

R&S®VSE-K106

LTE NB-IoT Measurement Application (Downlink) User Manual



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Version 12



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)

The following firmware options are described:

- R&S®VSE-K106 LTE NB-IoT Downlink Measurement Application (1320.7900.02)
- R&S®VSE-KT106 LTE NB-IoT Downlink Measurement Application (1345.1757.02)
- R&S®VSE-KP106 LTE NB-IoT Downlink Measurement Application (1345.2553.02)

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Contents

1	Documentation Overview.....	7
1.1	User Manuals and Help.....	7
1.2	Data Sheets and Brochures.....	7
1.3	Release Notes and Open Source Acknowledgment (OSA).....	8
1.4	Application Notes, Application Cards, White Papers, etc.....	8
1.5	Videos.....	8
2	Welcome to the LTE NB-IoT measurement application.....	9
2.1	Starting the LTE NB-IoT measurement application.....	9
2.2	Understanding the display information.....	10
3	Measurements and result displays.....	12
3.1	Selecting measurements.....	12
3.2	Selecting result displays.....	13
3.3	Performing measurements.....	14
3.4	I/Q measurements.....	14
3.5	Time alignment error.....	26
3.6	Frequency sweep measurements.....	27
4	Configuration.....	31
4.1	Configuration overview.....	31
4.2	I/Q measurements configuration.....	33
4.2.1	Defining signal characteristics.....	34
4.2.2	Test scenarios.....	38
4.2.3	Configuring MIMO setups.....	38
4.2.4	NPDSCH settings.....	39
4.2.5	Configuring the control channel.....	40
4.2.6	Selecting the input and output source.....	41
4.2.7	Frequency configuration.....	45
4.2.8	Amplitude configuration.....	46
4.2.9	Configuring the data capture.....	50
4.2.10	Trigger configuration.....	51
4.2.11	Parameter estimation and tracking.....	53

4.2.12	Configuring demodulation parameters.....	54
4.2.13	Automatic configuration.....	56
4.3	Time alignment error measurement configuration.....	56
4.4	Frequency sweep measurement configuration.....	57
4.4.1	Channel power ACLR measurement.....	57
4.4.2	SEM measurement configuration.....	57
5	Analysis.....	60
5.1	General analysis tools.....	60
5.1.1	Data export.....	60
5.1.2	Microservice export.....	61
5.1.3	Diagram scale.....	61
5.1.4	Zoom.....	62
5.1.5	Markers.....	62
5.2	Analysis tools for I/Q measurements.....	63
5.2.1	Layout of numerical results.....	63
5.2.2	Evaluation range.....	64
5.2.3	Result settings.....	66
5.3	Analysis tools for frequency sweep measurements.....	67
6	Remote control.....	68
6.1	Common suffixes.....	68
6.2	Introduction.....	69
6.2.1	Conventions used in descriptions.....	69
6.2.2	Long and short form.....	70
6.2.3	Numeric suffixes.....	70
6.2.4	Optional keywords.....	71
6.2.5	Alternative keywords.....	71
6.2.6	SCPI parameters.....	71
6.3	NB-IoT application selection.....	73
6.4	Screen layout.....	74
6.4.1	General layout.....	74
6.4.2	Layout over all channels.....	75
6.4.3	Layout of a single channel.....	79
6.5	Trace data readout.....	85

6.5.1	Using the TRACe[:DATA] command.....	85
6.5.2	Result readout.....	96
6.6	Numeric result readout.....	97
6.6.1	Result for selection.....	97
6.6.2	Time alignment error.....	103
6.6.3	Marker table.....	103
6.6.4	CCDF table.....	106
6.7	Remote commands to configure the application.....	108
6.7.1	General configuration.....	108
6.7.2	Configuring I/Q measurements.....	109
6.7.3	Configuring time alignment measurements.....	142
6.7.4	Frequency sweep measurements.....	143
6.8	Analysis.....	145
6.8.1	Trace export.....	145
6.8.2	Microservice export.....	147
6.8.3	Evaluation range.....	147
6.8.4	Y-axis scale.....	149
6.8.5	Result settings.....	151
	Annex.....	153
A	Performing time alignment measurements.....	153
B	Annex: reference.....	154
B.1	Menu reference.....	154
B.1.1	Common R&S VSE menus.....	154
B.1.2	LTE measurement menus.....	156
B.2	Reference of toolbar functions.....	158
	List of commands.....	162
	Index.....	166

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 NB-IoT measurement application

The LTE NB-IoT measurement application is a firmware application that adds functionality to perform measurements on LTE NB-IoT 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.

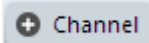
<https://www.rohde-schwarz.com/manual/vse>.

- [Starting the LTE NB-IoT measurement application](#).....9
- [Understanding the display information](#).....10

2.1 Starting the LTE NB-IoT measurement application

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

To open the LTE NB-IoT application

1.  Channel

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 "NB-IoT" item.



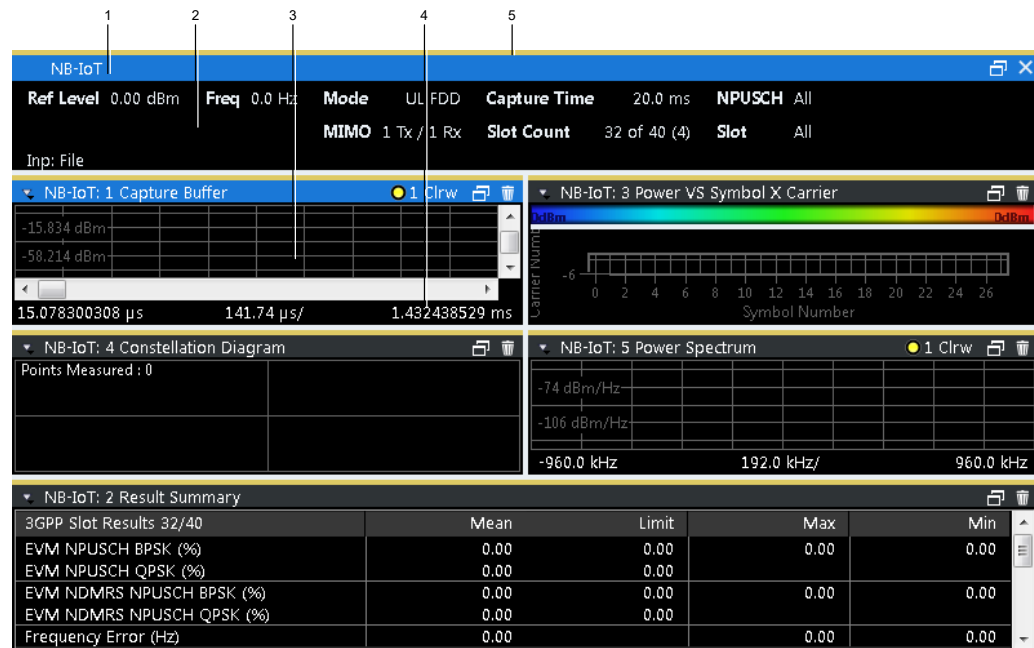
The R&S VSE opens a new measurement channel for the NB-IoT application.

The application is started with the default settings. It can be configured in the "Overview" dialog box, which is displayed when you select the "Overview" softkey from the "Meas Setup" menu.

For more information see [Chapter 4, "Configuration"](#), on page 31.

2.2 Understanding the display information

The following figure shows a measurement diagram during analyzer operation. 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: yellow)

Channel bar information

In the LTE NB-IoT 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
Offset	Reference level offset
Freq	Center frequency
E-UTRA Freq	Center frequency of the LTE channel (in-band deployment only)
Mode	NB-IoT standard
MIMO	Number of Tx and Rx antennas in the measurement setup
Capture Time	Length of the signal that has been captured

Frame Count	Number of frames that have been captured
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 (for example trigger settings). This information is displayed only when applicable for the current measurement. For details see the R&S VSE Getting Started manual.

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 NPSS): The NPSS correlation failed.
 - Sync Failed (NSSS): The NSSS correlation failed.

3 Measurements and result displays

The LTE NB-IoT measurement application measures and analyzes various aspects of an NB-IoT 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 can 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 108

Result display selection: `LAYout:ADD[:WINDow]?` on page 79

- [Selecting measurements](#).....12
- [Selecting result displays](#).....13
- [Performing measurements](#).....14
- [I/Q measurements](#).....14
- [Time alignment error](#).....26
- [Frequency sweep measurements](#).....27

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 NB-IoT 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 108

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"](#), on page 26.

Remote command:

`CONFigure[:LTE]:MEASurement` on page 108

Channel power ACLR

ACLR measurements process captured the I/Q data.

The ACLR measurements evaluates the leakage ratio of neighboring channels and evaluates if the signal is within the defined limits. The measurement provides several result displays. You can combine the result displays in any way.

For more information on the result displays, see [Chapter 3.6, "Frequency sweep measurements"](#), on page 27.

Remote command:

`CONFigure[:LTE]:MEASurement` on page 108

SEM

SEM measurements process captured the I/Q data.

The SEM measurements tests the signal against a spectrum emission mask and evaluates if the signal is within the defined limits. The measurement provides several result displays. You can combine the result displays in any way.

For more information on the result displays, see [Chapter 3.6, "Frequency sweep measurements"](#), on page 27.

Remote command:

`CONFigure[:LTE]:MEASurement` on page 108

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
- Power vs Symbol X Carrier
- Constellation Diagram
- Power Spectrum
- Result Summary

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 79

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: "Overview" > "Select Measurement" > "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 108

Result display selection: `LAYout:ADD[:WINDow]?` on page 79

Capture Buffer.....	15
EVM vs Carrier.....	16
EVM vs Symbol.....	16
EVM vs Subframe.....	17
Frequency Error vs Symbol.....	17
Power Spectrum.....	18
Channel Flatness.....	18
Group Delay.....	19
Channel Flatness Difference.....	19
Constellation Diagram.....	19
CCDF.....	20
Allocation Summary.....	21
Bitstream.....	21

EVM vs Symbol x Carrier.....	22
Power vs Symbol x Carrier.....	23
Allocation ID vs Symbol x Carrier.....	23
Result Summary.....	24
Marker Table.....	25

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.

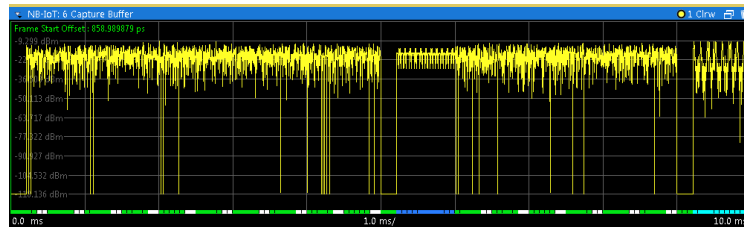






Figure 3-1: Capture buffer without zoom

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 NPSS and data.
-  Indicates the NSSS 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.

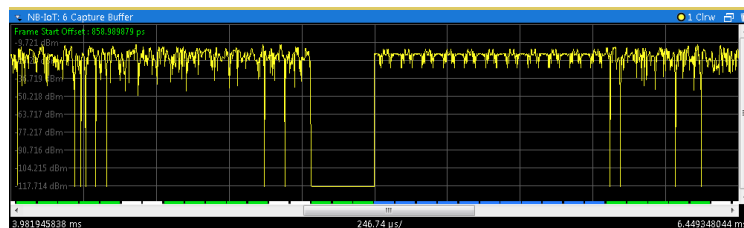


Figure 3-2: Capture buffer after a zoom has been applied

Remote command:

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

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

Query (x-axis): `TRACe<n>[:DATA]:X?` on page 95

Subframe start offset: `FETCh[:CC<cc>]:SUMMary:TFRame?` on page 102

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.

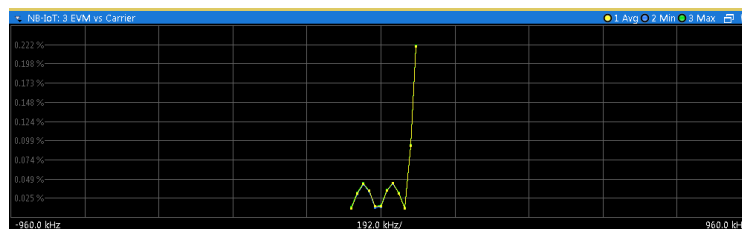
The results are based on an average EVM that is calculated over the resource elements for each subcarrier. This average subcarrier EVM is determined for each analyzed subframe in the capture buffer.

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 64.

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 95

EVM vs Symbol

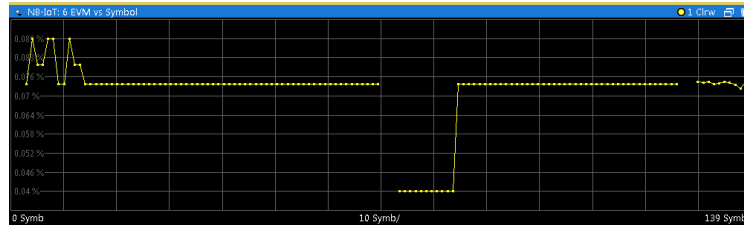
The "EVM vs Symbol" result display shows the error vector magnitude (EVM) of the OFDM symbols. You can use it as a debugging technique to identify any symbols whose EVM is too high.

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.

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 95

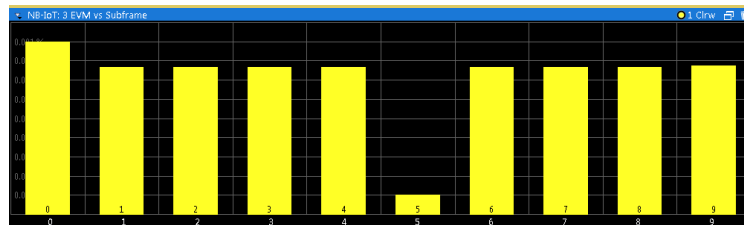
EVM vs Subframe

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 95

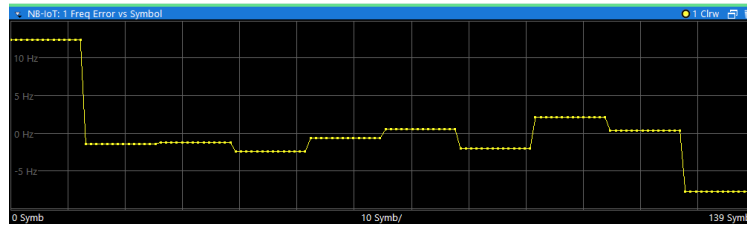
Frequency Error vs Symbol

The "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.

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 NPDSCH 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?`

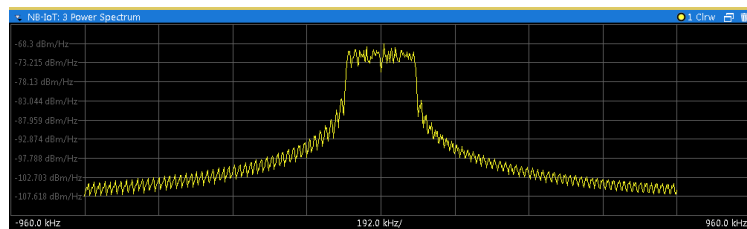
Query (x-axis): `TRACe<n>[:DATA]:X?` on page 95

Power Spectrum

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

The displayed bandwidth is always 7.68 MHz.

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?`

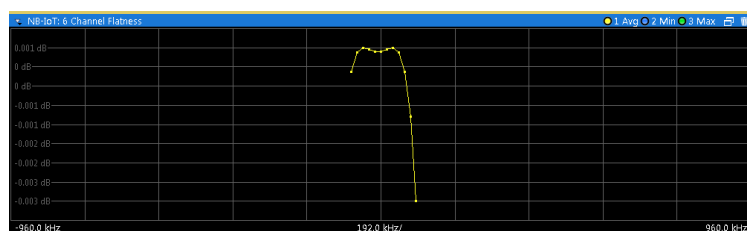
Query (x-axis): `TRACe<n>[:DATA]:X?` on page 95

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 95

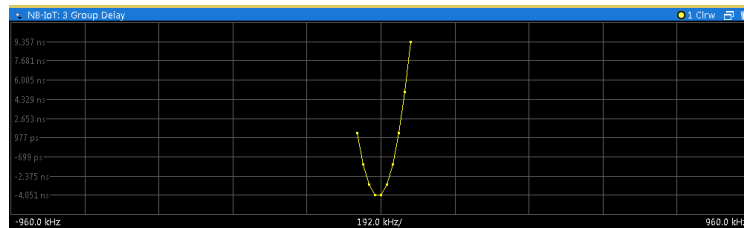
Group Delay

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?`

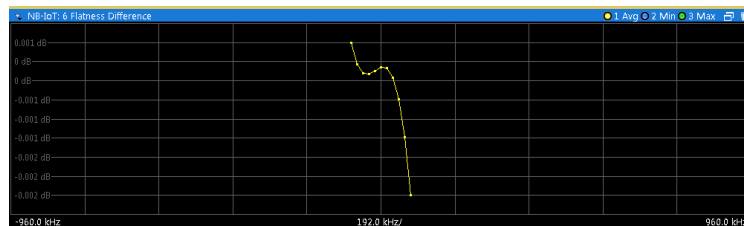
Query (x-axis): `TRACe<n>[:DATA]:X?` on page 95

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, FDI`

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






Query (x-axis): `TRACe<n>[:DATA]:X?` on page 95

Constellation Diagram

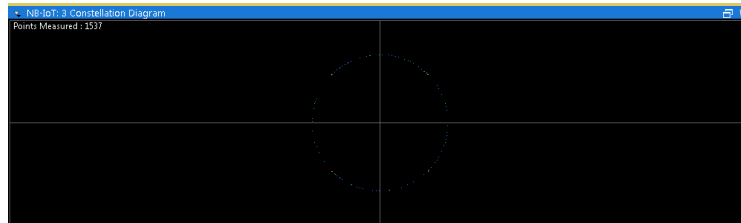
The "Constellation Diagram" shows the in-phase and quadrature phase results and is an indicator of the quality of the modulation of the signal.

