the cell ID.
	<numeric value> (integer only)
	Number of the cell ID.
	Range: 0 to 503

Example:	//Select two carriers an define a cell ID for each
	`CONF:NOCC 2`
	`CONF:DL:CC1:PLC:CID 12`
	`CONF:DL:CC2:PLC:CID 15`
	Selects 2 carriers and defines a cell ID for each one.

Manual operation:	See "Configuring the Physical Layer Cell Identity" on page 64

CONFigure[:LTE]:DL[:CC<cc>]:PLC:CIDGroup <GroupNumber>

Selects the cell ID group.

Suffix:

<cc>	Component Carrier

Parameters:

<GroupNumber>	**AUTO**
	Automatic selection
	0...167 (integer only)
	Manual selection
	*RST: AUTO

Example:	//Select cell identity group
	`CONF:DL:PLC:CIDG 134`
	//Turn on automatic cell identity group detection
	`CONF:DL:PLC:CIDG AUTO`

Manual operation:	See "Configuring the Physical Layer Cell Identity" on page 64

CONFigure[:LTE]:DL[:CC<cc>]:PLC:PLID <Identity>

Defines the physical layer cell identity for downlink signals.

Suffix:

<cc>   Component Carrier

Parameters:

<Identity>   **AUTO**
                        Automatic selection
                        0...2 (integer only)
                        Manual selection
                        *RST: AUTO

Example: //Select physical layer cell identity
                        CONF:DL:PLC:PLID 1

Manual operation: See "Configuring the Physical Layer Cell Identity" on page 64

CONFigure[:LTE]:DL[:CC<cc>]:TDD:SPSC <Configuration>

Selects the special TDD subframe configuration.

Suffix:

<cc>   Component Carrier

Parameters:

<Configuration>   <numeric value> (integer only)
                        Numeric value that defines the subframe configuration.
                        Subframe configurations 7 and 8 are only available if the cyclic
                        prefix is normal.
                        Range: 0 to 8
                        *RST: 0

Example: //Single carrier measurements:
                        //Select subframe configuration 7, available only with a normal
                        cyclic prefix
                        CONF:DL:CYCP NORM
                        CONF:DL:TDD:SPSC 7

Example: //Carrier aggregation measurements:
                        //Select special subframe configuration 2 for the first carrier
                        CONF:DL:CC1:TDD:SPSC 2

Manual operation: See "Conf. of Special Subframe" on page 63

CONFigure[:LTE]:DL[:CC<cc>]:TDD:UDConf <Configuration>

Selects the subframe configuration for TDD signals.

Suffix:

<cc>   Component Carrier

Parameters:

<Configuration>	<numeric value> (integer only)

Range: 0 to 6
*RST: 0

Example: //Single carrier measurements:
//Selects allocation configuration
CONF:DL:TDD:UDC 4

Example: //Carrier aggregation measurements:
//Select allocation configuration for the first carrier
CONF:DL:CC1:TDD:UDC 4

Manual operation: See "TDD UL/DL Allocations" on page 63

CONFigure[:LTE]:LDIRection <Direction>

Selects the link direction.

Parameters:

<Direction>   **DL**
Selects the mode to analyze downlink signals.

UL
Selects the mode to analyze uplink signals.

Example: //Select downlink mode
CONF:LDIR DL

Manual operation: See "Selecting the LTE mode" on page 59

FETCh[:CC<cc>]:CYCPrefix?

Queries the cyclic prefix type that has been detected.

Suffix:

<cc>   Component Carrier

Return values:

<PrefixType>   The command returns -1 if no valid result has been detected yet.

NORM
Normal cyclic prefix length detected

EXT
Extended cyclic prefix length detected

Example: //Query current cyclic prefix length type
FETC:CYCP?

Usage: Query only

FETCh[:CC<cc>]:PLC:CIDGroup?

Queries the cell identity group that has been detected.

Suffix:

<cc>   Component Carrier

Return values:

<CIDGroup>   The command returns -1 if no valid result has been detected yet.

Range: 0 to 167

Example: //Query the current cell identity group
                           `FETC:PLC:CIDG?`

Usage: Query only

Manual operation: See "Configuring the Physical Layer Cell Identity" on page 64

FETCh[:CC<cc>]:PLC:PLID?

Queries the cell identity that has been detected.

Suffix:

<cc>   Component Carrier

Return values:

<Identity>   The command returns -1 if no valid result has been detected yet.

Range: 0 to 2

Example: //Query the current cell identity
                           `FETC:PLC:PLID?`

Usage: Query only

Manual operation: See "Configuring the Physical Layer Cell Identity" on page 64

MMEMory:LOAD[:CC<cc>]:DEModsetting <File>

Restores previously saved demodulation settings.

The file must be of type `.allocation` and depends on the link direction that was currently selected when the file was saved. You can load only files with correct link directions.

Suffix:

<cc>   Component Carrier

Parameters:

<File>   String containing the path and name of the file.

Example: //Load allocation file
                           `MMEM:LOAD:DEM 'D:\USER\Settingsfile.allocation'`

Manual operation: See "User defined test scenarios" on page 66

MMEMory:LOAD[:CC<cc>]:TMOD:DL <TestModel>

Loads an EUTRA test model (E-TM).

The EUTRA test models are in accordance with 3GPP 36.141.

You can also select an O-RAN test case with the command.

Suffix:

<cc>   Component Carrier

Setting parameters:

<TestModel>   **<string>**
                                 String that contains the name of the test model, e.g.
                                 `'E-TM1_1__20MHz'` (E-TM1.1). To select a test model for a dif-
                                 ferent bandwidth, replace "20MHz" with either "1_4MHz",
                                 "3MHz", "5MHz", "10MHz" or "15MHz".
                                 Alternatively, a string that contains the name of the O-RAN test
                                 case, e.g. `'TC 3.2.3.7.1'`.

Example: //Select test model 2 for a 10 MHz bandwidth.
                                 `MMEM:LOAD:TMOD:DL 'E-TM2__10MHz'`

Example: //Select O-RAN test case
                                 `MMEM:LOAD:TMOD:DL 'TC 3.2.3.7.1'`

Usage: Setting only

Manual operation: See "3GPP test models" on page 65
                                 See "ORAN test cases" on page 65

MMEMory:STORe<n>[:CC<cc>]:DEModsetting <FileName>

Saves the signal description.

Suffix:

<n>   irrelevant

<cc>   irrelevant

Parameters:

<FileName>   String containing the path and name of the file.
                                 The file extension is `.allocation`.

Example: //Save signal description
                                 `MMEM:STOR:DEM 'c:\TestSignal.allocation'`

Manual operation: See "User defined test scenarios" on page 66

MIMO setup

CALibration:PHASe:GENerate <Path>

Generates calibration data for beamforming measurements and saves it to a file.

Parameters:

<Path>   String containing the path and name of the calibration file.

Example: //Generate calibration data and save it
                          `CAL:PHAS:GEN 'C:\calibration.cal'`

CALibration:PHASe:LOAD <Path>

Restores a calibration file for beamforming measurements that you have previously created.

Parameters:

<Path>   String containing the path and name of the calibration file.

Example: //Restore calibration data
                          `CAL:PHAS:LOAD 'C:\calibration.cal'`

CONFigure[:LTE]:DL[:CC<cc>]:MIMO:ASELection <Antenna>

Selects the antenna for measurements with MIMO setups.

For time alignment error measurements, the command selects the reference antenna.

Suffix:

<cc>   Component Carrier

Parameters:

<Antenna>   **ANT1 | ANT2 | ANT3 | ANT4**
                         Select a single antenna to be analyzed

                         ALL
                         Select all antennas to be analyzed

                         AUT1 | AUT2 | AUT4
                         Automatically selects the antenna(s) to be analyzed.
                         AUT1 tests a single antenna, AUT2 tests two antennas, AUT4
                         tests four antennas.
                         Available if the number of input channels is taken "From
                         Antenna Selection".

                         AUTO
                         Automatically selects the antenna(s) to be analyzed.

                         *RST: ANT1

Example: //Select a MIMO setup with two antennas and test antenna num-
                         ber two
                         `CONF:DL:MIMO:CONF TX2`
                         `CONF:DL:MIMO:ASEL ANT2`

Manual operation: See "Time Alignment Error" on page 37
                         See "Tx Antenna Selection" on page 69

CONFigure[:LTE]:DL[:CC<cc>]:MIMO:CONFig <NoOfAntennas>

Sets the number of antennas in the MIMO setup.

Suffix:

<cc>	Component Carrier

Parameters:

<NoOfAntennas>	**TX1**
	Use one Tx-antenna
	TX2
	Use two Tx-antennas
	TX4
	Use four Tx-antennas
	*RST: TX1

Example: //Select MIMO configuration with two antennas
                            `CONF:DL:MIMO:CONF TX2`

Manual operation: See "DUT MIMO Configuration" on page 68

CONFigure[:LTE]:NSOurces <InputSources>

Selects the number of input channels you are using to capture several streams of I/Q data.

Parameters:

<InputSources>	**1 | 2 | 4 | 8**
	ASEL
	Number of channels is the same as the number of Tx antennas in the test setup (`CONFigure[:LTE]:DL[:CC<cc>]:MIMO:CONFig`).

Example: //Select four input channels
                            `CONF:NSO 4`

Manual operation: See "Number Of Input Sources" on page 67

PDSCH settings

[SENSe:][LTE:]DL:FORMat:PSCD <Format>

Selects the method of identifying the PDSCH resource allocation.

Parameters:

<Format>   **OFF**

Applies the user configuration of the PDSCH subframe regard-
less of the signal characteristics.

PDCCH

Identifies the configuration according to the data in the PDCCH
DCIs.

PHYDET

Manual PDSCH configuration: analysis only if the actual sub-
frame configuration matches the configured one.
Automatic PDSCH configuration: physical detection of the con-
figuration.

*RST: PHYD

Example: //Select user configuration and do not check the received signal
DL:FORM:PSCD OFF

Manual operation: See "PDSCH Subframe Configuration Detection" on page 70

[SENSe:][LTE:]DL:DEMod:AUTO <State>

Turns automatic demodulation on and off.

Parameters:

<State>   ON | OFF | 1 | 0

*RST: ON

Example: //Turn on auto demodulation
DL:DEM:AUTO ON

Manual operation: See "Auto PDSCH Demodulation" on page 71

CONFigure[:LTE]:DL[:CC<cc>]:CSUBframes <Subframes>

Selects the number of configurable subframes in the downlink signal.

Suffix:

<cc>   Component Carrier

Parameters:

<Subframes>   Range: 0 to 39
*RST: 1

Example: //Define the number of configurable subframes
`CONF:DL:CSUB 5`

CONFigure[:LTE]:DL[:CC<cc>]:SUBFrame<sf>:ALCount <Allocations>

Defines the number of allocations in a downlink subframe.

Suffix:

<cc>   Component Carrier

<sf>   Subframe

Parameters:

<Allocations>   <numeric value>

*RST: 1

Example: //Define number of allocations in a subframe
`CONF:DL:SUBF2:ALC 5`

CONFigure[:LTE]:DL[:CC<cc>]:SUBFrame<sf>:ALLoc<al>:GAP <VRBGap>

Turns the VRB Gap on and off.

Suffix:

<cc>   Component Carrier

<sf>   Subframe

<al>   Allocation

Parameters:

<VRBGap>   **0**
Selects localized VRBs

1
Selects distributed VRBs and applies the first gap

2
Selects distributed VRBs and applies the second gap (for channel bandwidths > 50 resource blocks)

*RST: 0

Example: //Select localized VRBs for allocation 5 in subframe 2
`CONF:DL:SUBF2:ALL5:GAP 0`

Manual operation: See "VRB Gap" on page 73

CONFigure[:LTE]:DL[:CC<cc>]:SUBFrame<sf>:ALLoc<al>:POWer <Power>

Defines the (relative) power of an allocation in a downlink subframe.

Suffix:

<cc>   Component Carrier

<sf>   Subframe

<al>	Allocation

Parameters:

<Power>	<numeric value>
	*RST: 0 dB
	Default unit: dB

Example:	//Define relative power for allocation 5 in subframe 2.
	CONF:DL:SUBF2:ALL5:POW -1.3

Manual operation:	See "Power" on page 74

CONFigure[:LTE]:DL[:CC<cc>]:SUBFrame<sf>:ALLoc<al>:PRECoding:AP <Port>

Selects the antenna port for the beamforming scheme.

The command is available for measurements on a single antenna.