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
-  : 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:

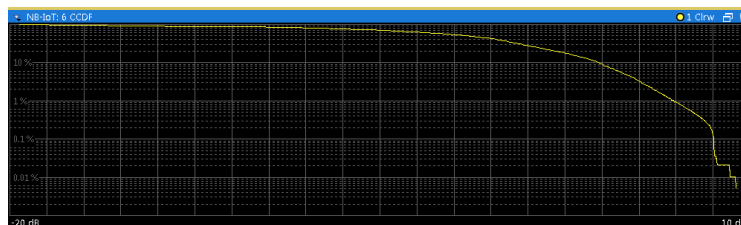
Selection: `LAY:ADD ? '1',LEFT,CONS`

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 107

Numerical results: `CALCulate<n>:STATistics:RESult<res>?` on page 107

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).

SF	Allocation ID	RBs	Rel Pow[dB]	Mod	Pow per RE[dBm]	EVM [%]
0	NRS-Ant1		0.000	QPSK	-29.134	0.026
	NPBCH		0.000	QPSK	-29.134	0.084
	ALL	0				0.081
1	NRS-Ant1	1	0.000	QPSK	-29.134	0.026
	NPDSCH/NPDCCH	1	0.000	QPSK	-29.134	0.076
	ALL	1				0.074
2	NRS-Ant1	1	0.000	QPSK	-29.134	0.026
	NPDSCH/NPDCCH	1	0.000	QPSK	-29.134	0.076
	ALL	1				0.074
3	NRS-Ant1		0.000	QPSK	-29.134	0.026

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 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](#)

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 NPDSCH allocations that contribute to the bitstream. 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 NPDSCH [reference data](#) = "All 0".
- Turn off [automatic demodulation](#) of the NPDSCH to define the location of the NPDSCH (subframes and N_RNTI).

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.

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

SF	Allocation ID	Code word	Mod	Symbol Index	Bitstream
0	NPBCH	1/1	QPSK	0	03 02 02 02 00 03 01 00 00 00 02 01 02 03 02 02
0	NPBCH	1/1	QPSK	16	03 01 02 00 02 03 01 03 00 01 03 00 02 01 03 00
0	NPBCH	1/1	QPSK	32	03 00 00 01 02 00 02 00 03 03 02 01 00 03 00 00
0	NPBCH	1/1	QPSK	48	01 01 03 03 01 01 03 03 03 00 00 02 03 01 03 02
0	NPBCH	1/1	QPSK	64	03 01 01 01 02 00 00 02 00 01 03 03 02 02 01 03
0	NPBCH	1/1	QPSK	80	03 03 01 03 01 00 00 00 01 01 00 00 00 03 03 02
0	NPBCH	1/1	QPSK	96	02 02 02 01
1	NPDSCH/NPDCCH	1/1	QPSK	0	00 03 03 00 00 02 00 00 00 00 00 03 02 01 03 00
1	NPDSCH/NPDCCH	1/1	QPSK	16	00 03 03 02 02 00 02 01 01 00 00 02 01 02 00 01
1	NPDSCH/NPDCCH	1/1	QPSK	32	02 01 02 02 03 03 02 02 03 01 01 02 03 03 01 02
1	NPDSCH/NPDCCH	1/1	QPSK	48	02 01 01 01 01 00 00 00 00 03 00 03 00 00 03 01
1	NPDSCH/NPDCCH	1/1	QPSK	64	03 03 00 02 03 03 01 02 01 01 00 03 01 01 03 00

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.

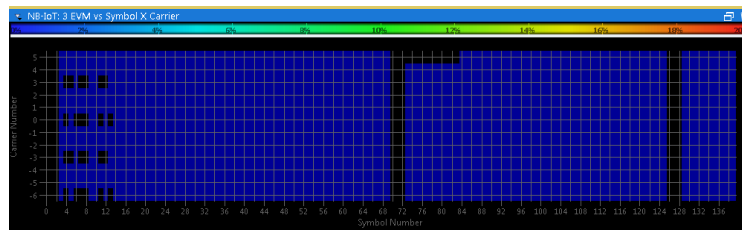
Remote command:

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

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:

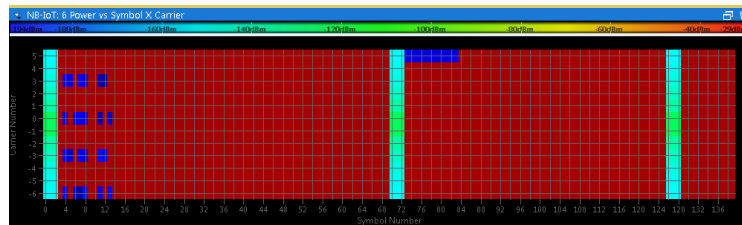
Selection: `LAY:ADD ? '1', LEFT, EVSC`

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`

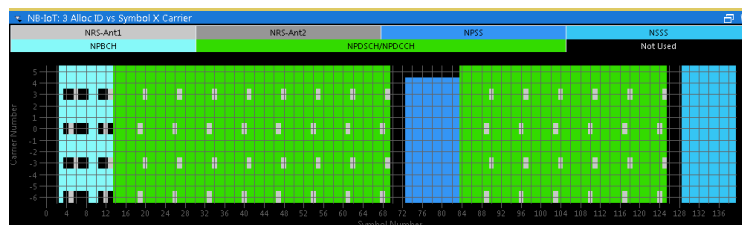
Query: `TRACe:DATA?`

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?`

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

SF All	Sel Ant 1	Mean	Max	Limit	Min
EVM All (%)		0.07	0.08		0.04
EVM Phys Channel (%)		0.08	0.08		0.08
EVM Phys Signal (%)		0.06	0.07		0.03
Frequency Error (Hz)		0.00	0.01		-0.00
Sampling Error (ppm)		0.01	0.06		-0.00
RSTP (dBm)		-29.13	-29.13		-29.13
OSTP (dBm)		-18.38	-18.34		-18.72
RSSI (dBm)		-18.43	-18.34		-19.13
Power (dBm)		-18.73	-18.34		-20.26
Crest Factor (dB)		9.42			

The table shows results that refer to the complete frame. For each result, the minimum, mean and maximum values are displayed. It also indicates limit values as defined in the NB-IoT standard and 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.

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 98
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. NPDSCH, NPBCH or NPDCCH, for example, are physical channels. For more information, see 3GPP 36.211. FETCH[:CC<cc>]:SUMMARY:EVM:PCHANNEL[:AVERAGE]? on page 99
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 99
Frequency Error	Shows the difference in the measured center frequency and the reference center frequency. FETCH[:CC<cc>]:SUMMARY:FERROR[:AVERAGE]? on page 100
Sampling Error	Shows the difference in measured symbol clock and reference symbol clock relative to the system sampling rate. FETCH[:CC<cc>]:SUMMARY:SEERROR[:AVERAGE]? on page 102

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 102
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 NPDSCH. FETCh[:CC<cc>]:SUMMary:OSTP[:AVERAge]? on page 100
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 101
Power	Shows the average time domain power of the analyzed signal. FETCh[:CC<cc>]:SUMMary:POWer[:AVERAge]? on page 100
NB-IoT Power	Shows the power of all resource elements used by NB-IoT. FETCh[:CC<cc>]:SUMMary:NBPower[:AVERAge]? on page 101
Crest Factor	Shows the peak-to-average power ratio of captured signal. FETCh[:CC<cc>]:SUMMary:CRESt[:AVERAge]? on page 98

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	Shows the "EVM", power and allocation type at the marker position. Only in 3D result displays (for example "EVM vs Symbol x Carrier").
Z-Power	
Z-Alloc ID	

Wnd	Type	Trc	Ref	X-value	Y-value	Z-type	Z-value
1	M1	1		-82.500 kHz	7.82 dB		
1	D1	1	M1	135.000 kHz	-8.00 dB		
3	M1	1		Symbol 72	Carrier 3	EVM	NaN
						Power	-14.96 dBm
						Alloc ID	Not Used
5	M1	1		320.300 µs	-3.84 dBm		
5	D2	1	M1	10.000 ms	-0.00 dB		
5	D3	1	M1	9.709 ms	-1.51 dB		

Remote command:

LAY:ADD? '1',RIGH, MTAB, see LAYout:ADD[:WINDow]? on page 79

Results:

CALCulate<n>:MARKer<m>:X on page 104

CALCulate<n>:MARKer<m>:Y on page 105

CALCulate<n>:MARKer<m>:Z? on page 105

CALCulate<n>:MARKer<m>:Z:ALL? on page 106

3.5 Time alignment error

Access: "Overview" > "Select Measurement" > "Time Alignment"

The time alignment error measurement captures and analyzes new I/Q data when you select it.

The time alignment error measurement only works under the following conditions:

- It is only available in a MIMO setup (2 antennas).
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 measurement, see [Chapter A, "Performing time alignment measurements"](#), on page 153.
- It is only available for the [stand alone deployment](#).

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

- ["Capture Buffer"](#) on page 15
- ["Power Spectrum"](#) on page 18
- ["Marker Table"](#) on page 25

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 108

Result display selection: LAYout:ADD[:WINDow]? on page 79

[Time Alignment Error](#)..... 26

Time Alignment Error

The time alignment is an indicator of how well the transmission antennas in a MIMO system are synchronized. The time alignment error is the time delay between a reference antenna (for example antenna 1) and another antenna.

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 subframe.

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 4.3, "Time alignment error measurement configuration"](#), on page 56.

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 103

Reference antenna: `CONFigure[:LTE]:DL[:CC<cc>]:MIMO:ASElection` on page 117

3.6 Frequency sweep measurements

Access (ACLR): "Meas Setup" > "Select Measurement" > "Channel Power ACLR"

The NB-IoT application supports the following frequency sweep measurements.

- Adjacent channel leakage ratio (ACLR)
- Spectrum emission mask (SEM)

Frequency sweep measurements also capture and process I/Q data to analyze a signal.

Make sure to have sufficient bandwidth to be able to capture the whole signal, including neighboring channels.

Features of the frequency sweep measurements:

- Frequency sweep measurements are only available for the [stand alone deployment](#).
- Gated trigger is possible by using I/Q files for the ACLR and SEM.

In addition to the specific diagrams and table (see description below), frequency sweep measurements support the following result displays.

- ["Marker Table"](#) on page 25
 - Marker peak list
- Both result displays have the same contents as the spectrum application.

Remote command:

Measurement selection: `CONFigure[:LTE]:MEASurement` on page 108

Result display selection: `LAYout:ADD[:WINDow] ?` on page 79

Adjacent Channel Leakage Ratio (ACLR).....	28
L Result diagram.....	28
L Result summary.....	28
Spectrum Emission Mask (SEM).....	29
L Result diagram.....	29
L Result summary.....	29
Marker Peak List.....	30

Adjacent Channel Leakage Ratio (ACLR)

The adjacent channel leakage ratio (ACLR) measurement is designed to analyze signals that contain multiple signals for different radio standards. Using the ACLR measurement, you can determine the power of the transmit (Tx) channel and the power of the neighboring (adjacent) channels to the left and right of the Tx channel. Thus, the ACLR measurement provides information about the power in the adjacent channels as well as the leakage into these adjacent channels.

When you measure the ACLR in the NB-IoT application, the R&S VSE automatically selects appropriate ACLR settings based on the selected channel bandwidth.

For a comprehensive description of the ACLR measurement, refer to the user manual of the R&S VSE.

Remote command:

Selection: `CONF:MEAS ACLR`

Result diagram ← Adjacent Channel Leakage Ratio (ACLR)

The result diagram is a graphic representation of the signals with a trace that shows the measured signal. Individual channels (Tx and adjacent channels) are indicated by vertical lines and corresponding labels.

In addition, the R&S VSE highlights the channels (blue: Tx channel, green: adjacent channels).

The x-axis represents the frequency with a frequency span that relates to the specified NB-IoT channel and adjacent channel bandwidths. On the y-axis, the power is plotted in dBm.

The power for the Tx channel is an absolute value in dBm. The power of the adjacent channels is relative to the power of the Tx channel.

In addition, the R&S VSE tests the ACLR measurement results against the limits defined by 3GPP.

Remote command:

Result query: `TRACe:DATA?`

Result summary ← Adjacent Channel Leakage Ratio (ACLR)

The result summary shows the signal characteristics in numerical form. Each row in the table corresponds to a certain channel type (Tx, adjacent channel). The columns contain the channel characteristics.

- **Channel**
Shows the channel type (Tx, adjacent or alternate channel).
- **Bandwidth**
Shows the channel bandwidth.
- **Offset**

- Shows the channel spacing.
- **Power**
Shows the power of the Tx channel.
- **Lower / Upper**
Shows the relative power of the lower and upper adjacent and alternate channels. The values turn red if the power violates the limits.

Remote command:

Result query: `CALCulate<n>:MARKer<m>:FUNCTION:POWer<sb>:RESult[:CURRent]?`

Spectrum Emission Mask (SEM)

The "Spectrum Emission Mask" (SEM) measurement shows the quality of the measured signal by comparing the power values in the frequency range near the carrier against a spectral mask that is defined by the 3GPP specifications. In this way, you can test the performance of the DUT and identify the emissions and their distance to the limit.

For a comprehensive description of the SEM measurement, refer to the user manual of the R&S VSE.

Remote command:

Selection: `CONF:MEAS ESP`

Result diagram ← Spectrum Emission Mask (SEM)

The result diagram is a graphic representation of the signal with a trace that shows the measured signal. The SEM is represented by a red line.

If any measured power levels are above that limit line, the test fails. If all power levels are inside the specified limits, the test passes. The application labels the limit line to indicate whether the limit check has passed or failed.

The x-axis represents the frequency with a frequency span that relates to the specified NB-IoT channel bandwidths. The y-axis shows the signal power in dBm.

Remote command:

Result query: `TRACe:DATA?`

Result summary ← Spectrum Emission Mask (SEM)

The result summary shows the signal characteristics in numerical form. Each row in the table corresponds to a certain SEM range. The columns contain the range characteristics. If a limit fails, the range characteristics turn red.

- **Start / Stop Freq Rel**
Shows the start and stop frequency of each section of the spectrum emission mask relative to the center frequency.
- **RBW**
Shows the resolution bandwidth of each section of the spectrum emission mask.
- **Freq at Δ to Limit**
Shows the absolute frequency whose power measurement being closest to the limit line for the corresponding frequency segment.
- **Power Abs**
Shows the absolute measured power of the frequency whose power is closest to the limit. The application evaluates this value for each frequency segment.
- **Power Rel**

Shows the distance from the measured power to the limit line at the frequency whose power is closest to the limit. The application evaluates this value for each frequency segment.

- **Δ to Limit**

Shows the minimal distance of the tolerance limit to the SEM trace for the corresponding frequency segment. Negative distances indicate that the trace is below the tolerance limit, positive distances indicate that the trace is above the tolerance limit.

Marker Peak List

The marker peak list determines the frequencies and levels of peaks in the spectrum or time domain. How many peaks are displayed can be defined, as well as the sort order. In addition, the detected peaks can be indicated in the diagram. The peak list can also be exported to a file for analysis in an external application.

3 Marker Peak List			
Wnd	No	X-Value	Y-Value
2	1	1.086245 ms	-75.810 dBm
2	2	2.172490 ms	-6.797 dBm
2	3	3.258736 ms	-76.448 dBm
2	4	4.831918 ms	-76.676 dBm
2	5	6.255274 ms	-76.482 dBm
2	6	6.798397 ms	-6.800 dBm
2	7	9.233084 ms	-76.519 dBm
2	8	10.075861 ms	-76.172 dBm
2	9	11.405574 ms	-6.801 dBm

Remote command:

LAY:ADD? '1',RIGH, PEAK, see [LAYout:ADD\[:WINDow\]?](#) on page 79

Results:

[CALCulate<n>:MARKer<m>:X](#) on page 104

[CALCulate<n>:MARKer<m>:Y](#) on page 105

4 Configuration

LTE NB-IoT 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 NB-IoT 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.