Suffix:

<cc>	Component Carrier
<sf>	Subframe
<al>	Allocation

Parameters:

<Port>	5	7	8

Example:	//Select antenna port for beamforming in allocation 3 in sub-frame 2.
	CONF:DL:SUBF2:ALL3:PREC:AP 5

Manual operation:	See "Beamforming (UE Spec RS)" on page 77

CONFigure[:LTE]:DL[:CC<cc>]:SUBFrame<sf>:ALLoc<al>:PRECoding:CBINdex
    <CodebookIndex>

Selects the codebook index for an allocation with spatial multiplexing precoding scheme.

Suffix:

<cc>	Component Carrier
<sf>	Subframe
<al>	Allocation

Parameters:

<CodebookIndex>	0...15
	*RST: 1

Example:	//Select codebook index for allocation 4 in subframe number 2.
	CONF:DL:SUBF2:ALL4:PREC:CBIN 3

Manual operation:	See "Spatial Multiplexing" on page 76

CONFigure[:LTE]:DL[:CC<cc>]:SUBFrame<sf>:ALLoc<al>:PRECoding:CDD
   <State>

Turns the cyclic delay diversity of an allocation with spatial multiplexing precoding scheme on and off.

Suffix:

<cc>   Component Carrier

<sf>   Subframe

<al>   Allocation

Parameters:

<State>   ON | OFF | 1 | 0

                          *RST: OFF

Example: //Turn on cyclic delay diversity for allocation 3 in subframe 2
                          CONF:DL:SUBF2:ALL3:PREC:CDD ON

Manual operation: See "Spatial Multiplexing" on page 76

CONFigure[:LTE]:DL[:CC<cc>]:SUBFrame<sf>:ALLoc<al>:PRECoding:
   CLMapping <Mapping>

Selects the codeword to layer mapping.

Suffix:

<cc>   Component Carrier

<sf>   Subframe

<al>   Allocation

Parameters:

<Mapping>   LC11 | LC21 | LC22 | LC31 | LC32 | LC41 | LC42 | LC52 | LC62 |
                          LC72 | LC82

Example: //Select codeword-to-layer mapping for allocation 3 in subframe
                          2.
                          CONF:DL:SUBF2:ALL3:PREC:CLM LC11

Manual operation: See "Spatial Multiplexing" on page 76
                          See "Beamforming (UE Spec RS)" on page 77

CONFigure[:LTE]:DL[:CC<cc>]:SUBFrame<sf>:ALLoc<al>:PRECoding:SCID
   <Identity>

Selects the scrambling identity (nSCID).

The command is available for antenna ports 7 and 8.

Suffix:

<cc>   Component Carrier

<sf>   Subframe

<al>	Allocation

Parameters:

<Identity>	0	1

Example:	//Select scrambling identity for allocation 4 in subframe 2
	CONF:DL:SUBF2:ALL4:PREC:SCID 1

Manual operation:	See "Beamforming (UE Spec RS)" on page 77

CONFigure[:LTE]:DL[:CC<cc>]:SUBFrame<sf>:ALLoc<al>:PRECoding[:SCHeme] <Scheme>

Selects the precoding scheme of an allocation.

Suffix:

<cc>	Component Carrier

<sf>	Subframe

<al>	Allocation

Parameters:

<Scheme>	**NONE**
	Do not use a precoding scheme.
	BF
	Use beamforming scheme.
	SPM
	Use spatial multiplexing scheme.
	TXD
	Use transmit diversity scheme.
	*RST: NONE

Example:	//Select precoding scheme for allocation 3 in subframe 2
	CONF:DL:SUBF2:ALL3:PREC:SCH SPM

Manual operation:	See "None" on page 76
	See "Transmit Diversity" on page 76
	See "Spatial Multiplexing" on page 76
	See "Beamforming (UE Spec RS)" on page 77

CONFigure[:LTE]:DL[:CC<cc>]:SUBFrame<sf>:ALLoc<al>:PSOFfset <StartOffset>

Defines the PDSCH start offset for a particular PDSCH allocation.

Suffix:

<cc>	Component Carrier

<sf>	Subframe

<al>	Allocation

Parameters:

<StartOffset>	**<numeric value>**
	Number between 0 and 4.
	COMM
	Common PDSCH start offset.

Example:	//Defines a PDSCH start offset for the allocation 2 in subframe 2
	`CONF:DL:SUBF2:ALL2:PSOF 0`

Manual operation:	See "Carrier Aggregation" on page 77

CONFigure[:LTE]:DL[:CC<cc>]:SUBFrame<sf>:ALLoc<al>:RBCount
    <ResourceBlocks>

Selects the number of resource blocks of an allocation in a downlink subframe.

Suffix:

<cc>	Component Carrier
<sf>	Subframe
<al>	Allocation

Parameters:

<ResourceBlocks>	<numeric value>
	*RST: 6

Example:	//Define resource blocks for allocation 5 in subframe 2
	`CONF:DL:SUBF2:ALL5:RBC 25`

Manual operation:	See "Number of RB" on page 74

CONFigure[:LTE]:DL[:CC<cc>]:SUBFrame<sf>:ALLoc<al>:RBOFfset <Offset>

Defines the resource block offset of an allocation in a downlink subframe.

Suffix:

<cc>	Component Carrier
<sf>	Subframe
<al>	Allocation

Parameters:

<Offset>	<numeric value>
	*RST: 0

Example:	//Define resource block offset for allocation 5 in subframe 2
	`CONF:DL:SUBF2:ALL5:RBOF 3`

Manual operation:	See "Offset RB" on page 74

CONFigure[:LTE]:DL[:CC<cc>]:SUBFrame<sf>:ALLoc<al>:UEID <ID>

Defines the ID or N_RNTI.

Suffix:

<cc>　　　　　　　　　Component Carrier

<sf>　　　　　　　　　Subframe

<al>　　　　　　　　　Allocation

Parameters:

<ID>　　　　　　　　　ID of the user equipment.

Example:　　　　　//Assign ID to allocation 5 in subframe 2
　　　　　　　　　　　CONF:DL:SUBF2:ALL5:UEID 5

Manual operation:　See "ID/N_RNTI" on page 73

CONFigure[:LTE]:DL[:CC<cc>]:SUBFrame<sf>:ALLoc<al>[:CW<cw>]:MODulation
　　　　<Modulation>

Selects the modulation of an allocation in a downlink subframe.

Suffix:

<cc>　　　　　　　　　Component Carrier

<sf>　　　　　　　　　Subframe

<al>　　　　　　　　　Allocation

<cw>　　　　　　　　　Codeword

Parameters:

<Modulation>　　　　**QPSK**
　　　　　　　　　　　QPSK modulation

　　　　　　　　　　　QAM16
　　　　　　　　　　　16QAM modulation

　　　　　　　　　　　QAM64
　　　　　　　　　　　64QAM modulation

　　　　　　　　　　　QAM256
　　　　　　　　　　　256QAM modulation

　　　　　　　　　　　Q1K
　　　　　　　　　　　1024QAM modulation

　　　　　　　　　　　*RST:　　　QPSK

Example:　　　　　//Select modulation for the second codeword in allocation 5 in
　　　　　　　　　　　subframe 2
　　　　　　　　　　　CONF:DL:SUBF2:ALL5:CW2:MOD QAM64

Manual operation:　See "Modulation" on page 73

Global settings

CONFigure[:LTE]:ORAN:TCASe <Testcase>

Selects an O-RAN test case.

Parameters:

<Testcase>　　　　　　　**<string>**

String containing the name of the test case, e.g. "TC 3.2.3.7.1".

The string "NONE" removes a test case.

*RST:　　　NONE

Example:　　　　　　　//Select O-RAN test case TC 3.2.3.7.1

CONF:ORAN:TCAS "TC 3.2.3.7.1"

CONF:ORAN:TCAS "NONE"

Manual operation:　　See "ORAN Test Case" on page 78

Synchronization signal

CONFigure[:LTE]:DL[:CC<cc>]:SYNC:ANTenna <Antenna>

Selects the antenna that transmits the P-SYNC and the S-SYNC.

Suffix:

<cc>　　　　　　　　　　Component Carrier

Parameters:

<Antenna>　　　　　　　ANT1 | ANT2 | ANT3 | ANT4 | ALL | NONE

*RST:　　　ALL

Example:　　　　　　　//Transmit the P-SYNC and S-SYNC on all antennas

CONF:DL:SYNC:ANT ALL

Manual operation:　　See "P-/S-SYNC Tx Antenna" on page 79

CONFigure[:LTE]:DL[:CC<cc>]:SYNC:CSWeight:FHFRame:IMAGinary
　　　　<Imaginary>

Defines the signal weight for the imaginary part of the signal in the first half frame.

Prerequisites for this command

- Turn on custom sync signal weight (CONFigure[:LTE]:DL[:CC<cc>]:SYNC: CSWeight[:STATe]).

Suffix:

<cc>	Component Carrier

Parameters:

<Imaginary>	Range:	-1 to 1
	*RST:	0.000

Example: //Define imaginary part of sync signal weight
CONF:DL:SYNC:CSW ON
CONF:DL:SYNC:CSW:FHFR:IMAG 0.500

Manual operation: See "Custom Sync Weight" on page 80

CONFigure[:LTE]:DL[:CC<cc>]:SYNC:CSWeight:FHFRame:REAL <Real>

Defines the signal weight for the real part of the signal in the first half frame.

Prerequisites for this command

- Turn on custom sync signal weight (CONFigure[:LTE]:DL[:CC<cc>]:SYNC:CSWeight[:STATe]).

Suffix:

<cc>	Component Carrier

Parameters:

<Real>	Range:	-1 to 1
	*RST:	1.000

Example: //Define imaginary part of sync signal weight
CONF:DL:SYNC:CSW ON
CONF:DL:SYNC:CSW:FHFR:REAL 0.500

Manual operation: See "Custom Sync Weight" on page 80

CONFigure[:LTE]:DL[:CC<cc>]:SYNC:CSWeight:SHFRame:IMAGinary
    <Imaginary>

Defines the signal weight for the imaginary part of the signal in the second half frame.

Prerequisites for this command

- Turn on custom sync signal weight (CONFigure[:LTE]:DL[:CC<cc>]:SYNC:CSWeight[:STATe]).

Suffix:

<cc>	Component Carrier

Parameters:

<Imaginary>	Range:	-1 to 1
	*RST:	0.000

Example: //Define imaginary part of sync signal weight
CONF:DL:SYNC:CSW ON
CONF:DL:SYNC:CSW:SHFR:IMAG 0.500

Manual operation: See "Custom Sync Weight" on page 80

CONFigure[:LTE]:DL[:CC<cc>]:SYNC:CSWeight:SHFRame:REAL <Real>

Defines the signal weight for the real part of the signal in the second half frame.

Prerequisites for this command

- Turn on custom sync signal weight (`CONFigure[:LTE]:DL[:CC<cc>]:SYNC:CSWeight[:STATe]`).

Suffix:

<cc>   Component Carrier

Parameters:

<Real>   Range: -1 to 1
                                    *RST: 1.000

Example: //Define imaginary part of sync signal weight
                                    `CONF:DL:SYNC:CSW ON`
                                    `CONF:DL:SYNC:CSW:SHFR:REAL 0.500`

Manual operation: See "Custom Sync Weight" on page 80

CONFigure[:LTE]:DL[:CC<cc>]:SYNC:CSWeight[:STATe] <State>

Turns custom synchronization signal weighting on and off.

Suffix:

<cc>   Component Carrier

Parameters:

<State>   ON | OFF | 1 | 0
                                    *RST: OFF

Example: //Turn on synchronization signal weighting
                                    `CONF:DL:SYNC:CSW ON`

Manual operation: See "Custom Sync Weight" on page 80

CONFigure[:LTE]:DL[:CC<cc>]:SYNC:PPOWer <Power>

Defines the relative power of the P-SYNC.

Suffix:

<cc>   Component Carrier

Parameters:

<Power>   <numeric value>

                                    *RST: 0 dB
                                    Default unit: dB

Example: //Define relative power for P-SYNC
                                    `CONF:DL:SYNC:PPOW 0.5`

Manual operation: See "P-Sync Relative Power" on page 80

CONFigure[:LTE]:DL[:CC<cc>]:SYNC:SPOWer <Power>

Defines the relative power of the S-SYNC.

Suffix:

<cc>   Component Carrier

Parameters:

<Power>   <numeric value>

                                *RST: 0 dB
                                Default unit: dB

Example: //Define relative power for S-SYNC
                                `CONF:DL:SYNC:SPOW 0.5`

Manual operation: See " S-Sync Relative Power" on page 80

Reference signal

CONFigure[:LTE]:DL[:CC<cc>]:REFSig:POWer <Power>

Defines the relative power of the reference signal.

Suffix:

<cc>   Component Carrier

Parameters:

<Power>   <numeric value>

                                *RST: 0 dB
                                Default unit: dB

Example: //Define a relative power for reference signal
                                `CONF:DL:REFS:POW -1.2`

Manual operation: See "Rel Power (Reference Signal)" on page 81

Positioning reference signal

CONFigure[:LTE]:DL[:CC<cc>]:PRSS:BW <Bandwidth>

Defines the bandwidth of the positioning reference signal.

Suffix:

<cc>   Component Carrier

Parameters:

<Bandwidth>	BW1_40 | BW3_00 | BW5_00 | BW10_00 | BW15_00 | BW20_00
	*RST:　　　BW1_40
	Default unit: MHz

Example: //Define bandwidth for the positioning reference signal
`CONF:DL:PRSS:BW BW5_00`

Manual operation: See "Bandwidth" on page 82

CONFigure[:LTE]:DL[:CC<cc>]:PRSS:CI <Configuration>

Selects the configuration index of the positioning reference signal.

Suffix:

<cc>	Component Carrier

Parameters:

<Configuration>	<numeric value> (integer only)
	*RST:　　　0

Example: //Select configuration index for the positioning reference signal
`CONF:DL:PRSS:CI 2`

Manual operation: See "Configuration Index" on page 82

CONFigure[:LTE]:DL[:CC<cc>]:PRSS:NPRS <Subframes>

Defines the number of subframes the positioning reference signal occupies.

Suffix:

<cc>	Component Carrier

Parameters:

<Subframes>	1 | 2 | 4 | 6

Example: //Define subframes used by positioning reference signal
`CONF:DL:PRSS:NPRS 1`

Manual operation: See "Num. Subframes (N_PRS)" on page 83

CONFigure[:LTE]:DL[:CC<cc>]:PRSS:POWer <Power>

Defines the relative power of the positioning reference signal.

Suffix:

<cc>	Component Carrier

Parameters:

<Power>	Default unit: dB

Example: //Define relative power of positioning reference signal
`CONF:DL:PRSS:POW 1`

Manual operation: See "Relative Power (Positioning Reference Signal)" on page 83

CONFigure[:LTE]:DL[:CC<cc>]:PRSS:STATe <State>

Turns the positioning reference signal on and off.

Suffix:

<cc>   Component Carrier

Parameters:

<State>   ON | OFF | 1 | 0
                      *RST: OFF

Example: //Turn on the positioning reference signal.
                      CONF:DL:PRSS:STAT ON

Manual operation: See "Present" on page 82

CONFigure[:LTE]:DL[:CC<cc>]:SFNO <Offset>

Defines the frame number offset for the positioning reference signal.

Suffix:

<cc>   Component Carrier

Parameters:

<Offset>   <numeric value> (integer only)

Example: //Define frame number offset
                      CONF:DL:SFNO 4

Manual operation: See "Frame Number Offset" on page 83

CSI reference signal

CONFigure[:LTE]:DL[:CC<cc>]:CSIRs:CI <Index>

Selects the configuration index for the CSI reference signal.

Suffix:

<cc>   Component Carrier

Parameters:

<Index>   Number of the configuration index.

                      Range: 0 to 31

Example: //Select configuration index
CONF:DL:CSIR:CI 12

Manual operation: See "Configuration Index" on page 85

CONFigure[:LTE]:DL[:CC<cc>]:CSIRs:NAP <AntennaPorts>

Selects the number of antenna ports that transmit the CSI reference signal.

Suffix:
<cc>   Component Carrier

Parameters:
<AntennaPorts>   **TX1**

                      TX2

                      TX4

                      TX8

Example: //Select 2 antenna ports for CSI reference signal transmission
CONF:DL:CSIR:NAP TX2

Manual operation: See "Antenna Ports" on page 84

CONFigure[:LTE]:DL[:CC<cc>]:CSIRs:OPDSch <State>

Turns overwriting of PDSCH resource elements for UEs that do not consider the CSI reference signal on and off.

Suffix:
<cc>   Component Carrier

Parameters:
<State>   **ON | 1**
                      The CSI reference signal overwrites PDSCH resource elements.
                      OFF | 0
                      PDSCH resource elements remain.
                      *RST: OFF

Example: //Overwrite PDSCH resource elements if necessary
CONF:DL:CSIR:OPDS ON

Manual operation: See "Overwrite PDSCH" on page 85

CONFigure[:LTE]:DL[:CC<cc>]:CSIRs:POWer <Power>

Defines the relative power of the CSI reference signal.

Suffix:
<cc>   Component Carrier

Parameters:
<Power>   *RST: 0
                      Default unit: dB

Example: //Define relative power for the CSI reference signal.
CONF:DL:CSIR:POW 1

Manual operation: See "Relative Power (CSI Reference Signal)" on page 85

CONFigure[:LTE]:DL[:CC<cc>]:CSIRs:SCI <Configuration>

Defines the subframe configuration for the CSI reference signal.

Suffix:
<cc>   Component Carrier

Parameters:
<Configuration>   Number that selects the subframe configuration.

                     Range: 0 to 154

Example: //Select subframe configuration for CSI reference signal
CONF:DL:CSIR:SCI 4

Manual operation: See "Subframe Configuration" on page 85

CONFigure[:LTE]:DL[:CC<cc>]:CSIRs:STATe <State>

Turns the CSI reference signal on and off.

Suffix:
<cc>   Component Carrier

Parameters:
<State>   ON | OFF | 1 | 0
                     *RST: OFF

Example: //Turn on CSI reference signal
CONF:DL:CSIR:STAT ON

Manual operation: See "Present" on page 84

Control channel

CONFigure[:LTE]:DL[:CC<cc>]:EPDCch:LOCalized <State>

Turns localized transmission of the EPDCCH on and off.

Suffix:

<cc>   Component Carrier

Parameters:

<State>   ON | OFF | 1 | 0

                       *RST: ON

Example: //Turn on distributed transmission of the EPDCCH

                       `CONF:DL:EPDC:LOC OFF`

Manual operation: See "EPDCCH Localized" on page 93

CONFigure[:LTE]:DL[:CC<cc>]:EPDCch:NPRB <ResourceBlocks>

Selects the number of resource blocks that the EPDCCH-PRB set uses.

Suffix:

<cc>   Component Carrier

Parameters:

<ResourceBlocks>   0 | 2 | 4 | 8

                       When you select "0", the EPDCCH i not active.

Example: //Select number of EPDCCH-PRB resource blocks

                       `CONF:DL:EPDC:NPRB 4`

Manual operation: See "EPDCCH PRB Pairs" on page 93

CONFigure[:LTE]:DL[:CC<cc>]:EPDCch:POWer <Power>

Defines the relative power of the EPDCCH.

Suffix:

<cc>   Component Carrier

Parameters:

<Power>   <numeric value>

                       *RST: 0 dB

                       Default unit: DB

Example: //Define relative power of EPDCCH

                       `CONF:DL:EPDC:POW -0.5`

Manual operation: See "EPDCCH Rel Power" on page 93

CONFigure[:LTE]:DL[:CC<cc>]:EPDCch:RBASsign <ResourceBlocks>

Defines the resource blocks that the EPDCCH uses.

Suffix:

<cc>   Component Carrier

Parameters:
<ResourceBlocks>

Example: //Define number of EPDCCH resource blocks
                         CONF:DL:EPDC:RBAS 2

Manual operation: See "EPDCCH RB Assignment" on page 93

CONFigure[:LTE]:DL[:CC<cc>]:EPDCch:SID <SetID>

Defines the EPDCCH set ID used to generate EPDCCH reference symbols.

Suffix:

<cc>   Component Carrier

Parameters:
<SetID>   Range: 0 to 503
                         *RST: 0

Example: //Select EPDCC set ID
                         CONF:DL:EPDC:SID 10

Manual operation: See "EPDCCH Set ID" on page 93

CONFigure[:LTE]:DL[:CC<cc>]:PBCH:POWer <Power>

Defines the relative power of the PBCH.

Suffix:

<cc>   Component Carrier

Parameters:
<Power>   <numeric value>

                         *RST: 0 dB
                         Default unit: dB

Example: //Define PBCH power
                         CONF:DL:PBCH:POW −1.1

Manual operation: See "PBCH Relative Power" on page 87

CONFigure[:LTE]:DL[:CC<cc>]:PBCH:STAT <State>

Turns the PBCH on and off.

Suffix:

<cc>   Component Carrier

Parameters:

<State>   ON | OFF | 1 | 0

                                 *RST: ON

Example: //Turn on PBCH
                                 CONF:DL:PBCH:STAT ON

Manual operation: See "PBCH Present" on page 87

CONFigure[:LTE]:DL[:CC<cc>]:PCFich:POWer <Power>

Defines the relative power of the PCFICH.

Suffix:

<cc>   Component Carrier

Parameters:

<Power>   <numeric value>

                                 *RST: 0 dB
                                 Default unit: dB

Example: //Define relative PCFICH power
                                 CONF:DL:PCF:POW 0

Manual operation: See "PCFICH Relative Power" on page 88

CONFigure[:LTE]:DL[:CC<cc>]:PCFich:STAT <State>

Turns the PCFICH on and off.

Suffix:

<cc>   Component Carrier

Parameters:

<State>   ON | OFF | 1 | 0

                                 *RST: ON

Example: //Turn on PCFICH
                                 CONF:DL:PCF:STAT ON

Manual operation: See "PCFICH Present" on page 88

CONFigure[:LTE]:DL[:CC<cc>]:PDCCh:FORMat <Format>

Selects the PDCCH format.

Suffix:

<cc>   Component Carrier

Parameters:

<Format>   -1 | 0 | 1 | 2 | 3

                                 *RST: -1

Example: //Select PDCCH format
                                 CONF:DL:PDCCH:FORM 0

Manual operation: See "PDCCH Format" on page 91

CONFigure[:LTE]:DL[:CC<cc>]:PDCCh:NOPD <Quantity>

Sets the number of PDCCHs.

Suffix:
<cc>   Component Carrier

Parameters:
<Quantity>   <numeric value>
                                *RST: 0

Example: //Select number of PDCCHs
                                 CONF:DL:PDCCH:NOPD 3

Manual operation: See "Number of PDCCHs" on page 91

CONFigure[:LTE]:DL[:CC<cc>]:PDCCh:POWer <Power>

Defines the relative power of the PDCCH.

Suffix:
<cc>   Component Carrier

Parameters:
<Power>   <numeric value>
                                *RST: 0 dB
                                Default unit: dB

Example: //Define relative power for PDCCH
                                 CONF:DL:PDCCH:POW −1.2

Manual operation: See "PDCCH Rel Power" on page 92

CONFigure[:LTE]:DL[:CC<cc>]:PHICh:DURation <Duration>

Selects the PHICH duration.

Suffix:
<cc>   Component Carrier

Parameters:
<Duration>   **NORM**
                                Normal
                                EXT
                                Extended
                                *RST: NORM

| **Example:** | //Select PHICH duration |
| | `CONF:DL:PHIC:DUR NORM` |

| **Manual operation:** | See "PHICH Duration" on page 89 |

CONFigure[:LTE]:DL[:CC<cc>]:PHICh:MITM <State>

Includes or excludes the use of the PHICH special setting for enhanced test models.

Suffix:
| <cc> | Component Carrier |

Parameters:
| <State> | ON | OFF | 1 | 0 |
| | *RST: OFF |

| **Example:** | //Activate PHICH TDD m_i=1 (E-TM) |
| | `CONF:DL:PHIC:MITM ON` |

| **Manual operation:** | See "PHICH TDD m_i=1 (E-TM)" on page 90 |

CONFigure[:LTE]:DL[:CC<cc>]:PHICh:NGParameter <Method>

Selects the method that determines the number of PHICH groups in a subframe.

Suffix:
| <cc> | Component Carrier |

Parameters:
<Method>	AUTO	NG1_6	NG1_2	NG1	NG2	NGCustom
	Select `NGCUSTOM` to customize N_g. You can then define the number of PHICH groups with `CONFigure[:LTE]:DL[:CC<cc>]:PHICh:NOGRoups`.
	*RST: NG1_6

Example:	//Number of PHICH groups in the subframe depends on the number of resource blocks
	`CONF:DL:PHIC:NGP NG1_6`
	//Define a custom number of PHICH groups
	`CONF:DL:PHIC:NGP NGCUSTOM`
	`CONF:DL:PHIC:NOGR 5`

| **Manual operation:** | See "PHICH N_g" on page 90 |

CONFigure[:LTE]:DL[:CC<cc>]:PHICh:NOGRoups <NoOfGroups>

Defines the number of PHICH groups.