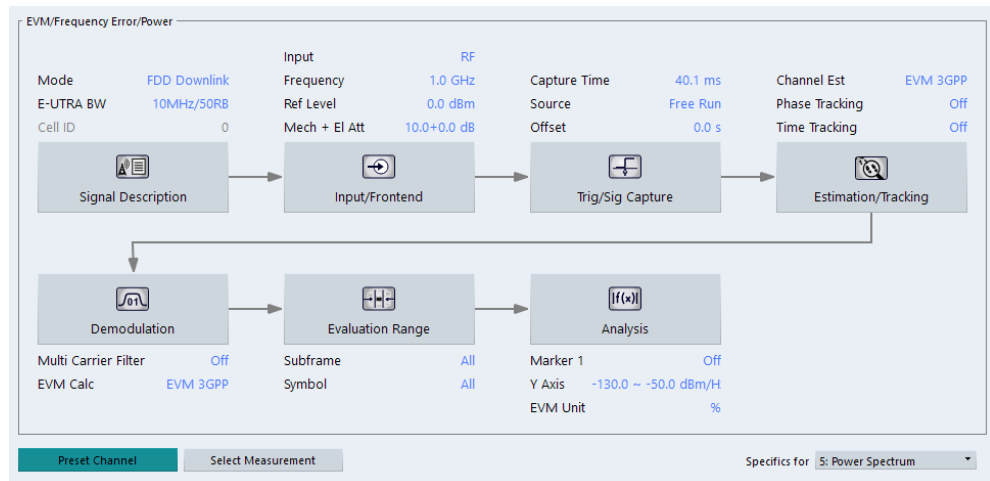
Unavailable menus

Note that the "Trace" and "Limits" menus have no contents and no function in the LTE NB-IoT application.

- [Configuration overview](#).....31
- [I/Q measurements configuration](#)..... 33
- [Time alignment error measurement configuration](#)..... 56
- [Frequency sweep measurement configuration](#)..... 57

4.1 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 4.2.1, "Defining signal characteristics"](#), on page 34.
2. Input / Frontend
See [Chapter 4.2.6, "Selecting the input and output source"](#), on page 41.
3. Trigger / Signal Capture
See [Chapter 4.2.10, "Trigger configuration"](#), on page 51.
See [Chapter 4.2.9, "Configuring the data capture"](#), on page 50
4. Estimation / Tracking
See [Chapter 4.2.11, "Parameter estimation and tracking"](#), on page 53.
5. Demodulation
See [Chapter 4.2.12, "Configuring demodulation parameters"](#), on page 54.
6. Evaluation Range
See [Chapter 5.2.2, "Evaluation range"](#), on page 64.
7. Analysis
See [Chapter 5, "Analysis"](#), on page 60.
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.....	33
Select Measurement.....	33
Specific Settings for.....	33

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 109

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 108

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.

4.2 I/Q measurements configuration

• Defining signal characteristics.....	34
• Test scenarios.....	38
• Configuring MIMO setups.....	38
• NPDSCH settings.....	39
• Configuring the control channel.....	40
• Selecting the input and output source.....	41
• Frequency configuration.....	45
• Amplitude configuration.....	46
• Configuring the data capture.....	50
• Trigger configuration.....	51
• Parameter estimation and tracking.....	53
• Configuring demodulation parameters.....	54
• Automatic configuration.....	56

4.2.1 Defining signal characteristics

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

The general signal characteristics contain settings to describe the general physical attributes of the signal. They are part of the "Signal Description" tab of the "Signal Description" dialog box.

The contents of the "Signal Description" dialog box depend on the deployment you have selected.

The remote commands required to configure the physical signal characteristics are described in "Physical settings" on page 110.

Selecting the NB-IoT mode.....	34
Deployment.....	35
Carrier Type.....	35
Defining physical settings for NB-IoT stand alone deployment.....	35
Defining physical settings for NB-IoT inband deployment.....	36
Defining physical settings for NB-IoT guardband deployment.....	36
Configuring the Physical Layer Cell Identity.....	37

Selecting the NB-IoT mode

The "Mode" selects the NB-IoT link direction you are testing.

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.

Note that the NB-IoT standard only supports FDD mode.

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.

Remote command:

Link direction: [CONFigure\[:LTE\]:LDIRection](#) on page 113

Deployment

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

You can select the deployment of the signal you are testing from the "Deployment" dropdown menu.

The application supports the following deployments.

- "Stand Alone"

The NB-IoT signal uses a dedicated spectrum outside of an LTE band, for example a frequency band currently used by GSM. With a carrier bandwidth of 200 kHz in GSM, there is enough room for an NB-IoT carrier (180 kHz), including a guard interval of 10 kHz on both sides of the carrier.
- "In Band"

The NB-IoT signal uses resource blocks within an LTE carrier.
- "Guard Band"

The NB-IoT signal uses the resource blocks of the guard band of an LTE carrier.

Remote command:

[CONFigure\[:LTE\]:DEPLoyment](#) on page 110

Carrier Type

Selects the NB-IoT carrier type. 3GPP defines different carrier types for NB-IoT signals.

- | | |
|--------------|---|
| "Anchor" | The UE assumes a carrier that transmits NPSS, NSSS, NPBCH and SIB-NB. |
| "Non-Anchor" | The UE assumes a carrier that does not transmit NPSS, NSSS, NPBCH and SIB-NB. |

Remote command:

[CONFigure\[:LTE\]:TYPE](#) on page 115

Defining physical settings for NB-IoT stand alone deployment

The physical properties of the NB-IoT signal depend on the channel bandwidth.

Currently, the 3GPP standard specifies a 200 kHz bandwidth for an NB-IoT carrier. This bandwidth corresponds to one LTE resource block (RB).

The application derives various other physical properties of the measured signal from the bandwidth.

- "Number of Resource Blocks" (NB_1RB)
- "FFT Size"
- "Sample Rate"
- "Occupied Bandwidth"
- "Occupied Carriers"

All values are read only.

Remote command:

not supported

Defining physical settings for NB-IoT inband deployment

When you use the in band deployment, you have to specify the characteristics of the LTE (E-UTRA) channel that the NB-IoT channel is located in.

Define the following E-UTRA properties:

- "E-UTRA Center Frequency"
Center frequency of the LTE channel.
- "E-UTRA Channel Bandwidth"
Channel bandwidth of the LTE channel (3 MHz, 5 MHz, 10 MHz, 15 MHz or 20 MHz).
Note that the 1.4 MHz bandwidth is not supported for in band transmission of NB-IoT signals.
- "E-UTRA CRS Sequence Info"
Cell-specific reference signal sequence. The sequence defines the assignment of resources between LTE and NB-IoT. These sequences are defined in 3GPP 36.213, chapter 16.8.
- "E-UTRA PRB Index"
For inband deployment, the physical resource block (PRB) index is derived from the E-UTRA CRS sequence info. It defines the location of the NB-IoT carriers in the E-UTRA signal.

In addition, the application shows various physical properties of the NB-IoT signal.

- "NB-IoT Channel Bandwidth", which is currently always 200 kHz.
- "NB-IoT Center Frequency", which is calculated from the E-UTRA channel characteristics.
- "FFT Size"
- "Sample Rate"
- "Occupied Bandwidth"
- "Occupied Carriers"

Remote command:

E-UTRA center frequency: `CONFigure[:LTE]:EUTRa:FREQuency` on page 111

E-UTRA channel bandwidth: `CONFigure[:LTE]:DL[:CC<cc>]:BW` on page 113

E-UTRA CRS sequence: `CONFigure[:LTE]:DL:SINFo` on page 112

E-UTRA PRB index: `CONFigure[:LTE]:DL:PINDEX` on page 112

Query NB-IoT center frequency: `[SENSe:]FREQuency:CENTer[:CC<cc>]` on page 124

Defining physical settings for NB-IoT guardband deployment

When you use the guard band deployment, you have to specify the characteristics of the LTE (E-UTRA) channel that the NB-IoT channel is located in.

Define the following E-UTRA properties:

- "E-UTRA Center Frequency"
Center frequency of the LTE channel.
- "E-UTRA Channel Bandwidth"
Channel bandwidth of the LTE channel (3 MHz, 5 MHz, 10 MHz, 15 MHz or 20 MHz).
Note that the 1.4 MHz bandwidth is not supported for guard band transmission of NB-IoT signals.
- " Δf to DC"

Location of the center frequency of the NB-IoT carrier relative to center frequency of the E-UTRA carrier (DC).

The location of the NB-IoT carrier in the guard band must fulfill several requirements, so possible frequencies are predefined. Available values depend on the "E-UTRA Channel Bandwidth".

If you select the "User Defined" menu item, you can also define locations that do not fulfill the requirements specified by 3GPP in the "User Value" field.

Positive values correspond to a location in the upper guard band, negative values to a location in the lower guard band.

In addition, the application shows various physical properties of the NB-IoT signal.

- "NB-IoT Channel Bandwidth", which is currently always 200 kHz.
- "NB-IoT Center Frequency", which is calculated from the E-UTRA channel characteristics.
- "FFT Size"
- "Sample Rate"
- "Occupied Bandwidth"
- "Occupied Carriers"

Remote command:

E-UTRA center frequency: `CONFigure[:LTE]:EUTRa:FREQuency` on page 111

E-UTRA channel bandwidth: `CONFigure[:LTE]:DL[:CC<cc>]:BW` on page 113

Location: `CONFigure[:LTE]:DL:FREQuency:GINDEX` on page 111

Custom location: `CONFigure[:LTE]:DL:FREQuency:OFFSet` on page 112

Query NB-IoT center frequency: `[SENSe:]FREQuency:CENTer[:CC<cc>]` on page 124

Configuring the Physical Layer Cell Identity

The "NCell ID", "NCell 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 NB-IoT 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".

Remote command:

Cell ID: [CONFigure\[:LTE\]:DL\[:CC<cc>\]:PLC:CID](#) on page 114

Cell Identity Group (setting): [CONFigure\[:LTE\]:DL\[:CC<cc>\]:PLC:CIDGroup](#) on page 114

Cell Identity Group (query): [FETCh\[:CC<cc>\]:PLC:CIDGroup?](#) on page 115

Identity (setting): [CONFigure\[:LTE\]:DL\[:CC<cc>\]:PLC:PLID](#) on page 114

Identity (query): [FETCh\[:CC<cc>\]:PLC:PLID?](#) on page 115

4.2.2 Test scenarios

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

Test scenarios are descriptions of specific NB-IoT 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 N-TM. These N-TM are defined in 3GPP 36.141.

There are three main test model groups, one for guardband operation, one for inband operation and one for standalone operation. Each of these main groups in turn contain signal descriptions for specific signal configurations (different transmission type, different bandwidth etc.).

Remote command:

[MMEMoRY:LOAD\[:CC<cc>\]:TMOd:DL](#) on page 116

User defined test scenarios

User defined test scenarios are custom signal descriptions for standardized measurements 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.

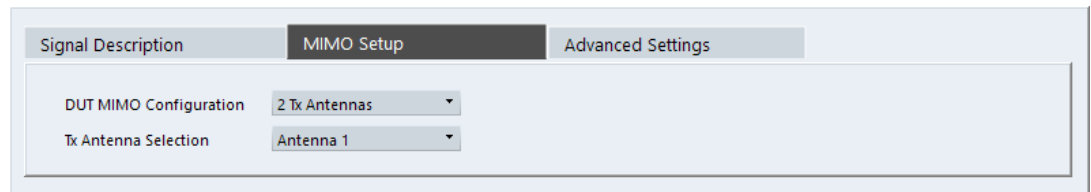
Remote command:

Save: [MMEMoRY:STORe<n>\[:CC<cc>\]:DEMOdsetting](#) on page 117

Restore: [MMEMoRY:LOAD\[:CC<cc>\]:DEMOdsetting](#) on page 116

4.2.3 Configuring MIMO setups

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



DUT MIMO Configuration	39
Tx Antenna Selection	39

DUT MIMO Configuration

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

The R&S VSE supports measurements on one and two antennas.

Remote command:

[CONFigure\[:LTE\]:DL\[:CC<cc>\]:MIMO:CONFig](#) on page 117

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.

Antenna 1	Tests antenna 1 only.
Antenna 2	Tests antenna 2 only.
Auto	Automatically selects the antenna to test.

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 117

4.2.4 NPDSCH settings

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

The NPDSCH settings contain settings to configure the parts of the NPDSCH that are evaluated.

The Narrowband Physical Downlink Shared Channel (NPDSCH) is the traffic channel and carries SIBs, upper layer data, and RAR messages. The application allows you to automatically demodulate the channel of the signal you are testing.

The remote commands required to configure the NPDSCH are described in "[NPDSCH settings](#)" on page 118.

[NPDSCH Demodulation](#).....40

NPDSCH Demodulation

Turns automatic demodulation of the NPDSCH on and off.

When you turn on this feature, the application automatically detects and demodulates both NPDSCH and NPDCCH subframes (NPDSCH and NPDCCH subframes are not distinguished by the application).

When you turn off automatic demodulation, you can specify in which subframes and in which N_RNTI (user equipment) the NPDSCH information is located in the signal. You can specify subframe numbers as a comma-separated list (1,2,6,7), a certain range with a dash (1-3), or a combination of both (1-3,5,6). The N_RNTI is a value between 0 and 65535.

This information about the NPDSCH is required to distinguish between NPDSCH and NPDCCH information, which in turn is required to calculate bit error information in the [bitstream](#) result display.

Remote command:

State: [CONFigure\[:LTE\]:DL:NPDSch:DMODulation](#) on page 118

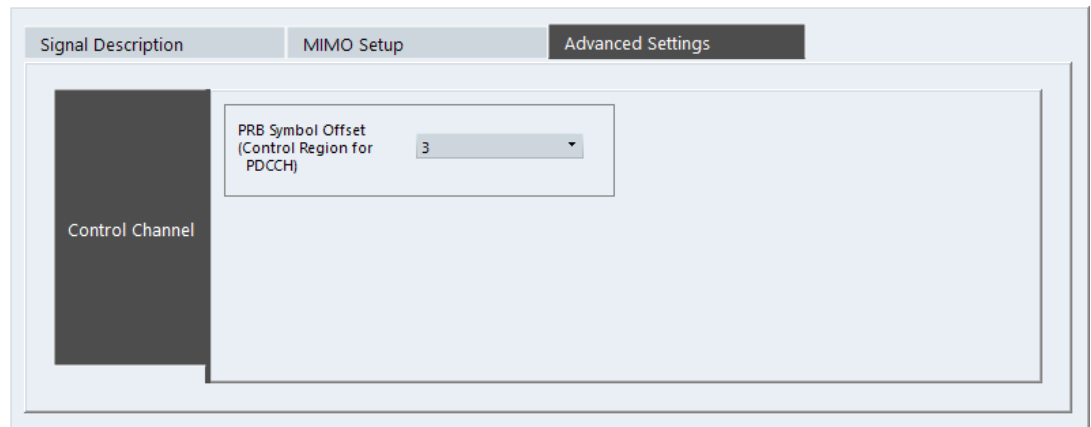
Subframes: [CONFigure\[:LTE\]:DL:NPDSch:SFList](#) on page 118

ID: [CONFigure\[:LTE\]:DL:NPDSch:UEID](#) on page 119

4.2.5 Configuring the control channel

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

The NPDSCH resource block symbol offset is part of the "Advanced Settings" tab of the "Signal Description" dialog box.



PRB Symbol Offset.....	41
------------------------	----

PRB Symbol Offset

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

Only available for the [in band deployment](#).

Remote command:

`CONFigure[:LTE]:DL[:CC<cc>]:PSOffset` on page 119

4.2.6 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.

- [RF input](#).....41
- [I/Q file input](#).....43

4.2.6.1 RF input

Functions to configure the RF input described elsewhere:

- ["Input Coupling"](#) on page 49
- ["Impedance"](#) on page 50

Note that the actual functions to configure the RF input depend on the configuration of the connected instrument.

High Pass Filter 1 to 3 GHz	42
YIG-Preselector	42
Capture Mode	42
Oscilloscope Sample Rate	43

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 121

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 121

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 122

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 124

Input source oscilloscope waveform mode:

[INPut<ip>:RF:CAPMode:WAVEform:SRATe](#) on page 123

Input source oscilloscope I/Q mode:

[INPut<ip>:RF:CAPMode:IQ:SRATe](#) on page 122

4.2.6.2 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 channel bar for any channel. The channel is automatically configured for file input, if necessary. 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.

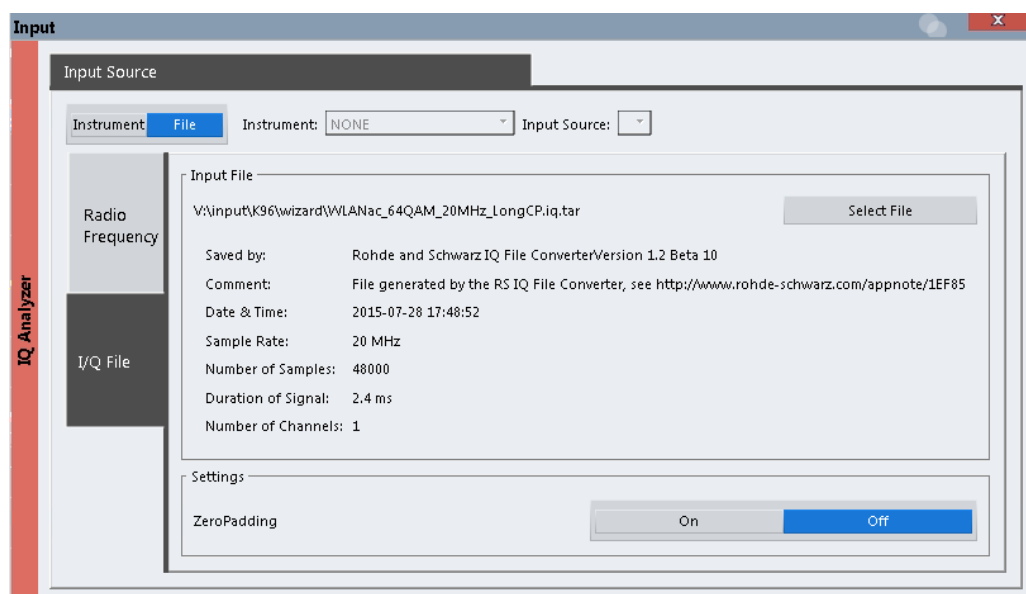
If the file contains data from multiple channels (e.g. from LTE measurements), it can be loaded to individual input sources, if the application supports them.