Suffix:
| <cc> | Component Carrier |

Parameters:

<NoOfGroups>	<numeric value> (integer only)
	*RST:　　　0

Example:　　　　　　//Define number of PHICH groups
CONF:DL:PHIC:NOGR 5

Manual operation:　　See "PHICH Number of Groups" on page 90

CONFigure[:LTE]:DL[:CC<cc>]:PHICh:POWer <Power>

Defines the relative power of the PHICH.

Suffix:

<cc>	Component Carrier

Parameters:

<Power>	<numeric value>
	*RST:　　　-3.01 dB
	Default unit: DB

Example:　　　　　　//Define the relative power of the PHICH
CONF:DL:PHIC:POW -1.3

Manual operation:　　See "PHICH Rel Power" on page 90

CONFigure[:LTE]:DL[:CC<cc>]:PSOFfset <Offset>

Defines the symbol offset for PDSCH allocations relative to the start of the subframe.

The offset applies to all subframes.

Suffix:

<cc>	Component Carrier

Parameters:

<Offset>	**AUTO** Automatically determines the symbol offset. **<numeric value>** Manual selection of the symbol offset. Range:　　　0　to　4 *RST:　　　AUTO

Example:　　　　　　//Define PRB symbol offset
CONF:DL:PSOF 2

Manual operation:　　See "PRB Symbol Offset" on page 86

Shared channel

CONFigure[:LTE]:DL[:CC<cc>]:PDSCh:PB <PowerRatio>

Selects the PDSCH power ratio.

Note that the power ratio depends on the number of antennas in the system.

Suffix:

<cc>   Component Carrier

Parameters:

<PowerRatio>   Numeric value that defines PDSCH P_B which defines the
                          power ratio in dB.

                          0 | 1 | 2 | 3
                          See PDSCH Power Ratio for an overview of resulting power
                          ratios.

                          RAT1
                          Ratio = 1, regardless of the number of antennas.

Example: //Select PDSCH P_B
                               CONF:DL:PDSC:PB 3

Manual operation: See "PDSCH Power Ratio" on page 94

MBSFN characteristics

CONFigure[:LTE]:DL[:CC<cc>]:MBSFn:AI:ID <ID>

Defines the ID of an MBFSN area.

Suffix:

<cc>   Component Carrier

Parameters:

<ID>   Range: 0 to 255

Example: //Select an area for the multimedia broadcast network
                               CONF:DL:MBSF:AI:ID 2

Manual operation: See "Area ID" on page 95

CONFigure[:LTE]:DL[:CC<cc>]:MBSFn:AI:NMRL <Configuration>

Selects the length of the control data region in an MBSFN subframe.

Suffix:

<cc>   Component Carrier

Parameters:

<Configuration>   **1**

The first symbol in a subframe carries data of the control chan-
nel.

2

The first two symbols in a subframe carry data of the control
channel.

Example: //Select length of control channel data
                          CONF:DL:MBSF:AI:NMRL 2

Manual operation: See "Non-MBSFN Region Length" on page 95

CONFigure[:LTE]:DL[:CC<cc>]:MBSFn:POWer <Power>

Defines the relative power of the MBSFN transmission.

Suffix:

<cc>   Component Carrier

Parameters:

<Power>   *RST: 0 dB
                          Default unit: dB

Example: //Define relative power for MBSFN transmission
                          CONF:DL:MBSF:POW -1.5

Manual operation: See "MBSFN Relative Power" on page 95

CONFigure[:LTE]:DL[:CC<cc>]:MBSFn:STATe <State>

Includes or excludes an MBSFN from the test setup.

Suffix:

<cc>   Component Carrier

Parameters:

<State>   ON | OFF | 1 | 0
                          *RST: OFF

Example: //Include an MBSFN in the test setup
                          CONF:DL:MBSF:STAT ON

Manual operation: See "Present" on page 95

CONFigure[:LTE]:DL[:CC<cc>]:MBSFn:SUBFrame<sf>:PMCH:MODulation
        <Modulation>

Selects the modulation type for an MBSFN subframe.

Suffix:

\<cc\>	Component Carrier
\<sf\>	Subframe

Parameters:

\<Modulation\>   QPSK | QAM16 | QAM64 | QAM256 | Q1K
                      *RST: QPSK

Example: //Selects modulation for MBSFN subframe
                      `CONF:DL:MBSF:SUBF2:PMCH:MOD QPSK`

Manual operation: See "Modulation" on page 96

CONFigure[:LTE]:DL[:CC\<cc\>]:MBSFn:SUBFrame\<sf\>:PMCH:STATe \<State\>

Turns the PMCH in an MBSFN subframe on and off.

Note that you first have to turn a subframe into an MBSFN subframe with
`CONFigure[:LTE]:DL[:CC<cc>]:MBSFn:SUBFrame<sf>:STATe`.

Suffix:

\<cc\>	Component Carrier
\<sf\>	Subframe

Parameters:

\<State\>   ON | OFF | 1 | 0
                      *RST: OFF

Example: //Turn on PMCH in second subframe
                      `CONF:DL:MBSF:SUBF2:PMCH:STAT ON`

Manual operation: See "PMCH Present" on page 96

CONFigure[:LTE]:DL[:CC\<cc\>]:MBSFn:SUBFrame\<sf\>:STATe \<State\>

Turns a subframe into an MBSFN subframe.

Suffix:

\<cc\>	Component Carrier
\<sf\>	Subframe

Parameters:

\<State\>   ON | OFF | 1 | 0
                      *RST: OFF

Example: //Turn the second subframe into an MBSFN subframe
                      `CONF:DL:MBSF:SUBF2:STAT ON`

Manual operation: See "Active" on page 96

7.8.2.2   Inputs configuration

Useful commands to perform measurements described elsewhere:

- INPut<ip>:COUPling<ant> on page 226

- INPut<ip>:IMPedance<ant> on page 228

INPut:FILE<fi>:PATH <FileName>[, <AnalysisBW>]

Selects the I/Q data file to be used as input for further measurements.

Suffix:

<fi>   1..n

Parameters:

<FileName>   String containing the path and name of the source file.
                            The file extension is *.iq.tar.

<AnalysisBW>   Optionally: The analysis bandwidth to be used by the measure-
                            ment. The bandwidth must be smaller than or equal to the band-
                            width of the data that was stored in the file.
                            Default unit: HZ

Example: INP:FILE:PATH 'C:\R_S\Instr\user\data.iq.tar'
                            Uses I/Q data from the specified file as input.

Manual operation: See "Data import and export" on page 118

INPut<ip>:FILE:ZPADing <State>

Enables or disables zeropadding for input from an I/Q data file that requires resam-
pling. For resampling, a number of samples are required due to filter settling. These
samples can either be taken from the provided I/Q data, or the software can add the
required number of samples (zeros) at the beginning and end of the file.

Suffix:

<ip>   1..n

Parameters:

<State>   ON | OFF | 0 | 1

                            OFF | 0
                            Switches the function off

ON | 1

Switches the function on

*RST: 0

Example: `INP:FILE:ZPAD ON`

Manual operation: See "Zero Padding" on page 101

INPut<ip>:FILTer:HPASs[:STATe] <State>

Activates an additional internal high-pass filter for RF input signals from 1 GHz to 3 GHz. This filter is used to remove the harmonics of the connected instrument to measure the harmonics for a DUT, for example.

Requires an additional high-pass filter hardware option.

(Note: for RF input signals outside the specified range, the high-pass filter has no effect. For signals with a frequency of approximately 4 GHz upwards, the harmonics are suppressed sufficiently by the YIG-preselector, if available.)

Suffix:

<ip>   1..n

Parameters:

<State>   ON | OFF | 0 | 1

OFF | 0

Switches the function off

ON | 1

Switches the function on

*RST: 0

Example: `INP:FILT:HPAS ON`

Turns on the filter.

Manual operation: See "High Pass Filter 1 to 3 GHz" on page 97

INPut<ip>:FILTer:YIG[:STATe] <State>

Enables or disables the YIG filter.

Suffix:

<ip>   1 | 2

irrelevant

Parameters:

<State>   ON | OFF | 0 | 1

Example: `INP:FILT:YIG OFF`

Deactivates the YIG-preselector.

Manual operation: See "YIG-Preselector" on page 97

INPut:SELect <Source>

Selects the signal source for measurements, i.e. it defines which connector is used to input data to the R&S VSE.

If no additional input options are installed, only RF input or file input is supported.

Parameters:

<Source>	**RF** Radio Frequency ("RF INPUT" connector)
	FIQ I/Q data file
	AIQ Analog Baseband signal (only available with optional "Analog Baseband" interface)
	*RST: RF

Manual operation: See "Input Type (Instrument / File)" on page 100

INPut<ip>:RF:CAPMode <CAPMode>

Determines how data from an oscilloscope is input to the R&S VSE software.

Is only available for connected oscilloscopes.

Suffix:

<ip>	1..n

Parameters:

<CAPMode>	AUTO | IQ | WAVeform
	IQ The measured waveform is converted to I/Q data directly on the R&S oscilloscope (requires option K11), and input to the R&S VSE software as I/Q data.
	WAVeform The data is input in its original waveform format and converted to I/Q data in the R&S VSE software. No additional options are required on the R&S oscilloscope.
	AUTO Uses "I/Q" mode when possible, and "Waveform" only when required by the application (e.g. Pulse measurement).
	*RST: IQ

Example: `INP:RF:CAPM WAV`

Manual operation: See "Capture Mode" on page 98

INPut<ip>:RF:CAPMode:IQ:SRATe <SamplingRate>

Determines the sample rate used by the connected oscilloscope for I/Q capture mode (see `INPut<ip>:RF:CAPMode` on page 220).

This setting is only available if an R&S oscilloscope is used to obtain the input data.

Suffix:

<ip> 1..n

Parameters:

<SamplingRate> 20 GHz | 40 GHz

No other sample rate values are allowed.

20 GHz
Achieves a higher decimation gain, but reduces the record length by half.
Only available for R&S oscilloscope models that support a sample rate of 20 GHz (see data sheet).

40 GHz
Provides a maximum sample rate.
Only available for R&S RTP13/RTP16 models that support a sample rate of 40 GHz (see data sheet).

*RST: 20 GHz
Default unit: HZ

Example: INP:RF:CAPM IQ
INP:RF:CAPM:IQ:SRAT 40 GHZ

Manual operation: See "Oscilloscope Sample Rate" on page 98

INPut<ip>:RF:CAPMode:WAVeform:SRATe <SamplingRate>

Determines the sample rate used by the connected oscilloscope for waveform capture mode (see INPut<ip>:RF:CAPMode on page 220).

This setting is only available if an R&S oscilloscope is used to obtain the input data, either directly or via the R&S FSW.

Suffix:

<ip> 1..n

Parameters:

<SamplingRate> 10 GHz | 20 GHz

No other sample rate values are allowed.

10 GHz
Default ; provides maximum record length

20 GHz
Achieves a higher decimation gain, but reduces the record length by half.
Only available for R&S oscilloscope models that support a sample rate of 20 GHz (see data sheet).
For R&S oscilloscopes with an analysis bandwidth of 4 GHz or larger, a sample rate of 20 GHZ is always used.

*RST: 10 GHz
Default unit: HZ

Example: INP:RF:CAPM WAV
                     INP:RF:CAPM:WAVE:SRAT 10000000

Manual operation: See "Oscilloscope Sample Rate" on page 98

INSTrument:BLOCk:CHANnel[:SETTings]:SOURce<si> <Type>

Selects an instrument or a file as the source of input provided to the channel.

For more information about configuring connected instruments or restoring files, see the R&S VSE base software user manual.

Suffix:
<si>   1 to 99
                     LTE-MIMO only: input source number

Parameters:
<Type>   FILE | DEVice | NONE

                     FILE
                     A loaded file is used for input.

                     DEVice
                     A configured device provides input for the measurement

                     NONE
                     No input source defined.

Manual operation: See "Input Source Type" on page 68
                       See "Input Type (Instrument / File)" on page 100

SYSTem:COMMunicate:RDEVice:OSCilloscope:SRATe <Rate>

Determines whether the 10 GHz mode (default) or 20 GHz mode of the connected oscilloscope is used. The 20 GHZ mode achieves a higher decimation gain, but reduces the record length by half.

Parameters:
<Rate>   10 GHz | 20 GHz

                     No other sample rate values are allowed.