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 configured 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 NB-IoT 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 .wav 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)	45
Input File	45
Zero Padding	45

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 123

[INPut:SElect](#) on page 121

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 120

4.2.7 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 screenshot shows a software interface for frequency configuration. It is divided into three sections:

- Frequency:** A text input field contains "1.00499" and a dropdown menu is set to "GHz".
- Center Frequency Stepsize:** A dropdown menu is set to "Manual" and a text input field contains "1.0 MHz".
- Frequency Offset:** A text input field contains "0.0 Hz".

The remote commands required to configure the frequency are described in [Chapter 6.7.2.3, "Frequency configuration"](#), on page 124.

Signal Frequency.....	46
L Center Frequency.....	46
L Frequency Stepsize.....	46

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.

Note that the center frequency for the **in-band deployment** is the center frequency of the used LTE channel (E-UTRA frequency).

Remote command:

Center frequency: `[SENSe:] FREQuency:CENTer[:CC<cc>]` on page 124

Frequency offset: `[SENSe:] FREQuency:CENTer[:CC<cc>]:OFFSet` on page 125

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:

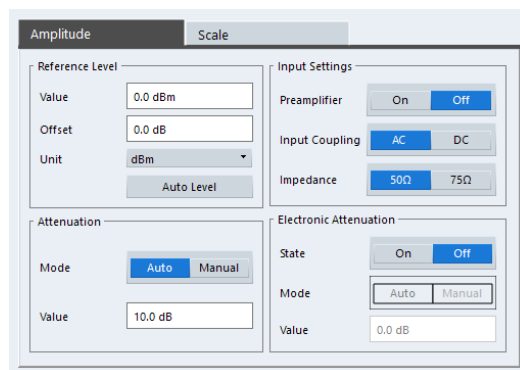
Frequency stepsize: `[SENSe:] FREQuency:CENTer:STEP` on page 125

4.2.8 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 6.7.2.4, "Amplitude configuration"](#), on page 126.

Reference Level.....	47
L Auto Level.....	47
L Reference Level Offset.....	48
Attenuating the Signal.....	48
L RF Attenuation.....	48
L Electronic Attenuation.....	48
Preamplifier.....	49
Input Coupling.....	49
Impedance.....	50

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 NB-IoT.

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 126

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").

Remote command:

Automatic: `[SENSe:]ADJust:LEVel<ant>` on page 142

Auto level mode: `[SENSe<ip>:]ADJust:CONFigure:LEVel:DURation:MODE` on page 142

Auto level time: `[SENSe<ip>:]ADJust:CONFigure:LEVel:DURation` on page 141

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 126

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 NB-IoT 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 127

Level: `INPut<ip>:ATTenuation<ant>` on page 127

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 130

Electronic attenuation: `INPut<ip>:EATT<ant>:AUTO` on page 130

Electronic attenuation: `INPut<ip>:EATT<ant>` on page 129

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 128

`INPut<ip>:GAIN<ant>[:VALue]` on page 128

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 128

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 25 Ω in series to the input impedance of the instrument.) The correction value in this case is 1.76 dB = 10 log (75 Ω /50 Ω).

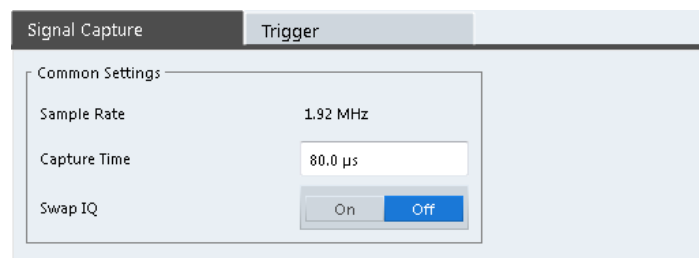
Not available for input from the optional "Analog Baseband" interface. For analog baseband input, an impedance of 50 Ω is always used.

Remote command:

[INPut<ip>:IMPedance<ant>](#) on page 129

4.2.9 Configuring the data capture

Access: "Overview" > "Trig / Sig Capture" > "Signal Capture"



Capture Time.....	50
Swap I/Q.....	50
Overall Frame Count.....	51
Auto According to Standard.....	51
Number of Frames to Analyze.....	51

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 NB-IoT frame is captured in the measurement.

Remote command:

[\[SENSe:\] SWEEp:TIME](#) on page 132

Swap I/Q

Swaps the real (I branch) and the imaginary (Q branch) parts of the signal.

Remote command:

[\[SENSe:\] SWAPiq](#) on page 132

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 NB-IoT frames found in one capture buffer.

Remote command:

[\[SENSe:\] \[LTE:\] FRAMe:COUNT:STATe](#) on page 131

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 131

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 131

4.2.10 Trigger configuration

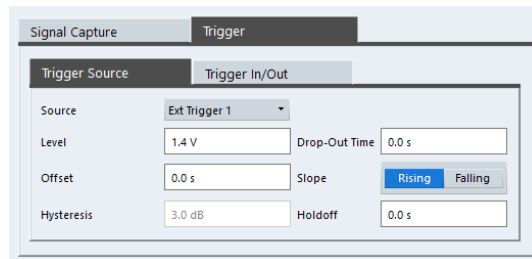
Access: "Overview" > "Trig / Sig Capture" > "Trigger"

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 a comprehensive description of the available trigger settings not described here, refer to the documentation of the connected instrument.



Trigger Source.....52

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 137

Level (external): `TRIGger[:SEquence]:LEVel<ant>[:EXternal<tp>]`
on page 134

Level (I/Q power): `TRIGger[:SEquence]:LEVel<ant>:IQPower` on page 135

Level (IF power): `TRIGger[:SEquence]:LEVel<ant>:IFPower` on page 134

Level (RF power): `TRIGger[:SEquence]:LEVel<ant>:RFPower` on page 135

Offset: `TRIGger[:SEquence]:HOLDoff<ant>[:TIME]` on page 133

Hysteresis: `TRIGger[:SEquence]:IFPower:HYSteresis` on page 134

Drop-out time: `TRIGger[:SEquence]:DTIME` on page 133

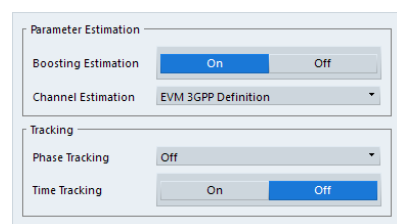
Slope: `TRIGger[:SEquence]:SLOPe` on page 137

Holdoff: `TRIGger[:SEquence]:IFPower:HOLDoff` on page 133

4.2.11 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	53
Channel Estimation	53
Phase	54
Time Tracking	54

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 NPSS and NSSS by analyzing the signal.

Boosting estimation is always active.

Remote command:

`[SENSe:] [LTE:] DL:DEMod:BEStimation` on page 140

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.

Remote command:

[\[SENSe:\] \[LTE:\] DL:DEMod:CESTimation](#) on page 140

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 Payload" Both reference signal and payload resource elements are used for the estimation of the phase error.

Remote command:

[\[SENSe:\] \[LTE:\] DL:TRACking:PHASe](#) on page 140

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.

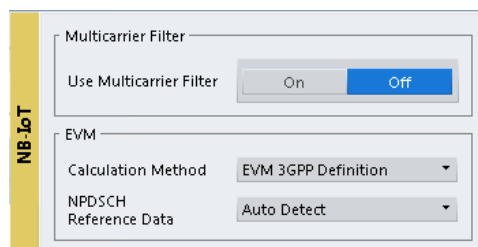
Remote command:

[\[SENSe:\] \[LTE:\] DL:TRACking:TIME](#) on page 141

4.2.12 Configuring demodulation parameters

Access: "Overview" > "Demodulation"

Demodulation settings contain settings that describe signal processing and the way the signal is measured.



The remote commands required to configure the demodulation are described in [Chapter 6.7.2.7, "Demodulation"](#), on page 138.

Multicarrier Filter.....	55
Scrambling of Coded Bits.....	55
EVM Calculation Method.....	55
NPDSCH Reference Data.....	55
Compensate Crosstalk.....	55

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 139

Scrambling of Coded Bits

Turns the scrambling of coded bits for all physical channels like NPDSCH on and off.

The scrambling of coded bits affects the bitstream results.

Remote command:

[\[SENSe:\] \[LTE:\] DL:DEMod:CBSCrambling](#) on page 138

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 Position" Calculates the EVM using the optimal timing position.

Remote command:

[\[SENSe:\] \[LTE:\] DL:DEMod:EVMCalc](#) on page 139

NPDSCH Reference Data

Selects the type of reference data to calculate the EVM for the NPDSCH.

By default, the R&S VSE automatically detects the NPDSCH reference values and maps the measured values to the nearest reference point.

"Auto Detect" Automatically detects the NPDSCH reference values.

"All 0" Assumes the NPDSCH to be all 0's, according to test model definitions.

Remote command:

[\[SENSe:\] \[LTE:\] DL:DEMod:PRData](#) on page 139

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 A, "Performing time alignment measurements"](#), on page 153.

Remote command:

`CONFigure[:LTE]:DL[:CC<cc>]:MIMO:CROStalk` on page 138

4.2.13 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 NB-IoT input signal.

Remote command:

`[SENSe:]ADJust:LEVel<ant>` on page 142

Auto Scaling

Scales the y-axis for best viewing results. Also see ["Automatic scaling of the y-axis"](#) on page 62.

Remote command:

`DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALE]:AUTO`
on page 150

4.3 Time alignment error measurement configuration

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 4.2.1, "Defining signal characteristics"](#), on page 34
- [Chapter 4.2.5, "Configuring the control channel"](#), on page 40
- [Chapter 4.2.6, "Selecting the input and output source"](#), on page 41
- [Chapter 4.2.7, "Frequency configuration"](#), on page 45
- [Chapter 4.2.8, "Amplitude configuration"](#), on page 46
- [Chapter 4.2.9, "Configuring the data capture"](#), on page 50
- [Chapter 4.2.10, "Trigger configuration"](#), on page 51

- [Chapter 4.2.12, "Configuring demodulation parameters"](#), on page 54

4.4 Frequency sweep measurement configuration

After starting one of the frequency sweep measurements, the application automatically loads the configuration required by measurements according to the 3GPP standard.

- The channel configuration defined in the standard for the ACLR measurement.
- The spectral mask as defined in the 3GPP standard for SEM measurements.

If you need a different measurement configuration, you can change all parameters as required. Except for the dialog box described below, the measurement configuration menus for the frequency sweep measurements are the same as in the Spectrum application.

Refer to the User Manual of the R&S VSE for a detailed description on how to configure ACLR and SEM measurements.

- [Channel power ACLR measurement](#)..... 57
- [SEM measurement configuration](#).....57

4.4.1 Channel power ACLR measurement

Access: "Meas Setup" > "Overview"

Access: "Meas Setup" > "CP / ACLR Config"

The ACLR measurement and its settings are basically the same as in the spectrum application of the connected instrument. For a comprehensive description, see the connected instrument user manual.

In addition, the ACLR measurement in the NB-IoT application has several exclusive settings not available in the spectrum application.

The signal description for ACLR measurements contains settings to describe general physical characteristics of the signal you are measuring.

Access: "Meas Setup" > "Signal Description"

- NB-IoT "Mode": The [NB-IoT mode](#) is always "FDD Downlink".
- "Deployment": The SEM measurement only supports measurements on stand-alone [deployment](#).
- "Channel Bandwidth": The [channel bandwidth](#) for the stand-alone deployment is a fix value of 200 kHz.
- "Adjacent Channels": Selects the adjacent channel configuration for the "Stand Alone" [deployment](#) as specified by 3GPP 36.104 chapter 6.6.2.

4.4.2 SEM measurement configuration

Access: "Meas Setup" > "Overview"

Access: "Meas Setup" > "Overview" > "SEM Setup"

The SEM measurement and its settings are basically the same as in the spectrum application of the connected instrument. For a comprehensive description, see the connected instrument user manual.

In addition, the SEM measurement in the NB-IoT application has several exclusive settings not available in the spectrum application.

The signal description for SEM measurements contains settings to describe general physical characteristics of the signal you are measuring.

Access: "Meas Setup" > "Signal Description"

- NB-IoT "Mode": The [NB-IoT mode](#) is always "FDD Downlink".
- "Deployment": The SEM measurement only supports measurements on stand-alone [deployment](#).
- "Channel Bandwidth": The [channel bandwidth](#) for the stand-alone deployment is a fix value of 200 kHz.

Note that SEM measurements are not possible if you measure with an R&S FSL.

Category	58
Tx Power	58
Power NB-IoT Carrier	59

Category

Selects the base station category to test. The base station category defines the shape of the SEM limit line.

You can select one of the following categories.

- Wide areas base stations
- Local area base stations
- Home base stations
- Medium range base stations

In addition to the base station category, the shape of the limit line depends on the power of the [NB-IoT carrier](#).

For medium range base stations, the shape of the limit line also depends on the power of the [transmission channel](#).

Remote command:

[SENSe:] POWER:SEM:CAteGory on page 143

Tx Power

Defines the Tx channel power for medium range base stations. The selected channel power has an effect on the shape of the SEM limit line.

You can define the channel power either manually or automatically. For automatic detection, the R&S VSE measures the power of the transmission channel.

Remote command:

State: [SENSe:] POWER:SEM:CHBS:AMPower:AUTO on page 144

Power: [SENSe:] POWER:SEM:CHBS:AMPower on page 144

Power NB-IoT Carrier

Defines the power of the NB-IoT carrier. The selected power has an effect on the shape of the SEM limit line.

You can define the channel power either manually or automatically.

For automatic detection, the R&S VSE measures the power of the NB-IoT carrier. The limit values are relative values based on the power of the NB-IoT carrier measured in the reference range.

For manual definition of the power, the limit values are absolute values based on the power of the NB-IoT carrier.

Remote command:

Mode: [\[SENSe:\]POWER:SEM:PIOM](#) on page 144

Power: [\[SENSe:\]POWER:SEM:PIOV](#) on page 145

5 Analysis

The R&S VSE provides various tools to analyze the measurement results.

- [General analysis tools](#).....60
- [Analysis tools for I/Q measurements](#)..... 63
- [Analysis tools for frequency sweep measurements](#).....67

5.1 General analysis tools

The general analysis tools are tools available for all measurements.

- [Data export](#).....60
- [Microservice export](#).....61
- [Diagram scale](#)..... 61
- [Zoom](#).....62
- [Markers](#)..... 62

5.1.1 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

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 95

I/Q export: `MMEMory:STORe<n>:IQ:STATe` on page 109

I/Q import: `INPut:FILE<fi>:PATH` on page 120

5.1.2 Microservice export

Access: "Edit" > "Microservice Export"

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 147

5.1.3 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 6.8.4, "Y-axis scale"](#), on page 149.

Manual scaling of the y-axis	61
Automatic scaling of the y-axis	62

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 150

`DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:MINimum`
on page 150

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 150

5.1.4 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.

5.1.5 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.

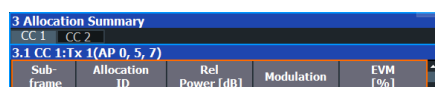
5.2 Analysis tools for I/Q measurements

- [Layout of numerical results](#)..... 63
- [Evaluation range](#)..... 64
- [Result settings](#)..... 66

5.2.1 Layout of numerical results

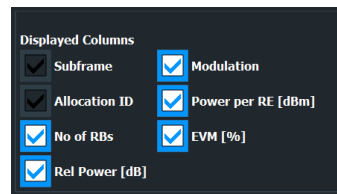
You can customize the displayed information of some numerical result displays or tables, for example the [allocation summary](#).

- ▶ Select some point in the header row of the table.



Sub-frame	Allocation ID	Rel Power [dB]	Modulation	EVM [%]
-----------	---------------	----------------	------------	---------

The application opens a dialog box to add or remove columns.

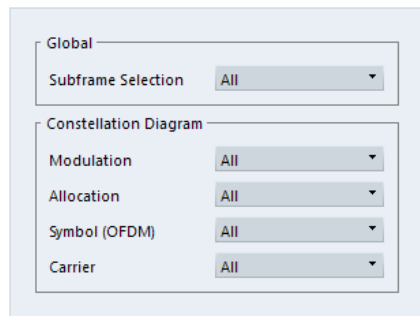


Add and remove columns as required.

5.2.2 Evaluation range

Access: "Overview" > "Evaluation Range"

The evaluation range defines the signal parts that are considered during signal analysis.



Subframe Selection.....	64
Evaluation range for the constellation diagram.....	65

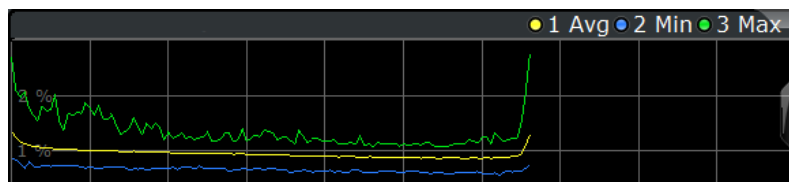
Subframe Selection

The "Subframe" selection filters the results by a specific subframe number.