                     *RST: 10 GHz
                     Default unit: HZ

Example: TRAC:IQ:SRAT?
                     //Result: 100000000
                     TRAC:IQ:RLEN?
                     //Result: 3128
                     SYST:COMM:RDEV:OSC:SRAT 20GHZ
                     TRAC:IQ:SRAT?
                     //Result: 200000000
                     TRAC:IQ:RLEN?
                     //Result: 1564

Manual operation: See "Oscilloscope Sample Rate" on page 98

7.8.2.3 Frequency configuration

[SENSe:]FREQuency:CENTer[:CC<cc>] <Frequency>

Sets the center frequency for RF measurements.

Component carrier measurements

- Defining or querying the frequency of the first carrier is possible with
  FREQ:CENT:CC1. The CC1 part of the syntax is mandatory in that case.

- FREQ:CENT? queries the measurement frequency (center of the two carriers).

Suffix:

<cc>	Component Carrier

Parameters:

<Frequency>	<numeric value>
	Range: fmin to fmax
	*RST: 1 GHz
	Default unit: Hz

Example: //Define frequency for measurement on one carrier:
                      FREQ:CENT 1GHZ

Example: //Define frequency for measurement on aggregated carriers:
                      FREQ:CENT:CC1 850MHZ

Manual operation: See "Remote commands to configure carrier aggregation"
                      on page 61
                      See "Center Frequency" on page 101

[SENSe:]FREQuency:CENTer[:CC<cc>]:OFFSet <Offset>

Defines the general frequency offset.

For measurements on multiple component carriers, the command defines the frequency offset for a component carrier. The effect of the command depends on the syntax:

- When you omit the [CC<cc>] syntax element, the command defines the overall frequency offset.
  In that case, the value is added to the measurement frequency and, in case of measurements with component carriers, the center frequency of the component carriers.

- When you include the [CC<cc>] syntax element, the command defines the offset of the component carrier relative the first component carrier.
  In that case, the command is not available for the first component carrier - thus, ...:CC1:... is not possible.

Suffix:

<cc>   Component Carrier

Parameters:

<Offset>   <numeric value>

• General frequency offset: frequency offset in Hz.
• Component carrier offset: frequency offset relative to the first component carrier in Hz.

Default unit: Hz

Example: //Add a frequency offset of 50 Hz to the measurement frequency.
//If you are measuring component carriers, the value is also added to the center frequencies of those carriers.
`FREQ:CENT:OFFS 50HZ`

Example: //Define a frequency offset of 15 MHz for the second component carrier relative to the first component carrier.
`FREQ:CENT:CC2:OFFS 15MHZ`

Manual operation: See "Remote commands to configure carrier aggregation" on page 61
See "Center Frequency" on page 101

[SENSe:]FREQuency:CENTer:STEP <StepSize>

Defines the center frequency step size.

You can increase or decrease the center frequency quickly in fixed steps using the `SENS:FREQ UP` and `SENS:FREQ DOWN` commands, see [SENSe:]FREQuency:CENTer[:CC<cc>] on page 223.

Parameters:

<StepSize> f_{max} is specified in the data sheet.

Range: 1 to fMAX
*RST: 0.1 x span
Default unit: Hz

Example: //Set the center frequency to 110 MHz.
`FREQ:CENT 100 MHz`
`FREQ:CENT:STEP 10 MHz`
`FREQ:CENT UP`

Manual operation: See "Frequency Stepsize" on page 102

7.8.2.4 Amplitude configuration

DISPlay[:WINDow\<n>][:SUBWindow\<w>]:TRACe\<t>:Y[:SCALe]:RLEVel\<ant>
        <ReferenceLevel>

Defines the reference level (for all traces in all windows).

With a reference level offset ≠ 0, the value range of the reference level is modified by the offset.

Suffix:

\<n>	irrelevant
\<w>	subwindow Not supported by all applications
\<t>	irrelevant
\<ant>	Input source (for MIMO measurements only)

Parameters:

\<ReferenceLevel>	The unit is variable. Range: see datasheet *RST: 0 dBm Default unit: DBM

Example: `DISP:TRAC:Y:RLEV –60dBm`

Manual operation: See "Reference Level" on page 103

DISPlay[:WINDow\<n>][:SUBWindow\<w>]:TRACe\<t>:Y[:SCALe]:RLEVel\<ant>:
        OFFSet <Offset>

Defines a reference level offset (for all traces in all windows).

Suffix:

\<n>	irrelevant
\<w>	subwindow Not supported by all applications
\<t>	irrelevant
\<ant>	Input source (for MIMO measurements only)

Parameters:

\<Offset>	Range: -200 dB to 200 dB *RST: 0dB Default unit: DB

Example: `DISP:TRAC:Y:RLEV:OFFS –10dB`

Manual operation: See "Reference Level Offset" on page 103

INPut\<ip>:ATTenuation\<ant> \<Attenuation>

Defines the RF attenuation level.

Prerequisites for this command

● Decouple attenuation from reference level (`INPut<ip>:ATTenuation<ant>:AUTO`).

Suffix:

\<ip>   irrelevant

\<ant>   irrelevant

Parameters:

\<Attenuation>   *RST: 10 dB
                         Default unit: dB

Example: //Define RF attenuation
                        `INP:ATT:AUTO OFF`
                        `INP:ATT 10`

Manual operation: See "RF Attenuation" on page 104

INPut\<ip>:ATTenuation\<ant>:AUTO \<State>

Couples and decouples the RF attenuation to the reference level.

Suffix:

\<ip>   irrelevant

\<ant>   irrelevant

Parameters:

\<State>   ON | OFF | 1 | 0
                         *RST: ON

Example: //Couple attenuation to reference level (auto attenuation)
                        `INP:ATT:AUTO ON`

Manual operation: See "RF Attenuation" on page 104

INPut\<ip>:COUPling\<ant> \<CouplingType>

Selects the coupling type of the RF input.

If an external frontend is active, the coupling is automatically set to `AC`.

Suffix:

\<ip>   1 | 2
                        irrelevant

\<ant>   Input source (for MIMO measurements only)

Parameters:

\<CouplingType>   AC | DC

AC

AC coupling

DC

DC coupling

*RST: AC

Example: `INP:COUP DC`

Manual operation: See "Input Coupling" on page 105

INPut\<ip>:GAIN\<ant>:STATe \<State>

Turns the internal preamplifier on the connected instrument on and off. It requires the additional preamplifier hardware option on the connected instrument.

Suffix:

\<ip>   1 | 2

               irrelevant

\<ant>   Input source (for MIMO measurements only)

Parameters:

\<State>   ON | OFF | 0 | 1

               OFF | 0

               Switches the function off

               ON | 1

               Switches the function on

               *RST: 0

Example: `INP:GAIN:STAT ON`

               `INP:GAIN:VAL 15`

               Switches on 15 dB preamplification.

Manual operation: See "Preamplifier" on page 104

INPut\<ip>:GAIN\<ant>[:VALue] \<Gain>

Selects the "gain" if the preamplifier is activated (`INP:GAIN:STAT ON`, see INPut\<ip>:GAIN\<ant>:STATe on page 227).

The command requires the additional preamplifier hardware option.

Suffix:

\<ip>   1 | 2

               irrelevant

\<ant>   Input source (for MIMO measurements only)

Parameters:

\<Gain>   15 dB and 30 dB

               All other values are rounded to the nearest of these two.

               30 dB

               Default unit: DB

Example:	`INP:GAIN:STAT ON`
	`INP:GAIN:VAL 30`
	Switches on 30 dB preamplification.
Manual operation:	See "Preamplifier" on page 104

INPut\<ip>:IMPedance\<ant> \<Impedance>

Selects the nominal input impedance of the RF input. In some applications, only 50 Ω are supported.

Suffix:

\<ip>	1 | 2
	irrelevant
\<ant>	Input source (for MIMO measurements only)

Parameters:

\<Impedance>	50 | 75
	*RST: 50 Ω
	Default unit: OHM

Example:	`INP:IMP 75`
Manual operation:	See "Impedance" on page 105

INPut\<ip>:EATT\<ant> \<Attenuation>

Defines the electronic attenuation level.

If the current reference level is not compatible with an attenuation that has been set manually, the command also adjusts the reference level.

Suffix:

\<ip>	irrelevant
\<ant>	Connected instrument

Parameters:

\<Attenuation>	Attenuation level in dB.
	Default unit: dB

Example:	//Define signal attenuation
	`INP:EATT 10`
Manual operation:	See "Electronic Attenuation" on page 104

INPut\<ip>:EATT\<ant>:AUTO \<State>

Turns automatic selection of the electronic attenuation on and off.

If on, electronic attenuation reduces the mechanical attenuation whenever possible.

Suffix:

\<ip>	irrelevant

| <ant> | 1...4 |
| | Connected instrument |

Parameters:

| <State> | ON \| OFF \| 1 \| 0 |
| | *RST: OFF |

Example: //Turn on automatic selection of electronic attenuation

INP:EATT:AUTO ON

Manual operation: See "Electronic Attenuation" on page 104

INPut<ip>:EATT<ant>:STATe <State>

Turns the electronic attenuator on and off.

Suffix:

| <ip> | irrelevant |

| <ant> | 1...4 |
| | Connected instrument |

Parameters:

| <State> | ON \| OFF |
| | *RST: OFF |

Example: //Turn on electronic attenuation

INP:EATT:STAT ON

Manual operation: See "Electronic Attenuation" on page 104

7.8.2.5 Data capture

[SENSe:][LTE:]FRAMe:COUNt <Subframes>

Defines the number of frames you want to analyze.

Prerequisites for this command

- Turn on overall frame count ([SENSe:][LTE:]FRAMe:COUNt:STATe).

- Turn on manual selection of frames to analyze ([SENSe:][LTE:]FRAMe:COUNt: AUTO).

Parameters:

| <Subframes> | <numeric value> (integer only) |
| | *RST: 1 |

Example:	//Define number of frames to analyze manually
	FRAM:COUN:STAT ON
	FRAM:COUN:AUTO OFF
	FRAM:COUN 20
Manual operation:	See "Number of Frames to Analyze" on page 107

[SENSe:][LTE:]FRAMe:COUNt:AUTO <State>

Turns automatic selection of the number of frames to analyze on and off.

Parameters:

<State>	**ON | 1**
	Selects the analyzed number of frames according to the LTE standard.
	OFF | 0
	Turns on manual selection of the number of frames.
Example:	//Turn on automatic selection of analyzed frames
	FRAM:COUN:AUTO ON
Manual operation:	See "Auto According to Standard" on page 107

[SENSe:][LTE:]FRAMe:COUNt:STATe <State>

Turns manual selection of the number of frames you want to analyze on and off.

Parameters:

<State>	**ON | 1**
	You can set the number of frames to analyze.
	OFF | 0
	The R&S VSE analyzes the frames captured in a single sweep.
	*RST: ON
Example:	//Turn on manual selection of number of frames
	FRAM:COUN:STAT ON
Manual operation:	See "Overall Frame Count" on page 106

[SENSe:][LTE:]FRAMe:SCOunt <Subframes>

Selects the maximum number of subframes to analyze.

Selecting a number of subframes different from the default one may become necessary if the capture time is less than 20.1 ms.

Parameters:

<Subframes>	**ALL**
	Analyzes all subframes of a frame (10).
	<numeric value> (integer only)
	Number of subframes that the application analyzes.
	Range: 1 to 9

	*RST:	ALL
Example:	//Select number of analyzed subframes FRAM:SCO 3	
Manual operation:	See "Maximum Number of Subframes per Frame to Analyze" on page 107	

[SENSe:]SWAPiq <State>

Turns a swap of the I and Q branches on and off.

Parameters:

<State>	ON | OFF | 1 | 0
	*RST: OFF

Example:	//Swap I and Q branches SWAP ON
Manual operation:	See "Swap I/Q" on page 106

[SENSe:]SWEep:TIME <CaptureLength>

Defines the capture time.

Parameters:

<CaptureLength>	<numeric value>
	*RST: 20.1 ms / 40.1 ms (DL TDD) Default unit: s

Example:	//Define capture time SWE:TIME 40ms
Manual operation:	See "Capture Time" on page 106

7.8.2.6 Trigger

The trigger functionality of the LTE measurement application is the same as that of the R&S VSE.

For a comprehensive description of the available remote control commands for trigger configuration, see the documentation of the R&S VSE.

TRIGger[:SEQuence]:DTIMe <DropoutTime>

Defines the time the input signal must stay below the trigger level before a trigger is detected again.

For input from the "Analog Baseband" interface using the baseband power trigger (BBP), the default drop out time is set to 100 ns to avoid unintentional trigger events (as no hysteresis can be configured in this case).

Parameters:

<DropoutTime>   Dropout time of the trigger.