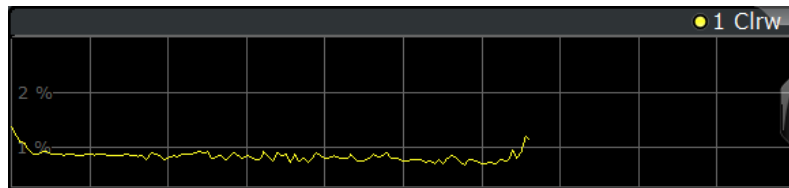
If you apply the filter, only the results for the subframe you have selected are displayed. Otherwise, the R&S VSE shows the results for all subframes that have been analyzed.

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
- Group Delay
- Power vs Symbol X Carrier
- Constellation Diagram
- Allocation Summary
- Time Alignment Error

Remote command:

[\[SENSe:\] \[LTE:\] \[CC<cc>:\] SUBFrame:SElect](#) on page 149

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.
- Carrier
Filters the results by a certain subcarrier.
- 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 148

Allocation: [\[SENSe:\] \[LTE:\] \[CC<cc>:\] ALLocation:SElect](#) on page 147

Symbol: [\[SENSe:\] \[LTE:\] \[CC<cc>:\] SYMBol:SElect](#) on page 149

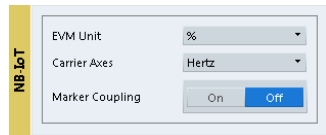
Carrier: [\[SENSe:\] \[LTE:\] \[CC<cc>:\] CARRier:SElect](#) on page 148

Location: [\[SENSe:\] \[LTE:\] \[CC<cc>:\] LOCation:SElect](#) on page 148

5.2.3 Result settings

Access: "Overview" > "Analysis" > "Result Settings"

Result settings define the way certain measurement results are displayed.



EVM Unit..... 66
 Bit Stream Format..... 66
 Carrier Axes..... 66
 Marker Coupling..... 67

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 152

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:

Sub-	Allocation	Code-	Modulation	Symbol	Bit Stream
Frame	ID	word	Index		
0	PBCH	1/1	QPSK	0	02 00 00 00 01 00 00 02 00 05 00 00 02 01 03 00
0	PBCH	1/1	QPSK	16	02 03 02 03 00 00 03 01 03 02 02 01 02 03 02 01
0	PBCH	1/1	QPSK	32	00 01 01 00 00 02 02 03 01 00 03 03 03 01 02 01
0	PBCH	1/1	QPSK	48	00 02 01 01 02 03 03 00 02 01 02 02 01 02

Figure 5-1: Bit stream display in downlink application if the bit stream format is set to "symbols"

Sub-	Allocation	Code-	Modulation	Bit	Bit Stream
Frame	ID	word	Index		
0	PBCH	1/1	QPSK	0	100000000100001000100001001110010101100001101
0	PBCH	1/1	QPSK	48	1110100110111001000101000010101010011111011001
0	PBCH	1/1	QPSK	96	00100101110111100100111011001100110000000110001
0	PBCH	1/1	QPSK	144	10010100011010010111111010001011000111010110010

Figure 5-2: Bit stream display in downlink application if the bit stream format is set to "bits"

Remote command:

`UNIT:BSTR` on page 151

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 152

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 151

5.3 Analysis tools for frequency sweep measurements

Access: "Overview" > "Analysis"

Access: "Overview" > "Analysis"

The analysis tools available for the frequency sweep measurements are the same as in the spectrum analyzer.

For more information, refer to the R&S VSE user manual.

6 Remote control

The following remote control commands are required to configure and perform LTE NB-IoT 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).

• Common suffixes	68
• Introduction	69
• NB-IoT application selection	73
• Screen layout	74
• Trace data readout	85
• Numeric result readout	97
• Remote commands to configure the application	108
• Analysis	145

6.1 Common suffixes

In the LTE NB-IoT measurement application, the following common suffixes are used in remote commands:

Table 6-1: Common suffixes used in remote commands in the LTE NB-IoT measurement application

Suffix	Value range	Description
<m>	1..4	Marker
<n>	1..16	Window (in the currently selected channel)
<t>	1..6	Trace
<lj>	1 to 8	Limit line
<ant>	1..2	Selects an antenna for MIMO measurements.
<cc>	1..5	Selects a component carrier. Irrelevant for the NB-IoT application.

Suffix	Value range	Description
<k>	---	Selects a limit line. Irrelevant for the NB-IoT application.
<np>	0...20	Selects a NPUSCH (NB-IoT uplink only)

6.2 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.

6.2.1 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.

6.2.2 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`.

6.2.3 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.

6.2.4 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.

6.2.5 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.

6.2.6 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.

- [Numeric values](#)..... 72
- [Boolean](#)..... 72
- [Character data](#)..... 73
- [Character strings](#)..... 73
- [Block data](#)..... 73

6.2.6.1 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.

6.2.6.2 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

6.2.6.3 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 6.2.2, "Long and short form"](#), on page 70.

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

6.2.6.4 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'`

6.2.6.5 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.

6.3 NB-IoT application selection

[INSTRument\[:SELeCt\]](#).....74

INSTrument[:SElect] <ChannelType>

Selects a new measurement channel with the defined channel type.

Parameters:

<ChannelType> **NIOT**
 LTE NB-IoT measurement channel

Example: //Select LTE NB-IoT application
 INST NIOT

6.4 Screen layout

- [General layout](#)..... 74
- [Layout over all channels](#)..... 75
- [Layout of a single channel](#)..... 79

6.4.1 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](#)..... 74
[DISPlay\[:WINDow<n>\]:TAB<tab>:SElect](#)..... 74

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
```

6.4.2 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.



For compatibility with other Rohde & Schwarz Signal and Spectrum Analyzers, the layout commands described in [Chapter 6.4.3, "Layout of a single channel"](#), on page 79 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]?	75
LAYout:GLOBal:CATalog[:WINDow]?	77
LAYout:GLOBal:IDENtify[:WINDow]?	78
LAYout:GLOBal:REMOve[:WINDow]	78
LAYout:GLOBal:REPLace[:WINDow]	78

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 <code>LAYout:GLOBal:IDENtify[:WINDow]? query</code> .

<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 6-2: <WindowType> parameter values for NB-IoT downlink measurement application

Parameter value	Window type
I/Q measurements	
AISC	Allocation ID vs. Symbol X Carrier
ASUM	Allocation Summary
CBUF	Capture Buffer
CCDF	CCDF
FLAT	Channel Flatness
CONS	Constellation Diagram
EVCA	EVM vs. Carrier
EVSC	EVM vs. Symbol X Carrier
EVSU	EVM vs. Subframe
EVSY	EVM vs. Symbol
FEVS	Frequency Error vs. Symbol
GDEL	Group Delay
MTAB	Marker Table
PSPE	Power Spectrum
PVSC	Power vs. Symbol X Carrier
RSUM	Result Summary

Parameter value	Window type
Time alignment error	
CBUF	Capture Buffer
MTAB	Marker Table
PSPE	Power Spectrum
TAL	Time Alignment Error
ACLR and SEM measurements	
DIAG	Diagram
PEAK	Peak List
MTAB	Marker Table
RSUM	Result Summary

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

6.4.3 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]?	79
LAYout:CATalog[:WINDow]?	81
LAYout:IDENtify[:WINDow]?	82
LAYout:REMOve[:WINDow]	82
LAYout:REPLace[:WINDow]	82
LAYout:WINDow<n>:ADD?	83
LAYout:WINDow<n>:IDENtify?	83
LAYout:WINDow<n>:REMOve	84
LAYout:WINDow<n>:REPLace	84
LAYout:WINDow<n>:TYPE	85

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.

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 <code>LAYout:CATalog[:WINDow]?</code> 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 <code>LAYout:GLOBal:REPLace[:WINDow]</code> 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 16
 See ["EVM vs Subframe"](#) on page 17
 See ["Frequency Error vs Symbol"](#) on page 17
 See ["Power Spectrum"](#) on page 18
 See ["Channel Flatness"](#) on page 18
 See ["Group Delay"](#) on page 19
 See ["Channel Flatness Difference"](#) on page 19
 See ["Constellation Diagram"](#) on page 19
 See ["CCDF"](#) on page 20
 See ["Allocation Summary"](#) on page 21
 See ["Bitstream"](#) on page 21
 See ["EVM vs Symbol x Carrier"](#) on page 22
 See ["Power vs Symbol x Carrier"](#) on page 23
 See ["Allocation ID vs Symbol x Carrier"](#) on page 23
 See ["Marker Table"](#) on page 25
 See ["Time Alignment Error"](#) on page 26
 See ["Marker Peak List"](#) on page 30

Table 6-3: <WindowType> parameter values for NB-IoT 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"
FLAT	"Channel Flatness"
CONS	"Constellation Diagram"
EVCA	"EVM vs. Carrier"
EVSC	"EVM vs. Symbol X Carrier"
EVSU	"EVM vs. Subframe"
EVSY	"EVM vs. Symbol"
FEVS	"Frequency Error vs. Symbol"
GDEL	"Group Delay"

Parameter value	Window type
MTAB	"Marker Table"
PSPE	"Power Spectrum"
PVSC	"Power vs. Symbol X Carrier"
RSUM	"Result Summary"
Time alignment error	
CBUF	"Capture Buffer"
MTAB	"Marker Table"
PSPE	"Power Spectrum"
TAL	"Time Alignment Error"
ACLR and SEM measurements	
DIAG	"Diagram"
PEAK	"Peak List"
MTAB	"Marker Table"
RSUM	"Result Summary"

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 79 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 79 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 79 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 79.

Note that this command is not available in all applications and measurements.

Suffix:

<n> 1..n
[Window](#)

Parameters:

<WindowType>

Example: `LAY:WIND2:TYPE?`

6.5 Trace data readout

- [Using the TRACe\[:DATA\] command](#)..... 85
- [Result readout](#).....96

6.5.1 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.

• Adjacent channel leakage ratio.....	86
• Allocation ID vs symbol x carrier.....	86
• Allocation summary.....	87
• Bit stream.....	88
• Capture buffer.....	89
• CCDF.....	89
• Channel and spectrum flatness.....	89
• Channel and spectrum flatness difference.....	90
• Group delay.....	90
• Constellation diagram.....	90
• EVM vs carrier.....	91
• EVM vs subframe.....	91
• EVM vs symbol.....	92
• EVM vs symbol x carrier.....	92
• Frequency error vs symbol.....	92
• Power spectrum.....	92
• Power vs symbol x carrier.....	93
• Spectrum emission mask.....	93
• Return value codes.....	94

6.5.1.1 Adjacent channel leakage ratio

For the ACLR result display, the number and type of returns values depend on the parameter.

- `TRAC:DATA TRACE1`
Returns one value for each trace point.

6.5.1.2 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 6.5.1.19, "Return value codes"](#), on page 94.

The following parameters are supported.

- TRAC:DATA TRACE1

6.5.1.3 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 6.5.1.19, "Return value codes"](#), on page 94.
- The unit for <relative power> is always dB.
- The <modulation> is encoded.
For the code assignment, see [Chapter 6.5.1.19, "Return value codes"](#), on page 94.
- 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:

Allocation Summary		Selection		Antenna: 1		
Sub-frame	Alloc. ID	Number of RB	Rel. Power/dB	Modulation	Power per RE/dBm	EVM/%
0	PS Ant1		0,000	QPSK	-45,546	0,733
	P-SYNC		-0,007	CAZAC	-42,558	0,254
	S-SYNC		0,005	RBPSK	-42,546	0,251

TRAC:DATA? TRACE1 would return:

```
0, -5, 0, 0.00000000000000, 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
```

6.5.1.4 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 NPDSCH 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 NPDSCH 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](#).

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.

6.5.1.5 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.

6.5.1.6 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.

6.5.1.7 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.

6.5.1.8 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 NB-IoT 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.

6.5.1.9 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 NB-IoT bandwidth.

The following parameters are supported.

- TRAC:DATA TRACE1
Returns the group delay.

6.5.1.10 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.

6.5.1.11 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.

6.5.1.12 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

6.5.1.13 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

6.5.1.14 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

6.5.1.15 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

6.5.1.16 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

6.5.1.17 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

6.5.1.18 Spectrum emission mask

For the SEM measurement, the number and type of returns values depend on the parameter.

- TRAC:DATA TRACE1

Returns one value for each trace point.

<absolute power>, ...

The unit is always dBm.

- TRAC:DATA LIST

Returns the contents of the SEM table. For every frequency in the spectrum emission mask, it returns 11 values.

<index>, <start frequency in Hz>, <stop frequency in Hz>,

<RBW in Hz>, <limit fail frequency in Hz>, <absolute power in

dBm>, <relative power in dBc>, <limit distance in dB>, <limit

check result>, <reserved>, <reserved>...

The <limit check result> is either a 0 (for PASS) or a 1 (for FAIL).

6.5.1.19 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.

<allocation ID>

Represents the allocation ID. The range is as follows.

- 0 = NPDSCH
- -1 = Invalid / not used
- -2 = All
- -3 = NPSS
- -4 = NSSS
- -5 = Reference Signal (Antenna 1)
- -6 = Reference Signal (Antenna 2)
- -10 = NPHICH
- -11 = NPDCCH
- -12 = NPCH

<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

<modulation>

Represents the modulation scheme.

- 0 = unrecognized
- 1 = RBPSK
- 2 = QPSK
- 7 = mixed modulation

- 8 = BPSK

FORMat[:DATA].....	95
TRACe<n>[:DATA]?.....	95
TRACe<n>[:DATA]:X?.....	95

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.

Return values:

<TraceData> For more information about the type of return values in the different result displays, see [Chapter 6.5.1, "Using the TRACe\[:DATA\] command"](#), on page 85.

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 61

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 16 See " EVM vs Subframe " on page 17 See " Frequency Error vs Symbol " on page 17 See " Power Spectrum " on page 18 See " Channel Flatness " on page 18 See " Group Delay " on page 19 See " Channel Flatness Difference " on page 19

6.5.2 Result readout

[CALCulate<n>:MARKer<m>:FUNCTION:POWER<sb>:RESult\[:CURRent\]?.....](#) 96

**CALCulate<n>:MARKer<m>:FUNCTION:POWER<sb>:RESult[:CURRent]?
[<Measurement>]**

Queries the results of the ACLR measurement or the total signal power level of the SEM measurement.

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 sweeps.

Suffix:	
<n>	Window
<m>	Marker
<sb>	irrelevant
Query parameters:	
<Measurement>	CPOW This parameter queries the channel power of the reference range.

MCAC

Queries the channel powers of the ACLR measurements as shown in the ACLR table.

Where available, this parameter also queries the power of the adjacent channels (for example in the ACLR measurement).

Return values:

<Result>

Results for the Spectrum Emission Mask measurement:

Power level in dBm.

Results for the ACLR measurements:

Relative power levels of the ACLR channels. The number of return values depends on the number of transmission and adjacent channels. The order of return values is:

- <TXChannelPower> is the power of the transmission channel in dBm
- <LowerAdjChannelPower> is the relative power of the lower adjacent channel in dB
- <UpperAdjChannelPower> is the relative power of the upper adjacent channel in dB
- <1stLowerAltChannelPower> is the relative power of the first lower alternate channel in dB
- <1stUpperAltChannelPower> is the relative power of the first lower alternate channel in dB
- (...)
- <nthLowerAltChannelPower> is the relative power of a subsequent lower alternate channel in dB
- <nthUpperAltChannelPower> is the relative power of a subsequent lower alternate channel in dB

Example:

```
CALC1:MARK:FUNC:POW:RES? MCAC
```

Returns the current ACLR measurement results.

Usage:

Query only

Manual operation: See "Result summary" on page 28

6.6 Numeric result readout

• Result for selection	97
• Time alignment error	103
• Marker table	103
• CCDF table	106

6.6.1 Result for selection

FETCh[:CC<cc>]:SUMMary:CRESt[:AVERage]?.....	98
FETCh[:CC<cc>]:SUMMary:EVM[:ALL]:MAXimum?.....	98
FETCh[:CC<cc>]:SUMMary:EVM[:ALL]:MINimum?.....	98
FETCh[:CC<cc>]:SUMMary:EVM[:ALL][:AVERage]?.....	98

FETCh[:CC<cc>]:SUMMary:EVM:PCHannel:MAXimum?	99
FETCh[:CC<cc>]:SUMMary:EVM:PCHannel:MINimum?	99
FETCh[:CC<cc>]:SUMMary:EVM:PCHannel[:AVERage]?	99
FETCh[:CC<cc>]:SUMMary:EVM:PSIGnal:MAXimum?	99
FETCh[:CC<cc>]:SUMMary:EVM:PSIGnal:MINimum?	99
FETCh[:CC<cc>]:SUMMary:EVM:PSIGnal[:AVERage]?	99
FETCh[:CC<cc>]:SUMMary:FERRor:MAXimum?	100
FETCh[:CC<cc>]:SUMMary:FERRor:MINimum?	100
FETCh[:CC<cc>]:SUMMary:FERRor[:AVERage]?	100
FETCh[:CC<cc>]:SUMMary:OSTP:MAXimum?	100
FETCh[:CC<cc>]:SUMMary:OSTP:MINimum?	100
FETCh[:CC<cc>]:SUMMary:OSTP[:AVERage]?	100
FETCh[:CC<cc>]:SUMMary:POWer:MAXimum?	100
FETCh[:CC<cc>]:SUMMary:POWer:MINimum?	100
FETCh[:CC<cc>]:SUMMary:POWer[:AVERage]?	100
FETCh[:CC<cc>]:SUMMary:NBP:MAXimum?	101
FETCh[:CC<cc>]:SUMMary:NBP:MINimum?	101
FETCh[:CC<cc>]:SUMMary:NBPowEr[:AVERage]?	101
FETCh[:CC<cc>]:SUMMary:RSSI:MAXimum?	101
FETCh[:CC<cc>]:SUMMary:RSSI:MINimum?	101
FETCh[:CC<cc>]:SUMMary:RSSI[:AVERage]?	101
FETCh[:CC<cc>]:SUMMary:RSTP:MAXimum?	102
FETCh[:CC<cc>]:SUMMary:RSTP:MINimum?	102
FETCh[:CC<cc>]:SUMMary:RSTP[:AVERage]?	102
FETCh[:CC<cc>]:SUMMary:SERRor:MAXimum?	102
FETCh[:CC<cc>]:SUMMary:SERRor:MINimum?	102
FETCh[:CC<cc>]:SUMMary:SERRor[:AVERage]?	102
FETCh[:CC<cc>]:SUMMary:TFRame?	102

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: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:NBP:MAXimum?
FETCh[:CC<cc>]:SUMMary:NBP:MINimum?
FETCh[:CC<cc>]:SUMMary:NBPpower[:AVERage]?

Queries the NB-IoT power.

Suffix:

<cc> irrelevant

Return values:

<Power> <numeric value>
 Minimum, maximum or average power, depending on the last command syntax element.
 Default unit: dBm

Example: //Query NB-IoT power
 FETC : SUMM : NBP ?

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

6.6.2 Time alignment error

FETCh:TAERror[:CC<cc>]:ANTenna<ant>:MAXimum.....	103
FETCh:TAERror[:CC<cc>]:ANTenna<ant>:MINimum.....	103
FETCh:TAERror[:CC<cc>]:ANTenna<ant>[:AVERage]?.....	103

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 26

6.6.3 Marker table

CALCulate<n>:DELTaMarker<m>:X.....	103
CALCulate<n>:DELTaMarker<m>:Y?.....	104
CALCulate<n>:MARKer<m>:X.....	104
CALCulate<n>:MARKer<m>:Y.....	105
CALCulate<n>:MARKer<m>:Z?.....	105
CALCulate<n>:MARKer<m>:Z:ALL?.....	106

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 25

See "[Marker Peak List](#)" on page 30

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 25

See "[Marker Peak List](#)" on page 30

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 25

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 25

6.6.4 CCDF table

CALCulate<n>:STATistics:CCDF:X<t>?.....	107
CALCulate<n>:STATistics:RESult<res>?.....	107

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 20

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:	<code>CALC:STAT:RES2? ALL</code> 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 20

6.7 Remote commands to configure the application

- [General configuration](#)..... 108
- [Configuring I/Q measurements](#)..... 109
- [Configuring time alignment measurements](#)..... 142
- [Frequency sweep measurements](#)..... 143

6.7.1 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 6.4, "Screen layout"](#), on page 74.

CONFigure[:LTE]:MEASurement	108
MMEMory:STORe<n>:IQ:STATe	109
SYSTem:PRESet:CHANnel[:EXEC]	109

CONFigure[:LTE]:MEASurement <Measurement>

Selects the measurement.

Parameters:

<Measurement>	ACLR Selects the Adjacent Channel Leakage Ratio measurement.
	ESpectrum Selects the Spectrum Emission Mask 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 ["Channel power ACLR"](#) on page 13
 See ["SEM"](#) on page 13
 See ["Adjacent Channel Leakage Ratio \(ACLR\)"](#) on page 28
 See ["Spectrum Emission Mask \(SEM\)"](#) on page 29
 See ["Select Measurement"](#) on page 33

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 61

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:PRESet:CHAN:EXEC
Restores the factory default settings to the "Spectrum2" channel.
```

Usage: Event

Manual operation: See ["Preset Channel"](#) on page 33

6.7.2 Configuring I/Q measurements

- [Signal characteristics](#)..... 110
- [Inputs configuration](#)..... 119
- [Frequency configuration](#)..... 124
- [Amplitude configuration](#)..... 126
- [Signal capture](#)..... 130
- [Trigger](#)..... 132
- [Demodulation](#)..... 138
- [Estimation & compensation](#)..... 139
- [Automatic configuration](#)..... 141

6.7.2.1 Signal characteristics

- Physical settings..... 110
- MIMO configuration..... 117
- NPDSCH settings..... 118
- Control channel..... 119

Physical settings

Commands to configure physical settings described elsewhere.

- [SENSe:] FREQuency: CENTer [:CC<cc>]

CONFigure[:LTE]:DEPLoyment.....	110
CONFigure[:LTE]:EUTRa:FREQuency.....	111
CONFigure[:LTE]:DL:FREQuency:GINdex.....	111
CONFigure[:LTE]:DL:FREQuency:OFFSet.....	112
CONFigure[:LTE]:DL:PINdex.....	112
CONFigure[:LTE]:DL:SINFo.....	112
CONFigure[:LTE]:LDIRection.....	113
CONFigure[:LTE]:DL[:CC<cc>]:BW.....	113
CONFigure[:LTE]:DL[:CC<cc>]:PLC:CID.....	114
CONFigure[:LTE]:DL[:CC<cc>]:PLC:CIDGroup.....	114
CONFigure[:LTE]:DL[:CC<cc>]:PLC:PLID.....	114
CONFigure[:LTE]:TYPE.....	115
FETCh[:CC<cc>]:PLC:CIDGroup?.....	115
FETCh[:CC<cc>]:PLC:PLID?.....	115
MMEMory:LOAD[:CC<cc>]:DEModsetting.....	116
MMEMory:LOAD[:CC<cc>]:TMOD:DL.....	116
MMEMory:STORe<n>[:CC<cc>]:DEModsetting.....	117

CONFigure[:LTE]:DEPLoyment <Deployment>

Selects the deployment of the NB-IoT carrier.

Parameters:

<Deployment>

GBANd

NB-IoT uses resource blocks of the guard band of an LTE carrier.

INBAND

NB-IoT uses resource blocks within an LTE carrier.

SALone

NB-IoT uses a frequency band outside of an LTE carrier.

*RST: SALone

Example:

```
//Select NB-IoT deployment
CONF:DEPL INB
```

Manual operation: See "Deployment" on page 35

CONFigure[:LTE]:EUTRa:FREQuency <Frequency>

Defines the center frequency of an E-UTRA channel.

Prerequisites for this command

- Select in band deployment of an NB-IoT carrier ([CONFigure\[:LTE\]:DEPLoyment](#)).

Parameters:

<Frequency> <numeric value>
 Default unit: Hz

Example: //Define E-UTRA channel center frequency
 CONF:DEPL INB
 CONF:EUTR:FREQ 1GHZ

Manual operation: See ["Defining physical settings for NB-IoT inband deployment"](#) on page 36
 See ["Defining physical settings for NB-IoT guardband deployment"](#) on page 36

CONFigure[:LTE]:DL:FREQuency:GINdex <Index>

Defines the location of the NB-IoT carrier in the E-UTRA guard band.

Prerequisites for this command

- Select guard band deployment of an NB-IoT carrier ([CONFigure\[:LTE\]:DEPLoyment](#)).

Parameters:

<Index> **<numeric value> (integer only)**
 Index number that represents the frequency band in the E-UTRA guard band that the NB-IoT carrier uses. The value range depends on the E-UTRA bandwidth.
 For example, for a E-UTRA bandwidth of 10 MHz, the value "+1" corresponds to the first possible location of the NB-IoT carrier in the upper guard band at an offset of 4.4975 MHz. A value of "-2" corresponds to a location in the lower guard band at an offset of -4.7025 MHz.

USER

Custom location of the NB-IoT carrier. Define the location with [CONFigure\[:LTE\]:DL:FREQuency:OFFSet](#).

Example: //Define location of NB-IoT carrier
 CONF:DEPL GBAN
 CONF:DL:GIND -4

Manual operation: See ["Defining physical settings for NB-IoT guardband deployment"](#) on page 36

CONFigure[:LTE]:DL:FREQuency:OFFSet <Frequency>

Defines the location of the NB-IoT carrier in the E-UTRA guard band.

Prerequisites for this command

- Select guard band deployment of an NB-IoT carrier ([CONFigure\[:LTE\]:DEPLoyment](#)).
- Select user defined location ([CONFigure\[:LTE\]:DL:FREQuency:GINdex](#)).

Parameters:

<Frequency> <numeric value>
 Frequency relative to the center frequency of the E-UTRA carrier.
 Default unit: Hz

Example: //Define location of carrier in guard band

```
CONF:DEPL GBAN
CONF:DL:FREQ:GIND USER
CONF:DL:FREQ:OFFS -2.5MHZ
```

Manual operation: See ["Defining physical settings for NB-IoT guardband deployment"](#) on page 36

CONFigure[:LTE]:DL:PINdex <Index>

Defines the PRB index of the E-UTRA channel.

Prerequisites for this command

- Select in band deployment of an NB-IoT carrier ([CONFigure\[:LTE\]:DEPLoyment](#)).

Parameters:

<Index> <numeric value> (integer only)
 *RST: depends on the E-UTRA channel bandwidth

Example: //Define E-UTRA PRB index

```
CONF:DEPL INB
CONF:DL:BW BW10_00
CONF:DL:PINd 9
```

Manual operation: See ["Defining physical settings for NB-IoT inband deployment"](#) on page 36

CONFigure[:LTE]:DL:SINFo <Sequence>

Defines the CRS sequence info of the E-UTRA channel.

Prerequisites for this command

- Select in band deployment of an NB-IoT carrier ([CONFigure\[:LTE\]:DEPLoyment](#)).

Parameters:

<Sequence> <numeric value> (integer only)
 *RST: depends on the E-UTRA channel bandwidth

Example:

```
//Define E-UTRA CRS sequence
CONF:DEPL INB
CONF:DL:BW BW10_00
CONF:DL:SINF 20
```

Manual operation: See ["Defining physical settings for NB-IoT inband deployment"](#) on page 36

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 NB-IoT mode"](#) on page 34

CONFigure[:LTE]:DL[:CC<cc>]:BW <Bandwidth>

Selects the E-UTRA channel bandwidth.

Prerequisites for this command

- Select inband or guard band deployment ([CONFigure\[:LTE\]:DEPLoyment](#)).

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 ["Defining physical settings for NB-IoT inband deployment"](#) on page 36
 See ["Defining physical settings for NB-IoT guardband deployment"](#) on page 36

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 cell ID
 CONF:DL:PLC:CID 15

Manual operation: See ["Configuring the Physical Layer Cell Identity"](#) on page 37

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 37

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 37

CONFigure[:LTE]:TYPE <Type>

Selects the NB-IoT carrier type.

Parameters:

<Type> **ANCHor**
NPSS, NSSS, NPBCH and SIB-NB transmission assumed.
NANChor
NPSS, NSSS, NPBCH and SIB-NB transmission not assumed.
***RST: ANCHor**

Example:

```
//Select carrier type
CONF:TYPE ANCH
```

Manual operation: See "[Carrier Type](#)" on page 35

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 37

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 37**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 38**MMEMory:LOAD[:CC<cc>]:TMOD:DL <TestModel>**

Loads an EUTRA test model (N-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.
'N-TM_Guardband'.**Example:**

```
//Select test model for guardband operation.
MMEM:LOAD:TMOD:DL 'N-TM_Guardband'
```

Usage:

Setting only

Manual operation: See "[3GPP test models](#)" on page 38

MMEMory:STORe<n>[:CC<cc>]:DEModing <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 38

MIMO configuration

CONFigure[:LTE]:DL[:CC<cc>]:MIMO:ASElection.....	117
CONFigure[:LTE]:DL[:CC<cc>]:MIMO:CONFig.....	117

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**
 Select a single antenna to be analyzed
ALL
 Select all antennas to be analyzed
AUTO
 Automatically selects the antenna(s) to be analyzed.
 *RST: ANT1

Example: //Select a MIMO setup with two antennas and test antenna number two
 CONF:DL:MIMO:CONF TX2
 CONF:DL:MIMO:ASEL ANT2

Manual operation: See ["Time Alignment Error"](#) on page 26
 See ["Tx Antenna Selection"](#) on page 39

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

*RST: TX1

Example:

```
//Select MIMO configuration with two antennas
CONF:DL:MIMO:CONF TX2
```

Manual operation: See "[DUT MIMO Configuration](#)" on page 39

NPDSCH settings

CONFigure[:LTE]:DL:NPDSch:DMODulation	118
CONFigure[:LTE]:DL:NPDSch:SFList	118
CONFigure[:LTE]:DL:NPDSch:UEID	119

CONFigure[:LTE]:DL:NPDSch:DMODulation <State>

Turns automatic NPDSCH and NPDCCH demodulation on and off.

Parameters:

<State> ON | OFF | 1 | 0

*RST: ON

Example:

```
//Turn on automatic demodulation
CONF:DL:NPDS:DMOD ON
```

Manual operation: See "[NPDSCH Demodulation](#)" on page 40

CONFigure[:LTE]:DL:NPDSch:SFList <Subframes>

Defines the subframes that contain the NPDSCH.

Prerequisites for this command

- Turn off automatic NPDSCH demodulation ([CONFigure\[:LTE\]:DL:NPDSch:DMODulation](#)).

Parameters:

<Subframes> String that contains the subframes as a comma-separated list (1,2,5,6), a certain range with a dash (1-3) or a combination of both (1-3,5,6).

*RST: ---

Example:

```
// Select NPDSCH subframes
CONF:DL:NPDS:DMOD OFF
CONF:DL:NPDS:SFL "1-3, 5, 6"
```

Manual operation: See "[NPDSCH Demodulation](#)" on page 40

CONFigure[:LTE]:DL:NPDSch:UEID <ID>

Defines the N_RNTI (user equipment ID) that contain the NPDSCH.

Prerequisites for this command

- Turn off automatic NPDSCH demodulation ([CONFigure\[:LTE\]:DL:NPDSch:DMODulation](#)).

Parameters:

<ID> Range: 0 to 65535
 *RST: 0

Example: // Select NPDSCH N_RNTI
 CONF:DL:NPDS:DMOD OFF
 CONF:DL:NPDS:UEID 16

Manual operation: See "[NPDSCH Demodulation](#)" on page 40

Control channel

[CONFigure\[:LTE\]:DL\[:CC<cc>\]:PSOffset](#)..... 119

CONFigure[:LTE]:DL[:CC<cc>]:PSOffset <Offset>

Defines the symbol offset for NPDSCH 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 41

6.7.2.2 Inputs configuration

Useful commands to perform measurements described elsewhere:

- [INPut<ip>:COUPling<ant>](#) on page 128
- [INPut<ip>:IMPedance<ant>](#) on page 129

[INPut:FILE<fi>:PATH](#)..... 120
[INPut<ip>:FILE:ZPADing](#)..... 120
[INPut<ip>:FILTer:HPASs\[:STATe\]](#)..... 121

INPut<ip>:FILTer:YIG[:STATe].....	121
INPut:SELEct.....	121
INPut<ip>:RF:CAPMode.....	122
INPut<ip>:RF:CAPMode:IQ:SRATe.....	122
INPut<ip>:RF:CAPMode:WAVEform:SRATe.....	123
INSTrument:BLOCK:CHANnel[:SETTings]:SOURce<si>.....	123
SYSTem:COMMunicate:RDEvice:OSCilloscope:SRATe.....	124

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 measurement. The bandwidth must be smaller than or equal to the bandwidth 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 61

INPut<ip>:FILE:ZPADing <State>

Enables or disables zeropadding 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.

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 45

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 42

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 42

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 45**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 42**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 122).

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.

Remote commands to configure the application

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 43

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 122).

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 43

INSTrument:BLOCK:CHANnel[:SETTings]:SOURce<si> <Type>

Selects an instrument or a file as the source of input provided to the channel.

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 Type \(Instrument / File\)"](#) on page 45

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 43

6.7.2.3 Frequency configuration

[SENSe:]FREQuency:CENTer[:CC<cc>]	124
[SENSe:]FREQuency:CENTer[:CC<cc>]:OFFSet	125
[SENSe:]FREQuency:CENTer:STEP	125

[SENSe:]FREQuency:CENTer[:CC<cc>] <Frequency>

Sets the center frequency for RF measurements.

Note that the [:CC<cc>] part of the syntax is not supported.