Range: 0 s to 10.0 s
*RST: 0 s
Default unit: S

Manual operation: See "Trigger Source" on page 108

TRIGger[:SEQuence]:HOLDoff<ant>[:TIME] <Offset>

Defines the trigger offset.

Suffix:
<ant>   Instrument

Parameters:
<Offset>   <numeric value>

*RST: 0 s
Default unit: s

Example: //Define trigger offset
TRIG:HOLD 5MS

Manual operation: See "Trigger Source" on page 108
See "Triggering multiple data streams (MIMO measurements)"
on page 109

TRIGger[:SEQuence]:IFPower:HOLDoff <Period>

Defines the holding time before the next trigger event.

Note that this command can be used for **any trigger source**, not just IF Power (despite the legacy keyword).

Parameters:
<Period>   Range: 0 s to 10 s
*RST: 0 s
Default unit: S

Example:	`TRIG:SOUR EXT`
	Sets an external trigger source.
	`TRIG:IFP:HOLD 200 ns`
	Sets the holding time to 200 ns.
Manual operation:	See "Trigger Source" on page 108

TRIGger[:SEQuence]:IFPower:HYSTeresis \<Hysteresis>

Defines the trigger hysteresis, which is only available for "IF Power" trigger sources.

Parameters:

\<Hysteresis>	Range: 3 dB to 50 dB
	*RST: 3 dB
	Default unit: DB
Example:	`TRIG:SOUR IFP`
	Sets the IF power trigger source.
	`TRIG:IFP:HYST 10DB`
	Sets the hysteresis limit value.
Manual operation:	See "Trigger Source" on page 108

TRIGger[:SEQuence]:LEVel\<ant>[:EXTernal\<tp>] \<Level>

Defines the level for an external trigger.

Suffix:

\<ant>	Instrument
\<tp>	Trigger port

Parameters:

\<Level>	Range: 0.5 V to 3.5 V
	*RST: 1.4 V
	Default unit: V
Example:	//Define trigger level
	`TRIG:LEV 2V`
Manual operation:	See "Trigger Source" on page 108
	See "Triggering multiple data streams (MIMO measurements)" on page 109

TRIGger[:SEQuence]:LEVel\<ant>:IFPower \<Level>

Defines the power level at the third intermediate frequency that must be exceeded to cause a trigger event.

Note that any RF attenuation or preamplification is considered when the trigger level is analyzed. If defined, a reference level offset is also considered.

Suffix:

\<ant>	Instrument

Parameters:

<Level>   <numeric value>

                                 For details on available trigger levels and trigger bandwidths see
                                 the data sheet.

                                 *RST: -10 dBm
                                 Default unit: dBm

Example: //Define trigger level

                                 `TRIG:SOUR IFP`

                                 `TRIG:LEV:IFP -30dBm`

Manual operation: See "Trigger Source" on page 108

TRIGger[:SEQuence]:LEVel<ant>:IQPower <Level>

Defines the magnitude the I/Q data must exceed to cause a trigger event.

Note that any RF attenuation or preamplification is considered when the trigger level is
analyzed. If defined, a reference level offset is also considered.

Suffix:

<ant>   Instrument

Parameters:

<Level>   <numeric value>

                                 Range: -130 dBm to 30 dBm
                                 *RST: -20 dBm
                                 Default unit: dBm

Example: //Define trigger level

                                 `TRIG:SOUR IQP`

                                 `TRIG:LEV:IQP -30dBm`

Manual operation: See "Trigger Source" on page 108

TRIGger[:SEQuence]:LEVel<ant>:RFPower <Level>

Defines the power level the RF input must exceed to cause a trigger event. Note that
any RF attenuation or preamplification is considered when the trigger level is analyzed.
If defined, a reference level offset is also considered.

The input signal must be between 500 MHz and 8 GHz.

Suffix:

<ant>   Instrument

Parameters:

<Level>   <numeric value>

                                 For details on available trigger levels and trigger bandwidths see
                                 the data sheet.

                                 *RST: -20 dBm
                                 Default unit: dBm

Example: //Define trigger level
```
TRIG:SOUR RFP
TRIG:LEV:RFP -30dBm
```

Manual operation: See "Trigger Source" on page 108

TRIGger[:SEQuence]:LEVel:MAPower <TriggerLevel>

Defines the power level that must be exceeded to cause a trigger event for (offline) input from a file.

Parameters:

<TriggerLevel>   For details on available trigger levels and trigger bandwidths, see the data sheet.

Default unit: DBM

Example: `TRIG:LEV:MAP -30DBM`

TRIGger[:SEQuence]:MAPower:HOLDoff <Period>

Defines the holding time before the next trigger event for (offline) input from a file.

Parameters:

<Period>   Range: 0 s to 10 s
                     *RST: 0 s
                     Default unit: S

Example: `TRIG:SOUR MAGN`
                     Sets an offline magnitude trigger source.
                     `TRIG:MAP:HOLD 200 ns`
                     Sets the holding time to 200 ns.

TRIGger[:SEQuence]:MAPower:HYSTeresis <Hysteresis>

Defines the trigger hysteresis for the (offline) magnitude trigger source (used for input from a file).

Parameters:

<Hysteresis>   Range: 3 dB to 50 dB
                     *RST: 3 dB
                     Default unit: DB

Example: `TRIG:SOUR MAP`
                     Sets the (offline) magnitude trigger source.
                     `TRIG:MAP:HYST 10DB`
                     Sets the hysteresis limit value.

TRIGger[:SEQuence]:PORT<ant> <port>

Selects the trigger port for measurements with devices that have several trigger ports.

Suffix:

<ant> Analyzer

Parameters:

<port> **PORT1**

PORT2

PORT3

Example: //Select trigger port 1

TRIG:PORT PORT1

Manual operation: See "Triggering multiple data streams (MIMO measurements)" on page 109

TRIGger[:SEQuence]:SLOPe <Type>

Selects the trigger slope.

Parameters:

<Type> POSitive | NEGative

POSitive
Triggers when the signal rises to the trigger level (rising edge).

NEGative
Triggers when the signal drops to the trigger level (falling edge).

*RST: POSitive

Example: TRIG:SLOP NEG

Manual operation: See "Trigger Source" on page 108
See "Triggering multiple data streams (MIMO measurements)" on page 109

TRIGger[:SEQuence]:SMSetting<ant> <State>

Selects the trigger configuration for secondary analyzers in a MIMO setup.

Suffix:

<ant> Instrument

Parameters:

<State> **ON | 1**
Uses the same trigger configuration as the primary analyzer.

OFF | 0
Uses a custom trigger configuration for the selected analyzer.

*RST: ON

Example: //Second analyzer uses same configuration as primary analyzer

TRIG:SMS2 ON

Manual operation: See "Triggering multiple data streams (MIMO measurements)" on page 109

TRIGger[:SEQuence]:SOURce<ant> <Source>

Selects the trigger source.

Note that the availability of trigger sources depends on the connected instrument.

Note on external triggers:

If a measurement is configured to wait for an external trigger signal in a remote control program, remote control is blocked until the trigger is received and the program can continue. Make sure this situation is avoided in your remote control programs.

Suffix:

<ant>   Analyzer

Parameters:

<Source>   **IMMediate**
Free run (no trigger event to start a measurement).

EXT | EXT2 | EXT3 | EXT4
Trigger signal from the corresponding "Trigger Input / Output" connector on the connected instrument, or the oscilloscope's corresponding input channel (if not used as an input source). For details on the connectors see the instrument's Getting Started manual.

RFPower
Measurement starts when the first intermediate frequency exceeds a certain level.
(Frequency and time domain measurements only.)

IFPower
Measurement starts when the second intermediate frequency exceeds a certain level.

IQPower
Measurement starts when the sampled I/Q data exceeds a certain magnitude.
For applications that process I/Q data, such as the I/Q analyzer or optional applications.

PSEN
External power sensor

MAGNitude
For (offline) input from a file, rather than an instrument.
The trigger level is specified by `TRIGger[:SEQuence]:LEVel:MAPower`.

*RST: IMMediate

Manual operation: See "Trigger Source" on page 108
See "Triggering multiple data streams (MIMO measurements)" on page 109

7.8.2.7 Demodulation

CONFigure[:LTE]:DL[:CC<cc>]:MIMO:CROSstalk <State>

Turns MIMO crosstalk compensation on and off.

Suffix:

<cc>	Component Carrier

Parameters:

<State>	ON | OFF | 1 | 0
	*RST: OFF

Example: //Turn on crosstalk compensation
CONF:DL:MIMO:CROS ON

Manual operation: See "Compensate Crosstalk" on page 112

[SENSe:][LTE:]DL:DEMod:MCFilter <State>

Turns suppression of interfering neighboring carriers on and off (e.g. LTE, WCDMA, GSM etc).

Parameters:

<State>	ON | OFF | 1 | 0
	*RST: OFF

Example: //Turn on interference suppression
DL:DEM:MCF ON

Manual operation: See "Multicarrier Filter" on page 112

[SENSe:][LTE:]DL:DEMod:CBSCrambling <State>

Turns scrambling of coded bits on and off.

Parameters:

<State>	ON | OFF | 1 | 0
	*RST: ON

Example: //Descramble coded bits
DL:DEM:CBSC ON

Manual operation: See "Scrambling of Coded Bits" on page 113

[SENSe:][LTE:]DL:DEMod:DACHannels <State>

Turns the decoding of all control channels on and off.

Parameters:

<State>   ON | OFF | 1 | 0

                           *RST: OFF

Example: //Turn on decoding of all control channels

                          DL:DEM:DACH ON

Manual operation: See "Decode All Channels" on page 113

[SENSe:][LTE:]DL:DEMod:EVMCalc <Calculation>

Selects the EVM calculation method.

Parameters:

<Calculation>   **TGPP**

                         3GPP definition

                         OTP

                         Optimal timing position

                         *RST: TGPP

Example: //Select EVM calculation method

                         DL:DEM:EVMC TGPP

Manual operation: See "EVM Calculation Method" on page 113

[SENSe:][LTE:]DL:DEMod:PRData <Reference>

Selects the type of reference data to calculate the EVM for the PDSCH.

Parameters:

<Reference>   **AUTO**

                         Automatic identification of reference data.

                         ALL0

                         Reference data is 0, according to the test model definition.

                         PS23

                         PDSCH based on ORAN PN23 (pseudo random sequence 23).

Example: //Select reference data for PDSCH demodulation

                         DL:DEM:PRD ALL0

Manual operation: See "PDSCH Reference Data" on page 114

[SENSe:][LTE:]DL:DEMod:SISYnc <State>

Turns suppression of 5G resources with a 30 kHz subcarrier spacing (dynamic spectrum sharing) on and off.

Parameters:

<State>	ON | OFF | 1 | 0
	*RST: OFF

Example: //Turn on suppression

DL:DEM:SISY ON

Manual operation: See "Suppress Interferer for Synchronization" on page 114

7.8.2.8 Estimation & compensation

Parameter estimation

[SENSe:][LTE:]DL:DEMod:BESTimation <State>

Turns boosting estimation on and off.

Parameters:

<State>	ON | OFF | 1 | 0
	*RST: ON

Example: //Turn on boosting estimation

DL:DEM:BEST ON

Manual operation: See "Boosting Estimation" on page 110

[SENSe:][LTE:]DL:DEMod:CESTimation <Type>

Selects the channel estimation type.

Parameters:

<Type>	**OFF**
	Turns off channel estimation.
	PIL
	Optimal, pilot only
	PILP
	Optimal, pilot and payload
	TGPP
	3GPP EVM definition
	*RST: TGPP

Example: //Select channel estimation type

DL:DEM:CEST TGPP

Manual operation: See "Channel Estimation" on page 110

Error compensation

[SENSe:][LTE:]DL:TRACking:PHASe <Type>

Selects the phase tracking type.

Parameters:

<Type>	**OFF**
	Deactivate phase tracking
	PIL
	Pilot only
	PILP
	Pilot and payload
	*RST: OFF

Example: //Select phase tracking type
                     DL:TRAC:PHAS PILPAY

Manual operation: See "Phase" on page 111

[SENSe:][LTE:]DL:TRACking:TIME <State>

Turns timing tracking on and off.

Parameters:

<State>	ON	OFF	1	0
	*RST: OFF

Example: //Turn on timing tracking
                     DL:TRAC:TIME ON

Manual operation: See "Time Tracking" on page 111

7.8.2.9 Automatic configuration

Commands to configure the application automatically described elsewhere.

● DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:AUTO

[SENSe<ip>:]ADJust:CONFigure:LEVel:DURation <Duration>

To determine the ideal reference level, the R&S VSE performs a measurement on the current input data. This command defines the length of the measurement if
[SENSe<ip>:]ADJust:CONFigure:LEVel:DURation:MODE is set to MANual.