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
```

Manual operation:

See ["Defining physical settings for NB-IoT inband deployment"](#) on page 36
 See ["Defining physical settings for NB-IoT guardband deployment"](#) on page 36
 See ["Center Frequency"](#) on page 46

[SENSe:]FREQUENCY:CENTer[:CC<cc>]:OFFSet `<Offset>`

Defines the general frequency offset.

Suffix:`<cc>` [Component Carrier](#)**Parameters:**

`<Offset>` `<numeric value>`
 • General frequency offset: frequency offset in Hz.
 Default unit: Hz

Example:

```
//Add a frequency offset of 50 Hz to the measurement frequency.
FREQ:CENT:OFFS 50HZ
```

Manual operation:

See ["Center Frequency"](#) on page 46

[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 124.

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 46

6.7.2.4 Amplitude configuration

DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:RLEVel<ant>.....	126
DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:RLEVel<ant>:OFFSet.....	126
INPut<ip>:ATTenuation<ant>.....	127
INPut<ip>:ATTenuation<ant>:AUTO.....	127
INPut<ip>:COUPling<ant>.....	128
INPut<ip>:GAIN<ant>:STATe.....	128
INPut<ip>:GAIN<ant>[:VALue].....	128
INPut<ip>:IMPedance<ant>.....	129
INPut<ip>:EATT<ant>.....	129
INPut<ip>:EATT<ant>:AUTO.....	130
INPut<ip>:EATT<ant>:STATe.....	130

**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 $\neq 0$, 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 47

**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 48

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 48

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 48

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 49

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 49

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 128).

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 49

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 50

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 48

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 48

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 48

6.7.2.5 Signal capture

[SENSe:][LTE:]FRAMe:COUNT	131
[SENSe:][LTE:]FRAMe:COUNT:AUTO	131
[SENSe:][LTE:]FRAMe:COUNT:STATe	131
[SENSe:]SWAPiq	132
[SENSe:]SWEp:TIME	132

[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:COUnT:STAT ON
FRAM:COUnT:AUtO OFF
FRAM:COUnT 20
```

Manual operation: See ["Number of Frames to Analyze"](#) on page 51

[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 NB-IoT standard.

OFF | 0
 Turns on manual selection of the number of frames.

Example:

```
//Turn on automatic selection of analyzed frames
FRAM:COUnT:AUtO ON
```

Manual operation: See ["Auto According to Standard"](#) on page 51

[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:COUnT:STAT ON
```

Manual operation: See ["Overall Frame Count"](#) on page 51

[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 50

[SENSe:]SWEep:TIME <CaptureLength>

Defines the capture time.

Parameters:

<CaptureLength> <numeric value>
*RST: 20.1 ms
Default unit: s

Example: //Define capture time
SWE:TIME 40ms

Manual operation: See "[Capture Time](#)" on page 50

6.7.2.6 Trigger

The trigger functionality of the NB-IoT 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.....	133
TRIGger[:SEQuence]:HOLDoff<ant>[:TIME].....	133
TRIGger[:SEQuence]:IFPower:HOLDoff.....	133
TRIGger[:SEQuence]:IFPower:HYSTerisis.....	134
TRIGger[:SEQuence]:LEVel<ant>[:EXTernal<tp>].....	134
TRIGger[:SEQuence]:LEVel<ant>:IFPower.....	134
TRIGger[:SEQuence]:LEVel<ant>:IQPower.....	135
TRIGger[:SEQuence]:LEVel:MAPower.....	135
TRIGger[:SEQuence]:LEVel<ant>:RFPower.....	135
TRIGger[:SEQuence]:MAPower:HOLDoff.....	136
TRIGger[:SEQuence]:MAPower:HYSTerisis.....	136
TRIGger[:SEQuence]:PORT<ant>.....	136
TRIGger[:SEQuence]:SLOPe.....	137
TRIGger[:SEQuence]:SOURce<ant>.....	137

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 52

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 52

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 52

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 52

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 52

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 52

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 52

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]: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 52

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

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 52

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 52

6.7.2.7 Demodulation

<code>CONFigure[:LTE]:DL[:CC<cc>]:MIMO:CROStalk</code>	138
<code>[SENSe:][LTE:]DL:DEMod:CBSCrambling</code>	138
<code>[SENSe:][LTE:]DL:DEMod:MCFilter</code>	139
<code>[SENSe:][LTE:]DL:DEMod:EVMCalc</code>	139
<code>[SENSe:][LTE:]DL:DEMod:PRData</code>	139

CONFigure[:LTE]:DL[:CC<cc>]:MIMO:CROStalk <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 55

[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 55

[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 55

[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 55

[SENSe:][LTE:]DL:DEMod:PRData <Reference>

Selects the type of reference data to calculate the EVM for the NPDSCH.

Parameters:

<Reference> **AUTO**
Automatic identification of reference data.
ALLO
Reference data is 0, according to the test model definition.

Example: //Select reference data for NPDSCH demodulation
DL:DEM:PRD ALLO

Manual operation: See "[NPDSCH Reference Data](#)" on page 55

6.7.2.8 Estimation & compensation**Parameter estimation**

[SENSe:][LTE:]DL:DEMod:BESTimation	140
[SENSe:][LTE:]DL:DEMod:CESTimation	140

[SENSe:][LTE:]DL:DEMod:BEStimation <State>

Turns boosting estimation on and off.

Note that boosting estimation is always active.

Parameters:

<State> ON | OFF | 1 | 0
*RST: ON

Example: //Turn on boosting estimation
DL:DEMod:BESt ON

Manual operation: See ["Boosting Estimation"](#) on page 53

[SENSe:][LTE:]DL:DEMod:CEStimation <Type>

Selects the channel estimation type.

Parameters:

<Type> **PIL**
Optimal, pilot only
PILP
Optimal, pilot and payload
TGPP
3GPP EVM definition
*RST: TGPP

Example: //Select channel estimation type
DL:DEMod:CESt TGPP

Manual operation: See ["Channel Estimation"](#) on page 53

Error compensation

[SENSe:][LTE:]DL:TRACking:PHASe.....	140
[SENSe:][LTE:]DL:TRACking:TIME.....	141

[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 54

[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 54

6.7.2.9 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`..... 141

`[SENSe<ip>:]ADJust:CONFigure:LEVel:DURation:MODE`..... 142

`[SENSe:]ADJust:LEVel<ant>`..... 142

[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 47

[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 141.

*RST: AUTO

Manual operation: See ["Auto Level"](#) on page 47

[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 47
See ["Auto leveling"](#) on page 56

6.7.3 Configuring time alignment measurements

All commands specific to the time alignment measurement are listed below.

Commands to configure the time alignment measurement described elsewhere:

- Commands in ["Physical settings"](#) on page 110.
- Commands in ["Control channel"](#) on page 119.
- Commands in [Chapter 6.7.2.7, "Demodulation"](#), on page 138.
- Commands in [Chapter 6.7.2.2, "Inputs configuration"](#), on page 119.
- Commands in [Chapter 6.7.2.3, "Frequency configuration"](#), on page 124.

- Commands in [Chapter 6.7.2.4, "Amplitude configuration"](#), on page 126.
- Commands in [Chapter 6.7.2.5, "Signal capture"](#), on page 130.

6.7.4 Frequency sweep measurements

The remote commands to configure the ACLR and SEM measurements are the same as in the spectrum application.

For a comprehensive description, see the R&S VSE user manual.

In addition, the SEM measurement in the NB-IoT application has several exclusive settings not available in the spectrum application.

Commands to configure exclusive ACLR settings described elsewhere.

- NB-IoT mode: `CONFigure[:LTE]:LDIRection` on page 113
- ACLR measurements are only possible for the stand-alone deployment.
- The adjacent channels are always set up according to the stand-alone deployment.

Commands to configure exclusive SEM settings described elsewhere.

- NB-IoT mode: `CONFigure[:LTE]:LDIRection` on page 113
- SEM measurements are only possible for the stand-alone deployment.

<code>[SENSe:]POWer:SEM:CATegory</code>	143
<code>[SENSe:]POWer:SEM:CHBS:AMPower</code>	144
<code>[SENSe:]POWer:SEM:CHBS:AMPower:AUTO</code>	144
<code>[SENSe:]POWer:SEM:PIOM</code>	144
<code>[SENSe:]POWer:SEM:PIOV</code>	145

`[SENSe:]POWer:SEM:CATegory <Category>`

Parameters:

<code><Category></code>	HOME Home base station
	LARE Local area base station
	MED Medium range base station
	WARE Wide area base station
	*RST: A

Example: //Select base station category
 POW:SEM:CAT MED

Manual operation: See "[Category](#)" on page 58

[SENSe:]POWer:SEM:CHBS:AMPower <Power>**Parameters:**

<Power> <numeric value>
 Default unit: dBm

Example:

```
//Define base station power
POW:SEM:CAT MED
POW:SEM:CHBS:AMP:AUTO OFF
POW:SEM:CHBS:AMP 0
```

Manual operation: See ["Tx Power"](#) on page 58

[SENSe:]POWer:SEM:CHBS:AMPower:AUTO <State>

Turn automatic detection of the TX channel power on and off.

Prerequisites for this command

- Select medium range base stations ([\[SENSe:\]POWer:SEM:CATegory](#)).

When you turn off automatic detection, you can define the TX channel power manually with [\[SENSe:\]POWer:SEM:CHBS:AMPower](#).

Parameters:

<State> ON | OFF | 1 | 0
 *RST: OFF

Example:

```
//Turn on automatic detection of the TX channel power
POW:SEM:CAT MED
POW:SEM:CHBS:AMP:AUTO ON
```

Manual operation: See ["Tx Power"](#) on page 58

[SENSe:]POWer:SEM:PIOM <Mode>

Selects the way that the limits of the spectrum emission mask are calculated.

Parameters:

<Mode> **AUTO**
 Automatically calculates the limits based on the NB-IoT power measured in the reference range.

MANual
 Calculates the limits based on the power defined with [\[SENSe:\]POWer:SEM:PIOV](#).

 *RST: AUTO

Example:

```
//Select calculation method for SEM limits
POW:SEM:PIOM AUTO
```

Manual operation: See ["Power NB-IoT Carrier"](#) on page 59

[SENSe:]POWer:SEM:PIOV <Power>

Defines the power of the NB-IoT carrier on which the calculation of the SEM limits is based.

Prerequisites for this command

- Select manual SEM limit calculation mode ([SENSe:] POWer:SEM:PIOM).

Parameters:

<Power> <numeric value>
 *RST: 0

Example: //Define NB-IoT power manually
 POW:SEM:PIOM MAN
 POW:SEM:PIOV -43

Manual operation: See "Power NB-IoT Carrier" on page 59

6.8 Analysis

- [Trace export](#)..... 145
- [Microservice export](#)..... 147
- [Evaluation range](#)..... 147
- [Y-axis scale](#)..... 149
- [Result settings](#)..... 151

6.8.1 Trace export

- [FORMat:DEXPort:DSEParator](#)..... 145
- [FORMat:DEXPort:HEADer](#)..... 146
- [FORMat:DEXPort:TRACes](#)..... 146
- [MMEMory:STORe<n>:TRACe](#)..... 146

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 146).

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.

6.8.2 Microservice export

[MMEMory:STORe<n>:MSERvice.....](#) 147

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'
```

6.8.3 Evaluation range

[\[SENSe:\]\[LTE:\]\[CC<cc>:\]ALlocation:SElect.....](#) 147

[\[SENSe:\]\[LTE:\]\[CC<cc>:\]CARRier:SElect.....](#) 148

[\[SENSe:\]\[LTE:\]\[CC<cc>:\]LOCation:SElect.....](#) 148

[\[SENSe:\]\[LTE:\]\[CC<cc>:\]MODulation:SElect.....](#) 148

[\[SENSe:\]\[LTE:\]\[CC<cc>:\]SUBFrame:SElect.....](#) 149

[\[SENSe:\]\[LTE:\]\[CC<cc>:\]SYMBOL:SElect.....](#) 149

[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 6.5.1.19, "Return value codes"](#), on page 94.

*RST: ALL

Example:

```
//Display results for NPDCCH
ALL:SEL -11
```

Manual operation: See ["Evaluation range for the constellation diagram"](#) on page 65

[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 65

[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 65

[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 6.5.1.19, "Return value codes"](#), on page 94.

*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 65

[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 64

[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 65

6.8.4 Y-axis scale

DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:AUTO.....	150
DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:MAXimum.....	150
DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:MINimum.....	150

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 56
See ["Automatic scaling of the y-axis"](#) on page 62

**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 61

**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 61

6.8.5 Result settings

CALCulate<n>:MARKer<m>:COUPling.....	151
UNIT:BSTR.....	151
UNIT:CAXes.....	152
UNIT:EVM.....	152

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 67

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 66

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 66

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 66

Annex

A Performing time alignment measurements

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

The measurement supports setups of up to two 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 A-1](#).

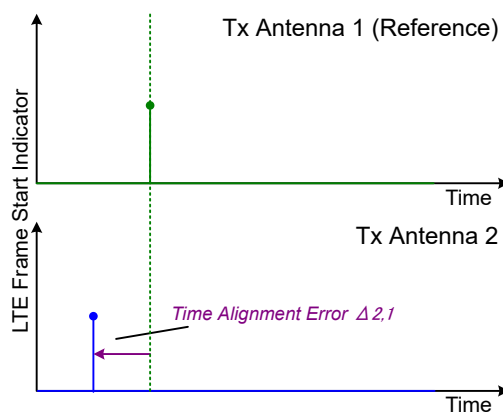


Figure A-1: Time Alignment Error (2 Tx antennas)

Test setup

Successful Time Alignment measurements require a correct test setup.

A typical test setup is shown in [Figure A-2](#).

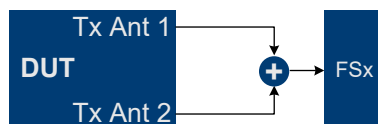


Figure A-2: Hardware setup

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

B Annex: reference

- [Menu reference](#)..... 154
- [Reference of toolbar functions](#)..... 158

B.1 Menu reference

Most functions in the R&S VSE are available from the menus.

- [Common R&S VSE menus](#)..... 154
- [LTE measurement menus](#)..... 156



B.1.1 Common R&S VSE menus

The following menus provide **basic functions for all applications**:

- [File menu](#)..... 154
- [Window menu](#)..... 155
- [Help menu](#)..... 156

B.1.1.1 File menu

The "File" menu includes all functionality directly related to any file operations, printing or setting up general parameters.


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
> 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.

Menu item	Corresponding icon in toolbar	Description
> 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

B.1.1.2 Window menu


The "Window" menu allows you to hide or show individual windows.

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

Menu item	Corresponding icon in toolbar	Description
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

B.1.1.3 Help menu

The "Help" menu provides access to help, support and licensing functions.

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

B.1.2 LTE measurement menus

- [Input & output menu](#)..... 156
- [Meas setup menu](#)..... 157
- [Trace menu](#)..... 157
- [Marker menu](#)..... 157
- [Limits menu](#)..... 158

B.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 B-1: "Input" menu items for LTE measurements

Menu item	Description
Amplitude	Chapter 4.2.8, "Amplitude configuration" , on page 46
Scale	Chapter 5.1.3, "Diagram scale" , on page 61
Frequency	Chapter 4.2.7, "Frequency configuration" , on page 45
Trigger	Chapter 4.2.10, "Trigger configuration" , on page 51
Input Source	Chapter 4.2.6, "Selecting the input and output source" , on page 41
Output Source	

B.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 B-2: "Meas Setup" menu items for NB-IoT measurements

Menu item	Description
Select Measurement	Chapter 3, "Measurements and result displays" , on page 12
Signal Description	Chapter 4.2.1, "Defining signal characteristics" , on page 34
MIMO Setup	Chapter 4.2.3, "Configuring MIMO setups" , on page 38
Signal Capture	Chapter 4.2.9, "Configuring the data capture" , on page 50
Trigger	Chapter 4.2.10, "Trigger configuration" , on page 51
Demod	Chapter 4.2.12, "Configuring demodulation parameters" , on page 54
Evaluation Range	Chapter 5.2.2, "Evaluation range" , on page 64
Result Settings	Chapter 5.2.3, "Result settings" , on page 66
Overview	Chapter 4.1, "Configuration overview" , on page 31

B.1.2.3 Trace menu




The "Trace" does not contain any functions for LTE measurements, traces are generally not configurable.

B.1.2.4 Marker menu

The "Marker" menu provides access to marker-specific functions.

This menu is application-specific.

Table B-3: "Marker" menu items for NB-IoT measurements

Menu item	Corresponding icon in toolbar	Description
Select marker <x>		Chapter 5.1.5, "Markers" , on page 62
Marker to Trace	-	Chapter 5.1.5, "Markers" , on page 62
All Markers Off		Chapter 5.1.5, "Markers" , on page 62
Marker...		Chapter 5.1.5, "Markers" , on page 62
Search	-	Chapter 5.1.5, "Markers" , on page 62

B.1.2.5 Limits menu

The "Limits" menu does not contain any functions for LTE measurements.

B.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.