Suffix:

<ip>	1..n

Parameters:

<Duration>	Numeric value in seconds

Range: 0.001 to 16000.0
*RST: 0.001
Default unit: s

Example: `ADJ:CONF:DUR:MODE MAN`
Selects manual definition of the measurement length.
`ADJ:CONF:LEV:DUR 5ms`
Length of the measurement is 5 ms.

Manual operation: See "Auto Level" on page 103

[SENSe<ip>:]ADJust:CONFigure:LEVel:DURation:MODE <Mode>

To determine the ideal reference level, the R&S VSE performs a measurement on the current input data. This command selects the way the R&S VSE determines the length of the measurement .

Suffix:

<ip>	1..n

Parameters:

<Mode>	**AUTO**

The R&S VSE determines the measurement length automatically according to the current input data.

MANual
The R&S VSE uses the measurement length defined by
`[SENSe<ip>:]ADJust:CONFigure:LEVel:DURation`
on page 241.

*RST: AUTO

Manual operation: See "Auto Level" on page 103

[SENSe:]ADJust:CONFigure:LTE

Automatically detects several signal characteristics and selects the appropriate parameters in the application.

The following signal characteristics are automatically detected.

- Carrier bandwidth

Example: //Determine signal characteristics based on the measurement signal
`ADJ:CONF:LTE`

Usage: Event

Manual operation: See "Auto LTE" on page 115

[SENSe:]ADJust:LEVel<ant>

Initiates a single (internal) measurement that evaluates and sets the ideal reference level for the current input data and measurement settings. This ensures that the settings of the RF attenuation and the reference level are optimally adjusted to the signal level without overloading the R&S VSE or limiting the dynamic range by an S/N ratio that is too small.

Suffix:

<ant>	1...4 Connected instrument

Example:	//Auto level on one instrument `ADJ:LEV2`

Usage:	Event

Manual operation:	See "Auto Level" on page 103 See "Auto leveling" on page 115

[SENSe:]ADJust:LEVel<ant>:ALL

Determines the ideal reference level based on the current measurement data and settings on all connected input sources.

This ensures that the settings of the RF attenuation and the reference level are optimally adjusted to the signal level without overloading the R&S VSE or limiting the dynamic range by an S/N ratio that is too small.

The command is available for MIMO measurements with more than one input source.

Suffix:

<ant>	irrelevant

Example:	//Auto level all connected instruments `ADJ:LEV:ALL`

Usage:	Event

Manual operation:	See "Auto Level" on page 103 See "Auto leveling" on page 115

7.8.3 Configuring time alignment measurements

All commands specific to the Transmit On/Off Power measurement are listed below.

Commands to configure Transmit On/Off Power measurement described elsewhere:

- `[SENSe:]FREQuency:CENTer[:CC<cc>]` on page 223
- Commands in "Signal characteristics" on page 184
- Commands in "Synchronization signal" on page 201

CONFigure[:LTE]:CAGGregation:STATe <State>

Turns carrier aggregation for time alignment error measurements on and off.

You can select the number of component carriers with `CONFigure[:LTE]:NOCC`.

Parameters:

<State>	ON | OFF | 1 | 0
	*RST:　　　OFF

Example:	//Select 2 component carrier
	`CONF:CAGG:STAT ON`
	`CONF:NOCC 2`

CONFigure[:LTE]:NOCC <Carrier>

Selects the number of component carriers analyzed in the measurement.

Parameters:

<Carrier>	Number of the component carriers that you would like to measure. The range depends on the measurement.
	For more information see "Carrier Aggregation" on page 60.
	*RST:　　　1

Example:	//Select number of component carriers
	`CONF:NOCC 2`

Manual operation:	See "Remote commands to configure carrier aggregation" on page 61

7.9　Analysis

7.9.1　Trace export

FORMat:DEXPort:DSEParator <Separator>

Selects the decimal separator for data exported in ASCII format.

Parameters:

<Separator>   POINt | COMMa

COMMa
Uses a comma as decimal separator, e.g. *4,05*.

POINt
Uses a point as decimal separator, e.g. *4.05*.

*RST: *RST has no effect on the decimal separator.
Default is POINt.

Example: `FORM:DEXP:DSEP POIN`
Sets the decimal point as separator.

FORMat:DEXPort:HEADer <State>

If enabled, additional instrument and measurement settings are included in the header of the export file for result data. If disabled, only the pure result data from the selected traces and tables is exported.

Trace data resulting from encrypted file input cannot be queried.

Parameters:

<State>   ON | OFF | 0 | 1

*RST: 1

FORMat:DEXPort:TRACes <Selection>

Selects the data to be included in a data export file (see `MMEMory:STORe<n>:TRACe` on page 246).

Trace data resulting from encrypted file input cannot be queried.

Parameters:

<Selection>   SINGle | ALL

SINGle
Only a single trace is selected for export, namely the one specified by the `MMEMory:STORe<n>:TRACe` command.

ALL
Selects all active traces and result tables (e.g. "Result Summary", marker peak list etc.) in the current application for export to an ASCII file.
The <trace> parameter for the `MMEMory:STORe<n>:TRACe` command is ignored.

*RST: SINGle

MMEMory:STORe<n>:TRACe <Trace>, <FileName>

Exports trace data from the specified window to an ASCII file.

You cannot query trace data resulting from encrypted file input.

Suffix:
<n>   Window

Parameters:
<Trace>   Number of the trace to be stored

<FileName>   String containing the path and name of the target file.

Example: MMEM:STOR1:TRAC 1,'C:\TEST.ASC'
                         Stores trace 1 from window 1 in the file TEST.ASC.

7.9.2 Microservice export

MMEMory:STORe<n>:MSERvice <FileName>

Exports the signal configuration to the microservice.

Suffix:
<n>   irrelevant

Parameters:
<FileName>   String containing the path and name of the file.
                           The file extension is .m5g.

Example: //Export to microservice
                             MMEM:STOR:MSER 'signal.xxx'

7.9.3 Evaluation range

CONFigure[:LTE]:DL[:CC<cc>]:BF:AP:CELL <Port>

Selects the antenna port for which beamforming measurement results are displayed.

The availabilty of ports depends on the number of transmit antennas and number of beamforming layers.

Suffix:

<cc>	Component Carrier

Parameters:

<Port>	Antenna port used by the cell reference signal.
	ALL
	Shows the results for all antenna ports.
	**AP_0	AP_1	AP_2	AP_3**
	Shows the results for antenna port 0, 1, 2 or 3 only.
	*RST: ALL

Example:	//Display results for all antenna ports
	`CONF:DL:BF:AP:CELL ALL`

Manual operation:	See "Beamforming Selection" on page 123

CONFigure[:LTE]:DL[:CC<cc>]:BF:AP:CSI <Port>

Selects the antenna port for which beamforming measurement results are displayed.

The availabilty of ports depends on the number of transmit antennas and number of beamforming layers.

Suffix:

<cc>	Component Carrier

Parameters:

<Port>	Antenna port used by the CSI reference signal.
	ALL
	Shows the results for all antenna ports.
	**AP_15	AP_16	AP_17	AP_18	AP_19	AP20	AP21	AP22**
	Shows the results for antenna port 15 to antenna port 22 only.
	*RST: ALL

Example:	//Display results for all antenna ports
	`CONF:DL:BF:AP:CSI ALL`

Manual operation:	See "Beamforming Selection" on page 123

CONFigure[:LTE]:DL[:CC<cc>]:BF:AP[:UERS] <Port>

Selects the antenna port for which beamforming measurement results are displayed.

The availabilty of ports depends on the number of transmit antennas and number of beamforming layers.

Suffix:

<cc>	Component Carrier

Parameters:

<Port>   Antenna port used by the UE reference signal.

ALL
Shows the results for all antenna ports.

AP_5_7 | AP_8 | AP_9 | AP_10 | AP_11 | AP_12 | AP_13 | AP_14
Shows the results for antenna port 5/7, 8, 9, 10, 11, 12, 13 or 14 only.

*RST: ALL

Example: //Display results for all antenna ports
CONF:DL:BF:AP:UERS ALL

Manual operation: See "Beamforming Selection" on page 123

[SENSe:][LTE:][CC<cc>:]ALLocation:SELect <Allocation>

Filters the displayed results in the constellation diagram by a certain type of allocation.

Suffix:

<cc>	Component Carrier

Parameters:

<Allocation>   **ALL**
Shows the results for all allocations.

<numeric_value> (integer only)
Shows the results for a single allocation type.
Allocation types are mapped to numeric values. For the code assignment, see Chapter 7.5.1.28, "Return value codes", on page 157.

*RST: ALL

Example: //Display results for PDCCH
ALL:SEL -11

Manual operation: See "Evaluation range for the constellation diagram" on page 122

[SENSe:][LTE:][CC<cc>:]CARRier:SELect <Carrier>

Filters the results in the constellation diagram by a certain subcarrier.

Suffix:

<cc>	Component Carrier

Parameters:

<Carrier>   **ALL**
Shows the results for all subcarriers.

<numeric_value> (integer only)
Shows the results for a single subcarrier.

*RST: ALL

Example: //Display results for subcarrier 1
CARR:SEL 1

Manual operation: See "Evaluation range for the constellation diagram"
on page 122

[SENSe:][LTE:][CC<cc>:]LOCation:SELect <Location>

Selects the data source of the constellation diagram.

Suffix:
<cc>   Component Carrier

Parameters:
<Location>   **AMD**
After the MIMO decoder
BMD
Before the MIMO decoder
*RST: BMD

Example: //Use data from after the MIMO decoder
LOC:SEL AMD

Manual operation: See "Evaluation range for the constellation diagram"
on page 122

[SENSe:][LTE:][CC<cc>:]MODulation:SELect <Modulation>

Filters the results in the constellation diagram by a certain type of modulation.

Suffix:
<cc>   Component Carrier

Parameters:
<Modulation>   **ALL**
Shows the results for all modulation types.
<numeric_value> (integer only)
Shows the results for a single modulation type.
Modulation types are mapped to numeric values. For the code
assignment, see Chapter 7.5.1.28, "Return value codes",
on page 157.
*RST: ALL

Example: //Display results for all elements with a QPSK modulation
MOD:SEL 2

Manual operation: See "Evaluation range for the constellation diagram"
on page 122

[SENSe:][LTE:][CC<cc>:]SUBFrame:SELect <Subframe>

Selects the subframe to be analyzed.

Suffix:

<cc>   Component Carrier

Parameters:

<Subframe>   ALL | <numeric value>

ALL
Select all subframes

0...39
Select a single subframe

*RST: ALL

Example: //Display results for all subframes
                             SUBF:SEL ALL

Manual operation: See "Subframe Selection" on page 121

[SENSe:][LTE:][CC<cc>:]SYMBol:SELect <Symbol>

Filters the results in the constellation diagram by a certain OFDM symbol.

Suffix:

<cc>   Component Carrier

Parameters:

<Symbol>   **ALL**
                             Shows the results for all subcarriers.

                             <numeric_value> (integer only)
                             Shows the results for a single OFDM symbol.

                             *RST: ALL

Example: //Display result for OFDM symbol 2
                             SYMB:SEL 2

Manual operation: See "Evaluation range for the constellation diagram"
                         on page 122

7.9.4 Y-axis scale

DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:AUTO <ONCE>

Automatically scales the y-axis of a diagram based on the displayed results.

Suffix:

<n>   Window

<w>	Subwindow
<t>	irrelevant

Setting parameters:

<ONCE>	**ALL** Scales the y-axis in all windows for an ideal viewing experience. **DEFault** Restores the default scale of the y-axis. **ONCE** Scales the y-axis in a specific window for an ideal viewing experience.

Example:	//Automatically scale the y-axis in subwindow 2 of window 2 `DISP:WIND2:SUBW2:TRAC:Y:AUTO ONCE`
Usage:	Setting only
Manual operation:	See "Auto Scaling" on page 115 See "Automatic scaling of the y-axis" on page 119

DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:MAXimum
       <Value>

Defines the maximum value displayed on the y-axis of a diagram.

Suffix:

<n>	Window
<w>	Subwindow
<t>	irrelevant

Parameters:

<Value>	Maximum displayed value. The unit and value range depend on the selected diagram.
Example:	//Define maximum value on y-axis in subwindow 2 of window 2 `DISP:WIND2:SUBW2:TRAC:Y:MAX 0`
Manual operation:	See "Manual scaling of the y-axis" on page 118

DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:MINimum
       <Value>

Defines the minimum value displayed on the vertical diagram axis.