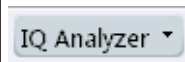






General toolbars

The following functions are generally available for all applications:



"Main" toolbar**Table B-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**Table B-5: Functions in the "Control" toolbar**

Icon	Description
	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
	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**Table B-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**Table B-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
	Zoom off: displays the diagram in its original size

Table B-8: Functions in the "Marker" toolbar

Icon	Description
	Place new marker
	Percent Marker (CCDF only)
	Select marker
	Marker type "normal"
	Marker type "delta"
	Global peak
	Absolute peak (Currently only for GSM application)
	Next peak to the left
	Next peak to the right

Reference of toolbar functions














Icon	Description
	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)
	Set marker value to center frequency
	Set reference level to marker value
	All markers off
	Marker search configuration
	Marker configuration

Table B-9: Functions in the "AutoSet" toolbar

Icon	Description
	Refresh measurement results (R&S VSE VSA and OFDM VSA applications only)
	Auto level
	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)
	Auto scale (R&S VSE 3GPP FDD + Pulse applications only)
	Auto scale all (R&S VSE 3GPP FDD + Pulse applications only)
	Auto all
	Configure auto settings

List of commands

[SENSe:]LTE:]CC<cc>:]ALLocation:SElect.....	147
[SENSe:]LTE:]CC<cc>:]CARRier:SElect.....	148
[SENSe:]LTE:]CC<cc>:]LOCation:SElect.....	148
[SENSe:]LTE:]CC<cc>:]MODulation:SElect.....	148
[SENSe:]LTE:]CC<cc>:]SUBFrame:SElect.....	149
[SENSe:]LTE:]CC<cc>:]SYMBol:SElect.....	149
[SENSe:]LTE:]DL:DEMod:BEStimation.....	140
[SENSe:]LTE:]DL:DEMod:CBSCrambling.....	138
[SENSe:]LTE:]DL:DEMod:CEStimation.....	140
[SENSe:]LTE:]DL:DEMod:EVMCalc.....	139
[SENSe:]LTE:]DL:DEMod:MCFilter.....	139
[SENSe:]LTE:]DL:DEMod:PRData.....	139
[SENSe:]LTE:]DL:TRACking:PHASe.....	140
[SENSe:]LTE:]DL:TRACking:TIME.....	141
[SENSe:]LTE:]FRAMe:COUNT.....	131
[SENSe:]LTE:]FRAMe:COUNT:AUTO.....	131
[SENSe:]LTE:]FRAMe:COUNT:STATe.....	131
[SENSe:]ADJust:LEVel<ant>.....	142
[SENSe:]FREQuency:CENTer:STEP.....	125
[SENSe:]FREQuency:CENTer[:CC<cc>].....	124
[SENSe:]FREQuency:CENTer[:CC<cc>]:OFFSet.....	125
[SENSe:]POWer:SEM:CATegory.....	143
[SENSe:]POWer:SEM:CHBS:AMPower.....	144
[SENSe:]POWer:SEM:CHBS:AMPower:AUTO.....	144
[SENSe:]POWer:SEM:PIOM.....	144
[SENSe:]POWer:SEM:PIOV.....	145
[SENSe:]SWAPiq.....	132
[SENSe:]SWEep:TIME.....	132
[SENSe<ip>:]ADJust:CONFigure:LEVel:DURation.....	141
[SENSe<ip>:]ADJust:CONFigure:LEVel:DURation:MODE.....	142
CALCulate<n>:DELTAmarker<m>:X.....	103
CALCulate<n>:DELTAmarker<m>:Y?.....	104
CALCulate<n>:MARKer<m>:COUPLing.....	151
CALCulate<n>:MARKer<m>:FUNCTION:POWer<sb>:RESult[:CURRent]?.....	96
CALCulate<n>:MARKer<m>:X.....	104
CALCulate<n>:MARKer<m>:Y.....	105
CALCulate<n>:MARKer<m>:Z:ALL?.....	106
CALCulate<n>:MARKer<m>:Z?.....	105
CALCulate<n>:STATistics:CCDF:X<t>?.....	107
CALCulate<n>:STATistics:RESult<res>?.....	107
CONFigure[:LTE]:DEPLoyment.....	110
CONFigure[:LTE]:DL:FREQuency:GINdex.....	111
CONFigure[:LTE]:DL:FREQuency:OFFSet.....	112
CONFigure[:LTE]:DL:NPDSch:DMODulation.....	118
CONFigure[:LTE]:DL:NPDSch:SFList.....	118
CONFigure[:LTE]:DL:NPDSch:UEID.....	119
CONFigure[:LTE]:DL:PINdex.....	112

CONFigure[:LTE]:DL:SINFo.....	112
CONFigure[:LTE]:DL[:CC<cc>]:BW.....	113
CONFigure[:LTE]:DL[:CC<cc>]:MIMO:ASElection.....	117
CONFigure[:LTE]:DL[:CC<cc>]:MIMO:CONFig.....	117
CONFigure[:LTE]:DL[:CC<cc>]:MIMO:CROStalk.....	138
CONFigure[:LTE]:DL[:CC<cc>]:PLC:CID.....	114
CONFigure[:LTE]:DL[:CC<cc>]:PLC:CIDGroup.....	114
CONFigure[:LTE]:DL[:CC<cc>]:PLC:PLID.....	114
CONFigure[:LTE]:DL[:CC<cc>]:PSOFset.....	119
CONFigure[:LTE]:EUTRa:FREQUency.....	111
CONFigure[:LTE]:LDIRection.....	113
CONFigure[:LTE]:MEASurement.....	108
CONFigure[:LTE]:TYPE.....	115
DISPlay[:WINDow<n>]:TAB<tab>:SElect.....	74
DISPlay[:WINDow<n>][:SUBWindow<w>]:SElect.....	74
DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:AUTO.....	150
DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:MAXimum.....	150
DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:MINimum.....	150
DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:RLEVel<ant>.....	126
DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:RLEVel<ant>:OFFSet.....	126
FETCh:TAERror[:CC<cc>]:ANTenna<ant>:MAXimum.....	103
FETCh:TAERror[:CC<cc>]:ANTenna<ant>:MINimum.....	103
FETCh:TAERror[:CC<cc>]:ANTenna<ant>[:AVERAge]?.....	103
FETCh[:CC<cc>]:PLC:CIDGroup?.....	115
FETCh[:CC<cc>]:PLC:PLID?.....	115
FETCh[:CC<cc>]:SUMMary:CRESt[:AVERAge]?.....	98
FETCh[:CC<cc>]:SUMMary:EVM:PCHannel:MAXimum?.....	99
FETCh[:CC<cc>]:SUMMary:EVM:PCHannel:MINimum?.....	99
FETCh[:CC<cc>]:SUMMary:EVM:PCHannel[:AVERAge]?.....	99
FETCh[:CC<cc>]:SUMMary:EVM:PSIGnal:MAXimum?.....	99
FETCh[:CC<cc>]:SUMMary:EVM:PSIGnal:MINimum?.....	99
FETCh[:CC<cc>]:SUMMary:EVM:PSIGnal[:AVERAge]?.....	99
FETCh[:CC<cc>]:SUMMary:EVM[:ALL]:MAXimum?.....	98
FETCh[:CC<cc>]:SUMMary:EVM[:ALL]:MINimum?.....	98
FETCh[:CC<cc>]:SUMMary:EVM[:ALL][:AVERAge]?.....	98
FETCh[:CC<cc>]:SUMMary:FERRor:MAXimum?.....	100
FETCh[:CC<cc>]:SUMMary:FERRor:MINimum?.....	100
FETCh[:CC<cc>]:SUMMary:FERRor[:AVERAge]?.....	100
FETCh[:CC<cc>]:SUMMary:NBP:MAXimum?.....	101
FETCh[:CC<cc>]:SUMMary:NBP:MINimum?.....	101
FETCh[:CC<cc>]:SUMMary:NBPower[:AVERAge]?.....	101
FETCh[:CC<cc>]:SUMMary:OSTP:MAXimum?.....	100
FETCh[:CC<cc>]:SUMMary:OSTP:MINimum?.....	100
FETCh[:CC<cc>]:SUMMary:OSTP[:AVERAge]?.....	100
FETCh[:CC<cc>]:SUMMary:POWer:MAXimum?.....	100
FETCh[:CC<cc>]:SUMMary:POWer:MINimum?.....	100
FETCh[:CC<cc>]:SUMMary:POWer[:AVERAge]?.....	100
FETCh[:CC<cc>]:SUMMary:RSSI:MAXimum?.....	101
FETCh[:CC<cc>]:SUMMary:RSSI:MINimum?.....	101
FETCh[:CC<cc>]:SUMMary:RSSI[:AVERAge]?.....	101

FETCh[:CC<cc>]:SUMMary:RSTP:MAXimum?	102
FETCh[:CC<cc>]:SUMMary:RSTP:MINimum?	102
FETCh[:CC<cc>]:SUMMary:RSTP[:AVERAge]?	102
FETCh[:CC<cc>]:SUMMary:SERRor:MAXimum?	102
FETCh[:CC<cc>]:SUMMary:SERRor:MINimum?	102
FETCh[:CC<cc>]:SUMMary:SERRor[:AVERAge]?	102
FETCh[:CC<cc>]:SUMMary:TFRame?	102
FORMat:DEXPort:DSEParator	145
FORMat:DEXPort:HEADer	146
FORMat:DEXPort:TRACes	146
FORMat[:DATA]	95
INPut:FILE<fi>:PATH	120
INPut:SElect	121
INPut<ip>:ATTenuation<ant>	127
INPut<ip>:ATTenuation<ant>:AUTO	127
INPut<ip>:COUPling<ant>	128
INPut<ip>:EATT<ant>	129
INPut<ip>:EATT<ant>:AUTO	130
INPut<ip>:EATT<ant>:STATe	130
INPut<ip>:FILE:ZPADing	120
INPut<ip>:FILTer:HPASs[:STATe]	121
INPut<ip>:FILTer:YIG[:STATe]	121
INPut<ip>:GAIN<ant>:STATe	128
INPut<ip>:GAIN<ant>[:VALue]	128
INPut<ip>:IMPedance<ant>	129
INPut<ip>:RF:CAPMode	122
INPut<ip>:RF:CAPMode:IQ:SRATe	122
INPut<ip>:RF:CAPMode:WAVEform:SRATe	123
INSTrument:BLOCK:CHANnel[:SETTings]:SOURce<si>	123
INSTrument[:SElect]	74
LAYout:ADD[:WINDow]?	79
LAYout:CATalog[:WINDow]?	81
LAYout:GLOBal:ADD[:WINDow]?	75
LAYout:GLOBal:CATalog[:WINDow]?	77
LAYout:GLOBal:IDENtify[:WINDow]?	78
LAYout:GLOBal:REMove[:WINDow]	78
LAYout:GLOBal:REPLace[:WINDow]	78
LAYout:IDENtify[:WINDow]?	82
LAYout:REMove[:WINDow]	82
LAYout:REPLace[:WINDow]	82
LAYout:WINDow<n>:ADD?	83
LAYout:WINDow<n>:IDENtify?	83
LAYout:WINDow<n>:REMove	84
LAYout:WINDow<n>:REPLace	84
LAYout:WINDow<n>:TYPE	85
MMEMory:LOAD[:CC<cc>]:DEMModsetting	116
MMEMory:LOAD[:CC<cc>]:TMOD:DL	116
MMEMory:STORe<n>:IQ:STATe	109
MMEMory:STORe<n>:MSERvice	147
MMEMory:STORe<n>:TRACe	146

MMEMory:STORe<n>[:CC<cc>]:DEModsetting.....	117
SYSTem:COMMunicate:RDEvice:OSCilloscope:SRATe.....	124
SYSTem:PRESet:CHANnel[:EXEC].....	109
TRACe<n>[:DATA]:X?.....	95
TRACe<n>[:DATA]?.....	95
TRIGger[:SEQuence]:DTIME.....	133
TRIGger[:SEQuence]:HOLDoff<ant>[:TIME].....	133
TRIGger[:SEQuence]:IFPower:HOLDoff.....	133
TRIGger[:SEQuence]:IFPower:HYSTeresis.....	134
TRIGger[:SEQuence]:LEVel:MAPower.....	135
TRIGger[:SEQuence]:LEVel<ant>:IFPower.....	134
TRIGger[:SEQuence]:LEVel<ant>:IQPower.....	135
TRIGger[:SEQuence]:LEVel<ant>:RFPower.....	135
TRIGger[:SEQuence]:LEVel<ant>[:EXternal<tp>].....	134
TRIGger[:SEQuence]:MAPower:HOLDoff.....	136
TRIGger[:SEQuence]:MAPower:HYSTeresis.....	136
TRIGger[:SEQuence]:PORT<ant>.....	136
TRIGger[:SEQuence]:SLOPe.....	137
TRIGger[:SEQuence]:SOURce<ant>.....	137
UNIT:BSTR.....	151
UNIT:CAXes.....	152
UNIT:EVM.....	152

Index

A

AC/DC coupling	49
ACLR	27, 28
Add channel	9
Allocation	
Filter by	65
Allocation ID vs symbol x carrier	23
Allocation summary	21
Amplitude	47
Antenna selection	38
Application cards	8
Application notes	8
Attenuation	48
Auto Detection (Cell Identity)	37
Auto level	47

B

Bandwidth	35, 36
Bit stream	21
Bitstream format	66
Boosting estimation	53
Brochures	7

C

Capture buffer	15
Capture time	50
Carrier	
Filter by	65
Carrier axis scale	66
CCDF	20
Cell ID	37
Cell Identity Group	37
Center frequency	46
Channel bandwidth	35, 36
Channel bar	10
Channel Estimation	53
Channel flatness	18
Channel flatness difference	19
Channel flatness group delay	19
Closing	
Windows (remote)	84
Configuration overview	31
Constellation diagram	19
Configuration	65
Constellation selection	65
Control channel	40
Conventions	
SCPI commands	69
CRS sequence	36

D

Data capture	50
Data format	
Remote	146
Data input	41
Data sheets	7
Demodulation configuration	54
Deployment	35
Display information	10
Duplexing	34

E

E-UTRA channel properties	36
Estimation	53
Channel	53
Physical channels	53
Evaluation methods	
Remote	75, 79
EVM calculation method	55
EVM unit	66
EVM vs Carrier	16
EVM vs subframe	17
EVM vs symbol	16
EVM vs symbol x carrier	22
External Attenuation	48

F

FFT size	35, 36
Filter	
Interference	55
Filters	
High-pass (RF input)	42
YIG (remote)	121
Format	
Data (remote)	146
Frequency	
Configuration	46
Frequency error vs symbol	17
Frequency sweep measurement	27

G

GSM	35
Guard band deployment	
Configuration	36

H

Hardware settings	10
High-pass filter	
RF input	42

I

I/Q measurement	14
Identity (Physical Layer)	37
Impedance	
Setting	50
In band deployment	35
Configuration	36
Input	
Coupling	49
Input source	41
Input sources	
Channels	45
Interference suppression	55

L

Level configuration	47
Link direction	34
LTE	35
LTE channel properties	36

M

Marker coupling	67
Marker table	
Evaluation method	25
Markers	
Table (evaluation method)	25
Measurement	12
ACLR	27, 28
alloc ID vs sym x carrier	23
allocation summary	21
bit stream	21
Capture buffer	15
CCDF	20
channel flatness	18
channel flatness difference	19
channel flatness group delay	19
constellation	19
Continuous	14
EVM vs carrier	16
EVM vs subframe	17
EVM vs sym x carr	22
EVM vs symbol	16
freq err vs symbol	17
Frequency sweep	27
I/Q	14
numerical	24
power spectrum	18
power vs sym x carr	23
Refresh	14
Result displays	13
result summary	24
Single	14
spectrum mask	29
Time alignment error	26
Measurement channels	
Input source	45
Measurement time	50
MIMO	
Configuration	38
Modulation	
Filter by	65
Multicarrier filter	55

N

NB-IoT application	9
NPDSCH reference data	55
Numerical results	24

O

Occupied bandwidth	35, 36
Offset	
Frequency	46
Reference level	47
Options	
High-pass filter	42
Preamplifier	49
Overview	31

P

Parameter estimation	53
Peak list	
Evaluation method	30
Phase error	54

Physical signal	34
Power spectrum	18
Power vs symbol x carrier	23
PRB index	36
PRB symbol offset	41
Preamplifier	
Setting	49
Softkey	49
Presetting	
Channels	33

R

Reference Level	47
Release notes	8
Remote commands	
Basics on syntax	69
Boolean values	72
Capitalization	70
Character data	73
Data blocks	73
Numeric values	72
Optional keywords	71
Parameters	71
Strings	73
Suffixes	70
Restoring	
Channel settings	33
Result displays	13
Marker table	25
Peak list	30
Result summary	24
Results	
Data format (remote)	146
RF input	41

S

Sample rate	35, 36
Scrambling of coded bits	55
Screen layout	10
Settings	
Auto	37
Bitstream format	66
Boosting estimation	53
Capture time	50
Carrier axes	66
Channel Estimation	53
Constellation selection	65
EVM calculation method	55
EVM unit	66
Ext Att	48
Frequency	46
ID	37
Identity	37
Identity Group	37
Marker coupling	67
Multicarrier filter	55
NPDSCH reference data	55
Phase tracking	54
PRB symbol offset	41
Ref Level	47
Scrambling of coded bits	55
Standard	34
Subframe selection	64
Swap I/Q	50
Timing error	54

Signal capture	50
Signal characteristics	34
Slope	
Trigger	137
Softkeys	
Preamp	49
Specifics for	
Configuration	33
Spectrum mask	29
Stand alone deployment	35
Configuration	35
Standard selection	34
Status bar	11
Step size	46
Subframe selection	64
Suffixes	
Common	68
Remote commands	70
Swap I/Q	50
Symbol	
Filter by	65

T

Time alignment error	26
Timing error	54
Toolbars	
AutoSet	161
Control	159
Functions	158
Help	160
Main	159
Marker	160
Overview	158
Zoom	160
Tracking	
Phase	54
Timing	54
Transmission path	34
Trigger	
Slope	137
Trigger configuration	51
Trigger source	52

V

Videos	8
--------------	---

W

White papers	8
Window title bar	11
Windows	
Adding (remote)	75, 79
Closing (remote)	84
Configuring	33
Querying (remote)	77, 78, 81, 82
Replacing (remote)	82
Types (remote)	75, 79

Y

YIG-preselector	
Activating/Deactivating	42
Activating/Deactivating (remote)	121

Z

Zoom	
Capture buffer	15