Suffix:

<n>	Window
<w>	Subwindow
<t>	irrelevant

Parameters:

<Value>   Minimum displayed value. The unit and value range depend on
                           the selected diagram.

Example: //Define minimum value on y-axis in subwindow 2 of window 2
                           `DISP:WIND2:SUBW2:TRAC:Y:MIN –50`

Manual operation: See "Manual scaling of the y-axis" on page 118

7.9.5 Result settings

CALCulate<n>:MARKer<m>:COUPling <State>

Couples or decouples markers in different result displays to each other.

Suffix:

<n>   irrelevant

<m>   irrelevant

Parameters:

<State>   ON | OFF | 1 | 0

                           *RST: OFF

Example: //Couple markers to each other.
                           `CALC:MARK:COUP ON`

Manual operation: See "Marker Coupling" on page 124

DISPlay[:WINDow<n>][:SUBWindow<w>]:COUPling <State>

Couples or decouples result display tabs (subwindows).

Subwindow coupling is available for measurements with multiple data streams (like
carrier aggregation).

Suffix:

<n>   Window

<w>   Subwindow

Parameters:

<State>   ON | OFF | 1 | 0

                           *RST: OFF

Example: //Turn on subwindow coupling
                           `DISP:COUP ON`

Manual operation: See "Subwindow Coupling" on page 125

UNIT:BSTR <Unit>

Selects the way the bit stream is displayed.

Parameters:
<Unit>   **SYMbols**
                          Displays the bit stream using symbols

                          BITs
                          Displays the bit stream using bits

                          *RST: SYMbols

Example: //Display bit stream as bits
                          UNIT:BSTR BIT

Manual operation: See "Bit Stream Format" on page 124

UNIT:CAXes <Unit>

Selects the scale of the x-axis for result displays that show subcarrier results.

Parameters:
<Unit>   **CARR**
                          Shows the number of the subcarriers on the x-axis.

                          HZ
                          Shows the frequency of the subcarriers on the x-axis.

Example: //Display frequency on the x-axis
                          UNIT:CAX HZ

Manual operation: See "Carrier Axes" on page 124

UNIT:EVM <Unit>

Selects the EVM unit.

Parameters:
<Unit>   **DB**
                          EVM results returned in dB

                          PCT
                          EVM results returned in %

                          *RST: PCT

Example: //Display EVM results in %
                          UNIT:EVM PCT

Manual operation: See "EVM Unit" on page 124

Annex

A Annex: reference

A.1 Menu reference

Most functions in the R&S VSE are available from the menus.

A.1.1 Common R&S VSE menus

The following menus provide **basic functions for all applications**:

A.1.1.1 File menu

The "File" menu includes all functionality directly related to any file operations, printing or setting up general parameters.

For a description of these functions see the "Data Management" chapter in the R&S VSE base software user manual.

Menu item	Corresponding icon in toolbar	Description
Save	💾	Saves the current software configuration to a file
Recall	📂	Recalls a saved software configuration from a file
Save IQ Recording	-	Saves the recorded I/Q data from a measurement channel to a file
Recall IQ Recording	-	Loads the recorded I/Q data from a file
Measurement Group >	-	Configures measurement channels and groups
> New Group	-	Inserts a new group in the measurement sequence
> Rename Group	-	Changes the name of the selected group

Menu item	Corresponding icon in toolbar	Description
> New Measurement Channel	-	Inserts a new channel in the selected group
> Replace Measurement Channel	-	Replaces the currently selected channel by the selected application.
> Rename Measurement Channel	-	Changes the name of the selected channel.
> Delete Current Measurement Channel	-	Deletes the currently selected channel.
> Measurement Group Setup	-	Displays the "Measurement Group Setup" tool window.
Instruments >	-	Configures instruments to be used for input to the R&S VSE software
> New	-	Creates a new instrument configuration
> Search	-	Searches for connected instruments in the network
> Delete All	-	Deletes all current instrument configurations
> Setup	-	Hides or displays the "Instrument" tool window
Preset >	-	Restores stored settings
> Selected Channel	-	Restores the default software configuration for an individual channel
> All	-	Restores the default software configuration globally for the entire software
> All & Delete Instruments		Restores the default software configuration globally for the entire software and deletes all instrument configurations
> Reset VSE Layout	-	Restores the default layout of windows, toolbars etc. in the R&S VSE
Preferences >	-	Configures global software settings
> General	-	
> Displayed Items	-	Hides or shows individual screen elements
> Theme & Color	-	Configures the style of individual screen elements
> Network & Remote	-	Configures the network settings and remote access to or from other devices
> Recording	-	Configures general recording parameters
Print	-	Opens "Print" dialog to print selected measurement results
Exit	-	Closes the R&S VSE

A.1.1.2 Window menu

The "Window" menu allows you to hide or show individual windows.

For a description of these functions see the "Controlling Instruments and Capturing Data" chapter in the R&S VSE base software user manual.

Menu item	Corresponding icon in toolbar	Description
Player	-	Displays the "Player" tool window to recall I/Q data recordings
Instruments	-	Displays the "Instruments" window to configure input instruments
Measurement Group Setup	-	Displays the "Measurement Group Setup" window to configure a measurement sequence
New Window >	⊡	Inserts a new result display window for the selected measurement channel
Channel Information >	-	Displays the channel bar with global channel information for the selected measurement channel
Active Windows >	-	Selects a result display as the active window; the corresponding channel is also activated

A.1.1.3 Help menu

The "Help" menu provides access to help, support and licensing functions.

For a description of these functions see the "Basic Operations" and "General Software Settings" chapters in the R&S VSE base software user manual.

Menu item	Corresponding icon in toolbar	Description
Help	?	Opens the Online help window
License	-	Licensing, version and options information
Support	-	Support functions
Register VSE	-	Opens the Rohde & Schwarz support page (http://www.rohde-schwarz.com/support) in a browser for registration.
Online Support	-	Opens the default web browser and attempts to establish an Internet connection to the Rohde & Schwarz product site.
About	-	Software version information

A.1.2 LTE measurement menus

A.1.2.1 Input & output menu

The "Input & Output" menu provides functions to configure the input source, frontend parameters and output settings for the measurement.

This menu is application-specific.

Table A-1: "Input" menu items for LTE measurements

Menu item	Description
Amplitude	Chapter 5.1.22, "Amplitude configuration", on page 102
Scale	Chapter 6.1.3, "Diagram scale", on page 118
Frequency	Chapter 5.1.21, "Frequency configuration", on page 101
Trigger	Chapter 5.1.24, "Trigger configuration", on page 107
Input Source	Chapter 5.1.20, "Selecting the input and output source", on page 97
Output Source	

A.1.2.2 Meas setup menu

The "Meas Setup" menu provides access to most measurement-specific settings, as well as bandwidth, sweep and auto configuration settings, and the configuration "Overview" window.

This menu is application-specific.

Table A-2: "Meas Setup" menu items for LTE measurements

Menu item	Description
Select Measurement	Chapter 3, "Measurements and result displays", on page 12
Signal Description	Chapter 5.1.2, "Signal characteristics", on page 59
MIMO Setup	Chapter 5.1.4, "Configuring MIMO setups", on page 66
PDSCH Settings	Chapter 5.1.5, "PDSCH demodulation", on page 70 Chapter 5.1.6, "PDSCH subframe configuration", on page 71
Trigger / Signal Capture	Chapter 5.1.23, "Data capture", on page 105
Parameter Estimation / Tracking	Chapter 5.1.25, "Parameter estimation and tracking", on page 110
Demod	Chapter 5.1.27, "Demodulation", on page 112
Evaluation Range	Chapter 6.2.2, "Evaluation range", on page 121
Result Settings	Chapter 6.2.3, "Result settings", on page 123
Overview	Chapter 5.1.1, "Configuration overview", on page 57

A.1.2.3 Trace menu

The "Trace" does not contain any functions for LTE measurements, traces are gener-
ally not configurable.

A.1.2.4 Marker menu

The "Marker" menu provides access to marker-specific functions.

This menu is application-specific.

Table A-3: "Marker" menu items for LTE measurements

Menu item	Corresponding icon in toolbar	Description
Select marker <x>	M1 ▼	Chapter 6.1.5, "Markers", on page 119
Marker to Trace	-	Chapter 6.1.5, "Markers", on page 119
All Markers Off	⊗▼	Chapter 6.1.5, "Markers", on page 119
Marker...	⚙▼	Chapter 6.1.5, "Markers", on page 119
Search	-	Chapter 6.1.5, "Markers", on page 119

A.1.2.5 Limits menu

The "Limits" menu does not contain any functions for LTE measurements.

A.2 Reference of toolbar functions

Common functions can be performed via the icons in the toolbars.

Individual toolbars can be hidden or displayed.

Hiding and displaying a toolbar

1. Right-click any toolbar or the menu bar.

   A context menu with a list of all available toolbars is displayed.

2. Select the toolbar you want to hide or display.

   A checkmark indicates that the toolbar is currently displayed.

   The toolbar is toggled on or off.

Note that some icons are only available for specific applications. Those functions are described in the individual application's User Manual.

General toolbars

The following functions are generally available for all applications:

"Main" toolbar

For a description of these functions see the R&S VSE base software user manual.

Table A-4: Functions in the "Main" toolbar

Icon	Description
	Overview: Displays the configuration overview for the current measurement channel
	Save: Saves the current software configuration to a file
	Recall: Recalls a saved software configuration from a file
	Save I/Q recording: Stores the recorded I/Q data to a file
	Recall I/Q recording: Loads recorded I/Q data from a file
	Print immediately: prints the current display (screenshot) as configured
	Add Window: Inserts a new result display window for the selected measurement channel
	MultiView mode: displays windows for all active measurement channels (disabled: only windows for currently selected channel are displayed)

"Control" toolbar

For a description of these functions see the R&S VSE base software user manual.

Table A-5: Functions in the "Control" toolbar

Icon	Description
IQ Analyzer ▾	Selects the currently active channel
▶	Capture: performs the selected measurement
❚❚	Pause: temporarily stops the current measurement
↻	Continuous: toggles to continuous measurement mode for next capture
→|	Single: toggles to single measurement mode for next capture

Icon	Description
●	Record: performs the selected measurement and records the captured data and results
↻	Refresh: Repeats the evaluation of the data currently in the capture buffer without capturing new data (VSA application only).

"Help" toolbar

For a description of these functions see the R&S VSE base software user manual.

Table A-6: Functions in the "Help" toolbar

Icon	Description
▸?	Help (+ Select): allows you to select an object for which context-specific help is displayed (not available in standard Windows dialog boxes or measurement result windows)
?	Help: displays context-sensitive help topic for currently selected element

Application-specific toolbars

The following toolbars are application-specific; not all functions shown here may be available in each application:

"Zoom" toolbar

For a description of these functions see the R&S VSE base software user manual.

Table A-7: Functions in the "Zoom" toolbar

Icon	Description
▸	Normal mouse mode: the cursor can be used to select (and move) markers in a zoomed display
🔍	Zoom mode: displays a dotted rectangle in the diagram that can be expanded to define the zoom area
🔍	Multiple zoom mode: multiple zoom areas can be defined for the same diagram
🔍 1:1	Zoom off: displays the diagram in its original size

Table A-8: Functions in the "Marker" toolbar

Icon	Description
▼	Place new marker
▼%	Percent Marker (CCDF only)
M1 ▾	Select marker
▼△	Marker type "normal"

Icon	Description
	Marker type "delta"
	Global peak
	Absolute peak (Currently only for GSM application)
	Next peak to the left
	Next peak to the right
	Next peak up (for spectrograms only: search in more recent frames)
	Next peak down (for spectrograms only: search in previous frames)
	Global minimum
	Next minimum left
	Next minimum right
	Next min up (for spectrograms only: search in more recent frames)
	Next min down (for spectrograms only: search in previous frames)
CF	Set marker value to center frequency
REF	Set reference level to marker value
	All markers off
	Marker search configuration
	Marker configuration

Table A-9: Functions in the "AutoSet" toolbar

Icon	Description
	Refresh measurement results (R&S VSE VSA and OFDM VSA applications only)
AUTO LEVEL	Auto level
AUTO FREQ	Auto frequency
	Auto trigger (R&S VSE GSM application only)
	Auto frame (R&S VSE GSM application only)
	Auto search (R&S VSE 3GPP FDD application only)

Icon	Description
	Auto scale (R&S VSE 3GPP FDD + Pulse applications only)
	Auto scale all (R&S VSE 3GPP FDD + Pulse applications only)
AUTO ALL	Auto all
⚙	Configure auto settings

List of commands

Index